2019 Conference on Lasers and Electro-Optics Europe & European Quantum Electronics Conference

Advance Programme

Munich ICM
International Congress Centre Munich, Germany
23 - 27 June 2019

www.cleoeurope.org

Sponsored by
• European Physical Society / Quantum Electronics and Optics Division
• IEEE Photonics Society
• The Optical Society
# GENERAL INFORMATION

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome to CLEO®/Europe-EQEC at WoP 2019</td>
<td>02</td>
</tr>
<tr>
<td>Conference Structure and Technical Sessions</td>
<td>03</td>
</tr>
<tr>
<td>Short Courses at a Glance</td>
<td>05</td>
</tr>
<tr>
<td>Conference Days at a Glance</td>
<td>06</td>
</tr>
<tr>
<td>Sessions at a Glance</td>
<td>16</td>
</tr>
<tr>
<td>How to Read the Session Codes?</td>
<td>17</td>
</tr>
<tr>
<td>How to Find the Room?</td>
<td>19</td>
</tr>
<tr>
<td>Topics</td>
<td>23</td>
</tr>
<tr>
<td>Committees</td>
<td>27</td>
</tr>
<tr>
<td>Official Congress Opening</td>
<td>34</td>
</tr>
<tr>
<td>Prizes and Awards</td>
<td>34</td>
</tr>
<tr>
<td>Speakers' Information</td>
<td>34</td>
</tr>
<tr>
<td>Poster Sessions</td>
<td>35</td>
</tr>
<tr>
<td>Short Courses</td>
<td>35</td>
</tr>
<tr>
<td>Laboratory Tours</td>
<td>35</td>
</tr>
<tr>
<td>Dinner and Social Events</td>
<td>36</td>
</tr>
<tr>
<td>Copyright</td>
<td>36</td>
</tr>
<tr>
<td>Exhibition Information</td>
<td>37</td>
</tr>
<tr>
<td>Application Panels</td>
<td>37</td>
</tr>
<tr>
<td>On site Facilities for Attendees</td>
<td>37</td>
</tr>
<tr>
<td>Conference Venue</td>
<td>39</td>
</tr>
<tr>
<td>How to reach the ICM Centre</td>
<td>40</td>
</tr>
<tr>
<td>Conference Registration</td>
<td>40</td>
</tr>
<tr>
<td>Cancellation</td>
<td>40</td>
</tr>
<tr>
<td>Conference Management, Language</td>
<td>40</td>
</tr>
<tr>
<td>Note to Exhibitors</td>
<td>40</td>
</tr>
<tr>
<td>Registration Hours</td>
<td>41</td>
</tr>
<tr>
<td>Hotel Information way</td>
<td>41</td>
</tr>
<tr>
<td>Transportation in Munich</td>
<td>41</td>
</tr>
<tr>
<td>Munich, Germany</td>
<td>42</td>
</tr>
</tbody>
</table>

# TECHNICAL PROGRAMME

<table>
<thead>
<tr>
<th>Session Type</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Courses</td>
<td>44</td>
</tr>
<tr>
<td>Plenary Talks</td>
<td>45</td>
</tr>
<tr>
<td>Tutorial Talks</td>
<td>46</td>
</tr>
<tr>
<td>Keynote Talks</td>
<td>46</td>
</tr>
<tr>
<td>Invited Talks</td>
<td>47</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day</th>
<th>Oral Sessions</th>
<th>Poster Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>Monday</td>
<td>106</td>
<td>126</td>
</tr>
<tr>
<td>Tuesday</td>
<td>142</td>
<td>160</td>
</tr>
<tr>
<td>Wednesday</td>
<td>170</td>
<td>196</td>
</tr>
<tr>
<td>Thursday</td>
<td>206</td>
<td>230</td>
</tr>
<tr>
<td>Authors' Index</td>
<td>240</td>
<td></td>
</tr>
</tbody>
</table>
Welcome to the 2019 Conference on Lasers and Electro-Optics Europe & European Quantum Electronics Conference (hereafter CLEO®/Europe-EQEC) at the World of Photonics Congress 2019

Following on from the very successful previous conferences held in Amsterdam (1994), Hamburg (1996), Glasgow (1998), Nice (2000) and Munich (2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017), the General and Programme Chairs warmly welcome you to the 2019 CLEO®/Europe-EQEC 2019 conference, which is being held in Munich from June 23 - 27. CLEO®/Europe-EQEC targets university and industry scientists and researchers as well as students and graduates. We extend a special welcome to attending young researchers, postgraduate and PhD students, and we wish them every success, especially if this is their first participation in a major scientific conference.

The CLEO®/Europe-EQEC conference series has established a strong tradition as the largest, most comprehensive and prestigious gathering of optics and photonics researchers and engineers in Europe. With technical co-sponsorship provided by the European Physical Society (EPS), the Institute of Electrical and Electronics Engineers (IEEE) Photonics Society, and the Optical Society (OSA), CLEO®/Europe and EQEC have a strong international presence in the complementary research areas of laser science, photonics and quantum electronics.

More specifically, CLEO®/Europe emphasizes applied physics, optical engineering and applications of photonics and laser technology, whereas EQEC addresses more basic research in laser physics, nonlinear optics and quantum optics. CLEO®/Europe will showcase the latest developments in a wide range of laser and photonics areas including solid-state lasers, semiconductor lasers, terahertz sources and applications, applications of nonlinear optics, optical materials, optical fabrication and characterization, ultrafast optical technologies, high-field laser and attosecond science, optical sensing and microscopy, optical technologies for communications and data storage, fibre and guided wave lasers and amplifiers, micro- and nanophotonics, photonic applications in biology and medicine, and material processing.

EQEC will feature the fundamentals of quantum optics and ultracold quantum matter, quantum information, quantum communication and sensing, topological states of light, precision metrology, ultrafast optical science, nonlinear phenomena, solitons, and self-organization, plasmonics and metamaterials, two-dimensional and novel materials, and theoretical and computational photonics modelling.

CLEO®/Europe-EQEC creates a unique forum where participants can obtain informative overviews and discuss recent advances on a wide range of topics, from fundamental light-matter interaction and new sources of coherent light to technology development, system engineering and various applications of photonics.

Over five days CLEO®/Europe-EQEC 2019 will showcase around 2000 technical contributions in the form of oral presentations in parallel sessions and posters from university, research organisations and industry, drawn from all countries around the world, and will provide an unparalleled opportunity to bring together scientists, engineers and users of laser and photonics technologies under the same roof.

Particular highlights of the 2019 programme will be a series of symposia: Neuromorphic photonics, label-free techniques for molecular identification, photonics for renewable energy and sustainability, nanoscale heat processes, quantum sensing and applications and finally a symposium on 50 years of integrated optics.

This year EPS Young Minds section will invite to a career event on professional paths inside and beyond academia where different career paths and opportunities for physicists will be discussed and promoted. In the form of panel discussions, young physicists – master students, graduate students, and post-docs – will have the opportunity to engage with 5 invited speakers through a Q&As session.

Additionally two joint sessions (ECBO-CLEO®/Europe and SPIE-Optical Metrology-EQEC 2019) held in cooperation with co-located conferences will be organised.

As usual prestigious EPS-QEOD prizes and OSA awards and honours will be remitted during a special plenary and award ceremony to take place on Tuesday 25 June 2019 from 10:30 to 12:30, room 1. For further information, see the separate booklet.

All conferences together form the World of Photonics Congress bundling various topical conferences under one roof and under the organisation of Messe München International. It is a strategic and operative umbrella for various individual conferences held by leading associations and organisations. The other co-located conferences include:

- European Conferences on Biomedical Optics organised by SPIE, OSA.
- Imaging and Applied Optics organised by OSA.
- LiM 2019 - Lasers in Manufacturing organised by WLTT.
- EOS Optical Technologies organised by EOS.
- Optical Metrology organised by SPIE Europe.

All co-located conferences will share registration and allow delegates to attend sessions.

As in former years, the meeting will be complemented by the LASER 2019 World of Photonics, the world’s largest tradeshow of laser and optical technology, which will provide researchers with the opportunity to see the latest developments in a very wide range of laser sources, optical and photonics products, and components.
Conference Structure and Technical Sessions

CLEO®/Europe-EQEC consists of a large number of technical presentations in a number of different formats:

**Plenary talks** are broad-scope, 60-minute long talks given by these world-leading scientists, and are accessible to a general technical audience including conference attendees, exhibitors, and exhibit visitors. Plenary talks are not held in parallel with other sessions, allowing maximum possible attendance. The 2019 plenary talks will be presented by Michal Lipson (CLEO®/Europe), Anton Zeilinger (EQEC), and Karsten Danzmann (World of Photonics). A special plenary highlighting the 2018 Nobel Prize in physics will be held by Nobel laureate Gérard Mourou.

**Tutorials** (60 minute talks) and **Keynote presentations** (45 minute talks) are also given by the world leaders in particular technical areas. They are generally directed at a more specific audience, and are thus delivered in parallel with other sessions. Keynotes provide a survey of the most exciting recent developments, and Tutorials are most attractive events that certainly contribute to the great atmosphere that makes the CLEO®/Europe-EQEC conference a unique meeting.

Additionally to these talks the conference will feature invited talks, special orals, and posters. Two sessions will be jointly held with colocated conferences:

- JS ECBO-CLEO®/Europe will feature a tutorial talk on “Light sheet microscopy: Imaging faster, wider and deeper” to take place on Sunday evening from 18:00 to 19:00 (room 5, ICM).
- JS SPIE-OM-EQEC will feature a session on computational photonics for metrology application including three invited talks to take place on Monday morning from 11:15 to 12:45 (room 2, ICM).

Other very much appreciated CLEO®/Europe-EQEC meetings are the special **Symposia** settled to anticipate and capture emerging fields in optics by giving emphasis to fast developing, well defined topics. Six symposia have been identified for CLEO®/Europe-EQEC 2019:

- JSI - Neuromorphic photonics
- JSII - Label-free techniques for molecular identification
- JSIII - Photonics for renewable energy and sustainability
- JSIV - Nanoscale heat processes
- JSV - Quantum sensing and applications
- JSVI - 50 years of integrated optics.

CLEO®/Europe-EQEC 2019 will also present twelve Short Courses. All courses at additional cost will take place in parallel on Sunday 23 June 2019.

The conference will also feature two postdeadline sessions on Wednesday evening, 26 June 2019 (19:00 to 20:30). Their purpose is to give the audience the chance to listen to the latest breaking news in optics, and these are usually one of the most attractive events that certainly contribute to the high quality of the atmosphere that makes the CLEO®/Europe-EQEC conference a unique meeting.

In addition to the technical sessions involving oral presentations, all scientific areas of both CLEO®/Europe and EQEC will be covered in poster sessions, which will provide an interactive and less formal way for researchers to discuss their work, interact and exchange ideas.

CLEO®/Europe-EQEC is now established as the largest and most comprehensive gathering of optics and photonics researchers and engineers in Europe, spanning classical and quantum optical science, laser technology and photonics applications.

The conference programme could not have been elaborated without the vital support and effort of 271 scientists, forming 13 CLEO®/Europe, 10 EQEC, 6 Joint Symposia and 2 Joint Sessions sub-committees, who have assembled an excellent series of talks and posters covering a wide range of fields in optics and quantum electronics. The technical programme featuring over 2000 presentations will consist of 4 plenary talks, 5 tutorial talks, 6 keynote talks, 86 invited talks, 22 talks upgraded to invited, 5 special oral contributions and 982 oral presentations. CLEO®/Europe-EQEC 2019 will feature a poster programme including 896 posters to be presented among the five poster sessions. 18 oral presentations will also be featured in the two post-deadline sessions to take place on Tuesday evening.

The Conference Chairs would like to extend their sincere thanks to the technical programme committee members for all their hard and fruitful work. A conference as large as CLEO®/Europe-EQEC requires two years of planning and organisation. Here, we also thank the staff of the European Physical Society, and the local conference chair in Munich for invaluable professional assistance during this period. We thank Messe München GmbH, the World of Photonics Congress steering committee, the CLEO®/Europe-EQEC steering committee and all the Sponsoring Societies for their guidance, support, and their invaluable advice, which ensures that this event not only remains at the core of optics and photonics research for many nations, but will also be a major event in Europe.

Let us finally thank our attendees. The real success of CLEO®/Europe-EQEC 2019 indeed rests on the efforts and commitments of these researchers and students, who all contribute to the tremendous evolution of our research field and to the high quality of the papers that will be presented.

We wish you all a lively, fruitful, and enjoyable conference, and we are looking forward to see you in Munich!
<table>
<thead>
<tr>
<th>ICM LOCATION</th>
<th>HALL A1 LOCATION</th>
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<tbody>
<tr>
<td>ROOM 12A</td>
<td>ROOM 3</td>
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</table>

**SH-1**
Short course 1: Ultrashort pulse characterization

**SH-2**
Short course 2: High-power fiber lasers

**SH-3**
Short course 3: Optical parametric oscillators

**SH-4**
Short course 4: Laser beam analysis, propagation...

**SH-5**
Short course 5: Practical quantum optics

**SH-6**
Short course 6: Mid-infrared semiconductor lasers

**SH-7**
THz measurements and their applications

**SH-8**
Atoms and molecules in tailored laser fields

**SH-9**
Frequency combs principles and applications

**SH-10**
Silicon photonics

**SH-11**
Optics in graphene and other 2D materials

**SH-12**
Finite element modelling methods for photonics...

**B E A K**
## Sunday at a glance

<table>
<thead>
<tr>
<th>Time</th>
<th>ROOM 1</th>
<th>ROOM 3</th>
<th>ROOM 4A</th>
<th>ROOM 4B</th>
<th>ROOM 5</th>
<th>ROOM 13A</th>
<th>ROOM 13B</th>
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<td>08:30</td>
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<td>Short-wavelengths thulium-doped fiber lasers</td>
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<td>12:00</td>
<td>CM-1</td>
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<td>Beam shaping for laser processing</td>
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**LUNCH BREAK**

**CE, CF, CI, CJ, JSI, JSII, JSIV AND JSV POSTER SESSIONS - HALL B0**

<table>
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## Sunday at a glance

### ICM LOCATION - HALL A1 LOCATION - HALL B1 LOCATION

<table>
<thead>
<tr>
<th>08:30</th>
<th>09:00</th>
<th>09:30</th>
<th>10:00</th>
<th>10:30</th>
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<tbody>
<tr>
<td>EE-1</td>
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<td>New principles of ultrafast spectroscopy</td>
<td>Atom interferometry and quantum optics</td>
<td>Optical fibre sensors</td>
<td>High-power oscillators</td>
<td>Probabilistic shaping and NFT-based transmission</td>
<td>Opportunities for advanced nano-structured and non-linear optical materials</td>
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### CE, CF, CI, CJ, JSI, JSII, JSIV AND JSV POSTER SESSIONS - HALL B0

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<td>Ultrafast phenomena in 2D materials and on surfaces</td>
<td>Magnetometry and biological imaging</td>
<td>LIDAR systems</td>
<td>New developments for ultrafast oscillators</td>
<td>Advanced high capacity fiber systems</td>
<td>Infrared material fibres glasses and applications</td>
<td>Photonic platforms for reservoir computing</td>
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<tr>
<td>Optomechanics and atomic clocks</td>
<td>Photoacoustic sensors</td>
<td>Fiber lasers</td>
<td>Components and systems for metro and short range networks</td>
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### COFFEE BREAK

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<td>Integrated sensors I</td>
<td>Solitons and self-compression</td>
<td>Integrated technologies for data networks</td>
<td>Multiferroics and non-linear optics and photonics</td>
<td>Neuromorphic photonic platforms</td>
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**Monday at a glance**

**ICM LOCATION**

<table>
<thead>
<tr>
<th>Time</th>
<th>ROOM 1</th>
<th>ROOM 2</th>
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**CA, CB, CD, CH, CL, CM AND EH POSTER SESSIONS - HALL B0**

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**“BIER & BREZEL” GET-TOGETHER SPONSORED BY SPIE, ICM FOYER, HALL B0 AND GROUND FLOOR (END 21:00)**
# Monday at a glance

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<td>Engineering nontrivial light fields</td>
<td>Laser nanostructuring of transparent materials for advanced devices</td>
<td>Clinical applications</td>
<td>Integrated sensors II</td>
<td>Techniques for wavelength conversion of ultrashort pulses</td>
<td>Novel light confinement waveguides technologies</td>
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### LUNCH BREAK

**CA, CB, CD, CH, CL, CM AND EH POSTER SESSIONS - HALL B0**

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<td>Metasurfaces-polarimetry, chirality and photon spin</td>
<td>3D laser additive micromanufacturing</td>
<td>Nano-optics, light field control and sensing</td>
<td>Fibre bio- and medical sensors</td>
<td>Characterisation of ultrashort laser pulses</td>
<td>Metamaterials and functional photonic bandgap systems</td>
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<td>Optics of graphene and related 2D materials</td>
<td>New trends on laser ablation</td>
<td>Novel lasers, instruments and technology</td>
<td>Microstructured fibre sensors</td>
<td>Ultrabroadband laser sources</td>
<td>Advances in optical fibre configurations and materials</td>
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**“BIER & BREZEL” GET-TOGETHER SPONSORED BY SPIE, ICM FOYER, HALL B0 AND GROUND FLOOR (END 21:00)**
### Tuesday at a glance

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<td>Quantum optomechanics</td>
<td>Exciton/polariton physics in 2D materials</td>
<td>Superluminescent diodes and semiconductor optical amplifiers</td>
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**ICM Location**

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**Coffee Break**

- 10:30

**Lunch Break**

- 12:30

**CC, CG, EE, AND EF Poster Sessions - Hall B0**

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**Coffee Break**

- 15:30

**CLEO®/EUROPE-EQEC Conference Dinner, Löwenbräukeller, Munich (End 23:00)**
## Tuesday at a glance

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ED-3 | EI-3 | CB-7 | CK-10 | EF-3
Direct comb spectroscopy I | Optical spectroscopy of 2D materials | Wavelength control of QCLs | Plasmonics and antennas | Photon fluids and Hawking-like effect

**COFFEE BREAK**

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**LUNCH BREAK**

**CK, EA, ED, EF, EI AND EJ POSTER SESSIONS - HALL B0**

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|       | Ultrafast 2μm fiber laser systems | Plasmonics and metamaterials with 2D-materials | Modulation instabilities and recurrence phenomena | Mid-infra-red lasers | Micro-comb-resonators | Engineering of complex electromagnetic fields
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| 15:00 |        |         |         |          |          |          |
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| 17:30 |        |         |         |          |          |          |
| 18:00 |        |         |         |          |          |          |
| 18:30 |        |         |         |          |          |          |

**HAPPY HOUR SPONSORED BY THE QUANTUM ELECTRONICS AND OPTICS DIVISION (QEOD) OF THE EUROPEAN PHYSICAL SOCIETY, ICM FOYER, HALL B0, GROUND FLOOR**

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**LUNCH BREAK**

**HAPPY HOUR SPONSORED BY THE QUANTUM ELECTRONICS AND OPTICS DIVISION (QEOD) OF THE EUROPEAN PHYSICAL SOCIETY, ICM FOYER, HALL B0, GROUND FLOOR**
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<td>EB-8</td>
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<td>CD-12</td>
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<td>Coherent beam combining and multi-core fibers</td>
<td>Plasmonic enhancement of light-matter interactions</td>
<td>Nonlinear and quantum aspects in topological photonics</td>
<td>Quantum networks</td>
<td>Vertical cavity semiconductor lasers</td>
<td>Quantum and information technologies</td>
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### Thursday at a glance

<table>
<thead>
<tr>
<th>Time</th>
<th>ICM LOCATION</th>
<th>HALL A1 LOCATION</th>
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</thead>
<tbody>
<tr>
<td>08:30</td>
<td>EG-3 Nanoscale imaging and spectroscopy</td>
<td>CH-10 Microscopy II</td>
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<tr>
<td>09:00</td>
<td>CD-9 Spectral broadening</td>
<td>CC-5 THz applications</td>
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<td>CF-9 Generation of few-cycle pulses</td>
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<td>CE-11 Micro resonators and diffractive optics</td>
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**COFFEE BREAK**

- EG-4 Nonlinear nano-optics
- CH-11 Infrared gas sensing
- CD-10 Novel approaches in nonlinear optics
- CC-6 High power THz pulse generation
- CF-10 Methods for CEP-stable sources
- CG-7 Generation and applications of attosecond pulses

**LUNCH BREAK**

**CD, EB, EC, EG AND JSIII POSTER SESSIONS - HALL B0**

- EG-5 Emission control at the nanoscale
- CH-12 Spectroscopic sensing
- EF-9 Solitons and their applications
- CC-7 CW THz systems and spectroscopy
- CF-11 XUV generation and characterisation
- CG-8 Harmonic generation and spectroscopy

**COFFEE BREAK**

- EG-6 Coupling at the nanoscale
- CH-13 Time-resolved sensing
- EF-10 Frequency conversion and localized structures
- CC-8 High power THz sources and application
- CF-12 New techniques for ultrafast spectroscopy and imaging
- CG-9 Photoemission spectroscopy and sources
## PLENARY SESSIONS

<table>
<thead>
<tr>
<th>PL-1</th>
<th>2019 CLEO/Europe Plenary Talk</th>
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<tbody>
<tr>
<td>PL-2</td>
<td>2019 WoP Congress Opening and Plenary Talk</td>
</tr>
<tr>
<td>PL-3</td>
<td>Nobel Prize Plenary Talk</td>
</tr>
<tr>
<td>PL-4</td>
<td>2019 EQEC Plenary Talk and Award Ceremony</td>
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</table>

### SPECIAL EVENT

| YM | Career event: Options after your PhD |

### CLEO®/EUROPE 2019 SESSIONS

#### CA – SOLID-STATE LASERS

<table>
<thead>
<tr>
<th>CA-1</th>
<th>Laser beam control</th>
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<tbody>
<tr>
<td>CA-2</td>
<td>Laser facilities</td>
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<td>CA-3</td>
<td>Waveguide lasers</td>
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<td>Visible and UV lasers</td>
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<td>CA-5</td>
<td>Thin disk lasers</td>
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<tr>
<th>CA-P</th>
<th>CA Poster session</th>
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<tr>
<td>CA-6</td>
<td>2 μm lasers</td>
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<tr>
<td>CA-7</td>
<td>Novel laser concepts</td>
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<td>CA-8</td>
<td>Ytterbium doped laser materials</td>
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<td>CA-9</td>
<td>Laser amplifier systems</td>
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<td>CA-10</td>
<td>Mid-infrared lasers</td>
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<td>CA-11</td>
<td>Nonlinear frequency conversion</td>
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#### CA – SEMICONDUCTOR LASERS

<table>
<thead>
<tr>
<th>CB-1</th>
<th>Semiconductor micro-lasers: Novel technology concepts</th>
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<tbody>
<tr>
<td>CB-2</td>
<td>Semiconductor micro-lasers: Novel dynamics</td>
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<tr>
<td>CB-3</td>
<td>Integrated semiconductor lasers and amplifiers</td>
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<td>CB-4</td>
<td>Superluminescent diodes and semiconductor optical amplifiers</td>
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<td>CB-P</td>
<td>CB Poster session</td>
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<td>CB-5</td>
<td>High-power semiconductor lasers</td>
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<td>CB-6</td>
<td>Long wavelength semiconductor lasers</td>
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<td>Wavelength control of QCLs</td>
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<td>Short pulse generation from semiconductor lasers</td>
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<td>Optical frequency combs in semiconductor lasers</td>
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<td>Semiconductor laser dynamics</td>
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<td>Vertical cavity semiconductor lasers</td>
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#### CC – TERAHERTZ SOURCES AND APPLICATIONS

<table>
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<tr>
<th>CC-P</th>
<th>CC Poster Session</th>
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<tbody>
<tr>
<td>CC-1</td>
<td>THz time-domain spectroscopy</td>
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<td>CC-2</td>
<td>THz QCL-broadband operation and modelling</td>
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<td>CC-3</td>
<td>THz QCL and THz imaging</td>
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<td>THz quantum optics and spintronics</td>
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<td>CC-5</td>
<td>THz applications</td>
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<tr>
<td>CC-6</td>
<td>High power THz pulse generation</td>
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<tr>
<td>CC-7</td>
<td>CW THz systems and spectroscopy</td>
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<tr>
<td>CC-8</td>
<td>High power THz sources and application</td>
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#### CD – APPLICATIONS OF NONLINEAR OPTICS

<table>
<thead>
<tr>
<th>CD-1</th>
<th>Solitons</th>
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<td>Nonlinear spectroscopy</td>
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<td>Tunable light sources</td>
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<td>CD-5</td>
<td>Nonlinear nano materials</td>
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<td>Micro-resonators</td>
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### Sessions at a Glance

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Date/Time</th>
<th>Location</th>
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<tbody>
<tr>
<td>CD-7</td>
<td>Micro-comb-resonators</td>
<td>Wednesday, 14:00 - 15:30, Room 13b ICM</td>
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<td>CD-8</td>
<td>Spatio-temporal manipulation of light</td>
<td>Wednesday, 16:00 - 17:30, Room 13b ICM</td>
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<td>CD-9</td>
<td>Spectral broadening</td>
<td>Thursday, 08:30 - 10:00, Room Osterseen ICM</td>
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<tr>
<td>CD-10</td>
<td>Novel approaches in nonlinear optics</td>
<td>Thursday, 10:30 - 12:00, Room Osterseen ICM</td>
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<tr>
<td>CD-P</td>
<td>CD Poster session</td>
<td>Thursday, 13:00 - 14:00, Hall B0</td>
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<td>CD-11</td>
<td>Nonlinear application at extreme wavelengths</td>
<td>Thursday, 14:00 - 15:30, Room 13b ICM</td>
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<tr>
<td>CD-12</td>
<td>Quantum and information technologies</td>
<td>Thursday, 16:00 - 17:30, Room 13b ICM</td>
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<td>CE-1</td>
<td>Opportunities for advanced nanostructured and non-linear optical materials</td>
<td>Sunday, 10:30 - 12:30, Room 7 Hall A1</td>
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<tr>
<td>CE-2</td>
<td>Infrared material fibres glasses and applications</td>
<td>Sunday, 10:30 - 12:30, Room 7 Hall A1</td>
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<tr>
<td>CE-3</td>
<td>Neuro-inspired computing and random photonics</td>
<td>Sunday, 10:30 - 12:30, Room 7 Hall A1</td>
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<tr>
<td>CE-4</td>
<td>Multiferroics and non-linear optics and photonics</td>
<td>Sunday, 10:30 - 12:30, Room 7 Hall A1</td>
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<td>CE-5</td>
<td>Novel light confinement waveguides technologies</td>
<td>Monday, 11:15 - 12:45, Room 3 Hall A1</td>
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<td>CE-6</td>
<td>Metamaterials and functional photonic bandgap systems</td>
<td>Monday, 14:15 - 15:45, Room 3 Hall A1</td>
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<td>CE-7</td>
<td>Advances in optical fibre configurations and materials</td>
<td>Monday, 16:15 - 17:45, Room 3 Hall A1</td>
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<tr>
<td>CE-8</td>
<td>High performance bragg gratings and mirrors</td>
<td>Tuesday, 08:30 - 10:00, Room 3 Hall A1</td>
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</table>

### How to read the Session Codes?

The following pages contain the abstracts of the papers presented at the 2019 CLEO®/Europe-EQEC.

All CLEO®/Europe sessions are on a white background and have a code beginning with a C.

All EQEC sessions are on a shaded background and have a code that begins with an E.

Both post-deadline sessions including CLEO®/Europe and EQEC presentations are on a white background and have a code beginning with PD.

**Exceptions mentioned below are on a dark background:**

- Short courses referenced with SH.
- Plenary talks referenced with PL.
- CLEO®/Europe-EQEC joint symposia referenced with JS.
- The ECBO-CLEO®/Europe joint session referenced with JS ECBO-CLEO®/Europe.
- SPIE-Optical Metrology/EQEC joint session on computational photonics for metrology application referenced with JS SPIE-OM-EQEC.

**Oral Presentations**

Oral presentations have a code made up of two parts, e.g.

**CM-1.1** SUN (Invited) 10:30

The first part (CM-1.1) indicates the Conference, the topic title, the session title and the placement of the presentation within the session, e.g.

- CM-1.1 = CLEO®/Europe
- CM-1.1 = Materials processing with lasers
- CM-1.1 = Beam shaping for laser processing
- CM-1.1 = First paper presented in the "Beam shaping for laser processing" session of the CM topic

The second part indicates the day when the presentation takes place.

- SUN = Sunday
- TUE = Tuesday
- THU = Thursday
- MON = Monday
- WED = Wednesday

The figures on the right specify at what time the talk begins (10:30 am).

**Posters**

Poster presentations have a code made up of two parts, e.g.

**EG-P.2** THU

The first part indicates the Conference, the topic title, the poster destination, and the order of presentation within the topic, e.g.

- EG-P.2 = EQEC
- EG-P.2 = Light-matter interactions at the nanoscale
- EG-P.2 = Poster
- EG-P.2 = Second poster in the "Light-matter interactions at the nanoscale" topic of the EQEC conference.

The second part indicates the day when the poster presentation takes place with the same abbreviations as for the oral presentations. All posters are displayed per topic according to their reference numbers over the conference days (see "days at a glance"). For two exceptional cases (CD, EF’), the abbreviation has a’ as the initial presentation day was changed.
Sessions at a Glance

CE-9 Rare earth, polymers, ceramics, fibres and beyond
Wednesday, 14:00 - 15:15, Room 3 Hall A1

CE-10 Advanced layered materials for photonics
Wednesday, 16:00 - 17:30, Room 3 Hall A1

CE-11 Micro resonators and diffractive optics
Thursday, 08:30 - 10:00, Room 3 Hall A1

CF – ULTRAFAST OPTICAL TECHNOLOGIES

CF-1 High-power oscillators
Sunday, 10:30 - 12:00, Room 2 Hall A1

CF-P CF Poster session
Sunday, 13:00 - 14:00, Hall B0

CF-2 New developments for ultrafast oscillators
Sunday, 14:00 - 15:30, Room 2 Hall A1

CF-3 Fiber lasers
Sunday, 16:00 - 17:30, Room 2 Hall A1

CF-4 Solitons and self-compression
Sunday, 18:00 - 19:30, Room 2 Hall A1

CF-5 Techniques for wavelength conversion of ultrashort pulses
Monday, 11:15 - 12:45, Room 2 Hall A1

CF-6 Characterisation of ultrashort laser pulses
Monday, 14:15 - 15:45, Room 2 Hall A1

CF-7 Ultrabroadband laser sources
Monday, 16:15 - 17:45, Room 2 Hall A1

CF-8 Generation and characterisation of ultraviolet pulses
Tuesday, 08:30 - 10:00, Room 2 Hall A1

CF-9 Generation of few-cycle pulses
Thursday, 08:30 - 10:00, Room 2 Hall A1

CF-10 Methods for CEP-stable sources
Thursday, 10:30 - 12:00, Room 2 Hall A1

CF-11 XUV generation and characterisation
Thursday, 14:00 - 15:30, Room 2 Hall A1

CF-12 New techniques for ultrafast spectroscopy and imaging
Thursday, 16:00 - 17:30, Room 2 Hall A1

CG – HIGH-FIELD LASER AND ATTOSECOND SCIENCE

CG-P CG Poster session
Tuesday, 13:00 - 14:00, Hall B0

CG-1 Strong-field and high-power sources and interactions
Tuesday, 14:00 - 15:30, Room 2 Hall A1

CG-2 Strong-field processes in atoms and molecules
Tuesday, 16:00 - 17:30, Room 2 Hall A1

CG-3 Twisted light fields
Wednesday, 08:30 - 10:00, Room 2 Hall A1

CG-4 Attosecond dynamics in bulk solids
Wednesday, 10:30 - 12:00, Room 2 Hall A1

CG-5 Ultrafast dynamics in molecules
Wednesday, 14:00 - 15:30, Room 2 Hall A1

CG-6 Interferometry and imaging
Wednesday, 16:00 - 17:30, Room 2 Hall A1

CG-7 Generation and applications of attosecond pulses
Thursday, 10:30 - 12:00, Room 3 Hall A1

CG-8 Harmonic generation and spectroscopy
Thursday, 14:00 - 15:30, Room 3 Hall A1

CG-9 Photoemission spectroscopy and sources
Thursday, 16:00 - 17:15, Room 3 Hall A1

CH – OPTICAL SENSING AND MICROSCOPY

CH-1 Optical fibre sensors
Sunday, 10:30 - 12:00, Room 1 Hall A1

CH-2 LIDAR systems
Sunday, 14:00 - 15:30, Room 1 Hall A1

CH-3 Photoacoustic sensors
Sunday, 16:00 - 17:30, Room 1 Hall A1

CH-4 Integrated sensors I
Sunday, 18:00 - 19:30, Room 1 Hall A1

CH-5 Integrated sensors II
Monday, 11:15 - 12:45, Room 1 Hall A1

CH-P CH Poster Session
Monday, 13:15 - 14:15, Hall B0

CH-6 Fibre bio- and medical sensors
Monday, 14:15 - 15:45, Room 1 Hall A1

CH-7 Microstructured fibre sensors
Monday, 16:15 - 17:45, Room 1 Hall A1

CH-8 Nanostructured sensors
Tuesday, 08:30 - 10:00, Room 1 Hall A1

CH-9 Microscopy I
Wednesday, 10:30 - 12:00, Room 14b ICM

CH-10 Microscopy II
Thursday, 08:30 - 10:00, Room 14b ICM

CH-11 Infrared gas sensing
Thursday, 10:30 - 12:00, Room 14b ICM

CH-12 Spectroscopic sensing
Thursday, 14:00 - 15:30, Room 14b ICM

CH-13 Time-resolved sensing
Thursday, 16:00 - 17:30, Room 14b ICM

CI – OPTICAL TECHNOLOGIES FOR COMMUNICATIONS AND DATA STORAGE

CI-1 Probabilistic shaping and NFT-based transmission
Sunday, 10:30 - 12:00, Room 6 Hall A1

CI-P CI Poster session
Sunday, 13:00 - 14:00, Hall B0

CI-2 Advanced high capacity fiber systems
Sunday, 14:00 - 15:30, Room 6 Hall A1

CI-3 Components and systems for metro and short range networks
Sunday, 16:00 - 17:30, Room 6 Hall A1

CI-4 Integrated technologies for data networks
Sunday, 18:00 - 19:30, Room 6 Hall A1

CI-5 Phase and spectrum manipulation for photonic devices
Tuesday, 14:00 - 15:30, Room 4a ICM
### CJ – FIBRE AND GUIDED WAVE LASERS AND AMPLIFIERS

| CJ-1 | Short-wavelengths thulium-doped fiber lasers  
|      | Sunday, 10:30 - 12:00, Room 3 ICM |
| CJ-P | CJ Poster session  
|      | Sunday, 13:00 - 14:00, Hall B0 |
| CJ-2 | Fiber lasers characterisation and components  
|      | Sunday, 14:00 - 15:30, Room 3 ICM |
| CJ-3 | Hollow-core fibers and systems  
|      | Sunday, 16:00 - 17:30, Room 3 ICM |
| CJ-4 | Large-mode-area-fiber-based laser systems  
|      | Sunday, 18:00 - 19:30, Room 3 ICM |
| CJ-5 | Mid-IR laser sources and components  
|      | Monday, 11:15 - 12:45, Room 1 ICM |
| CJ-6 | Waveguide lasers  
|      | Monday, 14:15 - 15:45, Room 1 ICM |
| CJ-7 | Mode-locked fiber lasers and nonlinear amplifiers  
|      | Monday, 16:15 - 17:45, Room 1 ICM |
| CJ-8 | Nonlinear frequency conversion and 2 µm fiber lasers  
|      | Tuesday, 08:30 - 10:00, Room 1 ICM |
| CJ-9 | Multimode nonlinear fiber optics  
|      | Tuesday, 16:00 - 17:30, Room 1 ICM |
| CJ-10 | Ultrafast 2µm fiber laser systems  
|      | Wednesday, 14:00 - 15:30, Room 1 ICM |
| CJ-11 | Spatiotemporal effects in multimode fiber lasers  
|      | Thursday, 08:30 - 10:00, Room 1 ICM |
| CJ-12 | Single frequency and tunable lasers  
|      | Thursday, 10:30 - 12:00, Room 1 ICM |
| CJ-13 | Raman and NIR fiber lasers  
|      | Thursday, 14:00 - 15:30, Room 1 ICM |
| CJ-14 | Coherent beam combining and multi-core fibers  
|      | Thursday, 16:00 - 17:30, Room 1 ICM |

### CK – MICRO- AND NANO-PHOTONICS

| CK-1 | Light management  
|      | Sunday, 10:30 - 12:00, Room 14a ICM |
| CK-2 | Light coupling  
|      | Sunday, 14:00 - 15:30, Room 14a ICM |
| CK-3 | Active devices  
|      | Sunday, 16:00 - 17:30, Room 14a ICM |
| CK-4 | Photonic integration  
|      | Monday, 11:15 - 12:45, Room 4b ICM |
| CK-5 | Microresonators  
|      | Monday, 14:15 - 15:45, Room 4b ICM |
| CK-6 | From nano to quantum sensing  
|      | Monday, 16:15 - 17:45, Room 4b ICM |
| CK-7 | Metasurface  
|      | Tuesday, 08:30 - 10:00, Room 14a ICM |
| CK-8 | Novel nano and micro fabrication techniques  
|      | Tuesday, 14:00 - 15:30, Room 14b ICM |

### How to find the room?

#### A map locating the rooms can be found in the inner cover of the advance programme.

#### Talks and courses: CLEO®/Europe-EQEC talks and courses take place in the congress centre, so called ICM, on your left when entering the main entrance West of Neue Messe Munich or in the exhibition hall B1 or in the exhibition hall A1 located on your right. The rooms in the halls are numbered and named according to famous physicists. A few talks take place in the Osterseen room: Follow your way to the ICM and then on your right take the stairs or the elevator to go to the second floor and reach this room at the end of the corridor.

To save space in the layout of the parallel sessions, all locations are abbreviated to the strict minimum such as "Room 1 ICM" instead of "Room 1, Ground Floor / First Floor, Congress Centre". Below you will find the detailed locations of all CLEO®/Europe-EQEC rooms:

#### Rooms located in the ICM:

- **Room 1, Ground Floor / First Floor, Congress Centre**
  - Room 2, Ground Floor, Congress Centre
  - Room 3, Ground Floor, Congress Centre
  - Room 4a, Ground Floor, Congress Centre
  - Room 4b, Ground Floor, Congress Centre
  - Room 5, Ground Floor, Congress Centre
  - Room 12a, First Floor, Congress Centre (SH only)
  - Room 12b, First Floor, Congress Centre (SH only)
  - Room 13a, First Floor, Congress Centre (SH only)
  - Room 13b, First Floor, Congress Centre (SH only)
  - Room 14a, First Floor, Congress Centre (SH only)
  - Room 14b, First Floor, Congress Centre (SH only)
  - Room 21, Second Floor, Congress Centre (SH only)

#### Rooms located in the exhibition hall B1:

- **Room B1**
  - Room B11 "Thomas Edison 1", First Floor, Exhibition Hall B1
  - Room B12 "Thomas Edison 2", First Floor, Exhibition Hall B1 (SH only)
  - Room B13 "Thomas Edison 3", First Floor, Exhibition Hall B1 (SH only)

#### Rooms located in the exhibition hall A1:

- **Room A1**
  - Room A1 "Albert Einstein", Ground Floor, Exhibition Hall A1
  - Room A2 "Emmy Noether", Ground Floor, Exhibition Hall A1 (SH only)
  - Room A3 "Theodore Maiman", Ground Floor, Exhibition Hall A1 (SH only)
  - Room A4 "Emmett Leith", Ground Floor, Exhibition Hall A1 (SH only)
  - Room A5 "Marie Curie", Ground Floor, Exhibition Hall A1 (SH only)
  - Room A6 "Charles Townes", Ground Floor, Exhibition Hall A1 (SH only)
  - Room A7 "Dennis Gabor", Ground Floor, Exhibition Hall A1 (SH only)
  - Room A8 "Gustav Gabor", Ground Floor, Exhibition Hall A1 (SH only)
  - Room A11 "Gordon Hertz", Ground Floor, Exhibition Hall A1 (SH only)
  - Room A12 "Max Born", First Floor, Exhibition Hall A1 (SH only)

#### Note:

Be aware that a few minutes are required to walk from the ICM to the rooms located in the exhibition hall A1.

#### Posters:

All poster sessions take place in the Hall B0, Ground Floor, Congress Centre.
GENERAL INFORMATION

Sessions at a Glance

20

CK-9  Frequency combs  Tuesday, 16:00 - 17:30, Room 14b ICM

CK-10  Plasmonics and antennas  Wednesday, 08:30 - 10:00, Room 13b ICM

CK-11  Novel materials and their characterisation  Wednesday, 10:30 - 12:00, Room 13b ICM

CK-P  CK Poster session  Wednesday, 13:00 - 14:00, Hall B0

CL – PHOTONIC APPLICATIONS IN BIOLOGY AND MEDICINE

CL-1  Clinical applications  Monday, 11:15 - 12:45, Room Osterseen ICM

CL-P  CL Poster session  Monday, 13:15 - 14:15, Hall B0

CL-2  Nano-optics, light field control and sensing  Monday, 14:15 - 15:45, Room Osterseen ICM

CL-3  Novel lasers, instruments and technology  Monday, 16:15 - 17:45, Room Osterseen ICM

CL-4  Chip-based methods and cellular sensing  Tuesday, 08:30 - 10:00, Room Osterseen ICM

CL-5  Label-free imaging and sensing  Tuesday, 14:00 - 15:30, Room Osterseen ICM

CM – MATERIALS PROCESSING WITH LASERS

CM-1  Beam shaping for laser processing  Sunday, 10:30 - 12:00, Room 14b ICM

CM-2  Silicon structuring by ultrafast lasers  Sunday, 14:00 - 15:30, Room 14b ICM

CM-3  Advanced functionalization of materials  Sunday, 16:00 - 17:30, Room 14b ICM

CM-4  Femtosecond laser writing of integrated photonic devices  Sunday, 18:00 - 19:30, Room 14b ICM

CM-5  Laser nanostructuring of transparent materials for advanced devices  Monday, 11:15 - 12:45, Room 14b ICM

CM-P  CM Poster session  Monday, 13:15 - 14:15, Hall B0

EA – QUANTUM OPTICS AND ULTRACOLD QUANTUM MATTER

EA-1  Quantum effects  Monday, 14:15 - 15:45, Room 4a ICM

EA-2  Coherent atom-light interaction  Monday, 16:15 - 17:45, Room 4a ICM

EA-3  Quantum optomechanics  Tuesday, 08:30 - 10:00, Room 4a ICM

EA-4  Quantum control  Tuesday, 14:00 - 15:30, Room 1 ICM

EA-5  Long-range interactions  Tuesday, 16:00 - 17:30, Room 4a ICM

EA-6  Integrated quantum photonics  Wednesday, 08:30 - 10:00, Room 1 Hall A1

EA-7  Nanoclassical light  Wednesday, 10:30 - 12:00, Room 1 Hall A1

EA-P  EA Poster session  Wednesday, 13:00 - 14:00, Hall B0

EA/EB-1  Quantum memories I  Wednesday, 14:00 - 15:30, Room 14b ICM

EA/EB-2  Quantum memories II  Wednesday, 16:00 - 17:30, Room 14b ICM

EB – QUANTUM INFORMATION, COMMUNICATION, AND SENSING

EB-1  Quantum interfaces  Sunday, 10:30 - 12:00, Room 1 ICM

EB-2  Integrated and engineered photonics  Sunday, 14:00 - 15:30, Room 1 ICM

EB-3  Quantum communication and applications  Sunday, 16:00 - 17:30, Room 1 ICM

EB-4  Quantum information processing  Sunday, 18:00 - 19:30, Room 1 ICM

EB-5  Quantum state engineering  Monday, 11:15 - 12:45, Room 3 ICM

EB-6  Quantum state characterization and foundation  Thursday, 10:30 - 12:00, Room 5 ICM

EB-P  EB Poster session  Thursday, 13:00 - 14:00, Hall B0

EB-7  Colour centres and novel sources  Thursday, 14:00 - 15:30, Room 5 ICM

EB-8  Quantum networks  Thursday, 16:00 - 17:30, Room 5 ICM

EC – TOPOLOGICAL STATES OF LIGHT

EC-1  Novel systems for topological photonics I  Thursday, 08:30 - 10:00, Room 13b ICM

EC-2  Novel systems for topological photonics II  Thursday, 10:30 - 12:00, Room 13b ICM

EC-P  EC Poster session  Thursday, 13:00 - 14:00, Hall B0

EC-3  Lasing and driven dissipative topological systems  Thursday, 14:00 - 15:30, Room 4b ICM

EC-4  Nonlinear and quantum aspects in topological photonics  Thursday, 16:00 - 17:30, Room 4b ICM

ED – PRECISION METROLOGY AND FREQUENCY COMBS

ED-1  Frequency metrology and transfer  Tuesday, 14:00 - 15:30, Room 1 Hall A1
<table>
<thead>
<tr>
<th>Session ID</th>
<th>Title</th>
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<tbody>
<tr>
<td>ED-2</td>
<td>Precision spectroscopy</td>
<td>Tuesday, 16:00 - 17:30, Room 1 Hall A1</td>
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<tr>
<td>ED-3</td>
<td>Direct comb spectroscopy I</td>
<td>Wednesday, 08:30 - 10:00, Room 4a ICM</td>
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<td>ED-4</td>
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<td>Wednesday, 10:30 - 12:00, Room 4a ICM</td>
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<tr>
<td>ED-P</td>
<td>ED Poster session</td>
<td>Wednesday, 13:00 - 14:00, Hall B0</td>
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<tr>
<td>ED-5</td>
<td>Frequency combs: Sources and characterization I</td>
<td>Wednesday, 14:00 - 15:30, Room 1 Hall A1</td>
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<tr>
<td>ED-P</td>
<td>ED Poster session</td>
<td>Wednesday, 13:00 - 14:00, Hall B0</td>
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<tr>
<td>EE – ULTRAFAST OPTICAL SCIENCE</td>
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<tr>
<td>EE-1</td>
<td>New principles of ultrafast spectroscopy</td>
<td>Sunday, 10:30 - 12:00, Room 14c ICM</td>
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<tr>
<td>EE-2</td>
<td>Ultrafast phenomena in 2D materials and on surfaces</td>
<td>Sunday, 14:00 - 15:30, Room 14c ICM</td>
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<tr>
<td>EE-3</td>
<td>Ultrafast control by light</td>
<td>Monday, 11:15 - 12:45, Room 4a ICM</td>
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<td>EE-P</td>
<td>EE Poster Session</td>
<td>Tuesday, 13:00 - 14:00, Hall B0</td>
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<tr>
<td>EE-4</td>
<td>Interaction between ultrafast sources and matter</td>
<td>Tuesday, 14:00 - 15:30, Room 4b ICM</td>
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<tr>
<td>EE-5</td>
<td>Ultrafast processes in fibers</td>
<td>Tuesday, 16:00 - 17:30, Room 4b ICM</td>
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**EF – NONLINEAR PHENOMENA, SOLITONS AND SELF-ORGANIZATION**

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<td>EF-1</td>
<td>Nonlinear nano-optics and plasmonics</td>
<td>Tuesday, 14:00 - 15:30, Room 14a ICM</td>
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<tr>
<td>EF-2</td>
<td>Mode locking and spatio-temporal localization</td>
<td>Tuesday, 16:00 - 17:30, Room 14a ICM</td>
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<tr>
<td>EF-3</td>
<td>Photon fluids and Hawking-like effect</td>
<td>Wednesday, 08:30 - 10:00, Room 14a ICM</td>
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<tr>
<td>EF-4</td>
<td>Nonlinear integrated photonics</td>
<td>Wednesday, 10:30 - 12:00, Room 14a ICM</td>
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<tr>
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<td>EF Poster Session</td>
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**EG – LIGHT–MATTER INTERACTIONS AT THE NANOSCALE**

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<td>EG-1</td>
<td>Engineering of complex electromagnetic fields</td>
<td>Wednesday, 14:00 - 15:30, Room 14a ICM</td>
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<tr>
<td>EG-2</td>
<td>Ultrafast and strong field nano-optics</td>
<td>Wednesday, 16:00 - 17:30, Room 14a ICM</td>
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<tr>
<td>EG-3</td>
<td>Nanoscale imaging and spectroscopy</td>
<td>Thursday, 08:30 - 10:00, Room 14a ICM</td>
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<td>EG-P</td>
<td>EG Poster session</td>
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<td>Thursday, 08:30 - 10:00, Room 14a ICM</td>
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**EI – TWO-DIMENSIONAL AND NOVEL MATERIALS**

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<tbody>
<tr>
<td>EI-1</td>
<td>Optics of graphene and related 2D materials</td>
<td>Monday, 16:15 - 17:45, Room 14a ICM</td>
<td></td>
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<tr>
<td>EI-2</td>
<td>Exciton/polariton physics in 2D materials</td>
<td>Tuesday, 08:30 - 10:00, Room 4b ICM</td>
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<tr>
<td>EI-3</td>
<td>Optical spectroscopy of 2D materials</td>
<td>Wednesday, 08:30 - 10:00, Room 4b ICM</td>
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<tr>
<td>EI-4</td>
<td>Hot electrons and nonlinear dynamics in 2D materials</td>
<td>Wednesday, 10:30 - 12:00, Room 4b ICM</td>
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<tr>
<td>EI-P</td>
<td>EI Poster session</td>
<td>Thursday, 13:00 - 14:00, Hall B0</td>
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**EJ – THEORETICAL AND COMPUTATIONAL PHOTONICS MODELLING**

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<th>Location</th>
</tr>
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<tbody>
<tr>
<td>EJ-1</td>
<td>Theoretical and computational photonics methods</td>
<td>Wednesday, 10:30 - 12:00, Room Osterseen ICM</td>
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<td>Sessions at a Glance</td>
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</table>
| **EJ-P** | **EJ Poster session**  
Wednesday, 13:00 - 14:00, Hall B0 |
| **EJ-2** | **Computational quantum optics, plasmonics and metamaterials**  
Wednesday, 14:00 - 15:30, Room Osterseen ICM |
| **EJ-3** | **Application-driven computational photonics modelling**  
Wednesday, 16:00 - 17:30, Room Osterseen ICM |
| **JSI – NEUROMORPHIC PHOTONICS** |
| **JSI-P** | **JSI Poster session**  
Sunday, 13:00 - 14:00, Hall B0 |
| **JSI-1** | **Photonic platforms for reservoir computing**  
Sunday, 14:00 - 15:30, Room 8 Hall A1 |
| **JSI-2** | **Neuromorphic processing for optical communications**  
Sunday, 16:00 - 17:30, Room 8 Hall A1 |
| **JSI-3** | **Neuromorphic photonic platforms**  
Sunday, 18:00 - 19:30, Room 8 Hall A1 |
| **JSII – LABEL-FREE TECHNIQUES FOR MOLECULAR IDENTIFICATION** |
| **JSII-P** | **JSII Poster session**  
Sunday, 13:00 - 14:00, Hall B0 |
| **JSII-1** | **Raman spectroscopy I**  
Sunday, 14:00 - 15:30, Room 4a ICM |
| **JSII-2** | **Raman spectroscopy II**  
Sunday, 16:00 - 17:30, Room 4a ICM |
| **JSIII – PHOTONICS FOR RENEWABLE ENERGY AND SUSTAINABILITY** |
| **JSIII-1** | **Light management for photovoltaics**  
Thursday, 08:30 - 10:00, Room 4a ICM |
| **JSIII-2** | **Thermo-photronics, materials and energy efficiency**  
Thursday, 10:30 - 12:00, Room 4a ICM |
| **JSIII-P** | **JSIII Poster session**  
Thursday, 13:00 - 14:00, Hall B0 |
| **JSIV – NANOSECOND HEAT PROCESSES** |
| **JSIV-P** | **JSIV Poster session**  
Sunday, 13:00 - 14:00, Hall B0 |
| **JSIV-1** | **Nanoscale heat transfer background**  
Sunday, 14:00 - 15:30, Room 4b ICM |
| **JSIV-2** | **Nanodevices controlled by heat manipulation**  
Sunday, 16:00 - 17:30, Room 4b ICM |
| **JSIV-3** | **Nanoscale heat processes in plasmonic nanostructures**  
Sunday, 18:00 - 19:30, Room 4b ICM |
| **JSV – QUANTUM SENSING AND APPLICATIONS** |
| **JSV-1** | **Atom interferometry and quantum optics**  
Sunday, 10:30 - 12:00, Room 21 ICM |
| **JSV-P** | **JSV Poster Session**  
Sunday, 13:00 - 14:00, Hall B0 |
| **JSVI – 50 YEARS OF INTEGRATED OPTICS** |
| **JSVI-1** | **50 Years of integrated optics I**  
Wednesday, 16:00 - 17:30, Room 1 ICM |
| **JSVI-2** | **50 Years of integrated optics II**  
Thursday, 08:30 - 10:00, Room 5 ICM |
| **ECBO-CLEO®/EUROPE 2019 JOINT SESSION** |
| **JS ECBO-CLEO®/Europe** | **Joint Session ECBO-CLEO®/Europe**  
Sunday, 18:00 - 19:30, Room 5 ICM |
| **SPIE-OPTICAL METROLOGY-EQEC 2019 JOINT SESSION** |
| **JS SPIE-OM-EQEC** | **Computational photonics for metrology application**  
Monday, 11:15 - 12:45, Room 2 ICM |
| **POSTDEADLINE SESSIONS** |
| **PD-1** | **Postdeadline 1**  
Wednesday, 19:00 - 20:30, Room 13a ICM |
| **PD-2** | **Postdeadline 2**  
Wednesday, 19:00 - 20:30, Room 13b ICM |
**CLEO®/Europe 2019 Topics**

**CA – Solid-state Lasers**
Advances in solid-state lasers: novel solid-state lasers and amplifiers; high-power and high-energy lasers; power-scalable laser architectures; solid-state micro-chip lasers; crystalline waveguide lasers ns- and ps-pulse generation; short wavelength lasers; mid-infrared lasers; wavelength tuning techniques and tunable lasers; intracavity wavelength conversion; upconversion lasers; techniques for thermal management and beam quality control; amplitude and frequency stability; novel pump sources and pumping configurations; laser resonator design; spectroscopic characterisation of solid-state gain media; advanced laser crystals and glasses; laser characterisation and modelling; lasers for large-scale facilities.

**CHAIR:** Christian Kränkel, University of Hamburg, Germany

**CB – Semiconductor Lasers**
New technology, devices and applications; UV lasers, visible lasers, near-infrared lasers; mid to far-infrared semiconductor lasers including quantum cascade and inter-subband lasers; quantum well, wire, dot and dash lasers; high power and high brightness lasers; vertical (extended) cavity surface emitting lasers; optically-pumped semiconductor lasers; photonic crystal semiconductor lasers, micro-cavity lasers, nanolasers, plasmonic lasers, polariton lasers; semiconductor ring lasers; short-pulse generation, mode locking; semiconductor optical amplifiers; novel characterization techniques; functional applications, including but not limited to: switching, clock recovery, signal processing; semiconductor lasers in integrated photonic circuits; laser dynamics, synchronization, chaos.

**CHAIR:** Mariangela Gioannini, Politecnico di Torino, Italy

**CC – Terahertz Sources and Applications**
Sources for generating terahertz (far-infrared) radiation in the range from 200 GHz to 100 THz, based on various physical principles including ultrafast time-domain systems, direct generation using terahertz lasers, and sources based on nonlinear optical mixing and laser-created plasmas; applications using terahertz radiation for spectroscopy, nonlinear THz phenomena, sensing, and imaging; advances in terahertz communications; new terahertz measurement techniques and instrumentation, including advances in imaging, detector technologies, terahertz devices, terahertz imaging and environmental monitoring.

**CHAIR:** Jérôme Faist, ETH Zurich, Switzerland

**CD – Applications of Nonlinear Optics**
Novel applications of nonlinear optical phenomena and new devices; nonlinear frequency conversion for the UV, visible and IR; telecommunications applications and all-optical switching; all-optical delay lines and slow light; optical parametric devices such as optical parametric amplifiers and oscillators; nonlinear optics in waveguides and fibres, including photonic crystal structures and microstructured optical fibres; quasi-phase-matched materials and devices; novel nonlinear materials; metamaterials and nanostructures; stimulated scattering processes and devices; applications of optical solitons and photorefractive electro-optic and Kerr devices in crystals and semiconductors; Raman based devices including amplifiers and lasers; nonlinear probing of surfaces; multi-photon imaging and coherent Raman microscopy; quantum entangled applications.

**CHAIR:** Gregor Knoop, Paul Scherrer Institute, Villigen, Switzerland

**CE – Optical Materials, Fabrication and Characterisation**
Fabrication of optical materials; new crystalline and glass laser materials in bulk, fiber and waveguide geometry; micro- and nano-fabrication and -engineering techniques; heterogeneous integration techniques; optical characterisation of laser and nonlinear materials, micro-structured fibres and photonic crystal waveguides; micro- and nano-crystalline materials, single defect centres, quantum wells, quantum wires and quantum dots, nano-tubes and nano-needles, innovative organic materials.

**CHAIR:** Pier Sazio, University of Southampton, UK

**CF – Ultrafast Optical Technologies**
Femtosecond and picosecond pulse generation from solid state, fibre and waveguide sources; mode-locked lasers; few-cycle optical pulses; pulse compression, carrier-envelope phase stabilization and pulse characterization; light waveform synthesis metrology; ultrashort-pulse semiconductor lasers and devices; ultrafast parametric amplifiers and parametric chirped pulse amplifiers; ultrashort-pulse mid-IR generation; supercontinuum generation; dispersion management; ultrafast electro-optics; pulse-shaping; carrier-envelope effects; ultrafast characterization methods and measurement techniques, ultrafast optoelectronic systems and devices; applications of ultrafast technology, technological aspects of ultrafast spectroscopy; ultrafast microscopic techniques; electro-optic sampling; ultrashort XUV and X-ray pulse generation.

**CHAIR:** Hans-Jakob Wörner, ETH Zurich, Switzerland

**CG – High-field Laser and Attosecond Science**
Strong-field and attosecond phenomena; attosecond pulse generation; strong-field ionization and ionization dynamics; novel technologies for high-field physics and attosecond science; probing of ultrafast dynamics with intense free-electron laser pulses; control of high-field and attosecond phenomena; laser-driven rescattering and recollision phenomena; high-harmonic generation; time-resolved XUV/soft-x-ray spectroscopy, interferometry and microscopy; attosecond and femtosecond diffraction imaging with electrons or photons; molecular dynamics driven by strong fields or probed by high-field/attosecond methods; attosecond or strong-field driven electron dynamics in the condensed phase, bulk media, nanostructures, quantum-confined structures or surfaces; ultra-high-intensity laser physics and technology; laser-plasma interaction and particle acceleration; relativistic nonlinear optical phenomena.

**CHAIR:** Marian Marciniak, National Institute of Telecommunications, Warsaw, Poland
**CI – OPTICAL TECHNOLOGIES FOR COMMUNICATIONS AND DATA STORAGE**

Fibre devices including dispersion compensating and nonlinear fibre, fibre propagation and polarization effects, fibre gratings; Semiconductor devices for generation, processing and detection of optical signals including laser sources, detectors and modulators, performance monitoring devices, switches, optical components for enabling WDM and OTDM systems including filtering and switching; Digital signal processing and coding techniques, forward error correction, coded-modulation, nonlinear Fourier transform, faster-than-Nyquist; Transmission techniques for submarine, core and metropolitan transport networks, communication and access networks; multi-core / multi-mode fibre for transmission, optical amplification and functions, multi-band (O, E, S, C, L) optical amplification and transmission. Optical sub-systems including clock recovery techniques, packet/burst switching sub-systems, advanced modulation formats, wavelength-division-multiplexing, receivers for coherent detection, radio-over-fiber and microwave photonic technologies, optical regeneration, optics in storage area networks, optical delays and buffering, holographic and 3D optical data storage, near-field recording and super-resolution.

**CHAIR:** Alessandro Tonello, XLIM, Université Clermont Auvergne, Saint-Étienne du Rouvray, France

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**CK – MICRO- AND NANO-PHOTONICS**

Nanostructured materials and fabrication techniques for photonic applications; novel phenomena occurring when light is created, transported and detected in environments where either dimensionality or size are reduced and, in particular, when light-matter interaction occurs in regions smaller than or similar to the wavelength of light (nanophotonics). Periodic or quasi-periodic nanostructures (photic crystals); issues related to order/disorder in nanostructured materials; photonic integrated circuits and applications advancing the integration of photonic devices for biology, lighting, communication, sensing and energy efficiency; optical MEMS; hybrid and 2D nanomaterials including in-/organic nano-layers/wires, nanocrystals and single molecules.

**CHAIR:** Olivier Gauthier-Lafaye, LAAS CNRS, Toulouse, France
**ED – Precision Metrology and Frequency Combs**

Precision interferometry and spectroscopy including frequency combs; quantum metrology; ultimate limits of measurement precision as imposed by the nature of quanta; tests of fundamental symmetries; definition of basic units; measurement of fundamental constants; applications in different spectral ranges, including mid-infrared.

**CHAIR:** Rachel Grange, ETH Zurich, Switzerland

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**EE – Ultrafast Optical Science**

Fundamental aspects of ultrafast science in all spectral regimes; propagation and instabilities of ultrashort pulses in linear and nonlinear media, supercontinuum generation, ultrafast filamentation and applications, extreme events, rogue waves and turbulence dynamics; ultrafast spectroscopy of molecules, solids and low dimensional structures; ultrafast phenomena in physics, chemistry and biology; propagation media: gas, liquid, and solid materials; free-space and waveguided geometries; coherent control using femtosecond pulses.

**CHAIR:** Stefan Haacke, University of Strasbourg, CNRS IPCMS, France

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**EG – Light–Matter Interactions at the Nanoscale**

Fundamental aspects of light–matter interactions at the nanoscale: nanoantennas and nanophotonic architectures, classical and quantum models, detection, emission and manipulation of light and/or matter; quantum nano-optics: coherent, quantum and nonlinear optical effects; ultrafast and strong-field phenomena at the nanoscale; interactions with electrons/plasma and their applications, ultrafast dynamics; optical imaging and spectroscopy: nanoscopy, nano-optical forces and tweezers; nano-energy: radiative transfer, photovoltaics and catalysis.

**CHAIR:** Niek van Hulst, ICFO - The Institute of Photonic Sciences, Castelldefels, Barcelona, Spain

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**EH – Plasmonics and Metamaterials**

Metal nanophotonics from fundamentals towards applications and including all spectral regimes: plasmonic nanostructures, antennas, cavities and waveguides; metamaterials; hybrid materials; nonlinear structures and effects; active systems, systems with gain.

**CHAIR:** Flemius Koenderink, AMOLF, Amsterdam, The Netherlands

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**EI – Two-dimensional and Novel Materials**

Fundamental aspects and applications of graphene and other two-dimensional materials in optics and optoelectronics; light–matter interactions in 2D materials; ultrafast dynamics and nonlinear phenomena in 2D and novel materials, and mode–locked lasers; light sources, modulators, detectors, and other optoelectronic devices; photovoltaics; smart windows and flexible displays; terahertz devices; tunable plasmonics and metamaterials; integration with cavities and waveguides; multi-layered 2D heterostructures; perovskites and perovskite optoelectronics; NV centres; phase change materials.

**CHAIR:** Thomas Mueller, Vienna University of Technology, Austria

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**JSI – Neuromorphic Photonics**

Photonic neurons, attojoule per bit optoelectronic devices, photonic synaptic devices, spiking and excitability, analog optical computing, reservoir computing, neuromorphic algorithms, neuromorphic hardware, optical neural networks architecture, complex systems, deep learning hardware accelerators, Ising machines.

**CO-CHAIRS:**
- Paul Prucnal, Princeton University, USA
- Peter Bienstman, University of Ghent, Belgium
cells, electronic circuitries, buildings, and vehicles. Light–matter interaction enabled by nanophotonics and plasmonics underlie the performance of the third- and fourth-generation energy-conversion devices, including up- and down-conversion of photon energy, near-field radiative energy transfer, and hot electron generation and harvesting. Miniaturization of the energy harvesting photonic devices combined with the recent effort in developing optical materials for fully passive thermal regulation via radiation holds the promise to revolutionize wearable technologies. Low-loss optical communication networks help to reduce the growing energy demands and environmental heating effects. This symposium will put in the spotlight these recent advances in photonics and their applications to traditional and emerging applications in energy generation and sustainability. It seeks contributions offering transformative ideas on photon harvesting, spectral sorting, up- and down-conversion, emission control, and new applications beyond conventional solar cell technologies.

CO-CHAIRS:
Svetlana Boriskina, MIT, Boston, USA
Jan Goldschmidt, Fraunhofer ISE, Freiburg, Germany

JSIV – NANO SCALE HEAT PROCESSES
Heat is one of the main forms of energy and its control is of critical importance to efficiently manage the energy resources of nature and global warming issues. Nanoscale heat transfer and management is an extremely “hot” research topic, challenging due to the continuous miniaturization of devices, and in rapid development as proven by many scientific articles published in the best journals and magazines of physics, material science, optics and chemistry.

The purpose of the symposium is to discuss the state of the art in the Nanoscale Heat Transfer and management, as well as the recent advances in the study of self-heating via electron-phonon interaction in nano devices, and of near field radiation, allowing to exchange relevant information, to promote collaboration among scientists and to provide the scientific basis to the newcomers. The symposium will bring together scientists, technology developers and young researchers who are interested in the theoretical tools and in the development and investigation of a large variety of new materials and applications. Participants are encouraged to present their own results in the field.

CO-CHAIRS:
Sebastian Volz, Tokyo University, Japan
Roberto Li Voti, University Rome, Italy

JSV – QUANTUM SENSING AND APPLICATIONS
Based on the development in controlling and manipulating systems at the quantum level in the recent past, a whole new technology – quantum technology - has emerged. Its specific implementations span a large variety of systems ranging from single electronic spins over atomic systems to solid state structures at the nano- and micrometer scale, and it covers notably novel schemes for computation, communication and sensing.

The focus of the joint symposium is the latter aspect in its broadest sense including the application of quantum technology tools and protocols for high-resolution scientific investigations.

CO-CHAIRS:
Sebastian Gleyzes, Collège de France, Paris, France
Michael Drewsen, Aarhus University, Denmark

JSVI – 50 YEARS OF INTEGRATED OPTICS
Early developments of integrated optics. Advances in active and passive, linear and nonlinear integrated optical components. Numerical tools for integrated optical circuit design. Future directions in integrated optics. The symposium will only comprise invited talks.

CO-CHAIRS:
Trevor Benson, University of Nottingham, United Kingdom
Valdas Pasiskevicius, KTH – Royal Institute of Technology, Stockholm, Sweden

ECBO-CLEO®/Europe 2019 Joint Session

JS ECBO-CLEO®/Europe – JOINT SESSION ECBO-CLEO/Europe
The session to take place on Sunday evening will comprise a tutorial talk on “Light sheet microscopy: Imaging faster, wider and deeper”.

CO-CHAIRS:
Rainer Leitgeb, Medical University of Vienna, Austria
Varpu Majormäki, University of Jyväskylä, Finland

Joint Session SPIE-Optical Metrology-EQEC 2019 – Computational photonics for metrology application

One session to be presented on Monday morning will comprise a tutorial talk and two contributed talks from CLEO®/Europe (CL topic - Photonic Applications in Biology and Medicine) and ECBO.

CO-CHAIRS:
Thomas Huser, University of Bielefeld, Bielefeld, Germany
Rainer Leitgeb, Medical University Vienna, Vienna, Austria

NOTES

YM: Career event: Options
The EPS Young Minds section invites to a career event on professional paths inside and beyond academia where different career paths and opportunities for physicists will be discussed and promoted. In the form of panel discussions, young physicists – master students, graduate students, and post-docs – will have the opportunity to engage with 5 invited speakers through a Q&As session. The session takes place on Sunday afternoon.

CO-CHAIRS:
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| Daniele Faccio, University of Glasgow, United Kingdom | Rashid Zia, Brown University, Providence, USA | Lino Misoguti, Universidade de Sao Paulo, Brazil | Alexander Holleitner, Technische Universität München, Germany |
| Janos Hebling, University of Pecs, Hungary | Thomas Volz, Macquarie University, Sydney, Australia | Frank Setzpfandt, Friedrich Schiller University Jena, Germany | Luca Dal Negro, Boston University, USA |
| Takuya Higuchi, University of Erlangen-Nüremberg, Germany | Alejandro Blanco Redondo, University of Sydney, Australia | Noel Smyth, University of Edinburgh, United Kingdom | Vassili Fedotov, University of Southampton, United Kingdom |
| Anna-Marie Huijser, University of Twente, Enschede, The Netherlands | Moustapha Tlidi, Université Libre de Bruxelles, Belgium | Tenio Popmintchev, ICFO-The Institute of Photonic Sciences, Castelldefels, Spain | Kristjan Leosson, Innovation Center Iceland, Reykjavik, Iceland |
| Daniil Kartashov, Friedrich-Schiller University, Jena, Germany | Paolo Biagioni, Politecnico di Milano, Italy | Brahim Lounis, Institut d’Optique Graduate School CNRS, Bordeaux, France | François Marquier, École Normale Supérieure de Paris-Saclay, Laboratoire Aimé Cotton, Orsay, France |
| Tenio Popmintchev, University of California San Diego, USA | Mathieu Mivelle, Université Pierre et Marie Curie Paris, France | Walter Pfeiffer, University Bielefeld, Germany | Isabelle Staude, Abbe Center for Photonics Jena, Germany |
| Daniel Solli, UCLA, Los Angeles, USA | Costanza Toninelli, LENS and CNR-INO Florence, Italy | Claus Ropers, University of Göttingen, Germany | Thomas Taubner, I. Physikalisches Institut, RWTH Aachen, Germany |
| Stéphane Barland, CNRS Université de Nice Sophia Antipolis, France | Stéphane Barland, CNRS Université de Nice Sophia Antipolis, France | Costanza Toninelli, LENS and CNR-INO Florence, Italy | Gregory Wurtz, King’s College London, London, United Kingdom |
| Andrea Blanco Redondo, University of Sydney, Australia | Andrea Blanco Redondo, University of Sydney, Australia | Costanza Toninelli, LENS and CNR-INO Florence, Italy | Thomas Taubner, I. Physikalisches Institut, RWTH Aachen, Germany |
| Alejandra Giacomotti, Centre de Nanosciences et de Technologies (C2N), Palaiseau, France | Julien Javaloyes, Universitat de les Illes Balears, Spain | Lino Misoguti, Universidade de Sao Paulo, Brazil | Goki Eda, National University of Singapore, Singapore |
| Frank Setzpfandt, Friedrich Schiller University Jena, Germany | Frank Setzpfandt, Friedrich Schiller University Jena, Germany | Noel Smyth, University of Edinburgh, United Kingdom | Ilya Goykhman, Technion, Israel Institute of Technology, Haifa, Israel |
| Alexander Solntsev, University of Technology, Sydney, Australia | Alexander Solntsev, University of Technology, Sydney, Australia | Alexander Solntsev, University of Technology, Sydney, Australia | Alexander Holleitner, Technische Universität München, Germany |
# Committees

**CLEO®/Europe-EQEC 2019 Joint Symposium Program Committee**

<table>
<thead>
<tr>
<th>JSI – Neuromorphic Photonics Co-chairs:</th>
<th>Fabian Maucher, Aarhus University, Denmark</th>
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<td>Peter Bienstman, Ghent University, Belgium</td>
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<td>Paul Prucnal, Princeton University, USA</td>
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<th>JSII – Label-Free Techniques for Molecular Identification Co-chairs:</th>
<th>Carsten Rockstuhl, Institut für Theoretische Festkörperphysik Karlsruhe Institut für Technologie, Germany</th>
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<tr>
<td>Ji-Xiang Cheng, Boston University, USA</td>
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<td>Hanieh Fattahi, Max Planck Institute of Quantum Optics and LMU, Garching, Germany</td>
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<tr>
<th>JSIII – Photonics for Renewable Energy and Sustainability Co-chairs:</th>
<th>Vasili Perebeinos, Skolkovo Institute of Science and Technology, (Scoltech), Moscow, Russia</th>
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<tr>
<td>Svetlana Boriskina, MIT, Cambridge, MA, USA</td>
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<td>Jan Goldschmidt, Fraunhofer ISE, Freiburg, Germany</td>
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<th>JSIV – Nanoscale Heat Processes Co-chairs:</th>
<th>Miroslav Kolesik, University of Arizona, Tucson, AZ, USA</th>
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<td>Roberto Li Voti, Sapienza Università di Roma, Italy</td>
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<tr>
<th>JSV – Quantum Sensing and Applications Co-chairs:</th>
<th>Emmanuel Lorin de la Grandmaison, Carleton University, Ottawa, Canada</th>
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<tr>
<td>Michael Drewsen, Aarhus University, Denmark</td>
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<td>Sébastien Gleyzes, Laboratoire Kastler Brossel, Collège de France, Paris, France</td>
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<tr>
<th>JSVI – 50 Years of Integrated Optics Co-chairs:</th>
<th>Miroslav Kolesik, University of Arizona, Tucson, AZ, USA</th>
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<tr>
<td>Trevor Benson, University of Nottingham, United Kingdom</td>
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<td>Valdas Pasiskevicius, KTH, Stockholm, Sweden</td>
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**NOTES**
Short abstracts of the papers to be presented at CLEO®/Europe-EQEC 2019 appear in this advance programme.

The CLEO®/Europe-EQEC 2019 technical programme will feature around 2000 presentations including 4 plenary talks, 5 tutorial talks, 6 keynote talks, 86 invited talks, 22 talks upgraded to invited, 5 special oral contributions, 982 oral presentations and 896 posters presented among the five poster sessions. 18 oral presentations will also be featured in the two post-deadline sessions on Wednesday evening. Additionally 12 short courses will be proposed.

From 11 to 17 parallel sessions will take place daily during the conference. All sessions and short courses will be held at the International Congress Centre in Munich (so called ICM) or the exhibition halls of the trade fair grounds LASER WORLD of PHOTONICS 2019. These rooms are named according to famous physicists.

Conference Dates

CLEO®/Europe-EQEC 2019 will be running from Sunday 23 June, 10:30 to Thursday 27 June, 17:30.

New at CLEO®/Europe-EQEC!

EPS Young Minds section invites to a career event

EPS Young Minds section invites to a career event on professional paths inside and beyond academia where different career paths and opportunities for physicists will be discussed and promoted. In the form of panel discussions, young physicists – master students, graduate students, and postdocs – will have the opportunity to engage with 5 invited speakers through a Q&As session.

After a PhD, there are several ways to start a professional career. It is well known that a large percentage of Physics PhD students goes on to, ultimately, occupy a non-academic position. At the same time, there are several cases of successful careers as a researcher. Would you like to know the key to their success? Or are you looking for alternative careers? Some opportunities both in and outside academia will be presented during this career event.

This event will also present a view on different professional profiles, such as:
- Researchers in attosecond physics, photonics and ultrafast laser science;
- A laser consultant;
- A chief scientist and advisor; and
- A large photonics company founder and CEO.

**ANNOUNCED SPEAKERS:**
- Hanifeh Fattahi, Laser physicist and research group leader at Max Planck Institute of Quantum Optics
- Wilhelm Kaenders, Co-Founder and President, TOPTICA Photonics AG
- Gregory Quarles, Chief Scientist at The Optical Society (OSA)
- Clara Saraceno, Professor at Ruhr-Universität Bochum
- Gabrielle Thomas, Consultant

Further information, see www.cleoeurope.org/eps-young-minds-career-event/

**2019 World of Photonics congress opening and plenary talk**

The official World of Photonics congress opening will take place on Monday 24 June, from 9:40 to 11:00, room 1.

**TIME SCHEDULE:**

**09:40 – 10:00**
- Opening - Words of welcome by Reinhard Pfeffer, deputy CEO, Messe München GmbH.
- Welcome address by Peter Loosen, president of the World of Photonics congress steering committee, deputy director Fraunhofer Institute for Laser Technology (ILT).

**10:00 – 11:00**
- Plenary talk “Gravitational Waves Astronomy: Listening to the sounds of the dark universe!” by Karsten Danzmann, Max Planck Institute for Gravitational Physics (Albert Einstein Institute) and Institute for Gravitational Physics, Leibniz Universität, Hannover, Germany.

**Prizes and Awards**

A series of Prize and Award ceremonies will take place during the EQEC Plenary session scheduled Tuesday 25 June from 10:30 to 12:30, room 1.

During this session Anton Zeilinger, Vienna Center for Quantum Science and Technology University of Vienna, Austria; Institute for Quantum Optics and Quantum Information, Vienna, Austria will present a plenary talk on “Photonic Entanglement: from Foundations to Applications”.

The following prizes and awards will be presented:
- EPS-QEOD and EPS Young Minds 2019 Travel Grant Student Awards
- 2019 Awards of the European Physical Society – Quantum Electronics and Optics Division:
  - (2) Quantum Electronics prizes.
  - (2) Fresnel prizes.
- The Optical Society (OSA) Awards and Honours:
  - 2019 Herbert Walther Award.
  - 2019 Advocate of Optics
  - OSA Fellow Members

See PRIZES AND AWARDS CEREMONY BROCHURE.

**IUPAP C17 Young Scientist Prizes (YSP)**

**Speakers’ Information**

**DURATION OF THE TALKS:**
- Oral and special oral presentations are 15 minutes including discussion.
- Post-deadline presentations are 10 minutes including discussion.
- Invited presentations are 30 minutes including discussion.
- Tutorial presentations are 60 minutes including discussion.
- Keynote presentations are 45 minutes including discussion.
- Plenary presentations are 60 minutes including discussion.

Speakers are asked to check-in with the session chair in the room of their relevant session ten minutes before the beginning of the session.

During the World of Photonics congress a network-based presentation system will be used.
Along with a congress specific interface to ensure a high quality of all presentations: A software will distribute and relay all lectures onto the laptop in the conference room and display the overview of the ongoing program on the information screens inside and outside the room.

All speakers can upload their presentations to a protected server of Neumann & Müller prior to the conference. Upload-link and login details will be announced until 14 June. Each speaker will get an own account and a link where to upload the presentation until one hour before the session starts.

Those who did not do it are kindly requested to upload their presentation on-site in the Speakers’ Check-in located in the foyer on the 1st floor of the ICM.

Important: In any case all speakers need to check their presentations at the Speakers’ Check-in when they arrive to the ICM!

Please be assured that the presentations are securely protected against any external access. This applies for both the online upload as well as the upload on-site. After the conference all submitted files will be deleted from all storage media.

Location of the Speakers’ Check-In:
The Speakers’ Check-in is located in the foyer on the 1st floor of the ICM.

Opening times of the Speakers’ Check-in with technicians available to assist the speakers:
- Sunday, 23 June 7:30 a.m. – 7:30 p.m.
- Monday, 24 June 7:30 a.m. – 6:30 p.m.
- Tuesday, 25 June 7:30 a.m. – 6:30 p.m.
- Wednesday, 26 June 7:30 a.m. – 6:00 p.m.
- Thursday, 27 June 7:30 a.m. – 5:00 p.m.

Provided audiovisual equipment:
- HD video projector, screen with ratio 16:9 and lectern microphone.

Session Chairs:
For each oral session a nominated session chair will act to introduce the speakers, make sure the speakers stay within the appropriate time limits, help generate discussion.

Poster Sessions:
Posters are a major attraction and provide an intimate interaction between the presenter and the viewer. To allow participants to see as many posters as possible, all CLEO/Europe-EQEC 2019 posters will be displayed in Hall B0 (ground floor) next to the ICM centre. The conference will feature 5 poster sessions taking place from Sunday to Thursday after lunchtime. There will be no oral presentations during this time.

Poster time schedules:
- Sunday: 13:00 - 14:00 (CE, CF, CI, CJ, JSI, JSIV and JSV topics)
- Monday: 13:15 - 14:15 (CA, CB, CD, CH, CL, CM and EH topics)
- Tuesday: 13:00 - 14:00 (CC, CG, EE and EF topics)
- Wednesday: 13:00 - 14:00 (CK, EA, ED, EF, EI and EJ topics)
- Thursday: 13:00 - 14:00 (CD, EB, EC, EG and JSIII topics)

Authors are requested to display their poster on their allocated board in the morning of the day of their presentation. The poster presentations can remain on the boards until 4:00 pm.

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Authors are requested to display their poster on their allocated board in the morning of the day of their presentation. The poster presentations can remain on the boards until 4:00 pm.

In order to present their work and answer questions, authors are requested to be present in the vicinity of their poster on the day of their presentation time. There will be no oral presentations during this time.

Each author is provided with one board on which to display a summary of the paper. The size of the poster should not exceed 100-105 cm wide × 150 cm high. Fixing material (adhesive tape) will be provided.

The boards will be grouped by topics and marked with the poster reference numbers. The schedule of the poster sessions is presented on the respective pages of the advance programme.

Short Courses:
Twelve short courses at an extra cost will be presented in parallel on Sunday afternoon 23 June 2019. Each course is scheduled in two parts: Course Part I (1 hour ½), coffee break (30 minutes), Course Part II (1 hour ½). The courses are open to attendees of the World of Photonics congress and Laser World of Photonics exhibition subject to payment of the course fee. Advance registration is required in order to obtain the short course material. This material will not be available for purchase during the conference.

Laboratory Tours:
Guided laboratory tours through selected Munich (Garching) Laser Laboratories are scheduled to take place on Friday morning 28 June 2019 from 10:00 to 12:00.
General Information

CLEO®/Europe-EQEC conference dinner

Tuesday 25 June 2019, beginning from 19:00, Löwenbräukeller, Munich

The delegates registered with CLEO®/Europe-EQEC 2019 are invited to the conference reception at a special cost of € 10,- (including buffet + 2 drinks) per participant and € 35,- per additional guest. The dinner will take place at the famous Löwenbräukeller (www.loewenbraeukeller.com/en/home/) in downtown Munich. A rich selection of fine Bavarian food will be provided. Place is limited to 1000 seats. Registration and advance payment needs to be done via the conference on line registration system. No on site reservations are possible. Only persons in possession of a valid invitation card will be able to participate.

Conference publication

The accepted one-page summaries (oral or poster) will be available on line during the conference for those who have registered for the full week.

Post conference publications

After the conference, if approval given during the on line submission, the one-page summaries will be published on line by OSA Publishing (www.osa.org/en-us/publications/) and IEEE Photonics Society’s IEEE Xplore Digital Library (http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=6778445 ). Only papers (either oral or poster) for which the author(s) physically made the presentation at the conference will be eligible for the publications.

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Note: Part of the process of signing a publication agreement may include giving permission or not to IEEE to make and distribute video and audio recordings of their conference presentation. Granting IEEE this simple permission to record your presentation will not affect in any way your rights or your employer’s rights to own and use your presentations.

OSA is the exclusive owner of all rights, titles and interests throughout the world of the names “Conference on Lasers and Electro-Optics” and “CLEO” which is a registered trademark CLEO®.

Anti-harassment Policy and Code of Conduct

CLEO®/Europe-EQEC is committed to providing an environment that is conducive to the free and robust exchange of scientific ideas. This environment requires that all participants be treated with equal consideration and respect. While CLEO®/ Europe-EQEC encourages vigorous debate of ideas, personal attacks create an environment in which people feel threatened or intimidated.

Social Events

All conference participants are cordially invited to attend the following parties:

Monday 24 June 2019, from 19:00 to 21:00
"Bier & Brezel" Get together kindly sponsored by SPIE - ICM Foyer and Hall B0, ground floor

Wednesday 26 June 2019, from 17:45 to 18:45
Happy Hour kindly sponsored by EPS-QEOD - ICM Foyer and Hall B0, ground floor

Please type in the field "arrival": 9:35. You head the same choice, for your intended destination. Near the hotel as a starting point and, respectively, you can enter either the street or subway station - trip@enquiry

ers: https://efa.mvv-muenchen.de/index.html

laboratory, please go to the Munich public transport website (MVV) with a screen for English speakers: https://efa.mvv-muenchen.de/index.html - trip@enquiry

You can enter either the street or subway station near the hotel as a starting point and, respectively, the same choice, for your intended destination. Please type in the field “arrival”: 9:35. You head the same choice, for your intended destination.

Important: Transport!

Transportation needs to be arranged by the visitor. Transportation needs to be arranged by the visitor. You can enter either the street or subway station near the hotel as a starting point and, respectively, the same choice, for your intended destination.

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Participating laboratories and contact email addresses are listed at http://www.cleoeurope.org/laboratory-tours/. CLEO®/Europe-EQEC participants are invited to sign up for the laboratory visits via email to the contacts given on this page.

If possible, laboratory tour attendants should book their return flights in the evening, to be sure, that there is enough time.

Important: Transport!

Transportation needs to be arranged by the visitor. To find connections from the hotel to the chosen laboratory, please go to the Munich public transport website (MVV) with a screen for English speakers: https://efa.mvv-muenchen.de/index.html - trip@enquiry

ers: https://efa.mvv-muenchen.de/index.html

laboratory, please go to the Munich public transport website (MVV) with a screen for English speakers: https://efa.mvv-muenchen.de/index.html - trip@enquiry

You can enter either the street or subway station near the hotel as a starting point and, respectively, the same choice, for your intended destination.
This is not productive and does not advance the cause of science. All participants in CLEO®/Europe-EQEC and CLEO®/Europe-EQEC-managed events and activities are therefore expected to conduct themselves professionally and respectfully.

It is the policy of CLEO®/Europe-EQEC that all forms of bullying, discrimination, and harassment, sexual or otherwise, are prohibited in any CLEO®/Europe-EQEC or CLEO®/Europe-EQEC-managed events or activities. This policy applies to every individual at the event, whether attendee, speaker, exhibitor, award recipient, staff, contractor or other. It is also a violation of this policy to retaliate against an individual for reporting bullying, discrimination or harassment or to intentionally file a false report of bullying, discrimination, or harassment.

Bullying, discrimination, and harassment of any sort by someone in a position of power, prestige or authority is particularly harmful since those of lower status or rank may be hesitant to express their objections or discomfort from fear of retaliation.

CLEO®/Europe-EQEC may take any disciplinary action it deems appropriate if, after thorough investigation, it finds a violation occurred.

**Audio, video, photography, digital recording policy**

Conferences, courses, and poster sessions: For copyright reasons, photographs or recordings of any kind are prohibited without the prior written consent of the presenter or instructor.

Exhibition halls: For security and courtesy reasons, recordings of any kind are prohibited unless one has explicit permission from on-site company representatives.

**Capture and use of a person’s image**

By registering at CLEO®/Europe-EQEC, the registrant grants full permission to the management society to capture, store, use, and/or reproduce his/her image to be used in the future CLEO®/Europe-EQEC marketing materials or conference website. The registrant also waives any right to inspect or approve the use of the images or recordings. She/he also waives any right to royalties or other compensation arising from or related to the use of the images, recordings, or materials.

All conference registrants will have free entrance to the technical exhibition. Longer lunch breaks are organised to allow visits to the exhibition.

By registering at CLEO®/Europe-EQEC, the registrant also agrees to have Messe München GmbH use his/her personal particulars (title, first name, last name, company name, company address, country) for badge printing purposes and to pass on said information to exhibitors in case the registrant allowed to scan the badge during the online registration.

**Exhibition Information**

From Monday to Thursday, a major exhibition of laser and electro-optic equipment and services, LASER World of PHOTONICS 2019 will be held in conjunction with the congress. The latest technology first hand will be exhibited. The range of products exhibited will cover innovative optical technologies:

- Laser and optoelectronics;
- Optics;
- Manufacturing technology for optics;
- Sensors, test and measurement;
- Optical measurement systems;
- Laser and laser systems for production engineering;
- Optical information and communication;
- Biophotonics and medical engineering;
- Imaging;
- Illumination and energy;
- Security.

This combination of theory and practice, an extensive program of conferences and related events and the presence of all market leaders, decision-makers and users, make LASER World of PHOTONICS unique and, at the same time, the most important international information and networking platform for the industrial, research and development sectors.

LASER World of PHOTONICS features around 1 300 exhibitors in 5 halls and gives a complete overview of all the latest trends and applications. The exhibition should attract over 32 000 visitors.

Further information on the exhibition is available at [https://world-of-photonics.com/index-2.html](https://world-of-photonics.com/index-2.html)

**Opening hours of the exhibition**

The exhibition will be opened from Monday through Wednesday 09:00 - 17:00 and on Thursday 09:00 - 16:00.

**Application Panels**

The application panels organised by Messe München International are now a permanent part of the World of Photonics congress. The series of lectures that are held in the forums of the LASER World of PHOTONICS 2019 exhibition halls bridge the gap between science and practical application.

Well-known speakers from industry and research institutes report on the latest industrial and medical application findings in the sector for optical technologies and discuss current challenges with you. They will give attendees a comprehensive look at the latest trends and developments.

A series of 17 application panels will be held from Monday to Thursday. Broken down into four main categories:

- Biophotonics and medical applications (Hall B2),
- Lasers materials processing (Hall A3),
- Lasers and optics (Hall B3),
- Optical metrology and imaging (Hall B2).

The admission is free for all trade-fair visitors, exhibitors and congress participants. All are held in English.


**On-site Facilities for Attendees**

**Online Lecture Database**

The entire programme of events at the World of Photonics Congress is available online at: [https://www.photonics-congress.com/congress-program.html](https://www.photonics-congress.com/congress-program.html). With this online database you can get information about every conference, sub conference, session, oral lecture or poster presentation. For every lecture at least the information about the room and time data, the speaker and the assignment to the structure is available.
How it works: Switch on the WiFi function on your terminal device. Search for wireless networks and connect to the messingWiFi network.

INTERNET AND W-LAN LOUNGES
All congress participants using their own laptops/notebooks/pads have free access to W-LAN lounges located as follows:

- **ICM foyer Süd**
- **ICM main foyer of the ICM main entrance**
- **ICM 1st floor, opposite the Speakers' Check-In**
- **Exhibition Hall A1**

Internet is with high-speed access and unlimited download.

In the rooms, only the wifi-version with limited bandwidth (up to 1.5 Mbit/second) and limited download volume (50 MB per user per day) is available.

The reception quality and signal availability depends on structures, exhibits and other sources of interference in the halls and cannot be guaranteed.

### World of Photonics Congress App
The World of Photonics Congress-App is available in the Appstore and the Google Play Store. It offers an innovative tool, which can be used to prepare your timetable in an easy and professional way. This tool will allow to find the complete congress programme, save sessions/lectures in your personal calendar, easily create and access favourite lists, access detailed conference room plans, give general information about the congress. Online-push-notifications will be sent to app users during the congress. The Android and iOS links are to found at: https://www.photonics-congress.com/about/app/index.html

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The reception quality and signal availability depends on structures, exhibits and other sources of interference in the halls and cannot be guaranteed.

### Message board
A message board will be installed. Participants should consult it daily for internal messages.

### Full-service restaurants
Are you looking for a position or a new challenge in the photonics industry? The LASER career center gives you a number of specific options for your professional development.

At the Career Center in Hall B2, booth 122, visitors who have questions about careers and job applications, job changes or career entry will receive a free career consultation between 10.00 am to 5.00 pm from experienced personnel consultants of the consulting group Wirth + Partner who have a focus on the photonics industry. The registration for the coaching takes place under info@wirth-partner.com or 089/4599580 or on site at the exhibition stand.

Already now you can find the exhibitor’s job vacancies in the online career center.

### See the following links:
German: https://exhibitors.world-of-photonics.com/onlinekatalog/2019/job_offers

Further information at: https://world-of-photonics.com/visitors/supporting-program/career-center/index.html

### How it works:
Start your Internet browser. Enter any Internet address. The portal page of the free WiFi will appear on screen.

### catering
All conference attendees are invited to attend the free coffee breaks as marked in the tables of the days at a glance (first pages of the advance programme).

Lunches are **not included in the conference fee**.

A number of gastronomy facilities are available on site. Depending on the weather the beer garden outside (located between Halls A1 and B1) will be open.

### Catering
All conference attendees are invited to attend the free coffee breaks as marked in the tables of the days at a glance (first pages of the advance programme).

Lunches are **not included in the conference fee**.

A number of gastronomy facilities are available on site. Depending on the weather the beer garden outside (located between Halls A1 and B1) will be open.

### Message board
A message board will be installed. Participants should consult it daily for internal messages. It will be placed in the corridor between Entrance West and ICM.

### Office services currently proposed at cost:
- PC workstation with printers (applications from all MS Office packages)
- Internet access
- Laptop connections
- E-mail and fax (receive/send)
- Colour/black-and-white copies
- Stamps
- Additional services:
  - Information about cultural attractions in Munich
  - Hotel information
  - Flight/train information
  - Information about Munich International Trade Fairs
  - Taxi service (directly in front of ICM main entrance)

### Full-service restaurants

- **World of PHOTONICS career center** gives you
different challenges in the photonics industry? The LASER career center gives you

### How it works:
Switch on the WiFi function on your terminal device. Search for wireless networks and connect to the messingWiFi network.

### Business Centre
The business centre (open from Sunday to Thursday from 08:00 to 17:00 hour, closed Saturday) is centrally located next to the main entrance of the ICM.

### Office services currently proposed at cost:
- PC workstation with printers (applications from all MS Office packages)
- Internet access
- Laptop connections
- E-mail and fax (receive/send)
- Colour/black-and-white copies
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Other banks are also to be found in the centre of Munich or at the main railway station.

**TAXI SERVICE**
The taxi service is located in front of the ICM main entrance.

**AIRPORT SHUTTLE**
An airport shuttle operated by Autobus Oberbayern is organised in connection with the trade fair (from Sunday to Thursday) to and from Munich airport. For further details, see part on Conference venue.

**FIRST-AID**
First-aid stations are located in the East and West Entrances and on the North side of Hall C4. As a service partner of Munich International Trade Fairs, Aicher Ambulanz Union is responsible for the medical needs of guests and visitors at the trade-fair center and the ICM.
Phone: +49 89 742200, +49 89 949 28103 (for first-aid emergency call), mobile: +49 171 5663514.

**SECURITY SERVICE / LOST AND FOUND OFFICE**
The security headquarters are located in the administration building by gate 1. Open around-the-clock the office is accessible from the inside (via the administration building) and from the outside. This is also where you can claim lost items or turn in objects found at the Lost & Found office.

**PHARMACY**
The nearest pharmacy is “SaniPlus” in the Riem Arcaden shopping centre. It is located on the ground floor in the right portion of the building. Opening hours: Monday through Saturday 09:00 - 20:00.

**OPTICIAN**
The optician “Fielmann” has a retail outlet in the Riem Arcaden shopping centre.

**GROCERIES WITH BAKERY, CLOAKROOM, AND INFORMATION/TRAVEL SERVICE** … are located in the Main Hall of the Entrance West leading to Halls A1 and B1.

**POST OFFICE**
Deutsche Post has a small branch office in the Riem Arcaden shopping centre (lower level next to the “Edeka” supermarket).

**DRY CLEANING**
“Die Reinigung” dry cleaning is located in the Riem Arcaden shopping centre.

**PRESS SERVICES**
All members of the press are requested to register by Messe Munich. They will receive the conference material and badges that will admit them to all technical sessions and the exhibition.

**CLOAKROOM**
For congress attendees a cloakroom is located on the intermediate level of the ICM. In addition a cloakroom is located on the lower levels of the West Entrance. As a rule, it starts one hour before the exhibition begins and ends one hour after the exhibition closes.

**NOTE FOR SMOKERS**
Smoking in the ICM is forbidden. Smoking on the grounds of the exhibition space is only permitted in designated smoking areas outside the halls.

**Conference Venue**
CLEO®/Europe-EQEC 2019 will take place at the New Munich Trade Fair Centre at the ICM - International Congress Centre, Am Messesee 6, 81829 Munich, Germany. Please visit: http://www.messe-muenchen.de/ or http://www.icm-muenchen.de.
How to reach the ICM Centre

By car: simply follow the trade fair signs from the outskirts and throughout the city to the ICM. There you will find parking space.

By train: The ICM is about 20 minutes from Munich central station (Hauptbahnhof) by underground U2, exit “Messestadt West”. The U2 subway runs from 4:12 in the morning to about 1:00 after midnight. Further information on the underground is available at http://www.mvv-muenchen.de/ or at the information counters on the trade fair grounds.

From the airport: At Munich airport, the station for urban railway lines S1 and S8 is directly below the central area. Trains in the direction of the city centre run at 10-minute intervals. There are two routes from the airport to the ICM:

Route S1 / U2: S1 from the airport to Feldmoching station or Munich Central Station (Hauptbahnhof). Change to underground U2 that takes you directly to the ICM - Messestadt West.

Route S8 / U2: S8 from the airport to Munich central station (Hauptbahnhof). Change to underground U2 that takes you directly to the ICM - Messestadt West.

By taxi from the airport: Taxis are available in front of the terminals. The journey takes about 35 minutes, depending on the volume of traffic.

By hire car from the airport: All the major car rental firms are represented at Munich airport. The car rental centre with its own parking facilities is in front of module A, to the north of car park P6.

Please take the following route: From Munich Airport follow the signs “Messe/ICM” on the A92 in the direction of Munich to the motorway intersection Eching/Neufahrn. Then take the A9 in the direction of Munich to the motorway intersection München-Nord. Continue on the motorway ring road A99 in the direction of Salzburg to the motorway intersection München-Ost. Then take the A94 in the direction of Munich to the exit Feldkirchen-West or München-Riem. The journey takes about 35 minutes, depending on the volume of traffic.

How to take a taxi from the ICM Centre to the airport
You will find taxi ranks at all trade fair entrances and in front of the ICM going to the airport (Central Building).

Airport shuttle
An airport shuttle operated by Autobus Oberbayern is organised in connection with the trade fair (from Sunday to Thursday) to and from Munich airport. The bus departs every 20 minutes and travels nonstop to the exhibition grounds and the ICM. The bus directly stops in front of the West, East and North Entrances and in front of the entrance of the ICM congress centre. It provides service between the Munich airport and the trade-fair centre during the following schedule (every 20 minutes):

Departure times at Munich airport: from 8 am to 6 pm.

Terminal 1, Area A: at 00, at 20 and at 40
Terminal 1, Area Z (central area) four minutes later, at 04, at 24 and at 44
Terminal 2: four minutes earlier, at 36, and at 16 and at 36 (Please note: no stop in Area D).

Departure times at the exhibition grounds / ICM: from 9:40 am to 8 pm
The bus runs every 20 minutes. See the exact schedules at the information desk of the ICM. The trip takes approximately 45 minutes. The ride costs €9.00 one-way or €15.00 round trip.

Conference Registration

<table>
<thead>
<tr>
<th>Conference Registration Fees</th>
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</thead>
<tbody>
<tr>
<td>EPS/OSA/IEEE Member</td>
<td>€ 650</td>
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<tr>
<td>with the online digest</td>
<td></td>
</tr>
<tr>
<td>Non-Member</td>
<td>€ 780</td>
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<tr>
<td>with the online digest</td>
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<tr>
<td>EPS/OSA/IEEE Student Member*</td>
<td>€ 250</td>
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<tr>
<td>with the online digest</td>
<td></td>
</tr>
<tr>
<td>Student Non-Member (*)</td>
<td>€ 280</td>
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<tr>
<td>with the online digest</td>
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</tr>
<tr>
<td>One Day without the online digest</td>
<td>€ 320</td>
</tr>
<tr>
<td>Student (*) extra fee for Short Course</td>
<td>€ 220</td>
</tr>
<tr>
<td>Regular extra fee for Short Course</td>
<td>€ 350</td>
</tr>
<tr>
<td>Dinner ticket per participant</td>
<td>€ 10</td>
</tr>
<tr>
<td>Additional dinner ticket per guest</td>
<td>€ 35</td>
</tr>
</tbody>
</table>

Note: All registration fees are exempt from Value Added Tax. (*) Applications for the student rates must include a copy of an official student identity card, which must also be presented on-site when collecting registration materials.

The full week registration fee for the meeting includes admission to all CLEO®/Europe-EQEC 2019 technical sessions, as well as to those of all conferences co-located with the congress. It includes admission to the technical exhibition. Digest will be online. A login and password will be given. Coffee breaks as marked in the days at a glance are included. Lunches and tickets for public transportation are not included in the fees.

One-day registration fees are available for those wishing to attend one particular session rather than the whole conference. Please note that the online digest will not be included. Coffee breaks are included. Lunches and tickets for public transportation are not included in the fees.

Note: One-day registration tickets are activated on the day the participant goes through the gates of the congress or the fair and will only be valid for that day.

Registration forms are available on site.

Cancellation Policy

An administration charge of € 50 will be made for processing refunds. A request for cancellation must be made in writing. In the case of cancellation, requests received on or before Friday 14 June 2019 will be refunded (less the administration charge). No refunds will be available if notice of cancellation is received after 14 June 2019.

Conference management

European Physical Society
6 rue des Frères Lumière
68200 Mulhouse, France
This programme is edited by Patricia Helfenstein and André Wobst.

Language

English is the official language of the conferences.

Note to Exhibitors

Each exhibitor at LASER World of PHOTONICS 2019 is entitled to one free ticket to the World of Photonics congress 2019. Each exhibitor may also purchase up to five congress tickets for a special price.

All tickets are personalized, i.e. they are valid only for the person whose name appears on the ticket, and they are not transferrable.
General Information

Special tickets to the World of Photonics Congress may only be ordered and used by exhibiting companies.

The official congress proceedings are not included in the discount price for special tickets for exhibitors.

Messe Munich manages the order of these tickets: Congress tickets for exhibitors can be ordered via the Online Exhibitor Shop in the same way as exhibitor passes. After personalisation, these ticket(s) will be sent as e-ticket(s) by e-mail to the recipient(s).

Beyond that, exhibitors must purchase any additional tickets to the World of Photonics Congress from one of the organizing scientific associations at the regular price.

Note: Neither the free special tickets nor the discounted special tickets are available to speakers or poster presenters appearing at the World of Photonics Congress 2019. Speakers and poster presenters must register with the respective organizing association.

Registration hours and location

Registration for technical sessions will take place at the ICM centre. To enter the ICM centre please take the main Entrance West (named "Haupteingang WEST"). CLEO®/Europe-EQEC 2019 registration counters are located on the left side at the end of the main corridor just prior you enter the exhibition halls.

Hotel Information

The International Congress Centre (ICM) is located about 20 minutes from the Munich Central Station (Hauptbahnhof) by underground U2, exit "Messestadt West". Whether you are looking for a hotel, a guesthouse, a private accommodation, or a boarding house you should be able to find your accommodation downtown or in the surrounding area of Munich.

Messe Munich has arranged for an on-line hotel reservation which can be used for the CLEO®/Europe-EQEC 2019 participants. View https://tradefairs.com/en/LASER%20World%20of%20PHOTONICS/2019/Hotels/M%C3%BCnchen

The hotel guide of the Munich Trade Fairs offers you a large variety of accommodation possibilities for a pleasant stay. Whether near the ICM or centrally located and in the middle of the nightlife of Munich's trendy neighbourhoods or close to the mountains with a high recreation value - here you will find a comprehensive offer of accommodation in and around Munich as well as in the alpine upland - meeting your personal criteria. Hotels can be directly searched and booked via the hotel directory.

A large variety of rooms can be found using the link of the Tourism office: https://www.muenchen.de/int/en/accommodation-hotels.html

Hotels, pensions, apartments or youth hostels in Munich can also be found at:
https://www.euro-youth-hotel.de/
https://www.hostelworld.com/

Considering the large number of attendants to the exhibition, running in conjunction with the conference, we recommend to make your hotel reservation as soon as possible.

Transportation in Munich

Munich offers very good transportation means (hire cars, trams, metro and buses).

Participants of the World of Photonics congress who use local public transportation to get to Neue Messe Munich must buy a travel ticket, at their own expense.

Tickets can be purchased from all bus drivers, tram drivers, automatic ticket-dispensing machines at stations (S and U-Bahn stops) and from kiosks displaying the MVV logo. The machines understand several languages. Just select your flag. Some ticket machines accept 10 € and 20 € banknotes and most will give change. Please have some small coins ready! You can select your respective language on the ticket machines. Online tickets and mobile tickets can now also be purchased.

Buy your ticket depending on the zones you will cross and the time length you will need to travel:

• Stripe ticket (Streifenkarte): Stamp two stripes per zone. You are allowed to change and interrupt your journey. Return and round trips are not permitted.
• Single trip ticket: Valid for one person for one trip. You are allowed to change and interrupt your journey. Return and round trips are not permitted. The fare depends on the number of zones passed through.
• Single day ticket (Tageskarte): The most popular daily tickets are also available as excellent value-for-money 3-day tickets. If you want to stay for 2 days, 4 days or even longer, simply combine the 1-day ticket and 3-day tickets.
• Partner day ticket: Available for as many trips as you like for up to five adults together.

Fares for Single Day Tickets

1. Inner District (Innenraum) € 6,70
2. Munich XXL (München XXL) white and green zones € 8,90
3. Outer District (Außenraum) green, yellow, red zones € 6,70
4. Entire Network (Gesamtnetz) all zones € 13,00

Fare for 3-Day Inner District

white zone € 16,80

For your trip Munich city / Munich airport you will need a stripe ticket (8 stamps) or an entire network ticket. Inner district includes the city centre (Marienplatz, Hauptbahnhof, ...) and Neue Messe Munich.

Once you have purchased your ticket, be sure to validate it by stamping it in the blue boxes you will see. This should be done prior to entering the station or immediately after boarding a bus or tram. To validate a stripe ticket (Streifenkarte) you must fold back the sections not required and
Munich, Germany

The celebrated capital of Bavaria, located in the foothills of the Alps, is one of the major cities in Europe. The 1.3 million inhabitants city is famous for its science and industry environment. Munich offers fantastic opportunities for shopping, museums, theatres, art galleries and sightseeing. Its October beer festival is world famous. Tourist attractions include the Bavarian beer and South German cuisine tradition, and many half-day or one-day excursion opportunities to the nearby Bavarian Alps or places such as the fairy-tale castle of Neuschwanstein or the beautiful Tegernsee.

In June the weather is likely to be warm and the sun is likely to shine, although rain is not impossible.

Munich enjoys an outstanding public transportation system, and the modern Münchner Messe complex where CLEO®/Europe-EQEC 2019 and all Laser 2019 events will be held is easy to reach from the airport, from the city centre and from all Laser 2019 events will be held is easy to reach from the city centre.

GENERAL INFORMATION

MUNICH’S CHURCHES:

Munich is well-known for its many churches, among them:

- **Frauenkirche (Church Of Our Lady),**
  1 Frauenplatz,Munich
  **Opening hours:** 07:00-20:30 (no visits during the church services).  
  **Getting there:** all S-Bahn train, U-Bahn lines 3/6 to Marienplatz

- **Alter Peter (Church Of St. Peter),**
  1 Rindermarkt,Munich
  Climb the 299 steps of this parish church to enjoy a beautiful view of the Munich city centre.  
  **Opening hours:** Monday through Friday 09:00-18:30. Saturday, Sunday and holidays: 10:00-18:30.  
  **Getting there:** all S-Bahn trains, U-Bahn lines 3/6, Bus 52 to Marienplatz

- **Heiliggeistkirche,**
  Tal 77, 80331 Munich, Tel. 089/22 44 02
  **Opening hours:** Monday through Saturday 09:00-19:00, Sunday 08:30-19:00 (no visits during the church services)  
  **Getting there:** U-Bahn lines 3/6 to Marienplatz, Bus line 52/132 - station stop Viktualienmarkt Hl.Geist

MUNICH’S FAMOUS PLACES TO BE VISITED:

- **Marienplatz**
  The Marienplatz is named according to the column of the Virgin Mary at its centre. The statue, erected in 1638 to celebrate the end of the Swedish invasion, is topped by a gilded statue of Virgin Mary that was sculpted earlier, in 1590 by Hubert Gerhard. At each corner of the column’s pedestal is a statue of a putti, created by Ferdinand Murmann. The four putti symbolize the city’s overcoming of war, pestilence, hunger and heresy.
  The place is famous for its carillon in the New Town Hall Tower (Glockenspiel im Rathaussturm). This is the largest carillon in Germany, with near-lifesize figures performing the traditional Coopers’ Dance and a jousting match. Three times a day at 11:00, 12:00 and 17:00. The Marienplatz is a central place for the city’s Founding Festival as well as for Fasching (carnival) celebrations and the popular Christmas market. The major restaurants, coffees and shops are located in this area. Shops are closed on Sunday.

- **Königsplatz**
  Commissioned by Ludwig I, this neo-Classical square boasts the Propyläen gateway and the Glyptothek, a small but enchanting collection of Greek and Roman sculpture. It is the sight of an annual summer outdoor concert series.

- **Isartor (Isar Gate)**
  Most easterly of Munich’s three remaining town gates, dating from the 14<sup>th</sup> century. Careful restoration has recreated the dimensions and appearance of the original structure. The Isar Gate accommodates the Valentin Museum.

- **Karlstor (Charles’ Gate)**
  Westerly town gate from 14<sup>th</sup> century. Incorporated at the end of the 18<sup>th</sup> century into the square known as “Stachus” (officially Karlplatz). Today it marks one end of Munich’s primary pedestrian zone.

- **Sendlinger Tor (Sendlinger Gate)**
  Remaining towers of southerly fortifications from the 14<sup>th</sup> century.

BEER GARDENS

Nothing defines Munich more than its beer. You cannot talk about one without the other and you could never fully discover Munich without at least sampling its brews. Today the Munich breweries dispense 123 million gallons of beer annually. That is why many beer gardens are located in Munich:

- **Augustiner-Großgaststätte**
  Pedestrian Zone, Neuhauser Straße 16, 80331 Munich, Tel. 089/2 60 41 06.  
  The Augustiner Großgaststätte is one of the more traditional Munich establishments, with a history that reaches back to 1328. The Augustiner Brothers began brewing something heavenly in Augustiner’s back rooms up until 1855 when

More information at www.mvv-muenchen.de/en/homepage/index.html

Subway map at www.travelthroughgermany.com/website2/munichsubway.htm

Insert the ticket into the validating machine (see below for number of required sections). Once you have validated your ticket, you can travel with any form of transport as long as you continue to travel in the same direction.

More information at www.mvv-muenchen.de/en/homepage/index.html

Subway map at www.travelthroughgermany.com/website2/munichsubway.htm
the actual brewing plant was moved to Landsberger Straße. Today Augustiner Großgaststätte is a traditional beer hall with a small courtyard beer garden, smack dab in the middle of Munich's Marienplatz pedestrian zone. The food is great and the beer is the best.

- **Altes Hackerhaus**
  Sendlinger Str. 14, Munich, Tel. 089/2605026, http://www.hackerhaus.de
  **Opening hours:** 9 am to midnight daily.
  Located in Munich's newspaper publishing district and near Sendlinger Tor, Altes Hackerhaus has a long history involving two of the City's most renowned beer producing families, the Hackers and the Pschorrs. An entire wall in the restaurant is dedicated to the family tree, dating back to 1738 when the first Hackerhaus was founded. Highlights include a small but comfortable interior courtyard beer garden, and an outstanding restaurant serving excellent Bavarian fare. Although average by Munich high standards, Altes Hackerhaus benefits from its proximity to the Marienplatz (just a few blocks away) and easy access from the nearby U-Bahn stop at Sendlinger Tor.

- **Chinesischer Turm (Chinese Tower)**
  (Chinese tower) is one of Munich's largest beer gardens, and perhaps its most famous. With more than 7,000 seats around the famous erzat Chinese pagoda in the middle of Englischer Garten (900-acre park with shaded paths, brooks, ponds and swans), this place could hardly be overlooked. Location: Englischer Garten 3, open from 11.00 to midnight. The park stretches from the centre of the city (near Odeonsplatz) to the northern city border. Access: The best way to reach it is the bus No. 54 from "Muenchner Freiheit" underground station (exit at stop "Chinesischer Turm")

Munich is very famous for its **theatres** but also for its **Olympic Park** (see www.olympiapark.de/index.html) located Spiridon-Louis-Ring 21, 80809 Munich, Tel.: 089/30 67 - 0, Fax: 089/30 67 - 22 22

**Getting there:** U-Bahn line 3 to Olympiazentrum

**MUNICH'S MUSEUMS:**
- Bayerisches Nationalmuseum
- BMW Museum
- Deutsches Museum
- Deutsches Museum Flugwerft Schleißheim
- Glyptothek
- Münchner Stadtmuseum
- Neue Pinakothek
- Villa Stuck
- and many others (see https://www.muenchen.de/int/en/sights/museums.html).

**FOR THOSE WHO PREFER CITY SIGHTSEEING WITH HOP ON - HOP OFF BUSES:**
In the double-decker buses of City Sightseeing visitors to Munich can enjoy the open roof. During the hour-long city round trips the participants have a view of the best attractions that Munich offers. Explanations are given in eight different languages. Highlights and stops: The historic city centre, the Main Station, Odeonsplatz, the Opera, Maximilian Street, the Food Market, Stachus, the Pinakotheken, Nymphenburg Castle, Neuhausen, Olympia Park, Schwabing, the English Garden, Haidhausen...

Three tours are available that can be combined: City-Tour / Nymphenburg-Olympia-Tour / Schwabing-Tour. The tickets can also be used flexibly. They can be purchased on line in advance (with a price reduction) or in the bus and are valid for one or even two days. The departures of all the tours start at the 'Bahnhofsplatz' outside Elisenhof near the main railway station Munich.

For further information see: https://www.citysightseeing-munich.com/

**Further information on Munich** is available at http://www.muenchen.de/ (8 languages available).
CLEO®/Europe EQEC 2019 will present twelve short courses held in parallel to take place on Sunday afternoon 23 June 2019. The courses are at extra cost.

Advance registration is recommended in order to obtain the short course material. This material will not be available for purchase during the conference.

The courses are intended for engineers, scientists and graduate students with some general knowledge of optics and photonics, who wish to improve their detailed understanding of the particular technical domains covered. Each course is scheduled in two parts: Course Part 1 (90 minutes), coffee break (30 minutes), Course Part 2 (90 minutes).

Short course topics and presenters

Ultrashort pulse characterization SH-1
14:00 - 15:30 part 1 / 16:00 - 17:30 part 2
ROOM 12A ICM
Selcuk Aktürk, Athens, Greece

High-power fiber lasers SH-2
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM 12B ICM
Andy Clarkson, University of Southampton, United Kingdom

Optical parametric oscillators SH-3
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM 22A ICM
Majid Ebrahim-Zadeh, ICFO, Castelldefels (Barcelona), Spain

Laser beam analysis, propagation and spatial shaping techniques SH-4
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM 22B ICM
James R. Leger, University of Minnesota, Minneapolis, USA

Practical quantum optics SH-5
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM OSTERSEEN ICM
Gerd Leuchs, Max Planck Institute for the Science of Light and University of Erlangen, Erlangen, Germany

Mid-infrared semiconductor lasers SH-6
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM 3 HALL A1
Jérôme Faist, ETH Zürich, Switzerland

Terahertz measurements and their applications SH-7
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM 4 HALL A1
Daniel M. Mittleman, Rice University, Houston, TX, USA

Atoms and molecules in tailored laser fields SH-8
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM 5 HALL A1
Thomas Pfeifer, Max Planck Institute for Nuclear Physics, Heidelberg, Germany

Frequency combs principles and applications SH-9
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM A11 HALL A1
Thomas Udem, Max-Planck-Institut für Quantenoptik, Garching, Germany

Silicon photonics SH-10
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM A12 HALL A1
Dries Van Thourhout, Ghent University, Belgium

Optics in graphene and other 2D materials SH-11
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM B12 HALL B1
Coskun Kocabas, University of Manchester, UK

Finite element modeling methods for photonics and optics SH-12
14:00 - 15:30 Part 1 / 16:00 - 17:30 Part 2
ROOM B13 HALL B1
Arti Agrawal, University of Technology Sydney, Australia

The biographies of the short course speakers, the descriptions of the short courses are to be found on the conference web site:

http://www.cleoeurope.org/short-courses/
The revolution of silicon photonics

Micheal Lipson, Columbia University, New York, USA

Biography

Micheal Lipson is the Eugene Higgins Professor at Columbia University. Her research focus is on Nanophotonics and includes the investigation of novel phenomena, as well as the development of novel devices and applications. Lipson pioneered critical building blocks in the field of Silicon Photonics, which today is recognized as one of the most promising directions for solving the major bottlenecks in microelectronics. She is the inventor of over 30 issued patents and has co-authored more than 200 scientific publications. In recognition of her work in silicon photonics she was elected as a member of the National Academy of Sciences. She was also awarded the NAS Comstock Prize in Physics, the MacArthur Fellowship, the Blavatnik Award, the Optical Society's R. W. Wood Prize, the IEEE Photonics Award, and has received an honorary degree from Trinity College, University of Dublin. Since 2014 every year she has been named by Thomson Reuters as a top 1% highly cited researcher in the field of Physics.

Abstract

We are now experiencing a revolution in optical technologies, where one can print and control massive optical circuits, on a micro-electronic chip. This revolution is enabling a whole range of applications that are in need for scalable optical technologies and its opening the door to areas that only a decade ago were unimaginable.

PL-2: 2019 World of Photonics Congress Opening and Plenary Talk

Monday, 9:40 – 11:00
Location: Room 1 ICM

Gravitational wave astronomy: Listening to the sounds of the dark universe!

Karsten Danzmann, Max Planck Institute of Gravitational Physics, Hannover, Germany

Biography

Karsten Danzmann was born in 1955 and received his PhD in 1980. He worked at Stanford University, PTB Berlin and the Max Planck Institute for Quantum Optics in Garching. Currently he is Director of the Institute for Gravitational Physics of Leibniz Universität Hannover and Director at the Max Planck Institute for Gravitational Physics (Albert Einstein Institute) in Hannover, where he heads the Laser Interferometry and Gravitational Wave Astronomy Division. He is Consortium Lead of the LISA space mission, Lead Scientist of the GEO Collaboration and Speaker of the QuantumFrontiers Cluster of Excellence. He is a recipient of the Körber European Science Prize, the Stern Gerlach Medal, the Otto Hahn Prize, and shared the Edison Volta Prize, the Gruber Cosmology Prize, and the Special Breakthrough Prize in Fundamental Physics.

Abstract

Since 3 years astronomy has been different. Gravitational waves finally let us listen to the universe. Ground-based detectors are now routinely detecting signals from the coalescences of Black Holes with dozens of solar masses. And space-based detectors will open the low-frequency gravitational wave sky in the early 2030s.

PL-3: Nobel Prize Plenary Talk

Monday, 18:00 – 19:00
Location: Room 1 ICM

A passion for extreme light

Gérard Mourou, Ecole Polytechnique, Palaiseau, France

Biography

Gérard Mourou is Professor Haut-College at the Ecole polytechnique. He is also the A.D. Moore Distinguished University Emeritus Professor of the University of Michigan. He received his undergraduate education at the University of Grenoble (1967) and his Ph.D. from University Paris VI in 1973. He has made numerous contributions to the field of ultrafast lasers, high-speed electronics, and medicine. But, his most important invention, demonstrated with his student Donna Strickland while at the University of Rochester (N.Y.), is the laser amplification technique known as Chirped Pulse Amplification (CPA), universally used today. CPA revolutionized the field of optics, opening new branches like attosecond pulse generation, Nonlinear QED, compact particle accelerators. It extended the field of optics to nuclear and particle physics. In 2005, Prof. Mourou proposed a new infrastructure; the Extreme Light Infrastructure (ELI), which is distributed over three pillars located in Czech Republic, Romania, and Hungary. Prof. Mourou also pioneered the field of femtosecond ophthalmology that relies on a CPA femtosecond laser for precise myopia corrections and corneal transplants. Over a million such procedures are now performed annually. Prof. Mourou is member of the U.S. National Academy of Engineering, and a foreign member of the Russian Science Academy, the Austrian Sciences Academy, and the Lombardy Academy for Sciences and Letters. He is Chevalier de la Légion d’honneur and was awarded the 2018 Nobel Prize in Physics with his former student Donna Strickland.

Abstract

Extreme light is providing a vast range of high energy radiations and particles along with the highest field, highest pressure. Its applications in science and technology will be discussed.
PL-4: 2019 EQEC Plenary Talk and Awards Ceremony

> **Tuesday, 10:30 – 12:30**  
  **Location:** Room 1 ICM

This session will feature a plenary talk presented together with a series of prize and award ceremonies. See separate brochure.

PL-4.1  
**TUE 10:30**  
Photonic entanglement: From foundations to applications

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**Biography**  
Anton Zeilinger was always interested in the foundations of quantum mechanics. He performed many fundamental quantum experiments with neutrons, atoms, molecules, and photons. He became most fascinated by quantum entanglement. With entangled photons he performed pioneering experiments on quantum teleportation, on quantum cryptography, on quantum gates, on interaction-free measurement, on quantum imaging, on test of realism and locality etc. To his surprise these experiments helped lay the basis for a number of procedures in the field of quantum information technology. The stations of his career include the Technical Universities of Vienna and Munich, M.I.T. and the University of Innsbruck.

Anton Zeilinger is Professor of Physics Emeritus at the University of Vienna and President of the Austrian Academy of Sciences.

**Abstract**  
Entangled photons have become an essential workhorse for experiments on the foundations of quantum mechanics. Tests of Bell’s Inequality (cf. the Einstein-Podolsky-Rosen Paradox) have with increasing sophistication ruled out more and more alternative views to quantum mechanics.

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**TUTORIAL TALKS**

**Joint session ECBO-CLEO/Europe**

> **Sunday, 18:00 – 19:00**  
  **Location:** Room 5 ICM

**JS ECBO-CLEO/Europe.1**  
**SUN 18:00**

**Light sheet microscopy: Imaging faster, wider and deeper**  
Kishan Dholakia, University of St Andrews, St Andrews, United Kingdom

This talk will describe the basics of light sheet microscopy. The latest advances for this field in neuroscience and developmental biology using beam shaping will be discussed.

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**EH-1: Engineering nontrivial light fields**

> **Monday, 11:15 – 12:45**  
  **Location:** Room 14a ICM

**EH-1.1**  
**MON 11:15**

Metamaterials, anapoles and flying donuts  
Nikolay Zheludev, University of Southampton, Southampton, United Kingdom

Metamaterials have been the platform for experimental development of a new chapter in electrodynamics devoted to toroidal and anapole modes of excitation and the generation of electromagnetic flying donuts, topologically robust formation of vortices.

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**EI-1: Optics of graphene and related 2D materials**

> **Monday, 16:15 – 17:45**  
  **Location:** Room 14a ICM

**EI-1.1**  
**MON 16:15**

Graphene for photonics and optoelectronics  
Andrea Ferrari, University of Cambridge, Cambridge, United Kingdom

Graphene has great potential in photonics and optoelectronics, where the combination of its unique optical and electronic properties can be fully exploited, and the absence of a bandgap can be beneficial.

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**JSVI-1: 50 Years of integrated optics I**

> **Wednesday, 16:00 – 17:30**  
  **Location:** Room 1 ICM

**JSVI-1.1**  
**WED 16:00**

Quantum dot lasers epitaxially grown on Si  
John Bowers, University of California, Santa Barbara, USA

InAs quantum dot lasers epitaxially grown on Si show promise for achieving lower threshold, higher temperature, reduced reflection sensitivity and lower cost. Optimization of the buffer layers on Si reduces dislocation densities and improves lifetimes.

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**CG-7: Generation and applications of attosecond pulses**

> **Thursday, 10:30 – 12:00**  
  **Location:** Room 3 Hall A1

**CG-7.1**  
**THU 10:30**

An introduction to attosecond pulses and attosecond physics  
Anne L’Huillier, Lund University, Lund, Sweden

This tutorial will discuss the physics behind the generation of attosecond pulses, their temporal and spatial properties, including spatio-temporal couplings, and their application to study the dynamics of resonant and non-resonant photoionization.

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**CD-4: Nonlinear imaging**

> **Sunday, 18:00 – 19:30**  
  **Location:** Room 13b ICM

**CD-4.1**  
**SUN 18:00**

Challenges and trends in optical molecular imaging  
Sophie Brasselet, Institut Fresnel, Marseille, France

We describe possibilities that optics offers to investigate ultrastructural properties of matter, from nanomaterials to cells and tissues, using polarized imaging in fluorescence and nonlinear optics.

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**ED-1: Frequency metrology and transfer**

> **Tuesday, 14:00 – 15:30**  
  **Location:** Room 1 Hall A1
ED-1.1 TUE 14:00
Magic conditions for optical lattice clocks to operate at $10^{-19}$ uncertainty

Hidetoshi Katori, The University of Tokyo, Tokyo, Japan

We report recent progress of optical lattice clocks in our group, which includes investigation of operational magic intensity for strontium atoms, transportable clocks, and determination of the magic wavelength for cadmium.

CJ-9: Multimode nonlinear fiber optics

> Tuesday, 16:00 – 17:30
  Location: Room 1 ICM

CJ-9.1 TUE 16:00
Nonlinear optics exploiting the spatial dimension

Siddharth Ramachandran, Boston University, Boston, USA

Nonlinear optics with spatial modes requires conservation of spin and orbital angular momentum in addition to linear momentum (i.e. propagating phase). We review the principles of, and unique applications afforded by, this emerging platform.

EC-1: Novel systems for topological photonics I

> Thursday, 8:30 – 10:00
  Location: Room 13b ICM

EC-1.1 THU 08:30
Topological photonics

Mordechai (Moti) Segev, Technion, Haifa, Israel

The fundamentals of the new area called Topological Photonics will be reviewed, along with exciting applications such as topological insulator lasers, new ideas related to topology in synthetic dimensions, current challenges and open questions.

CC-5: THz applications

> Thursday, 8:30 – 10:00
  Location: Room 1 Hall A1

CC-5.1 THU 08:30
Wireless Terahertz communications

Wolfgang Freude, Karlsruhe Institute of Technology, Karlsruhe, Germany

T-waves ranging from 0.1 THz to 1 THz become increasingly important as carriers for wireless high-speed data transmission. Data rates of 100 Gbit/s were achieved, and distances of 100 m to 1 km are targeted.

Notes
CH-1: Optical fibre sensors

» Sunday, 10:30–12:00
Location: Room 1 Hall A1

CH-1.1 SUN 10:30
The photonic guitar pickup: a high-sensitivity, high-bandwidth fiber strain sensor
Jack A. Barnes, Hans-Peter Loock, Queen’s University, Kingston, Canada

CI-1: Probabilistic shaping and NFT-based transmission

» Sunday, 10:30–12:00
Location: Room 6 Hall A1

CI-1.3 SUN 11:00
Probabilistic shaping and its applications to optical communications
Georg Böcherer, Mathematical and Algorithmic Sciences Lab, Huawei Technologies, France S.A.S.U., Boulogne-Billancourt, France

CE-1: Opportunities for advanced nanostructured and non-linear optical materials

» Sunday, 10:30–12:00
Location: Room 7 Hall A1

CE-1.1 SUN 10:30
New opportunities with old optical materials
Marko Loncar, Harvard University, Cambridge, USA

EB-2: Integrated and engineered photonics

» Sunday, 14:00 – 15:30
Location: Room 1 ICM

EB-2.1 SUN 14:00
Integrated semiconductor quantum photonics
Gregor Weihs¹, Silke Auchter¹, Huan Chen¹, Kaisa Laiho¹, Benedikt Pressl¹, Alexander Schlager¹, Hannah Thiel¹, Holger Suchomel³, Christian Schneider³, Martin Kamp³, and Sven Höfling⁶,³
¹Universität Innsbruck, Innsbruck, Austria, ²National University of Defense Technology, Changsha, China, ³Technische Universität Berlin, Berlin, Germany, ⁴Innsbruck Medical University, Innsbruck, Austria, ⁵Universität Würzburg, Würzburg, Germany, ⁶University of St. Andrews, St Andrews, UK

JSII-1: Raman spectroscopy I

» Sunday, 14:00 – 15:30
Location: Room 4a ICM

JSII-1.1 SUN 14:00
From coherent Raman microscopy to endoscopy
Hervé Rigneault, Aix Marseille Univ, CNRS, Centrale Marseille, Institut Fresnel, Marseille, France

JSII-1.2 SUN 14:30
The potential of linear and non-linear Raman spectroscopy for bedside and intraoperative medical diagnosis and therapy
Juergen Popp, Institute of Physical Chemistry and Abbe Center of Photonics, Friedrich-Schiller University Jena, Jena, Germany, Leibniz Institute of Photonic Technology and Member of the Research Alliance “Leibniz Health Technologies”, Jena, Germany, InfectoGnostics Research Campus Jena, Centre for Applied Research, Jena, Germany

JSIV-1: Nanoscale heat transfer background

» Sunday, 14:00 – 15:30
Location: Room 4b ICM

JSIV-1.1 SUN 14:00
Phonon transport in disordered 2D phononic crystals
Marianna Sledzinska¹, Bartłomiej Graczykowski², David Lacroix³, Francesc Alzina¹, Konstantinos Termentzidis², Umberto Melia³, and Clivia M. Sotomayor Torres¹,³
¹Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and BIST, Bellaterra (Barcelona), Spain, ²Adam Mickiewicz University, Poznan, Poland, ³University Claude Bernard Lyon 1, Lyon, France, ⁴ESAII, Univ. Politècnica de Catalunya, Barcelona, Spain, ⁵ICREA – Institució Catalana de Recerca i Estudis Avancats, Barcelona, Spain

CA-2: Laser facilities

» Sunday, 14:00 – 15:30
Location: Room 13a ICM

CA-2.3 SUN 14:30
First kilojoule pulse operation at ELI-beamlines
Erhard Gaul¹,², Sandra Bruce¹,², Gavin Friedman³, Gilles Chéraux¹,², Pavel Trojek¹,², Teddy Borger¹, Stepán Vyhlidka¹,², František Batysta², Roman Antipenkov³, Eric Beutlich¹, Jack Naylon¹, Jan Hubácek¹, Jan Bartonícek², Jeffrey Jarboe¹, Samuel Buck¹, Joshua King¹, Mathew Tyrrell¹, David Hessen¹, Andreas Gaul¹, Christopher Jaska¹, Jonas Kolenda¹, Michael Donovan¹,², Todd Ditmire¹, Pavel Bakule¹, Daniel Kramer¹, and Bedrich Rus¹
¹National Energetics, Austin, USA, ²Eli-Beamlines, Institute of Physics, Prague, Czech Republic, ³Ekspla, Vilnius, Lithuania

CD-2: Nonlinear spectroscopy

» Sunday, 14:00 – 15:30
Location: Room 13b ICM

CD-2.1 SUN 14:00
Time-domain ptychography
Thomas Feurer¹, Michael Brügmann¹, Tobias Schweizer¹, Alexander Heitd², Dirk Spangenberg³, and Erich Rohwer²
¹University of Bern, Bern, Switzerland, ²Stellenbosch University, Matieland, South Africa

CM-2: Silicon structuring by ultrafast lasers

» Sunday, 14:00 – 15:30
Location: Room 14b ICM
CM-2.1  SUN 14:00
Internal structuring of silicon by ultrafast laser irradiation
David Grojo, Aix-Marseille University, CNRS, LP3, Marseille, France

EE-2: Ultrafast phenomena in 2D materials and on surfaces

EE-2.1  SUN 14:00
Ultrafast SFG Study towards Water Splitting on TiO₂
Ellen Backus¹, Shumei Sun ², Saman Hosseinpour ³, Simon Schlegel¹, and Mischa Bonn²
¹University of Vienna, Vienna, Austria, ²Max Planck Institute for Polymer Research, Mainz, Germany

JSV-2: Magnetometry and biological imaging

JSV-2.1  SUN 14:00
Magnetic field imaging with microfabricated optically-pumped magnetometer arrays
Nicholas Nardelli¹, Sean Krzyzewski¹, Branislav Korenko¹, Gleb Romanov¹, Jeramy Hughes¹,², Orang Alem¹,², and Svenja Knappe¹,²
¹University of Colorado, Boulder, USA, ²FieldLine Inc., Boulder, USA

CI-2: Advanced high capacity fiber systems

CI-2.3  SUN 14:30
Multi-band optical systems to enable ultra-high speed transmissions
Alessio Ferrari¹, Antonio Napoli², Nelson Costa³, Johannes K. Fischer¹, Joao Pedro³, Wladek Forysiak¹, Andre Richter⁴, Erwan Pincessin⁵, and Vittorio Curri⁴
¹Politecnico di Torino, Torino, Italy, ²Infinera Germany, Munich, Germany, ³Infinera Portugal, Carnaxide, Portugal, ⁴Fraunhofer Institute for Telecommunications HHI, Berlin, Germany, ⁵AAPT, Aston University, Birmingham, United Kingdom

CE-2: Infrared material fibres glasses and applications

CE-2.3  SUN 14:30
Mid-infrared (MIR) glasses and fibres for medical applications
Angela B. Seddon, University of Nottingham, Nottingham, United Kingdom

JSI-1: Photonic platforms for reservoir computing

JSI-1.1  SUN 14:00
In-memory computing using electrical and photonic memory devices
Abu Sebastian, IBM Research - Zurich, Rueschlikon, Switzerland

JSI-2: Raman spectroscopy II

JSI-2.1  SUN 16:00
Probing neuronal membrane potentials and ionic fluxes at the single cell level by means of water
Sylvie Roke, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

JSIV-2: Nanodevices controlled by heat manipulation

JSIV-2.1  SUN 14:00
Evaporative electron cooling in asymmetric double barrier semiconductor heterostructures
Marc Bescond¹,², Aymen Yangui¹,², Tifei Yan¹, Naomí Nagai¹, and Kazuhiko Hirakawa²,³
¹Institute of Industrial Science, University of Tokyo, Tokyo, Japan, ²LIMMS/CNRS-IIS, UMI 2820, Tokyo, Japan, ³Institute for Nano Quantum Information Electronics, University of Tokyo, Tokyo, Japan

JSIV-2.2  SUN 16:30
Magneto-optical control for nanoscale thermotronics
Annika Ott¹, Riccardo Messina², Philippe Ben-Abdallah¹, and Svend-Age Bihs³
¹Institut für Physik, Carl von Ossietzky Universität, Oldenburg, Germany, ²Laboratoire Charles Fabry, Institut d’Optique, CNRS, Université Paris-Sud, Palaiseau, France

CA-3: Waveguide lasers

CA-3.3  SUN 16:30
Femtosecond-laser-written waveguide lasers at ~2 um
Xavier Mateos⁵, Esrom Kifle¹, Pavel Loiko⁵, Carolina Romero¹, Javier Rodriguez¹, Airán Ródenas¹,⁴, SunYung Choi¹, JiEun Bae¹, Fabian Rotermund¹, Uwe Griebner¹, Valentin Petrov⁶, Magdalena Aguiló⁶, and Francesc Díaz¹
¹University of Colorado, Boulder, USA, ²University of Nottingham, Nottingham, United Kingdom, ³Fraunhofer Institute for Telecommunications HHI, Berlin, Germany, ⁴Institute of Industrial Science, University of Tokyo, Tokyo, Japan, ⁵Politecnico di Torino, Torino, Italy, ⁶Mipping GmbH, Lannion, France
CM-3: Advanced functionalization of materials

- **SUNDAY, 16:00 – 17:30**
  - **Location**: Room 14b ICM

CM-3.3
Diamond functionalization by ultrafast laser pulses
Patrick Salter, Engineering Science, Oxford, United Kingdom

JSV-3: Optomechanics and atomic clocks

- **SUNDAY, 16:00 – 17:30**
  - **Location**: Room 21 ICM

JSV-3.1
Quantum measurement of a mechanical resonator at and below the standard quantum limit
Massimiliano Rossi1,2, David Mason1,3, Junxin Chen1,2, Yeghishe Tsatryan1, and Albert Schliesser1,2
1Niels Bohr Institute, Copenhagen, Denmark, 2Center for Hybrid Quantum Networks (Hy-Q), Copenhagen, Denmark

JSV-3.2
Ultra-low dissipation mechanical resonators for cavity optomechanics
Mohammad J. Bereyhi1, Alberto Beccari1, Sergey A. Fedorov1, Amir H. Ghadimi1, Ryan Schilling1, Dalziel J. Wilson1, Nils J. Engelsen1, and Tobias J. Kippenberg1
1Institute of Physics (IPHYS), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, 2IBM Research, Zurich, Switzerland

JSV-3.3
Ultrafast spectroscopy and control in the limits of single electrons and virtual photons
Alfred Leitenstorfer, University of Konstanz, Konstanz, Germany

CF-3: Fiber lasers

- **SUNDAY, 16:00 – 17:30**
  - **Location**: Room 2 Hall A1

CF-3.1
Ultrafast spectroscopy and control in the limits of single electrons and virtual photons
Alfred Leitenstorfer, University of Konstanz, Konstanz, Germany

JSI-2: Neuromorphic processing for optical communications

- **SUNDAY, 16:00 – 17:30**
  - **Location**: Room 8 Hall A1

JSI-2.1
Photonic machine learning implementations as decoders for optical communication systems
Apostolos Argyris, Julian Bueno, and Ingo Fischer
Instituto de Física Interdisciplinar y Sistemas Complejos IFISC (UIB-CSIC), 07122 Palma, Spain

JSI-2.4
Reinforcement learning in a large scale photonic network
Sheler Maktoobi, Louis Andreoli, Laurent Larger, Maxime Jacquot, and Daniel Brunner
FEMTO-ST Institute/Optics Department, CNRS & University Bourgogne Franche-Comté, Besançon, France

JSIV-3: Nanoscale heat processes in plasmonic nanostructures

- **SUNDAY, 18:00 – 19:30**
  - **Location**: Room 4b ICM

JSIV-3.1
Ultrafast thermo-optical dynamics of plasmonic nanoparticles
Francesco Banti1, Paolo Maioli1, Aurélien Crut1, Marco Gandolfi2, Fabio Medeghini1, Fabrice Vallée1, and Natalia Del Fatti1
1FemtoNanoOptics group Université de Lyon Institut Lumière Matière (iLM), Université Lyon 1 and CNRS 10 rue Ada Byron, 69622 Villeurbanne cedex, France, 2Dipartimento Matematica e Fisica & Interdisciplinary Laboratories for Advanced Materials Physics (I-LAMP), Università Cattolica del Sacro Cuore, Italy, Brescia, Italy, 3Laboratory for Soft Matter and Biophysics, Department of Physics and Astronomy, KU Leuven, Celestijnenlaan 200D, B-3001 Leuven, Belgium

CB-1: Semiconductor micro-lasers: Novel technology concepts

- **SUNDAY, 18:00 – 19:30**
  - **Location**: Room 14a ICM

CB-1.1
Flexible and Ultra-lightweight Polymer Membrane Lasers
Markus Karl, James M.E. Glackin, Marcel Schubert, Nils M. Kronenberg, Graham A. Turnbull, Ifor D.W. Samuel and Malte C. Gather
School of Physics and Astronomy, University of St Andrews, St Andrews, United Kingdom

CH-4: Integrated sensors I

- **SUNDAY, 18:00 – 19:30**
  - **Location**: Room 1 Hall A1

CH-4.1
On-chip infrared sensor technologies for Chem/Bio diagnostics: Quo vadis?
Boris Mizaikoff, Ulm University, Institute of Analytical and Bioanalytical Chemistry, Ulm, Germany
**Technical Programme**

**CF-4: Solitons and self-compression**

- **SUNDAY, 18:00 – 19:30**
  - **Location:** Room 2 Hall A1

**CF-4.1** SUN 18:00

Non-linear propagation of ultrashort mid-IR pulses

Valentina Shumakova¹, Skirmantas Alisauskas², Pavel Malevich², Claudia Gollner¹, Alexander Voronin³, Alexander Mitrofanov⁴, Dmitriy Sidorov-Biryukov⁵, Aleksei Zheltikov⁶, Daniil Kartashov⁴, and Andrius Pugzlys¹,²,⁷

¹Photonics Institute, TU Wien, Vienna, Austria, ²DESY, Hamburg, Germany, ³Physics Department, M.V. Lomonosov Moscow State University, Moscow, Russia, ⁴Russian Quantum Center, Skolkovo, Russia, ⁵Department of Physics and Astronomy, Texas A&M University, College Station, USA, ⁶Friedrich-Schiller University Jena, Jena, Germany, ⁷Center for Physical Sciences & Technology, Vilnius, Lithuania

**CE-4: Multiferroics and non-linear optics and photonics**

- **SUNDAY, 18:00 – 19:30**
  - **Location:** Room 7 Hall A1

**CE-4.3** SUN 18:30

Nonlinear laser spectroscopy of multiferroic materials

Manfred Fiebig, Dept. of Materials, ETH Zurich, Zurich, Switzerland

**JSI-3: Neuromorphic photonic platforms**

- **SUNDAY, 18:00 – 19:30**
  - **Location:** Room 8 Hall A1

**JS-3.1** SUN 18:00

Multiwavelength neuromorphic silicon photonics

Bhavin J. Shastri¹, Alexander N. Tait², Mitchell A. Nahmias³, Thomas Ferreira de Lima⁴, Hsuan-Tung Peng⁵, and Paul R. Prucnal⁵

¹Queen’s University, Kingston, Canada, ²Princeton University, Princeton, USA

**JS SPIE-OM-EQEC.2** MON 11:45

Lensless metrology for semiconductor lithography at EUV

Jacopo Mochi, Rajendran Rajeev, Dimitrios Kazazis, Li-Ting Tseng, Patrick Helfenstein, Sara Fernandez, Uldis Locans, Atoosa Dejkameh, Ricarda Nebling, and Yasin Ekinic

Paul Scherrer Institute, Villigen, Switzerland

**JS SPIE-OM-EQEC.3** MON 12:15

Metrology for and with Nanooptics

Thomas Persch, Friedrich Schiller University, Jena, Germany, Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany, Max Planck School of Photonics, Munich, Germany

**EE-3: Ultrafast control by light**

- **MONDAY, 11:15 – 12:45**
  - **Location:** Room 4a ICM

**EE-3.1** MON 11:15

Lightwave valleytronics at multi-terahertz clock rates

Christoph P. Schmid¹, Fabian Langer¹, Stefan Schlauderer¹, Martin Gmitra¹, Jaroslav Fabian¹, Philipp Nagler¹, Tobias Korn¹, Christian Schüller¹, Peter G. Hawkins², Johannes T. Steiner², Ulrich Huttner², Stefan W. Koch², Mackillo Kira³, and Rupert Huber¹

¹University of Regensburg, Regensburg, Germany, ²University of Marburg, Marburg, Germany, ³University of Michigan, Ann Arbor, USA

**CK-4: Photonic integration**

- **MONDAY, 11:15 – 12:45**
  - **Location:** Room 4b ICM

**CK-4.5** MON 12:15

Surface plasmon optoelectronics on silicon

Pierre Berini, University of Ottawa, Ottawa, Canada

**CM-5: Laser nanostructuring of trans-parent materials for advanced devices**

- **MONDAY, 11:15 – 12:45**
  - **Location:** Room 14b ICM

**CM-5.3** MON 11:45

Low-loss geometric phase elements by femtosecond laser writing in silica glass

Masaaki Sakakura, Yuhao Lei, Lei Wang, Yanhao Yu, and Peter G. Kazansky
University of Southampton, Southampton, United Kingdom

**CH-5: Integrated sensors II**

- **MONDAY, 11:15 – 12:45**
  - **Location:** Room 1 Hall A1

**CH-5.1** MON 11:15

Comparison of thin-film-transistor and photonic crystal protein sensors

Jian Jang Huang, Graduate Institute of Photonics and Optoelectronics, National Taiwan University, Taipei City, Taiwan
CF-5: Techniques for wavelength conversion of ultrashort pulses

- **Monday, 11:15 – 12:45**
  - **Location:** Room 2 Hall A1

  **CF-5.3**
  - **Monday, 11:45**
  - Mastering ultrafast UV light in hollow-core photonic crystal fibres
  - **Location:** Room 2 Hall A1

**CE-5: Novel light confinement waveguides technologies**

- **Monday, 11:15 – 12:45**
  - **Location:** Room 3 Hall A1

  **CE-5.1**
  - **Monday, 11:15**
  - The Light Cage - an on-chip hollow-core waveguide implemented by 3D nanoprinting
  - **Location:** Room 3 Hall A1

**CB-2: Semiconductor micro-lasers: Novel dynamics**

- **Monday, 14:15 – 15:45**
  - **Location:** Room 13b ICM

  **CB-2.3**
  - **Monday, 14:45**
  - Nonhermitian physics of nanophotonic molecule lasers
  - **Location:** Room 14b ICM

**CH-6: Fibre bio- and medical sensors**

- **Monday, 14:15 – 15:45**
  - **Location:** Room 1 Hall A1

  **CH-6.1**
  - **Monday, 14:15**
  - The next dimension of detection: Biomechanical analysis of tissue using optical elastography
  - **Location:** Room 1 Hall A1

**CE-6: Metamaterials and functional photonic bandgap systems**

- **Monday, 14:15 – 15:45**
  - **Location:** Room 3 Hall A1

  **CE-6.1**
  - **Monday, 14:15**
  - Giant broadband refraction in the visible in a nanodisordered ferroelectric perovskite
  - **Location:** Room 3 Hall A1

**CL-2: Nano-optics, light field control and sensing**

- **Monday, 14:15 – 15:45**
  - **Location:** Room Osterseen ICM

  **CL-2.3**
  - **Monday, 14:45**
  - Optical antenna based fluorescence correlation spectroscopy of biomembranes
  - **Location:** Room Osterseen ICM

**EA-2: Coherent atom-light interaction**

- **Monday, 16:15 – 17:45**
  - **Location:** Room 4a ICM

  **EA-2.5**
  - **Monday, 17:15**
  - Atomic vapor confined in a nanoscale geometry: from mesoscopic to collective effects
  - **Location:** Room 4a ICM

**CA-7: Novel laser concepts**

- **Monday, 16:15 – 17:45**
  - **Location:** Room 13a ICM

  **CA-7.1**
  - **Monday, 16:15**
  - Titanium Sapphire: A decade of diode-laser pumping
  - **Location:** Room 13a ICM
Jamie C. E. Coyle, John-Mark Hopkins, Alexander A. Lagatsky, and Alan J. Kemp
1Institute of Photonics, University of Strathclyde, Glasgow, United Kingdom, 2Fraunhofer Centre for Applied Photonics, Glasgow, United Kingdom
CA-7.4 MON 17:15
LED pumped transition metal lasers
Pierre Pichon, François Balembois, Frédéric Druon, Jean-Philippe Blanchot, and Patrick Georges
1Laboratoire Charles Fabry, Palaiseau, France, 2EFFILUX, Les Ulis, France

CF-7: Ultrabroadband laser sources
MON 16:15 – 17:45
Location: Room 2 Hall A1

37.1 TUE 16:15
51 W, multi-GW few-cycle laser spanning 1.2 – 2.2 μm wavelength
Martin Gebhardt, Christian Gaida, Tobias Heuermann, Cesar Jauregui, Jose Antonio-Lopez, Axel Schülzgen, Rodrigo Amezcu-Correa, Jan Rothhardt, and Jens Limpert
1Institute of Applied Physics, Friedrich-Schiller-Universität Jena, Jena, Germany, 2Helmholtz Institute Jena, Jena, Germany, 3CREOL, College of Optics and Photonics, University of Central Florida, Orlando, USA, 4Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

El-2: Exciton/polariton physics in 2D materials
TUE 8:30
Location: Room 14a ICM

El-2.2 TUE 8:30
Condensation and expansion of cavity polaritons based on two-dimensional crystals
Christian Schneider, Maximilian Waldherr, Nils Lundt, Martin Klaas, Lukasz Dusanovski, Alexey Kavokin, and Sven Höfling
1Technische Physik, University of Würzburg, Germany, Würzburg, Germany, 2WIAS, Shilongshan Road, Cloud Town, Hangzhou, China

CD-5: Nonlinear nano materials
TUE 14:00
Location: Room 13b ICM

CD-5.2 TUE 14:00
Nonlinear optics with nanomaterials
Zhipei Sun, Aalto University, Espoo, Finland

CB-6: Long wavelength semiconductor lasers
TUE 16:00 – 17:30
Location: Room 13a ICM
CB-6.1 TUE 16:00
GaSb-based swept-wavelength lasers for spectroscopic sensing applications in the 1.7-2.5 micron spectral range

Augustinas Vizbaras¹, Ieva Šimonytė¹, Augustinas Trinkūnas¹, Arūnas Miasojedovas¹, Tadas Buciūnas¹, Andreas De Groot², Mindaugas Greibus¹, Greta Naujokaitė¹, Valentinus Andruslis¹, Daan Martens², Serge Droz², Nicolas Torcheboeuf², Dmitri Boiko³, Žilvinas Dambrauskas⁴, Antanas Gulbinas⁴, and Kristijonas Vizbaras¹

¹Brolis Semiconductors UAB, Vilnius, Lithuania, ²Brolis Semiconductors BVBA, Ghent, Belgium, ³Centre Suisse d’Electronique et de Microtechnique SA (CSEM), Neuchatel, Switzerland, ⁴Institute for Digestive Research, Medical Academy, Lithuanian University of Health Sciences, Kaunas, Lithuania

ED-3: Direct comb spectroscopy I

Edward Diddams, National Institute of Standards and Technology (NIST), Boulder, USA, Department of Physics, University of Colorado, Boulder, USA

ED-3.1 WED 8:30
Infrared electric-field sampled frequency comb spectroscopy

Scott Diddams, National Institute of Standards and Technology (NIST), Boulder, USA, Department of Physics, University of Colorado, Boulder, USA

CB-7: Wavelength control of QCLs

Zhixin Wang¹, Yong Liang¹, Bo Meng¹, Yanting Sun², Giriprasanth Omanakuttan², Emilio Gini³, Mattias Beck¹, Ilia Sergachev⁴, Sebastian Lourdudoss⁶, Jérôme Faist¹, and Giacomo Scalari¹

¹ETH Zurich, Institute for Quantum Electronics, Zurich, Switzerland, ²KTH-Royal Institute of Technology, Department of Applied Physics, Stockholm, Sweden, ³FIRST laboratory ETH Zurich, Zurich, Switzerland, ⁴Wyss Zurich, Zurich, Switzerland

EA-6: Integrated quantum photonics

Christine Silberhorn, Paderborn University, Paderborn, Germany

CG-3: Twisted light fields

Thierry Ruchon¹, Céline Chappuis¹, Romain Génaux², David Bresteu³, Olivier Gobert¹, Giovanni De Ninno⁴,⁵, David Gauthier⁶, and Thierry Auguste¹

¹Leibniz Institute of Photonic Technology, Jena, Germany, ²Department of Chemistry, National Tsing Hua University, Hsinchu, Taiwan, ³Department of Electrophysics, National Chiao Tung University, Hsinchu, Taiwan, ⁴Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan, ⁵FIRST laboratory ETH Zurich, Zurich, Switzerland, ⁶Wyss Zurich, Zurich, Switzerland
CH-9.1
A hyperspectral camera based on a birefringent ultrastable common-path interferometer
Antonio Perri1,2, Barbara E. Nogueira de Faria1, Danielle C. Teles Ferreira1, Fabrizio Preda1,2, Dario Polli1,2, Ana Maria de Paula1, Daniela Comelli1, Gianluca Valentini1, Giulio Cerullo1,2, and Cristian Manzoni1
1IFN-CNR, Physics Department, Politecnico di Milano, Milan, Italy, 2NIREOS S.R.L., Milan, Italy

CG-4.1
Spatial and temporal field correlation measurements on the quantum ground state of electromagnetic radiation
Ileana Cristina Benea Chelmus, Francesca Fabiana Settembrini, Giacomo Scalari, and Jerome Faist
Quantum Optoelectronics Group, ETHZ, Zurich, Switzerland

EF-4.1
Generation and manipulation of quantum frequency states of light with Al-GaAs chips
Saverio Francesconi1, Giorgio Maltese1, Félicien Appas1, Aristide Lemaître2, Florent Baboux1, Maria Ines Amanti1, and Sara Ducci1
1Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot, Sorbonne Paris Cité, Paris, France, 2Centre de Nanosciences et de Nanotechnologies, CNRS/Université Paris Sud, Palaiseau, France

EF-4.2
Spatio-temporal field correlation measurements on the quantum ground state of electromagnetic radiation
Félicien Appas1, Aristide Lemaître2, Florent Baboux1, Maria Ines Amanti1, and Sara Ducci1
1Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot, Sorbonne Paris Cité, Paris, France, 2Centre de Nanosciences et de Nanotechnologies, CNRS/Université Paris Sud, Palaiseau, France

EF-4.3
Generation and manipulation of quantum frequency states of light with Al-GaAs chips
Saverio Francesconi1, Giorgio Maltese1, Félicien Appas1, Aristide Lemaître2, Florent Baboux1, Maria Ines Amanti1, and Sara Ducci1
1Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot, Sorbonne Paris Cité, Paris, France, 2Centre de Nanosciences et de Nanotechnologies, CNRS/Université Paris Sud, Palaiseau, France

CF-4: THz quantum optics and spintronics

CG-4.5
Generation and manipulation of quantum frequency states of light with Al-GaAs chips
Saverio Francesconi1, Giorgio Maltese1, Félicien Appas1, Aristide Lemaître2, Florent Baboux1, Maria Ines Amanti1, and Sara Ducci1
1Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot, Sorbonne Paris Cité, Paris, France, 2Centre de Nanosciences et de Nanotechnologies, CNRS/Université Paris Sud, Palaiseau, France

CH-9: Microscopy I

EF-3.1
Control of light-matter interaction in two-dimensional materials
Vinod Menon, City College & Graduate Center of CUNY, New York, USA

CA-10: Mid-infrared lasers

CA-10.3
Rare-earth doped sesquioxide ceramics for highly efficient mid-infrared lasers
Jun Wang1, Danlei Yin1, Peng Liu2, Jie Ma2, Ying Wang2, and Dingyuan Tang1
1Nanyang Technological University, Singapore, 2Jiangsu Key Laboratory of Advanced Laser Materials and Devices, Jiangsu Normal University, XuZhou, China

EG-1: Engineering of complex electromagnetic fields

EG-1.3
Colour Engineering: form nature to applications
Silvia Vignolini, Chemistry Department University of Cambridge, Cambridge, UK
EJ-2: Computational quantum optics, plasmonics and metamaterials

- **Wednesday, 14:00 – 15:30**
  - **Location:** Room Osterseen ICM

**EJ-2.1**
Quantum phenomena in the electrodynamics of nanoplasmonic structures
N. Asger Mortensen, Center for Nano Optics, University of Southern Denmark, Odense, Denmark

**EJ-2.3**
EJ-2: Application-driven computational photonics modeling

- **Wednesday, 16:00 – 17:30**
  - **Location:** Room Osterseen ICM

**EJ-3.1**
THz emission driven by ionization pressure in relativistic plasmas
Luc Bergé and Jérémy Dédard
CEA-DAM, DIF, Arpajon, France

**JSVI-1: 50 Years of integrated optics I**

- **Wednesday, 16:00 – 17:30**
  - **Location:** Room 1 ICM

**JSVI-1.2**
Photonic chipscale soliton frequency combs
Tobias J. Kippenberg, EPFL, Lausanne, Switzerland

**CD-8: Spatio-temporal manipulation of light**

- **Wednesday, 16:00 – 17:30**
  - **Location:** Room 13b ICM

**CD-8.1**
Phase manipulation with nonlinear metasurfaces
Nitipat Pholchai¹ and Thomas Zentgraf²
¹Department of Industrial Physics and Medical Instrumentation, King Mongkut’s University of Technology North Bangkok, Bangkok, Thailand, ²University of Paderborn, Department of Physics, Paderborn, Germany

**JSII-1: Light management for photovoltaics**

- **Thursday, 8:30 – 10:00**
  - **Location:** Room 4a ICM

**JSII-1.1**
Tailored disorder for the light management in photovoltaics
Stefan Nanz², Aimi Abass³, Evgeniia Slivina², Peter M. Piechulla¹, Alexander Sprafke¹, Ralf B. Wehrspohn¹,², and Carsten Rockstuhl¹,²
¹Institute of Theoretical Solid State Physics, Karlsruhe Institute of Technology, Karlsruhe, Germany, ²Institute of Nanotechnology, Karlsruhe Institute of Technology, Karlsruhe, Germany,
³Institute of Physics, Martin Luther University Halle-Wittenberg, Halle (Saale), Germany

**JSII-1.3**
Spatiotemporal effects in multimode fiber lasers
Frank Wise, Cornell University, Ithaca, NY, USA

**JSVI-2: 50 Years of integrated optics II**

- **Thursday, 8:30 – 10:00**
  - **Location:** Room 5 ICM

**JSVI-2.1**
Glass integrated optics: 50 Years and still growing strong
Giancarlo C. Righini¹,², Simone Berneschi¹, Andrea Chiappini³, Alessandro Chiasera³, Maurizio Ferrari¹,³, Gualtiero Nunzi Conti¹,², and Stefano Pelli¹,²
¹IFAC-CNR, Institute of Applied Physics “N. Carrara”, Firenze, Italy, ²Enrico Fermi Center, Roma, Italy, ³IFN-CNR, Institute of Photonics & Nanotechnologies, Trento, Italy

**JSVI-2.2**
Numerical techniques for modelling integrated optical circuits
Francesco Prudenzano, Department of Electrical and Information Engineering, Polytechnic University of Bari, Bari, Italy

**JSII-2: Thermo-photonics, materials and energy efficiency**

- **Thursday, 10:30 – 12:00**
  - **Location:** Room 4a ICM

**JSII-2.1**
Control of thermo-photonic energy flows with nano-structured and 2D materials
Ognjen Ilic, Caltech, Pasadena, USA

**EF-8: Solitons in microcavities**

- **Thursday, 10:30 – 12:00**
  - **Location:** Room 4b ICM

**EF-8.3**
Observation of laser-cavity solitons in micro-resonators
Hualong Bao¹, Andrew Cooper¹, Maxwell Rowley¹, Luigi Di Lauro², Juan Sebastian Totero Gongora³, Sai T. Chu¹, Brent E. Little³, Gian-Luca Oppo⁴, Roberto Morandotti⁵,⁶,⁷, David J. Moss⁸, Benjamin Wetzel⁹, Marco Peccianti¹, and Alessia Pasquazi¹
¹University of Sussex, Brighton, United Kingdom, ²University of Hong Kong, Hong Kong, China, ³Xian Institute of Optics and Precision

**EG-3: Nanoscale imaging and spectroscopy**

- **Thursday, 8:30 – 10:00**
  - **Location:** Room 14a ICM

**EG-1.3**
Dynamic plasmonic displays and holograms
Laura Na Liu, University of Heidelberg, Heidelberg, Germany
MECHANICS, XI’AN, CHINA, 4SUPA, UNIVERSITY OF STRATHCLYDE, GLASGOW, UNITED KINGDOM, 4INRS-EMT, QUÉBEC, CANADA, 6INSTITUTE FOR FUNDAMENTAL AND FRONTIER SCIENCES, CHENGDU, CHINA, 7ITMO UNIVERSITY, ST. PETERSBURG, RUSSIA, 8CENTRE FOR MICROPOTONICS, HAWTHORN, AUSTRALIA, 9XLim RESEARCH INSTITUTE, LIMOGES, FRANCE

EC-2: Novel systems for topological photonics II

Thursday, 10:30 – 12:00
Location: Room 13b ICM

EC-2.1

Thursday, 10:30

Exploring topological photonics in synthetic dimensions

Hannah M. Price1, Tomoki Ozawa2, Nathan Goldman3, Oded Zilberberg4, and Iacopo Carusotto5

1University of Birmingham, Birmingham, United Kingdom, 2Interdisciplinary Theoretical and Mathematical Sciences Program (iTHEMS), RIKEN, Saitama, Japan, 3Université Libre de Bruxelles, Brussels, Belgium, 4ETH Zurich, Zurich, Switzerland, 5INO-CNR BEC Center, Trento, Italy

EC-3: Lasing and driven dissipative systems

Thursday, 14:00 – 15:30
Location: Room 4b ICM

EC-3.3

Thursday, 14:30

Topological insulator laser

Miguel A. Bandres1,2, Steffen Wittek3, Gal Harari4,5, Midya Parto3, Jinhan Ren6, Morderchai Segev1, Demetrios N. Christodoulides3, and Mercedes Khajavikhan1

1Technion, Haifa, Israel, 2CREOL, University of Central Florida, Orlando, USA

CD-11: Nonlinear application at extreme wavelengths

Thursday, 14:00 – 15:30
Location: Room 13b ICM

CD-11.1

Thursday, 14:00

XUV free electron laser based nonlinear optics

Claudio Masciovecchio, Elettra Sincrotrone Trieste, Trieste, Italy

CF-11: XUV generation and characterisation

Thursday, 14:00 – 15:30
Location: Room 2 Hall A1

CF-11.1

Thursday, 14:00

Realization of polarization control in high-order harmonic generation

Pei-Chi Huang1, Po-Yao Huang1, Kuang-Yu Chang1, and Ming-Chang Chen1,2

1Aix-Marseille Univ, CNRS, Instut Fresnel, Marseille, France, 2FEMTO-ST Institute, CNRS, Université de Bourgogne Franche-Comté, Besançon, France, 3Department of Graphic Arts and Photophysics, Faculty of Chemical Technology, University of Pardubice, Pardubice, Czech Republic, 4Institut des sciences chimiques de Rennes, CNRS, Equipe Verres et Céramiques, Université de Rennes 1, Rennes, France

CD-11.5

Thursday, 14:00

Multi-qubit registers of individually addressable solid-state defect centers

Eric Bersin1, Michael Walsh1, Sara Mouradian1, Matthew Trusheim1, Kevin Chen1, Tim Schröder3, and Dirk Englund1

1Massachusetts Institute of Technology, Cambridge, USA, 2Humboldt University of Berlin, Berlin, Germany

CD-11.3

Thursday, 14:30

The next generation of quantum emitters?

David Norris, ETH Zurich, Zurich, Switzerland

CD-11.2

Thursday, 15:00

Room-temperature 1 to 7.5 THz metrological grade terahertz spectrometer

Michele De Regis1, Luigi Consolino1,2, Saverio Bartalini1,3, and Paolo De Natale1,2

1INO, Istituto Nazionale di Ottica-CNR, Florence, Italy, 2LENS, European Laboratory for Nonlinear Spectroscopy, Sesto Fiorentino (FI), Italy

CD-11.4

Thursday, 15:30

Experimental demonstration and numerical study of plasmon-soliton waves

Sergey A. Babin, Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia, Novosibirsk State University, Novosibirsk, Russia

CD-11.5

Thursday, 16:00

Giants nonlinear response at a plasmonic nanofocus drives efficient four wave mixing over micron length scales

Rupert Oulton, Nicholas Gusken, Michael Nielsen, Xingyuan Shi, Paul Dichtl, and Stefan Maier

Imperial College London, London, UK

CD-11.6

Thursday, 16:30

Experimental demonstration and numerical study of plasmon-soliton waves

Gilles Renversez1, Mahmoud Elsawy1, Mathieu Chauvet2, Tinu Kurikose3, Tomaz Halenkov3, Virginie Nazabal4, and Petr Nemec3

1Aix-Marseille Univ, CNRS, Institut Fresnel, Marseille, France, 2FEMTO-ST Institute, CNRS, Université de Bourgogne Franche-Comté, Besançon, France, 3Department of Graphic Arts and Photophysics, Faculty of Chemical Technology, University of Pardubice, Pardubice, Czech Republic, 4Institut des sciences chimiques de Rennes, CNRS, Equipe Verres et Céramiques, Université de Rennes 1, Rennes, France

CD-11.7

Thursday, 17:00

Multi-qubit registers of individually addressable solid-state defect centers

Eric Bersin1, Michael Walsh1, Sara Mouradian1, Matthew Trusheim1, Kevin Chen1, Tim Schröder3, and Dirk Englund1

1Massachusetts Institute of Technology, Cambridge, USA, 2Humboldt University of Berlin, Berlin, Germany

CD-11.8

Thursday, 17:30

The next generation of quantum emitters?

David Norris, ETH Zurich, Zurich, Switzerland

CD-11.9

Thursday, 18:00

Experimental demonstration and numerical study of plasmon-soliton waves

Sergey A. Babin, Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia, Novosibirsk State University, Novosibirsk, Russia

CD-11.10

Thursday, 18:30

Giants nonlinear response at a plasmonic nanofocus drives efficient four wave mixing over micron length scales

Rupert Oulton, Nicholas Gusken, Michael Nielsen, Xingyuan Shi, Paul Dichtl, and Stefan Maier

Imperial College London, London, UK
EH-6: Plasmonic enhancement of light-matter interactions

> **THURSDAY, 16:00 – 17:30**  
  **Location:** Room 4a ICM

**EH-6.3** THU 16:30
Strong plasmon-exciton interactions at a single nanoantenna level

Timur Shegai, Chalmers University of Technology, Gothenburg, Sweden

CD-12: Quantum and information technologies

> **THURSDAY, 16:00 – 17:30**  
  **Location:** Room 13b ICM

**CD-12.1** THU 16:00
Demonstration of distributed quantum sensing using nonlinear optics

Xueshi Guo¹, Casper Breum¹, Johannes Borregaard², Shuro Izumi¹, Mikkel V. Larsen¹, Jonas S. Neergaard-Nielsen¹, and Ulrik L. Andersen¹

¹Technical University of Denmark, Department of Physics, Lyngby, Denmark; ²University of Copenhagen, Department of Mathematical Sciences, Copenhagen, Denmark
EB-1.1 SUN (Invited) 10:30
Diamond light matter quantum interface
F. Jelezko; Institute of Quantum Optics, Ulm University, Ulm, Germany
Interfac ing coherent optical transitions with long-lived spin qubits will be the main topic of this talk. Prospects for realizing coherent quantum registers based on optically controlled GeV centers will be discussed.

EB-1.2 SUN 10:45
Thulium-doped fibre laser with 25 W Single-mode Output at 1726 nm
M. Burns, P. Shardlow, P. Barua, T. Jefferson-Brain, J. Sahu, and W. Clarkson; Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom
A thulium-doped fibre laser tunable from 1850 to 1900 nm with near-diffraction-limited beam quality and designed for power scalability and efficient two-for-one cross-relaxation at short wavelengths exceeds 50% slope efficiency wth launched 792-nm pump power.

CA-1.1 SUN 10:30
Comparative Study of Harmonic Generation in Air and Argon in Light Filaments Driven by Circularly Polarized Mid-IR Pulses
V. Shumakov1, C. Goillner2, A. Voronin3,4, A. Mitrofanov2,3,4, D. Sidorov-Biryukov5, A. Zheltikov2,3,4, D. Kartashev7, A. Baltuskas8, and A. Pugzlys2,9; Photonics Institute, TU Wien, Austria; 2Physics Department, M.V. Lomonosov Moscow State University, Moscow, Russia; 3Russian Quantum Center, Skolkovo, Russia; 4Department of Physics and Astronomy, Texas A&MS University, College Station, USA; 5Friedrich-Schiller University Jena, Germany; 6Center for Physical Sciences & Technology, Vilnius, Lithuania
Low-order harmonics in mid-IR laser filaments are generated in air and argon at different ellipticity of driving pulses. Rotational excitation of molecules allows generation of harmonics in air in the case of circular polarization.

CA-1.2 SUN 10:45
Experimental Realization of a Handedness-Preserving Chiral Photonic Crystal Mirror
B. Semnani1,2, J. Flannery1,3, R. Al Maraf2,4, and M. Bajcsy1,2,5; 1Institute for Quantum Computing, University of Waterloo, Waterloo, Canada; 2Department of Electrical and Computer Engineering, University of Waterloo, Waterloo, Canada; 3Department of Physics and Astronomy, University of Waterloo, Waterloo, Canada
This work reports on our unprecedented experimental observation of a giant chira-optical effect in an ultra-thin photonic crystal mirror. The mirror selectively reflects one spin state of light while, unusually, preserving its handedness.
D. Fausti  
**spectroscopy**

Femtosecond covariance spectroscopy

D. Fausti; University of Trieste, Trieste, Italy

I will review the possibility to retrieve nonlinear responses in complex materials by measuring noise correlations of classical and quantum nature.

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**CH-1.1 SUN (Invited)**  10:30

The photonic guitar pickup: a high-sensitivity, high-bandwidth fiber strain sensor

J.A. Barnes and •H.-P. Loock; Dept. of Chemistry, Queen’s University, Kingston, Canada

We present a fiber sensor strain based on a locked fiber Fabry-Perot (FFF) and its use to monitor acoustic and ultrasound signals. Examples are an acoustic guitar, medical ultrasound and two different (photo-)acoustic resonators.

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**CF-1.1 SUN**  10:30

Statistical Properties of Phase and Eigenvalues of Nonlinear Fourier Transform of Second Order Solitons

3TRUMPFLaser GmbH, Schramberg, Germany

We present an Yb:YAG thin-disk oscillator delivering a record-high 350-W average power with 940-fs, 40-μJ pulses exploiting vacuum operation, multiple passes on the disk, and large pump spot. Power scaling toward 500 W appears feasible.

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**CF-1.2 SUN**  10:45

Towards 45 watt single-cycle pulses from Yb:YAG thin-disk oscillators

1Ludwig-Maximilians-Universität München, Garching, Germany;  
2Max-Planck-Institut für Quantenoptik, Garching, Germany;  
3Max-Planck-Institut für die Physik des Lichts, Erlangen, Germany;  
4Currently at: TRUMPF Laser GmbH, Schramberg, Germany

By employing a hybrid external nonlinear stage, 45-W, 7-μs pulses from a 6-μJ, 265-fs Yb:YAG thin-disk oscillator are generated. Careful optimization of parameters holds promise for generation of self-compressed, single-cycle pulses at 45 W.
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| **EB-1-2 SUN 11:00**<br>Time-Bin Entanglement Between a Diamond Spin and a Telecom Photon.<br>• A. Tchebotareva,1,2, S. Hermans,1,3 P. Humphreys1,2, D. Vogt1,2, P. Harruna1,3, L. Cheng,2, A. Verlaan2, N. Dijkstra1, W. de Jong1, A. Dréau1,2, and R. Hanson1,2; QuTech, Delft University of Technology, Delft, Netherlands; 2TNO - Netherlands Organisation for Applied Scientific Research, Delft, Netherlands; 3Kavli Institute of Nanoscience, Delft University of Technology, Delft, Netherlands; 4Institute of Nanoscience, Delft University, Delft, Netherlands; 5Laboratoire Charles Coulomb, Université de Montpellier, Montpellier, France; 6Zernike Institute, University of Groningen, Groningen, Netherlands. We experimentally demonstrate entanglement preservation between an NV spin in diamond and the NV-emitted photon upon its quantum frequency conversion to the telecom band. This is crucial for realizing long-distance NV-based quantum networks. | **RO...**<br>**All-normal-dispersion mode-locked Tm:ZBLAN fiber laser**<br>• H. Sagara and M. Toksrakawat; ILS, UEC, Tokyo, Japan. We have developed an all-normal-dispersion Tm:ZBLAN fiber laser at 1.9 µm. An output power of 63mW at 76.6MHz repetition rate with ~80nm spectral bandwidth were obtained. 106 fs pulse duration was obtained after compression. | **CA-1-3 SUN 11:00**<br>Compact Non-Astigmatic Alexandrite Ring Laser with Unidirectional Single-Longitudinal-Mode operation<br>• S. Satihian1, G. Tawy2, X. Sheng3, A. Minassian2, and M. Damzen1; 1Imperial College London, London, United Kingdom; 2Unilase Ltd, London, United Kingdom. We report single-longitudinal-mode operation of a wavelength-tunable Alexandrite unidirectional ring laser with a simplified non-astigmatic design, producing continuous-wave output 0.69 W and in excellent TEM00 beam quality (M2 < 1.1) across its full pumping range. | **CD-1-3 SUN 11:00**<br>Soliton self-compression in air filled Kagome HCPCF<br>• M. Maurel1,2, F. Amram1, B. Debord1,2, F. Gérôme1,2, and F. Benabid1,2; 1GPPMM group, Xlim laboratory, Limoges, France; 2G2Optiques, Limoges, France. We report on experimental propagation dynamics of ultra-short-pulse in HCPCF showing compression to a highly stable 22-fs pulse in a single-stage, and original sequence between soliton red and blue frequency-shift for input pulse energy-range of 100-250 pJ. | **CM-1-2 SUN 11:00**<br>Shaped accelerating beams for materials processing<br>• D. Mansouri1,2,3 and D. Papazoglou1; 1Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology - Hellas (FORTH), Heraklion, Greece; 2Materials Science and Technology Department, University of Crete, Heraklion, Greece. Accelerating optical wavepackets, further focused by a lens or an axicon, can be tuned to achieve a rich control of the focal voxel over an extended range of working distances and act as light scalpels. | **CM-1-3 SUN 11:15**<br>Conical-phase front beam shaping for deep laser-writing of optical waveguides<br>• E. Alimohammadian, S. Liu, E. Ertorer, J. Li, and P.R. Herman; Department of Electrical & Computer Engineering, University of Toronto, Toronto, Canada. Conical phase front shaping of focused femtosecond laser beams are shown to manipulate counteracting effects of surface aberration and Kerr lensing in deep focussing and permit writing of low loss optical waveguides in fused silica. | **CB-1.3 SUN 11:15**<br>Phase modulator based on optomechanically deformable gratings<br>• C.B. Rojas Hurtado1, J. Dickmann2, and S. Kroker1; 1Physikalisch-Technische Bundesanstalt, Braunschweig, Germany; 2Technische Universität Braunschweig, Braunschweig, Germany. We propose a deformable nanosctructured surface consisting of a subwavelength grating as a phase shifter modulator by exploiting its tunable optomechanical response, which can be controlled either optically or piezo-electrically. | **CA-1.3 SUN 11:15**<br>Generation of Multiple Up-converted OAM States from a Tunable Optical Vortex Parametric Laser Source<br>• G. Marcucci1, D. Pierangeli1, A. Agnani2, E. DelRe1, and C. Conti1; 1Sapienza University, Rome, Italy; 2Hebrew University of Jerusalem, Jerusalem, Israel. We introduce the topological control, based on correspondences between phases and genus of toroidal surfaces associated with nonlinear Schroedinger equation. We prove it experimentally and report observations of controlled transitions from shock to rogue waves. | **CA-1.4 SUN 11:15**<br>Laser and Information Technologies, Shatura, Russia; 2Universities. We present a frequency conversion for single photon pairs with different wavelengths on a single device. This enables conversions of time-bin entangled photon pairs from the NIR to the telecom band. | **CA-1.4 SUN 11:15**<br>Ultrashort Light Source at 1.8 µm Based on Thulium-Doped Fibers for Three-Photon Microscopy<br>• Y. Nomura1,2, H. Murakoshi1, and T. Fujii1; 1Institute for Molec...
EE-1.2 SUN 11:00
Generalizing time-domain ptychography for single beam applications

D-M. Spangenberger1, M. Brügmann2, R. Rohwer3, and T. Feurer3
1 Laser Research Institute, Stellenbosch University, Stellenbosch, South Africa; 2 Institute of Applied Physics, University of Bern, Bern, Switzerland

Time-domain ptychography has found many applications since migration from the spatial domain. Here I will discuss a generalised reconstruction algorithm for single beam applications.

EE-1.3 SUN 11:15
Bi-elliptical High Harmonic Spectroscopy of Atomic Potentials

E. Bordà1, O. Neufeld2, O. Kfir2, A. Fleischer3, and O. Cohen1
1 Physics Department and Solid State Institute, Technion - Israel Institute of Technology, Haifa, Israel; 2 4th Physical Institute, University of Göttingen, Göttingen, Germany; 3 Raymond and Beverly Sackler Faculty of Exact Science, School of Chemistry, Tel Aviv University, Tel Aviv, Israel

We theoretically and experimentally demonstrate that bi-elliptical high harmonic generation is sensitive to both the effective potential structure and to the valence-orbital width of noble gas atoms, and analyze the responsible (non semi-classical) physical mechanisms.

JSV-1.2 SUN 11:00
Improving the accuracy of atom gravimeters with ultracold sources

K. Karcher, A. Immnaliiev, S. Merlet, and F. Pereira dos Santos; LNE-SYRTE, Paris, France

Using ultracold atoms we tackled and improved by a factor three the uncertainty of the limiting effect of atom gravimeters: the wavefront aberration bias due to distortions of the laser beam splitters driving the interferometer.

JSV-1.3 SUN 11:15
The role of trap symmetry in an atom-chip interferometer above the Bose-Einstein condensation threshold

M. Dupont-Nivet1, C. Westbrook2, and S. Schwart3
1 Thales Research and Technology France, Palaiseau, France; 2 Laboratoire Charles Fabry de l’Institut d’Optique, Palaiseau, France; 3 Laboratoire Kaatzer Brossel de l’Ecole Normale Supérieure, Paris, France

We study an atom-chip interferometer using 87 rubidium above the Bose-Einstein condensation threshold. The temperature and the traps symmetry dependencies of the contrast are in agreement with previous theoretical predictions.

CH-1.2 SUN 11:00
Functionalized carbon reinforcement structures with optical fibre sensors for carbon concrete composites

K. Bremer1, L.S.M. Alwis2, F. Weigand3, M. Kahne1, R. Hübli1, and B. Roth1
1 Hannover Centre for Technologies, Hannover, Germany; 2 Edinburgh Napier University, Edinburgh, United Kingdom; 3 Saxxon Textile Research Institute, Chemnitz, Germany; 4 Materialforschungs- und -präfandstalt an der Bauhaus-Universität Weimar, Weimar, Germany; 5 Cluster of Excellence PhoenixD, Leibniz University Hannover, Hannover, Germany

We present our latest efforts in the development of functionalized carbon reinforcement structures (FCFs). FCFs are textile based carbon structures with integrated optical fibre sensors for the reinforcement and structural health monitoring of concrete composites.

CH-1.3 SUN 11:00
Optical Fibre Sensors for Monitoring Sewer Concrete Corrosion

M. Ans1, P. Giri2, P. Dekker1, S. Taberti1, J. Gonzalez2, S. Clark2, T. Kuen4, L. Vorrestree4, H. Bumant3, and M. Withford1
1 Department of Physics and Astronomy, Macquarie University, North Ryde, NSW, Australia; 2 Department of Earth and Planetary Sciences, Macquarie University, North Ryde, NSW, Australia; 3 Sydney Water Corporation, Parramatta, NSW, Australia; 4 Melbourne Water, Victoria, VIC, Australia

We outline the development of long-lived optical fibre sensors to monitor temperature, stain, moisture and pH levels in wastewater concrete structures. The sensors will enable asset managers to monitor concrete corrosion and reduce maintenance costs.

CF-1.3 SUN 11:00
Thin-disk Mamyoshev oscillator supporting discrete similarieties

F.O. Ildau1,2,3, D.K. Kesimi1,2, M. Hoffmann1, and C.J. Saraceno1
1 UNAM-National Nanotechnology Research Center and Institute of Materials Science and Nanotechnology, Bilken University, Ankara, Turkey; 3 Department of Electrical and Electronic Engineering, Bilken University, Ankara, Turkey; 2 Department of Physics, Bilken University, Ankara, Turkey; 4 Department of Electrical Engineering and Information Technology, Ruhr University Bochum, Bochum, Germany

We present numerical simulations demonstrating that this approach is promising for the generation of multi-mJ pulses from thin-disk oscillators without any additional saturable absorbers.

CF-1.4 SUN 11:15
Overcoming the challenges in power scaling ultrafast thin-disk oscillators: nonlinearity management and thermal effects

F. Saltarelli, A. Diebold, I. Graumann, C. Phillips, and U. Keller; 1 Institute for Quantum Electronics, ETH Zurich, Zurich, Switzerland

We present a novel approach to nonlinearity management in a 210-W average power, 780-fs pulse thin-disk oscillator through an intracavity phase-mismatched nonlinear crystal and discuss how to overcome the thermal-lensing challenges for further power scaling.

CE-1.3 SUN 11:00
Integrated Waveguide Fourier Transform Spectrometer on Thin-Film Lithium Niobate

D. Pohl1, M. Reig Escalé2, M. Madi3, P. Broetz4, F. Kaufmann1, A. Sergeyev4, P. Giaacari2, U. Meier4, E. Alberti2, and R. Grange1
1 Optical Nanomaterial Group, Institute for Quantum Electronics, Department of Physics, ETH Zürich, Zürich, Switzerland; 2 Micos Engineering GmbH, Dubendorf, Switzerland

We demonstrate the principle of an integrated waveguide spectrometer on a lithium niobate-on-insulator platform. The electro-optic effect allows to retrieve the interferogram of a broadband source with a static array of metallic evanescent field samplers.
eb-1.4 sun 11:30 multimode opto-electro-mechanical transducer for non-reciprocal conversion of radio-frequency and optical signals
m. nicola, h. iman moaddel, n. riccardo, d.g. giovanni, and v. david, università di cameroni, cameroni, italy
by exploiting multi-mode electro-opto-mechanical interaction, we experimentally show the bandwidth increase of electro-opto-mechanical transducers, based on a sin membrane capacitively coupled to an lc circuit. moreover, we show that such system may realize a non-reciprocal transducer.

room 3 11:30

cj-1.5 sun 11:30 tunable mode locked fiber laser in 1750-1870nm by bending normal dispersion thulium doped fiber as a distribution filter
y. chen, y. chen, k. luo, q. wang, d. tang, and s. yoo, nanyang technological university, singapore, singapore
we report a tunable mode locked fiber laser in the 1750-1870nm region by incorporating a normal dispersion thulium doped fiber (ndtf), with the tunability of lasering wavelength achieved by bending ndtf as a distributed long-wavelength filter.

cj-1.6 sun 11:45 generating maximal entanglement between spectrally distinct solid-state emitters
k. johansson1, d. hurst2, j. rießer3, j. merk3, and p. kock3, 1technical university of denmark, kgs. lyngby, denmark, 2university of sheffield, sheffield, united kingdom
we have developed a protocol for deterministic and maximal entanglement generation between two spectrally distinct emitters embedded in a mach-zehnder interferometer. via optical state optimization the requirement for perfect spectral overlap can be relaxed.

room 4a 11:30

cj-1.6 sun 11:45 experimental observation of coexisting differently polarized cavity solitons in a monochromatically driven passive kerr resonator
a.u. nielsen1,2, b. garbin1,2, s. coen1,2, s.g. morduch2,3, and j.-c. tung1,2, 1 Optoelectronics Research Centre, University of Southampton, Highfield, Southampton, uk, 2Applied Photonics, Abbe Center of Photonics, Friedrich Schiller University Jena, Albert-Einstein-Straße 15, Jena, Germany, 3Technische Physik, University of Wuerzburg, Wuerzburg, Germany
we report on the coherent beam combining of 37 fiber chirped-pulse amplifiers involving a tiled-aperture geometry along with an interferometric phase measurement technique, as the last step towards 61 combined channels.

room 4b 11:45

cj-1.6 sun 11:45 fundamental design principles for reflective membranes in thermal noise limited cavities
j. dickmann1, j. meyer2, t. kästberg2, f.e. bruno3, r. norte4, p.g. steeneken4, and s. kroeker1,2, 1physikalisch-technische bundesanstalt braunschweig, braunschweig, germany, 2technische universität braunschweig, lena laboratory for emerging nanometrology, braunschweig, germany, 3delft university of technology, delft, netherlands
we present the analytical calculation of the brownian thermal noise of reflective membranes in fabry perot cavities. using this analysis in combination with the sensitivity dependencies of the membrane, we can optimize the signal-to-noise ratio.

room 2 11:45

ca-1.5 sun 11:30 handedness control of visible optical vortex output from a diode-pumped pr3+ylf laser
y. ma, j.-c. tung1,2, b. roth2,3, g. steinmeyer4,5, u. morgenstern2,3, and s. mujumdar2, 1nano-optics and mesoscopic optics laboratory, tata institute of fundamental research, mumbai, india, 2technische physik, university of wuerzburg, wuerzburg, germany
we quantify the generalized conductance fluctuations in two-dimensional anderson localization of light under near-periodic disorder and strong disorder. our statistically consistent measurements reveal hitherto-unknown differences in the two localization approaches.

ca-1.6 sun 11:45 coherent beam combining of 37 femtosecond fiber amplifiers
i. fisfis1, l. danaud1, a. hellmann1, j. le dortz2, s. bellanger2, j. bordoni2, c. larat2, e. lailler2, m. antier3, e. durand4, a. brigon2, and j.-c. chanteloup1, 1cole polytechnique, palaiseau, france, 2thales research & technology, palaiseau, france, 3thales las france sas, elancourt, france
we report on the coherent beam combining of 37 fiber chirped-pulse amplifiers involving a tiled-aperture geometry along with an interferometric phase measurement technique, as the last step towards 61 combined channels.

ck-1.5 sun 11:30 generalized conductance fluctuations in anderson localization at the two limits of disorder
r. kamara1, s. mondal1, m. balasubrahmanyan1, m. kamp2, and s. mujumdar2, 1nano-optics and mesoscopic optics laboratory, tata institute of fundamental research, mumbai, india, 2technische physik, university of wuerzburg, wuerzburg, germany
we report on the coherent beam combining of 37 fiber chirped-pulse amplifiers involving a tiled-aperture geometry along with an interferometric phase measurement technique, as the last step towards 61 combined channels.

ck-1.6 sun 11:45 generation of vector mathieu beams using geometrical phase elements and their application to laser micro processing
s. orlova1, v. sleva2, v. vosylius3, p. gotovski3, o. ulinas2, and t. gertul2,1, 1center for physical sciences and technology, industrial laboratory for photonic technologies, vilnius, lithuania, 2workshop of photonics, altcheria rd-3, vilnius, lithuania
vectoral geometrical phase elements are designed and implemented using nanogratings inscribed in the glass. we encode phase masks for generation of vector mathieu beam, which is used to induce volume modifications of transparent materials.

cm-1.4 sun 11:30 beam shaping with higher laguerre-gaussian orders for high power bessel beams
m.p. siems1, j.u. thomas2, c. vetter1, c. bergner1, h. gross3,4, and s. nolte1, 1institute of applied physics, abbe center of photonics, friedrich schiller university jena, albert-einstein-strasse 15, jena, germany, 2scht ag, hattenbergstraße 10, mainz, germany, 3femto st institute, univ. bourgogne franche-comté, cnrs, 15b avenue des montboucons, besançon, france, 4frauenhofer institute for applied optics and precision engineering, albert-einstein-strasse 7, jena, germany
elongated foci are essential for scaling ultrashort laser processes. however, axicon tips limit the quality of bessel beams – especially at high powers. we demonstrate how an apt combination of laguerre-gaussian modes can circumvent these singularities.
All-Optical Background-Free Detection of Ring Currents by Dynamical Symmetry Breaking High Harmonic Spectroscopy
O. Nesif, C. N. Calvez, J. B. Boccara, J. P. Marzin, S. Bally, and F. Mélin

Quantum-limited time-frequency multiparameter estimation through mode-selective photon measurement
Y. Ansari, F. M. Danos, J. Q. Leng, and B. Rehacek

Symmetrical Clock Synchronization with Time-Correlated Photon Pairs
J. Lee, L. Djordjevic, A. Greb, J. Trupke, A. Lamas-Linares, and C. Kartisiefer

Twinline Cross Fiber Interferometers for Precision Sensing
J. Villalora, E. Antonio-Lopez, J. Zubia, A. Schützger, and R. Ameszca-Carron

A Compressed Sensing Approach to Fibre Bragg Grating Interrogation
S. Sugavanam, A. A. Ghadebo, M. Kamalian-Kopaei, and A. Majumdar

Power-Scaling Nonlinear-Mirror Modeocked Thin-Disk Lasers

Field enhancement in a doubly resonant optical parametric oscillator
C.M. Dietrich, J. Babushkin, J.C. Andrade, L. Rust, and U. Morgan

Artificial Neural Network-Based Equaliser in the Nonlinear Fourier Domain for Fibre-Optic Communication Applications
M. Kamalian Kopae, A. Vasylenkov, O. Kolyar, M. Pkrakota, J. Prлицępsy, and S. Turitsyn

Development of Orientation-Patterned GaP on GaAs for Nonlinear Frequency Conversion

A Novel Fourth-Order Difference Scheme for the Direct Zakharov-Shabat Problem
S.B. Medvedev, A.A. Vasenov, I.S. Chkhlovskoy, and M.P. Fedoruk

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S.B. Medvedev, A.A. Vasenov, I.S. Chkhlovskoy, and M.P. Fedoruk
EB-2 SUN (Invited) 14:00
Integrated semiconductor quantumophotonics
1 Universität Innsbruck, Innsbruck, Austria; 2 National University of Defense Technology, Changsha, China; 3 Technische Universität Berlin, Berlin, Germany; 4 Innsbruck Medical University, Innsbruck, Austria; 5 Universität Würzburg, Würzburg, Germany; 6 University of St. Andrews, St Andrews, United Kingdom
AlGaNAs is a versatile semiconductor material, which is suitable for a variety of quantum photonics applications. We will present our results on photon pair creation and on integration of these sources towards a complete platform.

EB-2b SUN 14:00
Investigation of noise sources down to the shot-noise limit in Yb-doped fiber amplifiers for TMI investigations
1 Max Planck Institute for the Science of Light, Erlangen, Germany; 2 Department of Physics, University of Erlangen-Nuremberg, Erlangen, Germany; 3 SAOT, Graduate School in Advanced Optical Technologies, Erlangen, Germany; 4 Institute of Applied Physics, Friedrich-Schiller-University Jena, Jena, Germany; 5 Fraunhofer IOF Jena, Jena, Germany.

We use balanced homodyne detection to measure the amount of intensity noise in a fiber amplifier in relation to the shot noise limit, quantifying the impact of different noise sources at various frequencies.

CA-2 SUN 14:00
Progress of the development of new Vulcan PW OPCPA beamline
1 University of Applied Physics, Jena, Germany; 2 University of Innsbruck, Innsbruck, Austria; 3 Fraunhofer IOF Jena, Jena, Germany.

We report on a highly versatile OPCPA laser system developed and installed for pump-probe experiments at the FLASH2 free-electron laser facility in Hamburg. The laser system operates in a 10Hz 0.8ms burst-mode.

CA-3 SUN 14:00
From coherent Raman microscopy to endoscopy
H. Bigenwald, Aix Marseille Univ, CNRS, Central Marseille, Institut Fresnel, Marseille, France
Advanced in coherent Raman scattering (CRS) microscopy and endoscopy will acquire rapid images in few tens of micro-second per pixel is presented.

CA-4 SUN 14:00
Evaluating OCPA Pump-Probe Laser System for the FLASH2 XUV FEL beamline at DESY
1 Deutsche Elektronen-Synchrotron (DESY), Hamburg, Germany; 2 University of Bern, Bern, Switzerland; 3 Stellenbosch University, Matieland, South Africa.

Recently, we demonstrated time domain ptychography. Here, I will show ptychographic reconstruction of different time domain objects, ranging from ultrafast laser pulses, complex supercontinuum, attosecond XUV pulses to X-ray free electron laser pulses.

CA-5 SUN 14:00
Characteristics of Photodarkening-Induced Loss in Yb-Doped Fiber Amplifier
Y. Feng, C. Codemard, P. Barua, H. Lin
1 University of Applied Physics, Jena, Germany; 2 University of Innsbruck, Innsbruck, Austria; 3 Fraunhofer IOF Jena, Jena, Germany.

We discuss photon transport experiments in suspended 2D phononic crystal and compare them to simulations by Monte Carlo methods. Factors including symmetries, shape, surface roughness, filling factor, boundary conditions and temperature are considered.

CA-6 SUN 14:00
Photonic transport in disordered 2D phononic crystals
M. Sledzinska, R. Graceykowski, D. Lacroix, F. Alzina, K. Terentzi, U. Melia, and C. M. Sotomayor Torres
1 Instituto de Nanociencia & Nanotecnologia (ICN2), CSIC and BIST, Bellaterra (Barcelona), Spain; 2 Adam Mickiewicz University, Poznan, Poland; 3 Université de Lyon, CNRS, LEMTA, Nancy, France; 4 CNRS, INSa-Lyon, Université Claude Bernard Lyon 1, Lyon, France; 5 ESA, Univ. Politecnica de Catalunya, Barcelona, Spain; 6 ICREA-Instituto Catalana de Recerca i Estudis Avançats, Barcelona, Spain.

We will show ptychographic reconstruction of different time domain objects, ranging from ultrafast laser pulses, complex supercontinuum, attosecond XUV pulses to X-ray free electron laser pulses.

CA-7 SUN 14:00
Out-of-plane Focussing Polarization Control Grating Couplers for Photonic-Spintronic Integration
H. Becker, C. J. Krickel, D. Van Thourhout, and M. J. R. Heck
1 Aarhus University, Aarhus, Denmark; 2 Ghent University imec, Ghent, Belgium.

We demonstrate the first out-of-plane 2D focusing grating coupler on silicon designed for photonic-spintronic integration, allowing for full polarization control. We present design and experimental characterisation and argue for their applicability in spintronic integration.

CD-1 SUN (Invited) 14:00
Time-Domain Ptychography
T. Feurer, M. Bräutmann, T. Schweizer, A. Heidt, D. Spangenberg, and E. Rohrer
1 University of Bern, Bern, Switzerland; 2 Stellenbosch University, Matieland, South Africa.

We will show ptychographic reconstruction of different time domain objects, ranging from ultrafast laser pulses, complex supercontinuum, attosecond XUV pulses to X-ray free electron laser pulses.

CD-2 SUN (Invited) 14:00
Tailored Coupling Coefficient within sub-wave length nanostructured waveguides arrays to towards compact and efficient devices
A. Tabanou, F. Hentinger, and N. Belabas
1 CNRS C2N, Palaiseau, France; 2 Sub., below band-gap.
CH-2.1 SUN 14:00
Low Intensity LiDAR using Depth Aware Compressive Sensing and a Photon Number Resolving Detector

The biggest challenge for LiDAR systems is the trade-off between speed, resolution and range – but what if we could have them all? Compressive sensing photon-counting LiDARS are still in their infancy, and we present several simple improvements for them.

CF-2.1 SUN 14:00
Mode-Dependent Crosstalk Penalty in Few-mode Multi-Core Fiber Transmission
G. Rademacher1, B.J. Puttnam2, R.S. Lu2, A. Ross-Adams2, S. Gross2, M. Wirth2, N. Rivier2, Y. Sasuki2, H. Furukawa2, K. Saitoh2, K. Akahata2, Y. Awa2, and N. Wada2, 1Institut de la vision, Laboratoire Charles CI-2.2 SUN 14:15

Lightweight Optical Fibers with high Numerical Aperture in the Near-IR
J. Frrer Ortas1, A. Berberian2, L. Abdeladim1, B.Korenko2, S. Knappe2, O. Alem2, S. B.Krause, E. Nagel, and U. Marksteiner, B. Weiler, Rice University, TX, USA

The biggest challenge for LiDAR systems is the trade-off between speed, resolution and range – but what if we could have them all? Compressive sensing photon-counting LiDARS are still in their infancy, and we present several simple improvements for them.

CF-2.1 SUN 14:00
Wavelength Independent Image Classification Through A Multi-modal Fiber Using Deep Neural Networks
E. Backus1,2, S. Sun3, S. Hosseinpour2, S. Schlege1, and M. Bonn1, 1University of Vienna, Vienna, Austria; 2Max Planck Institute for Polymer Research, Mainz, Germany

Clean energy like hydro- gen can be generated on TiO2 by photocatalytic splitting with water. The mechanism of this reaction step.

For the first reaction step:

CF-2.1 SUN 14:00
Two-color 1.25-MHz sub-70-fs source at 1.3 and 1.7 μm for multi-modal probe microscopy in water-transparency bands
F. Draum, K. Guesmi, L. Abdeladim, T. Berberian1, P. Rigaud, I. Frer1, M. Hann1, P. Mahou2, J. J. Livet, W. Sapatto3, P. Georges4, and E. Fabry, Palaiseau, France; 2Laboratoire d’Optique et Biosciences, Palaiseau, France; 3Amplitude Laser Group, Pessac, France; 4Institut de la vision, Paris, France

A novel ultrafast laser concept providing simultaneous excitation in the two water-transparency windows at 1.3 and 1.7 μm, is presented. We also demonstrate its potentiality performing 3-photon microscopy on real brain tissues.

CF-2.2 SUN 14:15
Speckle Noise Reduction by Fiber Scrambling for Improving the Measurement Precision of an Airborne Wind Lidar System
O. Lux, C. Lemmerz, F. Weiler, U. Marksteiner, B. Wittchas, E. Nögel, and O. Rettebach, German Aerospace Center, Bremen, Germany

For the first reaction step:

CF-2.2 SUN 14:15
Directly Diode-Pumped, Kerr-Lens Mode-Locked Cr2ZnSe Oscillator
N. Nagi, S. Gröbner, V. Pervak, O. Pronin, K.F. Mak, and F. Krausz, 1Ludwig-Maximilians-Universität München, Garching, Germany; 2Max Planck Institute of Quantum Optics, Garching, Germany

For the first reaction step:

CF-2.2 SUN 14:15
RF-sputtering technique for fabrication of dielectric multilayer structures with low-threshold coherent emission at 1.5 μm
A. Chiarelli, C. Meroni, F. Scotognella, Y. Bouchez, A. Lukowiak, D. Ristic, G. Sperruzza, S. Varan1, L. Zier, M. Avenda1, S. Täschner, L. Tran, J. Zonta, G. Righini, and M. Ferrari, 1IFN – CNR CSFMO Lab. & FBK, Italy
S. Zhu, Y. Feng, S. Pidhirtly, S. Hong, J. Sahu, and J. Nilsson; Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom.

Optical Lithography

A. Santella, T. Hohne, and S. Rodt; 3, Technische Universität Berlin, Berlin, Germany;
2, Zuse Institut Berlin, Berlin, Germany; 2, Korea Institute of Science and Technology, Berlin, South Korea.

We report on the deterministic fabrication of complex quantum dot waveguide circuits using in-situ electron-beam lithography. Single-photon routing and 50/50 mode splitting by an MMI-coupler is demonstrated via an on-chip Hanbury Brown and Twiss experiment.

CB-1.1 SUN 11:30

Deterministic integration of quantum dots into on-chip multi-mode interference couplers via in-situ electron beam lithography


We report on the deterministic fabrication of complex quantum dot waveguide circuits using in-situ electron-beam lithography. Single-photon routing and 50/50 mode splitting by an MMI-coupler is demonstrated via an on-chip Hanbury Brown and Twiss experiment.
Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany

Fiber scrambling has significantly reduced the frequency and intensity fluctuations and thus the measurement error of an airborne Doppler wind lidar instrument by overcoming detrimental speckle noise introduced through the use of a multimode fiber.

EE-2.2 SUN 14:30
Few-femtosecond Plasmon Transients Probed with nm-scale Sensitivity
B. Lovázs1, P. Sándor2, Z. Pápa1, B. Éles1, B. Bánhidy1, P. Rácz1, C. Prietl, J.R. Krem1, and P. Dombi1; 1 Wigner Research Centre for Physics, Budapest, Hungary; 2Institut für Physik, Karl-Franzens-Universität, Graz, Austria

Photoelectric probing of few-femtosecond plasmon transients on nanostructures reveals the ultrafast dynamics of localized plasmon oscillation decay with nm-scale sensitivity at plasmonic hot spots.

JSV-2.2 SUN 14:30
The contribution has been withdrawn.

CH-2.3 SUN 14:30
Short-Range Supercontinuum Based LIDAR for Temperature Profiling
A. Saleh1,2, A. Aalto1, P. Ryczkowski1, T. Mikkonen1, and J. Toivanen1; 1Photonics Laboratory, Physics Unit, Tampere University, Tampere, Finland; 2Valmet Technologies Oy, Energy Services, Lentokenttakatu 11, Tampere, Finland

A new technique employing a supercontinuum light source has been developed for simultaneous remote sensing of multiple parameters. The approach enables temperature mapping inside a thermal device using only one inspection window.

CF-2.3 SUN 14:30
Towards Fully Stabilized 10GHz Optical Frequency Combs From SESAM-ModeLocked Yb:CALGO Lasers
L. Kräger, A. Mayer, C. Phillips, and U. Keller; Department of Physics, Institute of Quantum Electronics, ETH Zurich, Zurich, Switzerland

We present low-energy supercontinuum generation in silicon nitride waveguides driven by a repetition-rate stabilized SESAM-modelocked 10-GHz Yb:CALGO laser with 20-fs pulses at 580 mW suitable for self-referenced carrier-envelope offset frequency detection without amplification.

CS-2.3 SUN (Invited) 14:30
Multi-Band Optical System: New Generation Stability, Ultra-Bandwidth, and Efficiency
A. Ferrari1, A. Napoli2, N. Costa2, P. Ryczkowski1, C. Phillips2, W. Forster2, J. Pedrotti2, A. Richter2, E. Pincet2, and V. Corri1; 1Politecnico di Torino, Turin, Italy; 2Infineon Technologies Oy, Helsinki, Finland

We report the first demonstration of a new paradigm in mid-infrared (MIR) biophotonics, where the classification of high-speed image streams is demonstrated.
EB-2.3 SUN 14:45
Integration of Single Quantum Dots in Suspended Phononic Waveguides
A. Vogele1, X. Yuan2, M. Sommer1, M. Weiß3, E. Nysten4, S. da Silva5, A. Rastelli3, and H. Kroemer1, 2
Experimental Physik 1, Universität Augsburg, Augsburg, Germany; 3 Institute of Semiconductor and Solid State Physics, Johannes Kepler Universität Linz, Linz, Austria
Single Quantum Dots are integrated into suspended nanophononic waveguides. When strained by the guided flexural Lamb mode, Quantum Dots exhibit enhanced optomechanical coupling.

EB-2.4 SUN 15:00
On-chip photon pair source with pump rejection filters
D. Oser1, F. Maczei2, C. Alonso Ramos3, X. Le Roux4, L. Vivien4, S. Tanzilli5, É. Cassan4, and L. Labonté6, 7
1 Center for nanosciences and nanotechnologies, Palaiseau, France; 2 Institut de physique de Nice, Nice, France
Silicon micro-resonators have shown bright photon-pair generation. However, on-chip integration of pump-rejection filters remains a challenge. We demonstrate photon-pair source.

CJ-2.5 SUN 15:00
Fiber Fuse Effect in Hollow Core Optical Fibers
J. Boftot, A. Kolyadin, and A. Kosolapov, Fiber Optics Research Center of RAS, Moscow, Russia
Optical discharge propagation in air-filled hollow-core fibers under the ~1W average power laser radiation with an average velocity of ~1m/s was investigated. The results provide us insight into the nature of this process.

CJIV-1.3 SUN 15:00
Dual-Colour-Pump Broadband CARS in Single-Ring Gas-Filled Photonic Crystal Fibre
1 Max Planck Institute for the Science of Light, Erlangen, Germany; 2 Department of Physics, University of Erlangen-Nuremberg, Erlangen, Germany; 3 Institute of Applied Physics, University of Konstanz, Konstanz, Germany
Gas-filled hollow-core PCF is used for broadband coherent anti-Stokes Raman scattering with dual-color pumping. Suppression of the ~1W average power laser radiation with an average velocity of ~1m/s was investigated. The results provide us insight into the nature of this process.

CJIV-1.4 SUN 15:00
Dynamics of Highly Excited Stimulated Raman Scattering in Two-Dimensional Theory and Experiments
J. Spajtsek1, L. Perfetti2, N. Vast3, and K. Taninuma4, 5
1 Laboratoire des Solides Irradiés, École Polytechnique CNRS, Palaiseau, France; 2 Research Center for Ultra-High Voltage Electron Microscopy, Osaka, Japan
We study the hot electron relaxation of silicon dioxide nanowires in doped InSe, and the role of electron-photon coupling, using the computational methods based on density functional theory and the time-energy fluctuation-dissipation theorem for heat and density-functional theory. Short- and long-term stability parameters comply with gravitational wave detector requirements.

CA-2.4 SUN 15:00
Characterization, Integration and Operation of a 100-W Solid State Amplifier in the Advanced-VIRGO Pre-Stabilized Laser System
F. Cleva, J.-P. Coulon, and F. Kéfélian, 1 Université Côte d’Azur & CNRS, Nice, France
We report on a new 100-W solid state amplifier integrated in Advanced VIRGO pre-stabilized laser system. Short- and long-term stability parameters comply with gravitational wave detector requirements.
EE-2.4 SUN 14:45
Observing Nonlinear Plasmon-Exciton Dynamics by Coupling to Enhanced Harmonic Generation
J. Zhong, K. Janner, S. Li, A. Korte, A. Schimek, P. Schauf, B. Runges, and C. Lienau
III Institute of Physics, Carl von Ossietzky University, Oldenburg, Germany
AARC Centre of Excellence for Engineered Quantum Systems, Macquarie University, NSW 2109, Australia
Chemical and Quantum Physics, School of Sciences, RMIT University, Melbourne, Australia
Fraunhofer Institut für Angewandte Festkörperphysik (IAF), Freiburg, Germany
Centre of Excellence for Nanoscience BioPhotonics, School of Sciences, RMIT University, Melbourne, VIC 3001, Australia
We report the progress of our experimental study towards NV laser magnetometry in open fibre cavities and the theoretical study of NV absorbed diamond Raman laser in such a micro-cavity for magnetic sensing applications.

EE-2.4 SUN 15:00
Use of optical quantum sensors to study chemical processes
V. Ciminì, G. Giancani, L. Raggiò, T. Gasperi, M. Sbroscia, E. Boccia, D. Toiati, F. Bruni, M.A. Ricci, and M. Barbieri
Università degli studi di Roma TRE, Roma, Italy
Chiral optical nanoelectromechanical resonators (ONERs) and systems. Here we implement a quantum multiparameter protocol, robust against time-varying noise to study the dynamic of a chemical process.

CH-2.5 SUN 15:00
Atmospheric CO2-detection via Scheimpflug DIAL
Employing a Simple Fiber Amplifier
X. Yang1, J. Larsson1, R. Lindberg1, F. Rotermund1, U. Sundqvist2, and S. Bigotta3
1 Department of Physics, KAIST, Daejeon, South Korea
2 IMT Institute of Advanced Studies, L’Île-Saint-Denis, France
3 CNRS/UGA UPR2940, Grenoble, France
We measured the dependence between the signal of the absorption of CO2 on the wavelength. Our experiments show increased crosstalk sensitivity by 0.9 dB for few-mode fibres.

CH-2.4 SUN 15:45
Extending the Exposure Time in High-Resolution Mobile Tunnel LIDAR
T. Murakami1, N. Saito1, T. Michikawa1, Y. Komachi2, M. Sakashita1, S. Kogure1, K. Kase2, S. Wada3, and K. Midorikawa2
1 RIKEN Center for Advanced Photonics, 2-1 Hirosawa, Wako, Saitama, Japan
2 National Institute of Materials and Chemical Research, Tsukuba, Japan
3 University of Tokyo, Tokyo, Japan
We showed that enough exposure time is essential to satisfy the SN ratio and safety standards in a high-resolution vehicle-mounted laser measurement, and introduced time delay integration method as a solution.

CF-2.4 SUN 14:45
76 fs SWCNT-SA mode-locked Tm:MW04 laser at 2 μm
L. Wang1, Y. Zhao1, Y. Wang1, L. Zhang2, H. Lin1, J.E. Bae3, S.Y. Choi4, E. Rotermond5, P. Locket6, X. Mateos2, U. Griebner6, V. Petros6, and W. Chen1,2,5
1 Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany
2 Key Laboratory of Optoelectronic Materials Chemistry and Physics, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, Fuzhou, China
3 Department of Physics, KAIST, Daejeon, South Korea
4 ITM0 University, Petersburg, Russia
5 Physico-Cristallography de Matériaux et Nanomatériaux (FiCMA-FiCNA), Université Rovira i Virgili, Tarragona, Spain
We report on a SWCNT-SA mode-locked Tm:MW04 laser delivering pulses as short as 76 fs at 2.07 μm with a repetition rate of 86.5 MHz.

CF-2.5 SUN 15:00
Chirped-pulse optical parametric oscillators
P. Liu1 and Z. Zhang1
1 Huazhong University of Science & Technology, Wuhan, China
We demonstrated that by introducing self-phase modulation effects into a conventional optical-parametric-oscillator (OPO) cavity and disspating few-mode fibres. We show increased crosstalk sensitivity by 0.9 dB for upconversion (visible)

CI-2.4 SUN 15:00
Experimental observation of propagation direction dependent performance of single-mode multi-core and few-mode fiber links
R. S. Luis1, G. Radevich1, J.M. Putnam1, H. Farsakova1, Y. Away1, R. Maruyama2, K. Aikawa3, and N. Wada4
1 NICT, Koganei, Japan
2 Fujikura Ltd., Chiba, Japan
3 RIKEN Center for Advanced Materials and Chemistry, Tsukuba, Ibaraki, Japan
4 NICT, Koganei, Japan
We report the observation of direction dependent performance on links using multi-core and few-mode fibers. We measured the dependence between upconversion (visible)

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NOTES

EE-2.3 SUN 14:45
Visible/Multi-THz 2D Spectroscopy for Ultrafast Carrier Dynamics
J. Allerbeck1, L. Spitzer2, T. Karinbauer1, A. Leitenstorfer1, and D. Brida1,2
1 University of Konstanz, Konstanz, Germany
2 Université du Luxembourg, Luxembourg, Luxembourg
3 Japan Society for the Promotion of Science, Tokyo, Japan
Asymmetric two-dimensional spectroscopy, with visible excitation and multi-THz readout enables phase sensitive investigation of correlations between high- and low-energy excitations as demonstrated in preliminary studies that track ultrafast carrier dynamics in graphite.

JSV-2.4 SUN 15:00
Super-Quadrupole Upconversion Luminescence using Nanolaminate Ions
I. Carrasco1, L. Lavernesse2, L. Bigotta2, A. Tonelli3, M. Tonelli3, A.I. Zagumennyi5, and M. Pollinat4
1 University of Warwick, Coventry, United Kingdom
2 University of Torino, Torino, Italy
3 Università dell’Insubria, Varese, Italy
4 University of Western Australia, Perth, Australia
5 Russian University of Friendship of Peoples, Moscow, Russia
We demonstrate non-volatile synaptic weights based on ferroelectric barium titanate films integrated on Si waveguides for a photonic reservoir computing system. We discuss the impact of imperfections in such hardware weights on the reservoir performance.

JSI-1.3 SUN 15:45
Non-volatile photonic reservoir computing systems
P. Stark1, M. Geller1, E. Kremer1, P. Ehrle2, D. Canni3, F. Fompeyrine4, B.J. Offen5, and S. Abe6
1 IBM Research — Zurich, Rüschlikon, Switzerland
2 The University of Texas at Austin, Austin, USA
3 IMEC, Leuven, Belgium
4 Photonics Research Group, Ghent University – imec, Gent, Belgium
5 We present an experimental validation of delay-based reservoir computing using a semiconductor laser integrated on an InP chip, reaching computation speeds of up to 0.8 GHz.
of the non-resonant background by 15 dB permits detection of trace gas concentrations of 20 ppm under ambient conditions.

and momentum-resolved spectroscopy. Impact of pump transport is discussed.

of a single defect in hexagonal boron nitride to the guided modes of a tapered fiber is demonstrated resulting in an efficient system for photon collection.

in air with femtosecond laser ablation.

of a tapered fiber is demonstrated resulting in an efficient system for photon collection.

in air with femtosecond laser ablation.
nonlinearities in metal-dielectric composites is unclear. By spectrally and temporally probing coherent second harmonic fields we show how nanometer-sized plasmonic hot spots in gold nanoshapes drive the emission from embedded zinc-oxide nanoparticles.

We propose a new approach to time resolved measurements in condensed matter, in which the noise on the probe photon number is exploited to get additional information on the system under study.

We present a simple pump-and-direct (infrared) luminescence decay of Nd3+-doped laser materials under equivalent pump conditions. We found a strongly super-quadratic instead of the expected quadratic dependence. Calculations partially explain experiments.

EE-2.5 SUN 15:15
Photon number fluctuation in time domain experiment in superconducting B2212
J. Giust1, A. Marcinic2,3, and D. Fausti1,2; 1Department of Physics, University of Studi di Trieste, Trieste, Italy; 2Elettra-Sincrotrone Trieste S.C.p.A., Trieste, Italy

We propose a new approach to time-resolved measurements in condensed matter, in which the noise on the probe photon number is exploited to get additional information on the system under study.

We theoretically and experimentally demonstrate that when absorbance estimation in the Beer-Lambert law is considered, the advantage offered by optical quantum sensing strategies is drastically reduced by optimisation over the length of absorbing material.

A single free-running dual-comb MIXSEL for fast and precise distance measurements
J. Nürnberg, C.G.E. Alfieri, D. Waldburger, L. Krüger, M. Golling, and U. Keller; Department of Physics, Institute for Quantum Electronics, ETH Zürich, Zürich, Switzerland

We present time of flight LIDAR with a single, unstabilized dual-comb mode-locked integrated external-cavity surface emitting laser. We achieve accuracies as high as 20 μm at update rates as fast as 20 μs.

We theoretically and experimentally demonstrate that when absorbance estimation in the Beer-Lambert law is considered, the advantage offered by optical quantum sensing strategies is drastically reduced by optimisation over the length of absorbing material.
Ultra-violet optical amplifier based on plasma-core PCF

We report the first د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د د DUV/UV amplifier using an all-plasma-core photonic crystal fiber architecture with a maximum gain of 25 dB and a total optical power of 11 mW at 315 nm.

Probing neuronal membrane potentials and ionic fluxes at the single cell level by means of water

We report both theoretically and experimentally an efficient refrigeration technique based on evaporative electron cooling in asymmetric AlGaAs/GaAs double barrier heterostructures. At 300 K, electron temperature in the quantum well remarkably decreased by 50 K.
Quantum Measurement of a Mechanical Resonator and Below the Standard Quantum Limit

M. Ross1,2, D. Mason1,2, J. Chen1,2, Y. Taturyan1,2, and A. Schiesser1,2
Niels Bohr Institute, Copenhagen, Denmark
Center for Hybrid Quantum Networks (Hy-Q), Copenhagen, Denmark

We measure mechanical displacements within 3% of the Heisenberg limit. By exploiting quantum correlations in an optomechanical system, we achieve for the first time a total sensitivity below the standard quantum limit by 1.5 dB.

**Room 1 Hall A1**

**CH-3: Fiber lasers**
Chair: Christopher Phillips, ETH, Zurich, Switzerland

**Room 2 Hall A1**

**CF-3: Components and systems for metro and short range networks**
Chair: Juan-Diego Anja Castanon, Instituto de Óptica CSIC, Madrid, Spain

**Room 6 Hall A1**

**JSI-2: Neuromorphic processing for optical communications**
Chair: Markus Schmidt, Ghent University, Ghent, Belgium
Quantum Key Distribution with Small Satellites

O. Bayraktar1,2, P. Freiwang3, D. Garbe1, M. Grünfelder4, R. Huber1, C. Marquardt1, F. Molli5, J. Pudlak6, B. Rödiger3, W. Rosenfeld1, K. Schilling1, C. Schmidt7, and H. Weinfurter8

Center (DLR) IKN, Oberpfaffenhofen, Germany

Planck Institute of Quantum Optics, Erlangen, Germany

4 Quantum Key Distribution

EB-3.2 SUN 16:30

Three-dimensional pyramidal microlasers

S. Bittner1,2, M.A. Guidry3, Y. Song3, C. Lafargue4, R. Sobcyk5, D. Decamp1,3, R. Sosnowski6, J. Zys1,2, A. Grigis7, and M. Lebental8

1 Laboratoire de Photomun Quantique et Moléculaire, CNRS UMR 8537, ENS Paris-Saclay, Centre d’Etude de Photonique, France
2 Chaire Photonique, LMOP, CentraleSupélec, University Paris-Saclay, Metz, France
3 School of Physical Science and Technology, and Key Laboratory for Magnetism and Magnetic Materials of MOE, Lanzhou University, Lanzhou, China
4 Centre de Nanosciences et de la Nanotechnologie, CNRS, University Paris-Sud, University Paris-Saclay, Marne-la-Vallée, France
5 Laboratoire d’Analyse, Géométrie et Applications, CNRS UMR 7539, University Paris 13 City, Paris 13 University, Lille, France

Room 14a ICM
CM-3.2 SUN 16:15
Direct photo reduction of graphene oxide film for flexible electronics using femtosecond laser pulses
• Y.-S.D. Lee, J. An, and Y.-J. Kim; Singapore Centre for 3D Printing, School of Mechanical and Aerospace Engineering, Nanyang Technological University (NTU), 50 Nanyang Avenue, Singapore 639798, Singapore
Direct photo reduction of graphene oxide film coated on heat-sensitive polymers was enabled using femtosecond laser pulses. One-step fabrication, design flexibility, and high pattern resolution make this technique a promising candidate for flexible graphene electronics.

CM-3.3 SUN (Invited) 16:30
Diamond functionalization by ultrafast laser pulses
• P. Salter; Engineering Science, Oxford, United Kingdom
Ultrashort pulse laser offers many new opportunities for the functionalization of diamond substrates for technology applications. Electrical wires, optical waveguides and other carbon centres can all be fabricated in 3D beneath the diamond surface.

JSV-3.2 SUN (Invited) 16:30
Ultra-low dissipation mechanical resonators for cavity optomechanics
M.J. Bereyhi1, A. Beccari2, S.A. Fedorov1, A.H. Ghadimi1, R. Schilling1, D.J. Wilson2, N.J. Engheta3, and T. Kippenberg4.1 Institute of Physics (IPHYS), Ecole Polytechnique Féderale de Lausanne, Lausanne, Switzerland, 2IBM Research, Zurich, Switzerland
We study the theory of dissipation dilution and realize two experimental techniques — “elastic-strain engineering” and “clamp-tapering” — for exceptional mechanical quality factors (Q × f > 10^13 GHz) of high stress SiNx nanobeams at room temperature.

CH-3.3 SUN 16:30
Compact photoacoustic spectrometer based on a widely tunable mid-infrared pulsed optical parametric oscillator
L. Lunard1, D. Balder1-Harder1, A. Peremans2, J.C. Petersen2, and M. Lassen3.1 Danish Fundamental Metrology, Horsholm, Denmark, 2Laserspec BVBA, Namur, Belgium; 3IMEC, University of Namur, Namur, Belgium
We demonstrate the usefulness of a nanosecond-pulsed single-mode mid-infrared (MIR) optical parametric oscillator (OPO) integrated with photoacoustic (PA) spectroscopic. The compact PA sensor targets the major market opportunities in environmental monitoring and breath gas analysis.

CF-3.2 SUN 16:30
100 µJ, 100 kHz, CEP-Stable High-Power Few-Cycle Fiber Laser
• E. Shestakov1, D. Hoff2, S. Hädrich3, F. Just4, T. Eidam5, P. Jößner6, Z. Váralyay7, K. Osvay8, G.G. Paulus9,10, A. Tünnermann4,10, and J. Limpert4,9,10.1 Friedrich-Schiller-Universität Jena, Institute of Applied Physics, Jena, Germany; 2Friedrich-Schiller-Universität Jena, Institut für Optik und Quantelektronik, Jena, Germany; 3Helmholtz-Institut Jena, Jena, Germany; 4Active Fiber Systems GmbH, Jena, Germany; 5ELI-ALPS, ELI-HU Non-Profit Ltd., Szeged, Hungary; 6Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena, Germany.
We present a high-power Yb:fiber laser system delivering a promising candidate for high stress Si, exceptional mechanical quality, and “clamp-tapering” — for two experimental techniques sapphire dilution and realize two conventional DAS sensing range, limited by Modulation Instability threshold, with minimal sensing performance impairment.

CI-3.2 SUN 16:30
Two-Way PAM8/PAM4 VCSEL-Based IVLLC System with Parallel Optical Injection Locking
• C. Mackin, P. Narayanan, H. Tsai, S. Ambrogio, A. Chen, and G. Burr; IBM Research - Almaden, San Jose, USA
We demonstrate an advanced computational algorithm for optical communications that far exceeds conventional DAS sensitivity, limited by modulation instability. This system brings important enhancements in the scenario characterized by high-speed two-way free-space transmissions.
Co-existence of 87 Rb/85 quantum and 10 Gbit/s classical communications in 37-core fiber

B. Da Liu1, D. Bacca1, D. Cozzolino1, F. Da Ros2, X. Guo1, Y. Ding1, Y. Sasaki1, K. Atiawat1, S. Mik1, H. Tera1, T. Yamashita2, I. Neergaard-Nielsen1, M. Galili1, K. Rottwitt1, U.L. Andersen2, T. Morik1a, and L.K. Oxenløwe1b, CoE SPOC, Dep. Photonics Eng., Technical University of Denmark, Kgs. Lyngby2800, Denmark; 2Advanced Technology Laboratory, Fujikura Ltd., 1440, Matsuzaki, Sakura, Chiba, 285-8550, Japan; 3Advanced ICT Res. Inst., National Institute of Information and Communications Technology, 588-2 Irino, Nishi-ku, Kobe, 651-2429, Japan; 4Department of Electronics, Graduate School of Engineering, Nagoya University, Furo-cho, Chikusa-ku, Nagoya, Japan

Quantum key distribution faces a big obstacle in the integration with the existing infrastructure. As a step forward, we demonstrate the co-existence of high rate quantum communications with a classical channel in a 37-core fiber.

Trace-free Counterfactual Communication with a Nanophotonic Processor

I. Alonso Calafell1, T. Strömberg1, D.R.M.

Mid-IR HPCF gas-laser emitting at 4.6 µm

F. Gérôme1, F. Aghilbakhsh1, V. Nampoothiri2, B. Debord1, L. Vicent1, F. Benabid1, and W. Rudolph1; 1GPPM Group, Xilum Research Institute, CNRS UMR 7252, University of Limoges, Limoges, France; 2Department of Physics and Astronomy, University of New Mexico, Albuquerque, USA; 3Dept. of Engineering “Enzo Ferrari”, University of Modena and Reggio Emilia, Modena, Italy

We report on an optically pumped gas-laser based on N2-filled 1C-HPCF. The pulsed N2 HOFGLAS is pumped at 1.517µm and emits at 4.64 µm with a photon conversion efficiency of 9% and a slope of 3%.

Visualizing Cellular Secretion with Single-Protein Sensitivity via Interferometric Scattering Microscopy (iSCAT)

A. Gemmehardt1, K. König2, E. Nicol1, M. Daimer1, and V. Sandoghdar1, 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Friedrich Alexander University Erlangen-Nürnberg, Erlangen, Germany

We employ interferometric scattering microscopy (iSCAT) to detect single biomolecules without the need for any type of labeling. This method allows for the investigation of secretion dynamics from living cells in real-time.

In-band Pumplıng of Tm:LiYF₄, Channel Waveguide: A Power Scaling Strategy for ~2 µm Waveguide Lasers

P. Loiko1, R. Thouard1, R. Soulard1, G. Brasse1, J.-L. Doualan1, B. Guichardaz1, M. Guillon1, G. Tessier1, and A.C. Peacock1; 1Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2Wuhan National Laboratory for Optoelectronics, Huazhang University of Science and Technology, Wuhan, China; 3COMSIT, Department of Materials Science and Engineering, Clemson University, Clemson, USA; 4Department of Physics and Poreabs, Norwegian University of Science and Technology, Trondheim, Norway

Broad-band optical parametric amplification in a tapered silicon core fiber pumped in the telecom band

D. W. Li1, L. Shen1, H. Ren1, T. Hawkins1, J. Ballato1, U.J. Gibson1, and A.C. Peacock1; 1Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2Wuhan National Laboratory for Optoelectronics, Huazhang University of Science and Technology, Wuhan, China; 3COMSIT, Department of Materials Science and Engineering, Clemson University, Clemson, USA; 4Department of Physics and Poreabs, Norwegian University of Science and Technology, Trondheim, Norway

We propose and demonstrate a novel scheme, based on spin-orbit interactions of light, to realize integrated orbital angular momentum microlasers with a chirality that can be optically controlled.

Bi-Junction Carrier Depletion Type Electro-Optic Phase-Shifters

M. Ashour1, S. Schneider1, E. Molynek1, and J.N. Caspère1; 1Robert Bosch GmbH, Renningen, Germany; 2University of Konstanz, Konstanz, Germany

We present a low-loss technology-compatible bi-junction type electro-optic phase shifter through increasing overlap of voltage-controlled depletion area with the optical mode by 25% compared to a conventional PN implantation under the same implants conditions.

Light shaping for reconfigurable microscale temperature control

C. Liu1,2, P. Berto1,2, I. Flores1, M. Guillon1, G. Tessier1, and J.-L. Doualan1; 1Conseil Scientifique, CNRS, INSERM, Université Paris-Sud, CNRS UMR 8250 CNRS, Université Paris Descartes, Paris, France

Using a spatial light modulator, a pre-calculated heat source distribution is presented.

Bi-Junction Carrier Depletion Type Electro-Optic Phase-Shifters

M. Ashour1, S. Schneider1, E. Molynek1, and J.N. Caspère1; 1Robert Bosch GmbH, Renningen, Germany; 2University of Konstanz, Konstanz, Germany

We present a low-loss technology-compatible bi-junction type electro-optic phase shifter through increasing overlap of voltage-controlled depletion area with the optical mode by 25% compared to a conventional PN implantation under the same implants conditions.

Falmetal laser-doped monoclinic crystals are presented. Several saturable absorbers are studied.

Infrared ultra-short pulses generation using Stimulated Raman Scattering in gas-filled HC-PCF

D. Kergoustin1, F. Amran1, B. Debord, F. Gérôme1, and F. Benabid1; 1GPPM Group - Xilum research institute, CNRS UMR 7252, Limoges, France

We present the generation of first vibrational Stokes, ultra-short 1.8 µm pulses, by using stimulated Raman scattering in hydrogen-filled HC-PCF and a 1030 nm ultra-short laser as the pump.
We present an optomechanical coupling enhancing the optomechanical frequency comb. We combine for the first time a mid-infrared optical frequency comb Fourier transform spectrometer with cantilever-enhanced photoacoustic detection, and measure high-resolution broadband spectra of the fundamental band of methane in a few milliliter sample volume.

We present frequency-shifted feedback as a novel alternative to closed loop adaptive optics and measure high-resolution broadband spectra of the fundamental band of methane in a few milliliter sample volume.

We have combined a cantilever-enhanced photoacoustic spectrometer with multi-actuator adaptive lens. We present a dual-mode/dual-comb all-polarization-maintaining 77-MHz mode-locked Yb:fiber-laser. We use mechanical spectral subdivision to generate two pulse trains with a tunable difference in repetition rate (1 kHz to 6 kHz) from a single cavity.

We demonstrate that a multi actuator adaptive lens with closed loop adaptive optics can strongly reduce the effect of the turbulence on coupling performance. We present a dual-color/dual-comb all-polarization-maintaining 77-MHz mode-locked Yb:fiber-laser. We use mechanical spectral subdivision to generate two pulse trains with a tunable difference in repetition rate (1 kHz to 6 kHz) from a single cavity.

We have implemented an optical neural network with exceptional scalability in reinforcement learning. We demonstrate that a multi-actuator adaptive lens with closed loop adaptive optics can strongly reduce the effect of the turbulence on coupling performance. We present a dual-color/dual-comb all-polarization-maintaining 77-MHz mode-locked Yb:fiber-laser. We use mechanical spectral subdivision to generate two pulse trains with a tunable difference in repetition rate (1 kHz to 6 kHz) from a single cavity.

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of Engineering and Applied Science, California Institute of Technology, Pasadena, USA
We show a passively-synchronized pulsed fiber laser source that provides excellent stability, power level and wavelength tunability. Both high quality coherent anti-Stokes Raman scattering (CARS) and stimulated Raman scattering (SRS) images are demonstrated.

Projected on a plasmonic nanoparticle layer to produce a fast, reconfigurable and accurate temperature distribution in an arbitrarily-shaped 2D region.

Joule, France; 3CORIA UM66614, Université de Rennes, Saint Etienne du Rouvray, France
Tm:LiYF4/LiYF4 channel waveguides are produced by Liquid Phase Epitaxy and diamond-saw-dicing. Under in-band pumping by a 1679-nm Raman fiber laser, the Tm:LiYF4 waveguide laser generates 2.05 W at 1881.0 nm with a 78.3% slope efficiency.

State-of-the-art diamond Raman oscillators are demonstrated. We report the highest output-power from an external cavity diamond oscillator in continuous-wave operation mode at 1478 nm. Output power of 34 W with 11% conversion efficiency was achieved.

Periodic Amplitude of Radiative Heat Transfer
M. H. Frosz1, R. Pennetta1, M.T. Enders1, G. Ahmed2, and P.S. Russell2; 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Department of Physics, University of Erlangen-Nuremberg, Erlangen, Germany
We demonstrate that the direction and values of the radiative heat flux exchanged by two phase-change materials excited with a temperature difference periodic in time can be efficiently tuned through their common steady-state temperature.

VERSATILE WAVEGUIDE CHIP LASER FOR 2.9 µM EMISSION
J. F. Guay1, N. Bourbeau1, F. Gérard1, H. Fournier1, F. Piché1, J. Genest1, and D. Laroche1; 1Centre d'optique, photonique et laser, Université Laval, Quebec, Quebec, Canada; 2Laser Physics and Photonics Devices Laboratory, Future Industries Institute, School of Engineering, University of South Australia, Mawson Lakes, SA 5095, Australia
With strong potential for mid-infrared spectroscopy applications, an Ho+ and Pr+ co-doped glass chip laser is reported. The latest developments of the laser platform are presented, including results in continuous-wave and mode-locked regime.

Strong Enhancement of Light Extraction Efficiency in Sub-wavelength AlGaAs/GaAs Vertical-emitting Nanopillars
B. R. Romea1, J. P. Bourrè2, H. Fonseca2, J. Gaspar2, and J. Nieder1; 1Dept. of Nanophotonics, INL - International Iberian Nanotechnology Laboratory, Braga, Portugal; 2Dept. of Quantum and Energy Materials, INL - International Iberian Nanotechnology Laboratory, Braga, Portugal
We report a 27-fold improvement of light-extraction in sub-µm vertical-emitting AlGaAs/GaAs nanopillars compared to theoretical predictions. This enables emission intensities comparable to µm-sized devices, which is crucial for efficient optoelectronic devices for nanophotonic integrated circuits.

EB-3.5 SUN 17:15 Non-invasive Real-time Characterization of Hollow-core Photonic Crystal Fibres Using Whispering Gallery Mode Spectroscopy
S. Frick and J. Rarity; University of Bristol, Bristol, United Kingdom
Rangefinders use easily detectable light from lasers to illuminate an object and determine the distance to it. Replacing it with thermal light from a photon-pair source guarantees covert illumination for rangefinding.

Spectral density as high as 4 MW/nm per line.
We report on the fabrication of biomimetic multi-functional surfaces via femtosecond laser processing. The functionality of these surfaces is attributed to micro/nano self-assembled structures whose formation is exploited to texture the surface.

CM-3.5 SUN 17:15

Laser writing of 2D nanostructures in silver-doped phosphate glass

- Department of Physics, University of Gothenburg, Örgåvågen 6, SE-412 96 Göteborg, Sweden;
- University of Bordeaux, CNRS, ICMCB, UMR 5026, 87 avenue du Dr. A. Schweitzer, 33608 Pessac, France;
- Institute of Physics and Applied Physics, Yonsei University, 120-749 Seoul, South Korea.

We present a multi-scale theoretical model for direct laser writing in silver-containing glass, which includes silver-based chemical reactions, silver clusterization and charge separation. This modeling is applied for moving laser source and various beam geometries.

SV-3.4 SUN 17:15

Spin Squeezing in a Metrologically Relevant Regime

- M.-Z. Huang, P. Mezzoni, K. Oth, C.L. Garrido Alzue, and J. Reichel, Laboratoire Kastler Brossel, Paris, France;
- ENS-SYRTE, Paris, France.

We report preliminary results of a quantum-enhanced atom chip clock. Using rubidium atoms inside an on-chip optical cavity, we investigate light-induced spin squeezing in the $10^{-13}$ region of relative frequency stability.

CH-3.6 SUN 17:15

Fourier transform photoacoustic spectroscopy with supercontinuum light source

- T. Mikkonen, C. Amiot, A. Aalto, K. Patoskoski, G. Genty, and J. Toivonen, Photonic Laboratory, Physics Unit, Tampere University, Tampere, Finland;
- Institut FEMTO-ST, UMR 6174 CNRS, Université Bourgogne Franche-Comté, Besançon, France.

We demonstrated broadband photoacoustic spectroscopy using a supercontinuum and a Fourier transform spectrometer. We achieved a 20- and 70-fold increase in photoacoustic signal as compared to the use of a conventional infrared radiator.

CF-3.5 SUN 17:15

High energy level Raman-assisted Fiber Optical Parametric Chirped Pulse Amplification

- L. Fouche-Fort et al., Laboratoire Kastler Brossel, Paris, France;
- ENS-SYRTE, Paris, France.

We demonstrated fiber optical parametric chirped pulse amplification up to 1 J with re-compression up to 560 fs. This high energy level originates from combined Raman and parametric processes in specially designed solid core photonic bandgap fibers.

Cl-3.6 SUN 17:15

Sub-nJ Visible-Light Communication Relay Chain for 12V and V2V Intelligent transportation Systems

- T. Nawaz, M. Seminara, S. Caputo, F.S. Cataliotti, L. Muschi, and J. Gavrilotti, CREST, National Institute of Informatics, Tokyo, Japan;
- LENS, European Lab. for NonLinear Spectroscopy, Sesto Fiorentino, Italy;
- DIINFO Dept. of Information Engineering - Università di Firenze, Firenze, Italy.

We report on characterization of an ITS communication platform based on VLC, connecting realistic road signaling infrastructures (regular traffic light) and incoming receiving units. Our systems features decode-and-relay times below 1 ms, and attainable distances above 50 m.

Friday, June 21, 2019

Cleo®/Europe-EQEC 2019 · Sunday 23 June 2019

Room 14b ICM

Mechanical experiment where two Si$_2$N$_4$ membranes are placed inside a driven high finesse Fabry-Perot cavity. We obtain an enhancement of the optomechanical coupling strength by a factor $\sim 2.47$.

Room 21 ICM

A passive optical power buildup cavity, resulting in a 100 times sensitivity enhancement and an unprecedented NNEA of $1.75 \times 10^{-12}$ Wcm$^{-3}$ Hz$^{-1/2}$.

Room 1 Hall A1

Efficiency compared to saturable absorber systems.

Room 2 Hall A1

Efficiency in free space optical communication system.

Room 6 Hall A1

Francisco, Juazeiro-BA, Brazil;
Graduate Program in Materials Science, Universidade Federal de Pernambuco, Recife, PE, Brazil;
Departamento de Ciencias Fisicas, Universidad de la Frontera, Temuco, Chile;
Departamento de Ingeniería Mecánica, Universidad de la Frontera, Temuco, Chile.

We developed a matrix based on electrosprun cellulose nanofibers and doped it either with rhodamine 6G or ZnO nanoparticles to generate two kinds of flexible, environment-friendly random laser systems, which were also optically characterized.

CE-3.5 SUN 17:15

Plasmonic random laser with the embedding of silver nanostructure materials


We investigated the plasmonic random laser from the dye-covered PVA film with the embedding of different size and shape of silver nanoparticles to discuss the influence of light scattering and the localized surface plasmon.

Room 7 Hall A1

Spin-squeezed light source for the quantum-optical control of ultrafast light pulses

Room 8 Hall A1

Neural network and demonstrate reinforcement learning fully in hardware.
EB-4.1 SUN 18:00 Quantum Circuit Training with Trapped Ions


1 Joint Quantum Institute, University of Maryland, College Park, USA;
2 Department of Computer Science, University College London, London, United Kingdom;
3 Cambridge Quantum Computing Limited, Cambridge, United Kingdom;
4 Mind Foundry Limited, Oxford, United Kingdom;
5 Department of Mathematics, Central Connecticut State University, New Britain, USA;
6 IonQ, Inc., College Park, USA

We implement a generative modeling task using a quantum-classical hybrid scheme where the quantum circuits are executed on a trapped-ion quantum computer. We contrast two different classical training schemes, particle swarm and Bayesian optimization.

EB-4.2 SUN 18:15 Towards Continuous Variables Quantum Computing with Trapped Ions

- G. Maslennikov, J. Gan, K.-W. Tseng, C.H. Nguyen, and D. Matsukidai

1 Centre for Quantum Technologies, National University of Singapore, Singapore, Singapore;
Broadband mid-infrared directional and multimode interference couplers in GLS glass fabricated using femtosecond laser direct-writing


MQ Photonics Research Centre, Department of Physics, Macquarie University, North Ryde, Australia; Université de Köl, Köln, Germany

Mid-infrared broadband directional and multimode interference couplers for the detection of exoplanets using astronomical interferometry are presented. The devices are based on femtosecond laser written waveguides in GLS glass optimized for 4 micron wavelength.

On-Chip Infrared Sensor Technologies for Chem/Bio Diagnostics: Quo Vadis?

P. Masselin, J. Cacarek, and D. Le Coq

Université du Littoral-Côte d’Opale, Dunkerque, France; Université de Rennes, Rennes, France

We introduce a new process for the fabrication of on-chip infrared sensor technologies for chem/bio diagnostics. This process is based on femtosecond laser direct-writing of integrated photonic devices in high-index GLS glasses. We will discuss recent advances in on-chip infrared sensor technologies for the detection of chemicals and biomolecules.
We experimentally realize the conditional beam splitter gate using spin-motion coupling in a trapped Ytterbium ion. We demonstrate the applications of this gate with the aim to realize universal quantum computation toolbox with controllable variables.

Room 3 ICM


Room 4b ICM

JSIV-3.2 SUN 18:30

Tracking Ultrafast Energy Flow in Plasmonic Nano-Crystal Assemblies

A. Mazzanti, Z. Yang, M.-P. Pillet, G. Cerullo, P. Laporta, and G. Della Valle. Department of Physics, University of Siena, Italy. We present a new approach to the simulation of energy flow in plasmonic nanostructures.

Room 5 ICM

JSIV-3.3 SUN 18:45

Transient stable and oscillatory single vapour nanobubble formation by boiling around a gold nanoparticle

E. Jollans and M. Oriti. Huigengs-Kamerlingh Onnes Laboratory, Leiden University, Leiden, Netherlands. We present a novel method for the transient stabilization of bubble nanocosmic observables.

Room 13a ICM

CA-4.3 SUN 18:30

The first demonstration of a 639-nm regenerative laser amplifier

N. Sugiyama, S. Fujita, Y. Hara, and F. Kannari. Keio University, Yokohama, Japan. We report the first demonstration of a 639-nm regenerative laser amplifier using a Pr:YLF crystal for the first time, and obtained the maximum output pulse energy of 13 µJ with repetition rate of 10 kHz.

Room 13b ICM

CD-4.2 SUN 18:45

Passively Q-switched Nd3+:YVO4 Laser System for Self-Illuminated and Self-Synchronized Up-conversion of Images


Room 14a ICM

CB-1.3 SUN 18:45

Mechanism of Wavelength Tuning over 200 nm Range from InP/InGaAs Nano-lasers Grown on SOI

W.K. Ng, Y. Han, K.M. Lue, and K.S. Wong. Department of Physics, Hong Kong University of Science and Technology. We present a novel mechanism for wavelength tuning over 200 nm range from InP/InGaAs nano-lasers grown on SOI.
dure for direct laser writing of high performance waveguides. The propagation losses are measured on the order of 0.2 dB/cm in the mid-infrared ($\lambda = 4.5 \mu m$).

**CM-4.3 SUN 18:30**

Boson band vibrations aid refractive index mapping of waveguides in high index chalcogenide glass

T. Gretzinger, T. Fernandez, S. Gross, A. Arriola, and M. Wirthfort, MQ Photonics Research Centre, Department of Physics and Astronomy, Macquarie University, New South Wales, Australia.

The boson band mapping of waveguides fabricated by femtosecond laser inscription was used for the first time to identify and understand the material densification profile in chalcogenide glasses.

**CH-4.2 SUN 18:30**

All-dielectric High-Q Meta-surfaces for Infrared Absorption Spectroscopy Applications

- Institute of BioEngineering, Ecole Polytechnique Federale de Lausanne (EPFL), Lausanne, Switzerland
- Nonlinear Physics Centre, Research School of Physics and Engineering, Australian National University, Canberra, Australia
- Dipartimento di Fisica, Università di Milano, Milano, Italy
- Laboratoire Charles Fabry, Palaiseau, France
- Fastlites, Antibes, France

We characterize the nonlinear optical properties of blue-luminescent graphene quantum dots structures. Positive Kerr index and saturable absorption are found under ultraviolet illumination. We then infer the nonlinear properties of a single graphene nanoparticle.

**CM-4.4 SUN 18:45**

Direct writing of 3D integrated photonic circuits for all-photonic systems

- S. Piacentini, G. Corriglìa, A.S. Nayak, E. Pedretti, S. Minardi, and R. Osellame
- Dipartimento di Fisica, Politecnico di Milano, Milano, Italy
- University of Rome La Sapienza, Rome, Italy
- Institute for Complex Systems, University of Rome La Sapienza, Rome, Italy
- University of Rome La Sapienza, Rome, Italy

We present a nanophotonic method capable of detecting mid-infrared molecular fingerprints without the need for spectrometry, frequency scanning, or moving mechanical parts. We leverage high-Q metasurfaces with gradually tuned resonance frequencies to retrieve absorption signatures.

**CH-4.3 SUN 18:45**

Towards a Mid-infrared Lab-on-chip Sensor Using Ge-on-Si Waveguides

- University of Glasgow, Glasgow, United Kingdom

We demonstrate soliton self-compression of 0.3 mJ pulses to 2.7 fs in a 3 m long gas-filled hollow capillary fibre. Scaling to higher energies and convincing evidence of further compression to 1 fs is discussed.

**CF-4.2 SUN 18:30**

Soliton Self-Compression in Hollow Capillary Fibres

- J. Travers, T. Grigoreva, C. Brahms, and F. Belli
- School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom

We demonstrate soliton self-compression of 0.3 mJ pulses to 2.7 fs in a 3 m long gas-filled hollow capillary fibre. Scaling to higher energies and convincing evidence of further compression to 1 fs is discussed.

**CI-4.3 SUN 18:30**

SiC-SiO2 MEMS-DRR based widely tunable optical filters around 1550 nm with narrow FWHM

- J. Cesar, S. Paul, F. Küppers, and T. Kusserow
- IMP / TU Darmstadt, Darmstadt, Germany

We are presenting widely tunable optical Fabry-Perot filters based on novel material combination SiC/SiO2 MEMS-DRR. Large refractive index step (high reflectivity) enables very narrow FWHM of <0.1 nm with an FSR of >114 nm.

**CI-4.4 SUN 18:45**

High-Speed Balanced Avalanche Photodetector for Homodyne Detection

- E. Beckeberther, F. Ganzer, P. Rung, and M. Schell
- Fraunhofer Heinrich Hertz Institute, Berlin, Germany
- A High-Speed Balanced

We present a new concept for coherent Ising machines which is based on opto-electronic oscillators. We demonstrate a compact and inexpensive photonic setup that is able to solve difficult optimization problems.
Room 1 ICN

Center of Photonics, Friedrich Schiller University Jena, Jena, Germany; 2 Helmholtz-Institute Jena, Jena, Germany; 3 Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany.

We experimentally demonstrate a programmable integrated linear optic device as valid platform for quantum simulation of molecular vibrations and describe how our simulation methods can be extended further to simulate open system dynamics.

Room 3 ICN

EB-4.5 SUN 19:00

Time-Domain Multiplexed Two-Dimensional Cluster State for Large-Scale Universal Multi-Input One-Way Quantum Computation

A. Laing1, 3, W. Asavanant1, 3, Quantum Computation, 1 Imperial College London, London, UK; 2 Nokia Bell Labs, Cambridge, UK; 3 MIT, Cambridge, USA; 4 Indiana University Purdue University, Indianapolis, USA; 5 NTT Corporation, Atsugi, Japan.

We explore the boiling at the nanoscale by observing plasmonic vapour nanobubbles around a single gold nanoparticle. We move from explosive to stable nanobubbles through a Leidenfrost-like point. ~40 MHz nanobubble oscillations are observed.

Room 4b ICN

EB-4.5 SUN (Special Oral) 19:00

Interfacial Thermal Resistance between Light and Matter

C.-L. Chiu1, T.-K. Hsiao1, B.-Y. Chen1, and C.-W. Chang1, Center for Condensed Matter Sciences, National Taiwan University, Taipei, Taiwan.

We experimentally observe non-negligible interfacial thermal resistance between light and matter. The previous work overlooked the correlation between optical absorptivity and thermal conductivity of materials.

Room 5 ICN

JSV-3.4 SUN 19:00

Space-Qualified Pulsed DPSS UV Laser for Martian Subsurface Exploration

A. Böttner1, M. Ernst1, M. Huhnekoh1, R. Kalm1, L. Willmes1, P. Wefels1, D. Kracht1, J. Neumann1, and T. SOMA laser team1, 2, 3, 4, Laser Zentrum Hannover e.V., Hannover, Germany; 1 Max Planck Institute for Solar System Research, Göttingen, Germany.

We will give an overview over the design, realization, evolution and qualification of the flight model of the 266 nm diode-pumped passively Q-switched solid-state laser for the Mars Organic Molecule Analyzer (MOMA) instrument.

Room 13a ICN

CA-4.5 SUN 19:00

Theoretical modelling and experimental demonstration of a mid-infrared femtosecond upconversion system

A.F. Ashok1, R. Cober1, J. O'Connell1, S.C. Kumar2,3, M. Ebrahim-Zadeh1,2,4, P. Tidemand-Lichtenberg1, and C. Pedersen1, 2, 3, DTU Fotonik, Technical University of Denmark, DK-4000, Roskilde, Denmark; 1 Radiant, Edifici RDT, Mediterranean Technology Park, 08860 Castelldefels, Barcelona, Spain; 2 ICTO-Institut de Ciències Fotòniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels, Barcelona, Spain; 3 Institute of Science and Technology, Hong Kong University of Science and Technology, Hong Kong, China.

We present a self-illuminated and self-synchronized passively Q-switched compact diode-pumped Nd3+:YVO4 laser system at 1342 nm for intra-cavity coincidence pulsed laser up-conversion. The system is based on type-II second harmonic generation in a KTP crystal.

Room 13b ICN

CD-4.3 SUN 19:00

Loss-Coupled DFB Nanoridge Laser Monolithically Grown on a Standard 300-mm Si Wafer

Y. Shi1, M. Barabinskova2, Y. Mok2, M. Pantoavaki3, J. Van Campenhout2, R. Kanert2, and D. Van Thourhout1, 2, 3, INTREG Department, Ghent University, Gent, Belgium; 1IMEC, Heverlee, Belgium.

We report realization of two-dimensional cluster state, a source for universal one-way quantum computer, based on time-domain multiplexing approach. The state generation is unlimited and we verify the state up to 24,960 entangled light modes.
Low Bend Loss Femtosecond Written Waveguides Exploiting Microcrack Enhanced Modal Confinement

O. Melcher1,2,3, S. Willms1,2, I. Babushkin1,2, S. Bose1,2, B. Roth1,3, U. Morgner1,2, and A. Demircan1,2
1Institute of Quantum Optics, Leibniz University Hannover, Hannover, Germany; 2Cluster of Excellence PhoenixX (Photonics, Optics, and Engineering - Innovation Across Disciplines), Hannover, Germany; 3Hannover Centre for Optical Technologies, Hannover, Germany.

We propose a novel type of ultrashort optical soliton-molecules with high spectral density, exhibiting quantum mechanical analogies, such as emission of dipole-like radiation, great robustness against perturbation, or evaporation of localized states upon impact.

Second Harmonic Generation in Thermally Poled Nitroaniline All-Solid Microstructured Optical Fibers

G. Volakis and S. Pissadakis
Foundation for Research and Technology-Hellas (FORTH), Institute of Electronic Structure and Laser (IESL), N. Plastira 100, 70013, Heraklion, Greece

We propose and experimentally demonstrate the use of spatial light modulation for calculating the ground state of an Ising Hamiltonian. We realize configurations with thousands of interacting spins that settle in a low-temperature ferromagnetic-like phase.
Room 3 ICM

EB-4.6 SUN 19:15

Optical d-level frequency-time-based cluster states
• M. Kues1,2, C. Reimers1,3, S. Sciarra1,4, P. Roztocki1, M. Islam1, L. Romero Cortés1, Y. Zhang2, B. Fischer3, S. Loranger2, R. Kashyap2,6, A. Cino2, S. T. Chu2, B. E. Little3, D. J. Mos4, L. Caspani5, W. J. Munro1,11,12, J. Azaria1, and R. Morandotti1,13,14,15
1 Institute National de la Recherche Scientifique – Énergie Matériaux Télécommunications, Varennes, Canada; 2 School of Engineering, University of Glasgow, Glasgow, UK; 3 HyperLight Corporation, Cambridge, USA; 4 Department of Energy, Information Engineering and Mathematical Models, University of Palermo, Palermo, Italy; 5 Engineering Physics Department, Polytechnique Montréal, Montreal, Canada.

Room 4b ICM

JSIV-3.5 SUN 19:15

Advances in Photoacoustic and Photothermal Techniques for Nondestructive Characterization at Nanoscopic Scale
2 D. L. Vet1, G. Leal1, E. Pétrognie1, A. Belardini2, M. Centini1, C. Sibilia1, and M. Bertolotti2, Sapienza Università di Roma, Dipartimento SBAI, Roma, Italy.
Recent advances for the optothermal characterization of chiral materials, ordered/disordered nanowires/spheres by Photoacoustic and Photothermal techniques are summarized. Photothermal radiometry is also introduced to measure the effective thermal diffusivity in synthetic opals and Carbon Nanotubes.

Room 5 ICM

CA-4.6 SUN 19:15

High-energy two-colour picosecond Nd:YAG laser for Satellite Laser Ranging
1,2 A. Kornev1,•, R. Balmashnov1, I. Kuchma2, and A. Davtian2,1
1 ITMO University, Saint-Petersburg, Russia; 2 Lasers and Optical Systems Co. Ltd., Saint-Petersburg, Russia.
We report a high-energy high-repetition-rate two-colour picosecond Nd:YAG laser. The energy of 0.43 J and 0.3 J at 1064 nm and 532 nm wavelengths, respectively, and 200 Hz pulse repetition rate distinguish it from analogues.

Room 13a ICM

CD-4.4 SUN 19:15

Electro-optic control of intra-cavity image up-conversion for fast range-gated systems
1 A. J. Torregrosa1, H. J. Maestre1, M. L. Rico1, and J. Capmany1,• 1 Dpto. de Ingeniería de Comunicaciones, Universidad Miguel Hernández, Elche, Spain; 2 Dpto. de Tecnología Informática y Computación, Universidad de Alicante, Dpto.de Tecnología Informática y Computación, Universidad de Alicante, San Vicente del Raspeig, Spain.
We present an electro-optic technique to achieve fast and arbitrary gating time control of an intra-cavity CW up-conversion imaging system, which allows the use of EM-CCDs in range-gated imaging applications as an alternative to ICCDs with fast gating.
Femtosecond pulse inscription of 3D arrays of Bragg gratings in selected cores of a multicore optical fiber

A. Wolf1,2, K. Bronnikov1,2, A. Dostovalov1,2, and S. Babin1,2; 1Novosibirsk State University, Novosibirsk, Russia; 2Institute of Automation and Electrometry of the SB RAS, Novosibirsk, Russia

We report on inscription of RAS, Novosibirsk, Russia and Electrometry of the SB RAS, Novosibirsk, Russia and a multicore optical fiber/1 fiber femtosecond IR laser pulses.

Suspended Tantalum Pentoxide Rib Waveguides for Laser Absorption Spectroscopy

M. Vlk1, Y. Mittal1, G.S. Murugan1, and J. Jägerská1; 1Department of Physics and Technology, UiT The Arctic University of Norway, Tromso, Norway; 2Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom

We demonstrate successful fabrication of air-suspended tantalum pentoxide rib waveguides for gas sensing. The fine, high-aspect-ratio membrane structures were realized via selective removal of Si substrate using XeF2 etching and Al2O3 passivation.

Soliton Self-Compression and Spectral Broadening of 1 μm Femtosecond Pulses in Single-Domain KTiOPO4

A.-L. Viotti2, B. Hessmo1, S. Mikkelson1, C. Guo1, C. Arnold1, A. L’Huillier1, B. Momgau01, A. Melnikaitis1, F. Laurell1, and V. Pasiskevicius1; 1Royal Institute of Technology, Stockholm, Sweden; 2Lund University, Lund, Sweden; 3Laser Research Center, Vrije University, Vilnius, Lithuania

We demonstrate spectral broadening and pulse self-compression down to sub-20 fs in unpoled KTiOPO4 around 1030 nm. Different focusing configurations are investigated as well as pulse temporal characterization with a custom-built d-scan setup.

Towards High-Speed Energy-Efficient Pulse-Switching Networks Implemented in Carrier-Injection-Based Si-Photonic Networks

C. Kräkel1,2, H. Becker1, Y. Ban2, M. Heck3, J. Van Campenhout2, and D. Van Thourhout1,2; 1Photonics Research Group, IMEC, Ghent University-IMEC, Ghent, Belgium; 2IMEC, Kapeldreef 75, Leuven, Belgium; 3Department of Engineering, Aarhus University, Aarhus, Denmark

We show that carrier-injection-based Si-photonic is a suitable platform for reconfigurable networks to switch ps pulses with sub-GHz repetition. The usage of pre-emphasis-based driving results in ns switching transitions and reduces energy consumption by ~40%.
13:00 – 14:00
CE-P: CE Poster Session

CE-P.1 SUN
The influence has been withdrawn.

CE-P.2 SUN
Fabrication of nanometric gratings with electron beam lithography for studying the atom-surface interaction.
1. H. Brichà; Laser Physics Laboratory, Villeurbanne, France

Nanometric grating have many existing and potential applications such as atom-beam diffraction and interferometry and X and soft X-ray spectroscopy in astrophysics. A custom-made fabrication process has been developed to create free-standing gratings of versatile shapes in silicon nitride membrane.

CE-P.3 SUN
Improvement in Radiative Recombination Efficiency and Emission Power Density of Surface-Passivated InGaN Nano-disk in a Wire Heterostructure Array
1. P.K. Saha, V. Penden, S. Ganguly, and D. Saha; Indian Institute of Technology Bombay, Mumbai, India

In this work, the improvement in emission power density is demonstrated by fabricating InGaN nano-disk. Due to higher surface-to-volume ratio, internal quantum efficiency depends heavily on side-wall and hence, increases after surface treatment.

CE-P.4 SUN
Thermal Radiation Polarization Analysis of the Crystal Fiber Growth Zone: Determination of the Crystal Melt Reflective Index
1. G. Bufeotou, S. Russmann, V. Seregin, V. Kazhin, and V. Tsvetkov; 2. Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia; 3. National Research Nuclear University MEPhI, Moscow, Russia

Differential in polarization components intensity of thermal radiation measured across crystal fiber growth zone enables to determine the refractive index of crystal melt. For sapphire melt it is n=1.5703 near melt point in visible range.

CE-P.5 SUN
An Optical Method for the Determination of Azimuthal Orientation of Triangular Lattice Silica Glass Microstructured Optical Fiber
1. N. Korada1; 2. G. Violaki; and S. Pissadaki1
1. Foundation for Research and Technology-Hellas (FORTH), Institute of Electronic Structure and Laser (IESL), Heraklion, Greece; 2. Department of Materials Science & Technology, University of Creta, Heraklion, Greece

A simple and precise (<5o) optical method for the determination of microstructured optical fibers azimuthal lattice orientation is presented, based on the diffraction pattern generated upon cw visible laser light illumination of the fiber.

CE-P.6 SUN
Light transport and vortex formation in all solid band gap fibers
1. A. Pryamikov1, G. Alagaşhevet2, and S. Taritsyn2
1. Mendeleev University of Chemical Technology of Russia, 9, Muskmaya street, 125047, Moscow, Russia; 2. Aston Institute of Photonics Technologies, Birmingham, United Kingdom

In this work we demonstrate that formation of optical vortices in cladding elements of all solid band gap fibers can lead to a sharp decrease of the loss level by several orders of magnitude for the fundamental core mode.

CE-P.7 SUN
Optical properties of Ce-doped silica fiber
1. A. Yadav1, E. Zherebtsov1, N. Chichkov2, and E. Zherebtsov1
1. Laser Physics Laboratory, Villetaneuse, France; 2. Institute of Applied Physics, Technical University Bergakademie Freiberg, Leipziger Str. 23, Freiburg, Germany; 3. Helmholtz-Zentrum Dresden-Rossendorf, Helmholtz-Institute Freiberg for Resource Technology, Chemnitzer Str. 40, Freiburg, Germany

We present results on the influence of crystal structure on optical properties of REPO4. Focus is to understand optical properties in the blue, green, and red region of the spectrum for suitability in lighting application.

CE-P.8 SUN
High-power limitations of graphene nanocasted optical taper saturable absorbers
1. P. Mouchel1; 2. M. Kemel1; G. Semaan1; M. Salih1; M. Le Flôhic1; and E. Sanchez1
1. Laboratoire de Photonique d’Angers, E.A.4464, Université d’Angers, 2 boulevard Lavoisier, 49005 Angers, France; 2. Lumbird, 2 rue Paul Sabatier, 31390 Lambers, France

In this communication we point out the deterioration of the saturable absorption properties of graphene nanocasted fiber taper under high optical power. This is connected to thermal effects resulting from low thermal dissipation of graphene nano-flakes.

CE-P.9 SUN
Fabrication and characterization of new phosphate glasses and glass-ceramics suitable for drawing optical and biophotonic fibers
1. P. Lopez-Isco1; N. Ofah1; D. Pogliese1; R. Gumenyuk1; J. Massera1; N.G. Boetti2; D. Janmer3; C. Bousard-Pélelé4; D. Millet15; and L. Petit1
1. Politecnico di Torino, Dipartimento di Scienza Applicata e Tecnologia, Torino, Italy; 2. Photonics Laboratory, Tampere University, Tampere, Finland; 3. Faculty of Biomedical Science and Engineering and BioMedTech Institute, Tampere University, Tampere, Finland; 4. Fondazione LINKS – Leading Innovation & Knowledge for Society, Torino, Italy; 5. University of Rennes, Rennes, France

We will show that glass development pave the way towards new glasses, glass-ceramics and particles containing with enhanced spectroscopic properties, which can be drawn into new optical and biophotonic fibers.

CE-P.10 SUN
Structural variations and their influence on the optical properties of Rare Earth Orthophosphates
1. S.K. Sharma1,2, J. Beyer3, M. Fuchs3, R. Glogau3, and J. Heitmann3
1. Institute of Applied Physics, Technical University Bergakademie Freiberg, Leipziger Str. 23, Freiburg, Germany; 2. Helmholtz-Zentrum Dresden-Rossendorf, Helmholtz-Institute Freiberg for Resource Technology, Chemnitzer Str. 40, Freiburg, Germany

We present results on the influence of crystal structure on optical properties of REPO4. Focus is to understand optical properties in the blue, green, and red region of the spectrum for suitability in lighting application.

CE-P.11 SUN
Mid-infrared spectroscopy of Pr3+/Lu2O3 single crystal
1. A. Tancelli1; J. Xu1; A. Tredicucci2; A. Heuer2,3; and J. Heitmann2
1. Nanyang Technological University, Singapore; 2. Politecnico di Torino, Italy; 3. Istituto Nanoscienze-CNR and Physics Department “Enrico Fermi”, University of Pisa, Pisa, Italy

We report fabrication of photodarkening suppressed, high absorption, step index large-mode-area fiber for high power lasers. Extremely low pd is achieved by realizing cerium co-doping to equimolar Al:P fiber with very high 0.5mol% Yb2O3 concentration.

CE-P.12 SUN
Suppressing 1.06 μm Emission of Nd3+ Ions in Tellurite All Solid Photonic Bandgap Fibers With Double Cladding
1. H.T. Tong, K. Miura, N. Nishiharauchi, T. Suzuki, and Y. Oishi; Research Center for Advanced Photon Technology, Nagoya University, Japan

Novel Nd3+-doped tellurite all solid photonic bandgap fibers with double cladding were proposed for the first time to suppress the 1.06-μm emission. Compared to homogeneous structure, the heterogeneous structure provides effective control of photonic bandgap.

CE-P.13 SUN
Rare-Earth Doped Oxide Glasses and Fibers for Lasers Emitting in the 2-3 μm Spectral Range
1. B. Denker1,2, G. Galagan1,2, V. Dorofeen2,4, A. Motorn1,2, V. Kizilashv1, and S. Sverchkov1,2,3
1. Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia; 2. Drevyatek Institute of Chemistry of High-Parity Substances of the Russian Academy of Sciences, Nizhny Novgorod, Russia; 3. Fiber Optics Research Center of the Russian Academy of Sciences, Moscow, Russia; 4. Center of Laser Technology and Material Science, Moscow, Russia

Luminescent and lasing experiments with bulk and fiber samples showed that the properties of deeply dehydrated rare-earth doped tellurite and calcium-aluminate glasses are quite pertinent for lasers emitting in the 2-3μm spectral range.

CE-P.14 SUN
Photo darkening suppression in highly Yb-doped Aluminophosphosilicate fiber by addition of Cerium
1. R. Satharathan1,2, H. Li3,4, K.J. Lin5, S.H. Lin5, Y.M. Seng5, S.L. Chua5, and S. Yoo5,6,7,8
1,4 National University of Singapore, Singapore; 2,4 DSO National Laboratories, Singapore

We report fabrication of photodarkening suppressed, high absorption, step index large-mode-area fiber for high power lasers. Extremely low pd is achieved by realizing cerium co-doping to equimolar Al:P fiber with very high 0.5mol% Yb2O3 concentration.

CE-P.15 SUN
Persistent luminescence features in hexagonal Sr1-xAl2-xSiO4:Eu2+,Dy3+ compounds
1. V. Castaing1, C. Monteiro2, M. Allar3, and B. Viana4
1. PSL Research University, Chimie ParisTech, CNRS, Institut de Recherche de Chimie Paris, Paris, France; 2. CNRS, CEMHTI UPR3079, University of Orleans, F-45071, Orleans, France

White persistent phosphors are actively needed for new lighting applications. Rare-earth doped strontium...
aluminosilicate phosphors present persistent emission shifted toward the white color and the stabilization of the hexagonal phase leads to enhanced properties

CE.P.16 SUN
Fabrication of Fluorescent Gold Nanochannels in Thin Polymer Films by Direct Laser Writing
• M. Bitarafan, S. Suomalainen, and J. Toivonen; Tampere University, Tampere, Finland
We produce fluorescent gold nanochannels in thin polymer films using sub-microwatt laser beam. With this method, fluorescent micro-patterns can be made in an easy and cost-effective way.

CE.P.17 SUN
Optically Reconfigurable Surface Microstructures on Polymeric Thin Films
J. Kräger1, T. Calvelo2, N. Boile2, I. Reetz2, S. Masitik2, R. Conwell2, and D.J. McGee2; 1 Beuth Hochschule für Technik, Berlin, Germany; 2 The College of New Jersey, Ewing, USA
Optically reconfigurable microstructures have applications in diffractive optics. We report the optical era- sure and amplification of surface gratings written on azobenzene-polymer films by combining the reversible photomechanical film response with film scanning.

CE.P.18 SUN
Optical simulations of printed Polymer Optical Waveguides (POWs): search for their optical limitations caused by fabrication and application geometry
• C. Backhaus1, C. Vög1, J. Zeiter1, T. Reitberger2, N. Lindlein1, and J. Franks; 1 Institute of Optics, Information and Photonics, Erlangen, Germany; 2 Institute for Factory Automation and Production Systems, Erlangen, Germany
The research group OPTAVER established with printed Polymer Optical Waveguides (POWs) a new customised fabrication of short-range data transmission networks. To characterise the POWs the limitations in fabrication and application are monitored by optical simulations.

CE.P.19 SUN
X-ray microscopy of polymer photonic structures
E. Marakh1, R. Uppu1, A.T.I. Pacurarau1, P. Cioleus2, W.L. Vo1, and P.W.H. Pinkse1; 1 Complex Photonic Systems (CPS), MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands; 2 European Synchrotron Radiation Facility, Grenoble, France
We deterministically nanofabricate photonic structures by direct laser writing. X-ray tomography enables 3D volume reconstruction with deep sub-optical-wavelength resolution. We compare the design with the fabricated structures.

CE.P.20 SUN
Lanthanum Hexaboride: A Novel Material For Solar Energy Exploitation
• E. Sani1, L. Mercattelli1, M. Meucci1, L. Zoli2, and D. Scirè2; 1 CNR-INO National Institute of Optics, Firenze, Italy; 2 CNR-ISTEC Institute of Science and Technology for Ceramics, Faenza, Italy
We proof that optical properties of bulk ceramic LaB$_6$ are promising for a new concept of concentrating solar energy exploitation, which merges a high-temperature thermodynamic conversion to a direct power generation by thermoelectric effect.

CE.P.21 SUN
Laser-induced damage in passive and active polymer optical fibers
• K. Kiedrowski1, F. Jakobs2, J. Kielhorn2, H.-H. Johannes2, W. Kowalsky2, D. Krach1, I. Balasa1, and D. Ristau1, 2; 1 Lehrins Universität Hannover, Hannover, Germany; 2 Technische Universität Braunschweig, Braunschweig, Germany; 3 Laser Zentrum Hannover e.V., Hannover, Germany; 4 Cluster of Excellence PhoenixD (Photons, Optics, and Engineering - Innovation Across Disciplines), Hannover, Germany
Using a nanosecond pulsed laser system, various passive and active polymer optical fibers were investigated regarding the maximum transmittable pulse energy up to which no laser-induced damage was observed.

CE.P.22 SUN
Spectroscopic characterization of Er:Yb:YbTi2O7 nanoparticles for forensic applications
• A. Tonelli1, J. Xu1, M. Gasiai2, and R. Maalej2; 1 NEST-Instituto Nanoscienze CNR and Physics Department “Enrico Fermi”, University of Pisa, Pisa, Italy; 2 Laboratory Gloriosesources, Matériaux, Environnement et Changements Globaux, Faculty of Sciences of Sfax, Sfax, Tunisia
We report preparation of Er$^3+$:YTO and Er$^3+$:Yb$^3+$:YTO powders and their spectroscopic characterization. We used the optimized compositions to detect fingerprints on the surface of different objects, for example glass, under UV illumination.

CE.P.23 SUN
Comparative Study Of Spectroscopic Properties Of Pr3+$^+$ doped LiY3.3Lu0.7F7:LiYF4 And LiLuF4 Crystals
• M. Demesh1, N. Guskov1, A. Nizamutdinov1, O. Morozov1, S. Koralev1, V. Semashko1, V. Kisel1, A. Yasukevich2, and N. Kuleshov2; 1 Center for Optical Materials and Technologies, Belarusian National Technical University, Minsk, Belarus; 2 Institute of Physics, Kazan Federal University, Kazan, Russia
We present the detailed spectroscopic properties of Pr$_3^+$:Li$^{3+}$Y$_3$.3Lu$_{0.7}$F$_7$ crystal in comparison with Pr$_3^+$LiYF$_4$ and LiLuF$_4$ crystals.

CE.P.24 SUN
Yb-doped Double Tungstate Crystals for PV Down-Conversion Applications
• E. Sani1, A. Brugioni1, L. Mercattelli1, E.V. Zharkov2, D.A. Lis1, and K.A. Subotin1, 2; 1 CNR-INO National Institute of Optics, Firenze, Italy; 2 Prokhorov General Physics Institute of Russian Academy of Sciences, Moscow, Russia; 3 Mendeleev University of Chemical Technology of Russia, Moscow, Russia
Yb-doped scheelite-like double tungstate crystals of different chemical compositions were investigated. The efficient 900-nm emission from Yb was obtained under UV excitation, thanks to non-radiative energy transfer from donor centers of the hosts.

CE.P.25 SUN
Spectroscopy of Tm:Y2O3 Transparent Ceramic at Cryogenic Temperatures
• V. Yue1, Y. Jambunathan1, S. Paul David1, P. Ravirat1, J. Matsumoto2, X. Motes2, M. Aguil1, R. Diaz2, A. Lucianetti1, and T. Mocik1; 1 HI-ALE Centre, Institute of Physics Czech Academy of Sciences, Prague, Czech Republic; 2 Fisica e Cristal-lografa de Materiais e Nanomaterials (FCMA-FCTNA), Universitat Rovira i Virgili, Tarragona, Spain
The spectroscopy of Tm:Y$_2$O$_3$ ceramics is studied at cryogenic temperatures. An absorption cross-section of 4.78×10$^{-21}$ cm$^2$ at 793nm and an emission cross-section of 24.9×10$^{-21}$ cm$^2$ at 1930.9nm for 80K respectively are estimated.

CE.P.26 SUN
UV Luminescence in Ho:ZBLAN Glasses
• A. Jusza, P. Komorowski, J. Olas, K. Anders, and R. Pi-samowicz; Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Warsaw, Poland
In this work we present our recent results of extensive studies on short-wavelength luminescence in holmium-doped ZBLAN glass, with special emphasis on transitions originaitng from high energy levels emitting in UV and VIS spectral range.

CE.P.27 SUN
Temperature Dependence of Magnetic Permeability and Optical Polarization Rotation of Gallium-Terbium Garnet Crystals
• R. Ismagilova1, R. Shaikhdinul2,4, and O. Ryabushkin4, 3, 1 Moscow Institute of Physics and Technology, Moscow, Russia; 2 Koteliov Institute of Radio Engineering and Electronics of RAS, Moscow, Russia
Magneto-optical characteristics of gallium-terbium garnet crystal (TGG) were analyzed. Temperature dependences of TGG magnetic permeability, Verdet constant and optical absorption coefficient were experimentally measured. Influence of uniform and non-uniform heating on polarization rotation was investigated.

CE.P.28 SUN
Characterization of the Verdet constant of Dy2O3 ceramics in the two micron spectral range
• D. Voya1, O. Slezk2, H. Furuse3, R. Yashhara4, A. Lucianetti2, T. Mocik2, and M. Ceci2; 1 HI-ALE Centre, Institute of Physics ASCR v.v.i., Dolní Brezany, Czech Republic; 2 Department of Physical Electronics, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Prague, Czech Republic; 3 Kitami Institute of Technology, Kitami, Japan; 4 National Institute for Fusion Science, National Institutes of Natural Sciences, Toki, Japan
We present magneto-optical characterizations of novel material samples of Dy2O3-based ceramics in a broad spectral range of 0.6 – 2.4 μm. The material has a high potential for utilization in a high power mid-IR optical isolators.

CE.P.29 SUN
Terbium Aluminium Garnet Ceramics for Ultrahigh Power Laser Isolators
• S. Tokita1, M. Nishio1, H. Uehara2, K. Yanagisawa3, K. Fujikawa1, J. Kawakara1, and R. Yashhara1; 1 Institute of Laser Engineering, Osaka University, Osaka, Japan; 2 Konoshima Chemical Co. Ltd., Kagawa, Japan; 3 National Institute for Fusion Science, Gifu, Japan
We report measurement results of thermal and optical properties of a high-quality TAG ceramic. It is expected that the TAG ceramic can be used as 10 kW-level high-power isolator at a low temperature.

CE.P.30 SUN
Measuring the thermal expansion coefficient of ultrastable materials with 10$^{-9}$ K$^{-1}$ uncertainty
• M. Ghazi Zahedi, T. Legero, and U. Sterr; Physikalisch-Technische Bundesanstalt, Braunschweig, Germany
We report on an optimized interferometric technique and uncertainty to determine the coefficient of thermal expansion (CTE) for stable materials with small uncertainties of 10$^{-9}$ K$^{-1}$.

CE.P.31 SUN
Crystal growth and optical properties of mid-infrared nonlinear optical crystals
• S. Wang, X. Tao, and Z. Gao; State Key Laboratory of Crystal Materials, Jilin, China
We investigated the growth and properties of large-sized lithium containing chalcogenide crystals. A 3.6-4.8 and 7-12 μm widely tunable picosecond (ps) MIR optical parametric amplifier (OPA) based on LiSe crystal was demonstrated.

CE-P.32 SUN
Measurement of Effective Four-Photon Absorption in Semiconductors
• G. Polonyi1,2, B. Monozaszlai1,3, P.S. Nagrath1, G. Tóth1, P. Filippi1,2, and I.A. Fülöp1,2,3
1 Institute of Physics and Szentgád digest Research Centre, University of Pécs, Pécs, Hungary; 2 MTA-PTHE High-Field Terahertz Research Group, Pécs, Hungary; 3 ELLI-ALPS, ELH Hu Nonprofit Ltd., Szeged, Hungary; 4 Institute of Applied Physics, University of Bern, Switzerland
Effective four-photon absorption coefficients of GaP and ZrTe have been measured by the z-scan method at 1.75 μm pump wavelength. Anisotropy in the effective four-photon absorption has been shown in GaP.

CE-P.33 SUN
Thermal analysis of new liquidicics by EZ-scan technique
• VC. Ferreira1,2, G. Marin1,3, J. Dupont4,5, and R.B.R. Correia1,2,3,5
1 Optics, Photonics and Materials Group, Institute of Physics, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; 2 Laboratory of Molecular Catalysis, Institute of Chemistry, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; 3 School of Chemistry, University of Nottingham, Nottingham, United Kingdom
Two new liquidics presented an alteration in the electrical conductivity by the presence of light. Thermal characterizations for both liquidics by EZ-scan are presented and discussed a possible origin of conductivity change.

CE-P.34 SUN
Glass-hosted carbon nanotubes as a saturable absorber for ultrafast laser
• C. Jin, Y. Cui, and X. Liu; State Key Laboratory of Modern Optical Instrumentation, College of Optical Science and Engineering, Zhejiang University, Hangzhou, China
We successfully prepare single-walled carbon nanotube (SWCNT) glass composite as saturable absorber, which greatly enhances the thermal damage threshold. Moreover, the dissipative solitons are achieved with such SWCNT-glass composite for the first time.

CE-P.35 SUN
Tunable LiNbO3-based Diffraction Optical Elements for Control of Coherent Light
• A.R. Akhmatkhanov1,2, A.A. Estin1, V.S. Pavelyev3, and V.Y. Shur1
1 Institute of Natural Sciences and Mathematics, Ural Federal University, Ekaterinburg, Russia; 2 Image Processing Systems Institute, Russian Academy of Sciences, Samara, Russia
The electric field tunable diffraction optical elements, such as circular zone plates and 2D diffraction gratings, based on the stable tailored ferroelectric domain patterns created in lithium niobate single crystals will be presented.

CE-P.36 SUN
Periodically Poled MgO:LiNbO3, MgO:LiTaO3 and KTiOPO4 Crystals for Laser Light Frequency Conversion
• V. Shur1, A. Akhmatkhanov1, M. Chuvakova1, A. Estin1, O. Antipov1, A. Boyko1, and D. Kolker1
1 Institute of Natural Sciences and Mathematics, Ural Federal University, Ekaterinburg, Russia; 2 Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russia; 3 Novosibirsk State University, Novosibirsk, Russia
The recent achievements in periodical poling of lithium niobate, lithium tantalate and titanium silicophosphate crystals and experimental results of the deep study of the domain structure evolution and domain wall motion will be presented.

CE-P.37 SUN
Spectral characterization of transverse modes in random lasers
• A. Consoli1,2, S. Robalino1, N. Caselli1, and C. López1,4
1 Material Science Factory, Instituto de Ciencias de Materiales de Madrid (ICMM), Consejo Superior de Investigaciones Científicas (CSIC), Sor Juana Inés de la Cruz 3, 28049, Madrid, Spain; 2 ETSI de Telecomunicación, Universidad Rey Juan Carlos, C. Tulipán s/n, 28933, Madrid, Spain
Lateral emission from random lasers is spatially and spectrally characterized, observing bright and localized hotspots at different lasing wavelengths. Results suggest a simple theoretical interpretation and that wavelength selection is possible via spatial filtering.

CE-P.38 SUN
Low stress, anomalous dispersive silicon nitride waveguides fabricated by reactive sputtering
• A. Frigg1,2, A. Boes1, G. Ren1, D.-Y. Choi1, S. Gees1, and A. Mitchell1
1 School of Engineering, RMIT University, Melbourne, Australia; 2 Research School of Physics and Engineering, Australian National University, Canberra, Australia; 3 Evotec Ltd., Hauptstrasse 1a, Träsbach, Switzerland
We introduce 850 nm thick silicon nitride fabricated by reactive sputtering deposition for anomalous dispersive waveguides. A low stress of 41 MPa, low roughness, good uniformity and a thin-film material loss of 0.3 dB/cm was achieved.

CE-P.39 SUN
Silicon Photonics at the Interface with a Phase Change Material
• A. Hache, Département de physique, Université de Moncton, Moncton, Canada
Total internal reflection of light travelling in silicon interfaced with a phase change material is studied. Important changes in polarization states occur during the phase transition, which could be modulated on fast timescales by optical activation.

CE-P.40 SUN
Ultrafast dynamics in quantum dot doped nanocomposites at low temperatures: study by means of site-selective spectroscopy
• M. Kobayashi1, Y. Arashida1, G. Yamashita1, M. Kobayashi2, M. Ashida2, J.A. Johnson3, and I. Katayama1,2
1 Graduate School of Engineering, Yokohama National University, 79-5 Tokiwadai, Hodogaya-ku, Yokohama, Kanagawa 240-8501, Japan; 2 Graduate School of Engineering Science, Osaka University, 1-3 Machikaneyama-cho, Toyonaka, Osaka 560-8531, Japan; 3 Department of Physics, Osaka Dental University, 8-1 Kuzuha-hanazono, Hirakata, Osaka 573-1121, Japan;
4 Department of Chemistry and Biochemistry, Brigham Young University, Provo, Utah 84602, USA
To improve the noise level of the single-shot pump-probe waveforms at a high repetition rate, we combined the chirped-pulse single-shot detections and photonic time-stretch technique using a chirped-fiber Bragg grating (CFBG).

CE-P.41 SUN
The contribution has been withdrawn.

CE-P.42 SUN
Placing quantum dots in 3D photonic crystals and finding them back
A.S. Schulz1, D.A. Grischina1, C.A.M. Harteveld2, A. Pucarcovska3, A. Lagendijk1, J. Huskens1, G.J. Vancso1, P. Cloetens2, and W.L. Vos2
1 MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands; 2 European Synchrotron Radiation Facility (ESRF), Grenoble, France
We have functionalized 3D silicon photonic band gap crystals with PbS nanocrystal quantum dots. In X-ray fluorescence imaging experiments, we detect the 3D position of the quantum dots with 50 nm spatial resolution.

CE-P.43 SUN
Simulation of the plasmonic properties of gold nanosponges with nanotomographically reconstructed models
H. Honig1, D. Wang, and P. Schäuf1; Institute of Micro and Nanotechnologies and Institute of Materials science and Engineering, TU Ilmenau, Ilmenau, Germany
Real models of individual gold nanosponges have been reconstructed using 3D FIB nanotomography, and have been adopted for the FDTD simulation to study the distinct plasmonic properties.
CF-P.3 SUN
Ultrashot, picosecond OPCPA FrontEnd for the new Vulcan TAP beamline

M. Galletti1,2, G. Archipov1, P. Oliveira1, M. Ahmad1, E. Dilworth1, N. Rutherford1, M. Galamberti1, I. Mysagiev1, and C. Hernandez-Gomez2

1 Central Laser Facility, STFC, RAL, Didcot, United Kingdom; 2GoLP/IPFN Instituto Superior Tecnico, Universidade de Lisboa, Lisbon, Portugal

We present an ultrashort, picosecond OPCPA FrontEnd for the new Vulcan beamline. Broadband Ti:Sa pulses are amplified up to 1 mJ in a 4-stage OPA system pumped by picosecond Yb regenerative amplifier at 100 Hz.

CF-P.4 SUN
Real-time observation of build-up and shut-down dynamics of dispersion-managed soliton fiber laser

Y. Cui and X. Liu, State Key Laboratory of Modern Optical Instrumentation, Department of Optical Engineering, Zhejiang University, Hangzhou, China

We measure the birth and extinction processes of dispersion-managed soliton (DMS) in nanotube-mode-locked fiber laser, and several interesting phenomena are observed, which deviates from the previous reports about the formation of solitons.

CF-P.5 SUN
Laser Beam Homogenization Technology and Its Application in High Speed Photography

X. Zhud1, W. Wen, and L. Chuang, Institute of Fluid Physics, China Academy of Engineering Physics, mianyang, China

We proposed a method of laser beam homogenization based on diffractive optical components. Applications in experiments show that the homogenization system reduces the focal spot non-uniformity in high speed photography.

CF-P.6 SUN
Nonlinear Polarization Evolution Influence on Pump-induced Repetition Frequency Dynamics in Hybridly Mode-locked Erbium Fiber Laser

S. Leono1 and A. Krylov2, 1Bauman Moscow State Technical University, Moscow, Russia; 2Fiber Optics Research Center of the RAS, Moscow, Russia

We have shown for the first time a decisive contribution from Nonlinear Polarization Evolution mechanism to pump-induced repetition frequency response dynamics via frequency dependent loss term in stretched-pulse Erbium-doped all-fiber ring oscillator with distributed polarizer.

CF-P.7 SUN
Direct observation of intracavity pulse dynamics in all-normal dispersion all-fiber oscillator

J. Szczepanek1, T.M. Kardas1,2, C. Ruždzevič1, and Y. Stepanenko1,2, 1Faculty of Physics, University of Warsaw, Pasteura 5, 02-093, Warsaw, Poland; 2Fluence Sp. z o.o., Kasprzaka 44/52, 01-224, Warsaw, Poland

We present the experimental study of ultrashort pulse dynamics inside the all-FM-PM all-normal dispersion laser cavity using dispersive Fourier transform technique. The destabilization of pulse spectrum due to the stimulated Raman scattering process was investigated.

CF-P.8 SUN
Generation of identical femtosecond pulses with adjustable carrier-envelope phase

N. Golovin1, N. Dmitrieva1, E. Gorobov1, and A. Dmitriev2,1, 1Novosibirsk state technical university, Novosibirsk, Russia; 2Institute of laser physics of SB RAS, Novosibirsk, Russia

The method is proposed for creating femtosecond radiation without frequency comb offset when generating a synchronized pulse train with an adjustable carrier-envelope phase.

CF-P.9 SUN
Passively mode-locked depressed-cladding waveguide laser in Yb-doped fiber crystal glass


We report the first continuous-wave passively mode-locked Yb-doped glass laser inscription depressed-cladding waveguide laser. It operates with a pulse width of 6.43 ps and a repetition rate of 272 MHz at λ = 1021 nm.

CF-P.10 SUN
Output characteristics of terawatt pico-second CO2 laser system

A. Pesh and H. Saghaififar, Malek-Ashtar University of Technology, Isfahan, Iran

The key parameters for design of advanced terawatt pico-second CO2 laser systems are discussed and the optimization process were explored by numerical modeling.

CF-P.11 SUN
Interferometric Autocorrelation Measurements of Supercontinuum by Two-Photon Absorption in a GaP photodetector

S. Toeng, R. Makkitalo1, J. Ahvenjärvi3, P. Ryckowski1, M. Näätänen1, J.M. Dudley2, and G. Gentili1, 1Photonics Laboratory, Physics Unit, Tampere University, Tampere, Finland; 2Institut Femto-ST, UMR 6174 CNRS-Université Bourgogne Franche-Comté, Besançon, France

We present a passively mode-locked Dy13+ doped fluoride fiber laser emitting around 3.1 μm based on nonlinear polarization evolution (NPE) technique in a ring configuration, using in-band pumping at 2.8 μm, able to produce sub-pico-second (ps) pulses.

CF-P.12 SUN
Light bullets from chirped high-power femtosecond pulses under normal GVD for mid-IR optical parametric amplification

E. Smetanina1, E. Migal2, I. Thiéle3, and F. Potemkin3, 1Department of Physics, University of Gothenburg, SE-412 96 Gothenburg, Sweden; 2Department of Physics, Chalmers University of Technology, SE-411 96 Gothenburg, Sweden; 3Faculty of Physics and International Laser Center, M. V. Lomonosov Moscow State University, 119991 Moscow, Russia

We perform an extensive parametric analysis of supercontinuum generation in various dielectric materials and present a generation regime of the supercontinuum red wing that is highly appropriate as a seed for optical parametric amplifiers.

CF-P.13 SUN
Megawatt peak-power femtosecond ultralong ring fibre laser with InN SESAM

F. Gallazzi1, M. Jimenez-Rodriguez2, E. Monroy3, P. Corredor1, M. González-Herrera3, E.B. Naranjo4, and J.D. Ania Castañón1, 1Instituto de Óptica Daza de Valdés, IO-CSIC, Madrid, Spain; 2Photons Engineering Group, Electronics Dept (EPI), Universidad de Alcalá, Alcalá de Henares, Spain; 3University Grenoble-Alpes, CEA-INAC-PHELCIS, Grenoble, France

We experimentally demonstrate fundamental mode-locked fibre lasing at 1.55μm in a 2.37km ring cavity with InN SESAM, with peak powers over 1MW, over 200 nJ pulse energy and pulse durations below 250fs.

CF-P.14 SUN
Ultrafast mid-IR Dysprosium fluoride fiber laser

E. Wang1, F. Jobin2, S. Duval1, V. Fortin1, F. Laporta2, M. Bernier1, G. Galzerano3, and R. Vallée2, 1Département de Physique, Politecnico di Milano, Milano, Italy; 2Istituto di Fotonica e Nanotecnologie - CNR, Milano, Italy; 3Centre d’optique, photonique et laser (COPL), Université Laval, Québec, Canada; 4Femtum inc., Québec, Canada

We present a passively mode-locked Dy13+ doped fluoride fiber laser emitting around 3.1 μm based on nonlinear polarization evolution (NPE) technique in a ring configuration, using in-band pumping at 2.8 μm, able to produce sub-pico-second (ps) pulses.

CF-P.15 SUN
Quantum-Efficiency and Bandwidth Optimized Electro-Optic Sampling

C. Hofer1,2, S.A. Hussain1, W. Schweinberger3,2, M. Huber1, T.P. Butler1, D. Gerz2,1, N. Karpowicz1, F. Krausz1,2, and I. Pupeza1,2, 1Max Planck Institute of Quantum Optics, Garching, Germany; 2Ludwig-Maximilians-University Munich, Faculty of Physics, Garching, Germany; 3King Saud University, Department of Physics and Astronomy, Riyadh, Saudi Arabia

We discuss the bandwidth-efficiency tradeoff in electro-optic-sampling-based detection of mid-infrared waveforms. With high-power, 1-μm gating pulses we demonstrate record photon detection efficiencies, and predict a further improvement of this trade-off for 2-μm gating pulses.

CF-P.16 SUN
Controlling the spatio-temporal distribution of ultrashort pulses near focus by means of diffractive focusing and pulse shaping

I.J. Sola1, J. Pérez-Vizcaino2, G. Mínguez-Vega3, C. Hernández-García1, and B. Alonso1,2, 1University of Salamanca, Salamanca, Spain; 2Universitat Jaume I, Castellón, Spain; 3Sphere Ultrafast Photonics, Porto, Portugal

Complex spatio-temporal irradiance patterns of ultrafast pulses near focus have been created and controlled by the combined effect of diffractive focusing and pulse shaping. Experimental and theoretical results are in agreement, explaining the symmetries arising.

CF-P.17 SUN
Development of high-efficiency beam converter for ultrafast spatio-temporal control of light waves

K. Yamań1, K. Iwasa1, R. Sasaki1, K. Oka1, Y. Todai1, and M. Morita1,2, 1Hokkaido University, Sapporo, Japan; 2Hirohaki University, Hirohaki, Japan

We developed the high-efficiency beam converter for ultrafast spatio-temporal control of light waves and succeeded in controlling the light waves both in the azimuth and radial directions in the ultrashort regime.

CF-P.18 SUN
Monolithic and In-line Method for the Measurement of Time-dependent Polarization of Ultrashort Pulses

B. Alonso1,2, C. Hernández-García1, and J.I. Sola2, 1Sphere Ultrafast Photonics, S.A., Porto, Portugal; 2Grupo de Aplicaciones del Látier y Fotónica (ALF), University of Salamanca, Salamanca, Spain
We show theoretically and experimentally the performance of a compact and robust in-line method to characterize ultrashort laser pulses exhibiting time-dependent polarization presenting high stability and precision thanks to its monolithic configuration.

CF-P.19 SUN
Octave-spanning high-repetition-rate mid-IR supercontinuum for frequency comb synthesis
Y. Wang1, S.O. Leonov1, V.S. Shryakin2, G.E. Snopatin2, B.S. Stepanov3, V.G. Plotnichenko4, V.E. Karasik5, E. Vicentin1,2, A. Gambetta3,4, N. Coluccia1,2, C. Svelto1,2, P. Laporta1,2, and G. Galzerano1,2,3,4,5
1Istituto di Fotonica e Nanotecnologie - CNR, Milano, Italy; 2Dipartimento di Fisica, Politecnico di Milano, Milano, Italy; 3Bauman Moscow State Technical University, Moscow, Russia; 4G.G. Stokes Institute of Chemistry of High-Purity Substances of the Russian Academy of Sciences, Nizhny Novgorod, Russia; 5Fiber Optics Research Center of the Russian Academy of Sciences, Moscow, Russia; 

We report SC generation in tapered suspended-core 64 nm-diameter nanosilica fiber pumped by a few-optical-cycle Cr:ZnSe ultrafast laser at 2.4 μm. The generated SC covers the spectral region from 1.4 to 4.2 μm.

CF-P.20 SUN
Novel InN-based SESAMs with ultra-short time response
L. Monroy1, E. Monroy2, M. González-Herráez1, and F.B. Naranjo1,1,2,3
1University of Alcalá, Madrid, Spain; 2University Grenoble-Alpes, Grenoble, France

This work focuses on the optimization of InN-based SESAMs characterized by a 800% of nonlinear change in transmission, and the creation of pulses with 30 mW of average power and temporal durations of 150 fs.

CF-P.21 SUN
Wide and continuous tunable mode-locked Erbium-doped fiber laser based on the graphene oxide
Z.Y. Li1, L.Y. Tsai1, J-J. Wu1, S.Y. Tsay1, Y.H. Chen1, and J.H. Lin1
1Department of Electro-Optic Engineering, National Taiwan University of Technology, Taipei, Taiwan

Based on the graphene/PVA film and nonlinear polarization technique, we investigated the wide and continuous tuning of the wavelength from mode-locked pulses from the Erbium-doped fiber laser that revealed relatively stable operation state.

CF-P.22 SUN
Carrier to Envelope Phase (CEP) Stable, 2.37 μm, Ultrashort Pulses from a Hybrid Parametric – Laser Amplifier

P. Komin1, U. Shentop1,2, S. Nouch1,2, and G. Marcus1,2
1 Hebrew University, Jerusalem, Israel; 2Jerusalem College of Technology, Jerusalem, Israel
Combination of parametric generator and Cr:ZnSe laser amplifier resulted 30 μJ, 726 ps, at λc= 2375 nm. The CEP stability of the parametrically generated seed stands firm through 6 orders of magnitude of amplification.

CF-P.23 SUN
Supercontinuum generation in As2S3-silica nanospike waveguide pumped by Tm-doped fiber laser
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We report the first results of spectral broadening in As2S3-silica nanospike waveguide pumped in different multi-pulse regimes by a high-power femtosecond Tm-doped fiber laser. The results show that soliton-like regimes are preferable for supercontinuum generation.

CF-P.24 SUN
Frequency-Tunable Two-Colour Ultrafast Fiber Laser for Nonlinear Microscopy in the Fingerprint Regime Emitting at Central Frequencies 780 nm and 810 nm to 950 nm
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1Istituto di Fotonica e Nanotecnologie - CNR, Milano, Italy; 2Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Milano, Italy

We present a pulsed two-arm fiber laser emitting in the near infrared. The central frequency of one arm is tunable over a broad range allowing difference frequencies between 500 cm−1 and 2000 cm−1.

CF-P.25 SUN
Double-Pass Amplification of Picoscience Pulses with a Tapered Quantum-Dot Semiconductor Amplifier
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1Institute of Photonics and Quantum Sciences, School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom; 2Previously also with the School of Science and Engineering, University of Dundee, Dundee, United Kingdom; 3I3 Lab, Palaiseau, France; 4Dipartimento di Elettronica e Telecomunicazioni, Politecnico di Torino, Turin, Italy

Double-pass amplification of picosecond pulses is shown for the first time, with up to 7 dB gain enhancement compared to single-pass, as demonstrated with 5GHz, 2.2 ps pulses (125 ps), generated by a mode-locked quantum-dot laser diode seed.

CF-P.26 SUN
4-nJ Erbium all-fiber hybrid highly chirped dissipative soliton oscillator
I. Zhdanov1,2, D. Kharenkov1,2, A. Rednyakova3, M. Fedorov3,4, S. Tutyrina5,6, and S. Bahin1,2,7
1Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; 2Novosibirsk State University, Novosibirsk, Russia; 3Institute of Computational Technologies SB RAS, Novosibirsk, Russia; 4University of Helsinki, Helsinki, Finland; 5Institute of Photonics and Technologies, Birmingham, United Kingdom

We perform a next step in dissipative soliton generation in an all-fiber Erbium oscillator. More than 3 times energy increasing up to 4 nJ has been achieved by lengthening the cavity with PM Raman fiber.

CF-P.27 SUN
Radially and azimuthally polarized few-cycle pulses by post-compression in a multipass cell
H. Cao, R.S. Nagymihaly, V. Chvykov, N. Khodakovskiy, K. Orsay, and M. Kalabukhov
ELI-ALPS, ELI-HU Nonlinear Technologies (INIT), Universitat Jaume I, 12071 Castellón, Spain

Previously also with the School of Science and Engineering of the CAS, Prague, Czech Republic

We present a bidirectional frequency-shifting loop that generates two acousto-optic frequency combs with tunable spectral spacing. Our approach opens new ways to generate accelerating wave-packets all over the electromagnetic spectrum.

CF-P.28 SUN
All-Fiber Mode-Locked Thulium Doped Fiber Laser Using a Novel Femtosecond Laser Inscribed 45°-Tilted Fiber Grating
A. Theodosiou1, J. Lobrat1, N. Kanagaraj2, P. Peterka3, K. Kallí4, I. Kállik4, and P. Honzatko5
1Photonics and Optical Sensors Research Laboratory, Cyprus University of Technology, Saripolou, Cyprus; 2Institute of Photronics and Electronics of the CAS, Prague, Czech Republic

We present a pulsed thulium-doped fiber laser based on the novel 45°-tilted fiber grating inscribed by femtosecond laser is demonstrated. A stable 862 fs soliton-like pulse at 1870 nm is reported, confirming the capability of the grating for stable laser operation.

CF-P.29 SUN
Plasma profile along a hollow-core photonic crystal fibre measured with counter-propagating probe solitons
F. Tani, M. I. Suresh, J. R. Koehler, and P. St.J. Russell
Max Planck Institute for the Science of Light, Erlangen, Germany

The free electron density distribution along gas-filled photonic crystal fibre, created by a self-compressed soliton that ionises the gas, is studied via the frequency shift of the dispersive wave emitted by a counter-propagating probe soliton.

CF-P.30 SUN
Ultra-broadband partially coherent accelerating beams
D. Mansour1,2 and D. Papazoglou1,2,3
1Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology - Hellas (FORTH), Heraklion, Greece; 2Materials Science and Technology Department, University of Crete, Heraklion, Greece

Using optical aberrations of reflecting systems as continuous phase-masks we generate an ultra-broadband partially coherent accelerating beams of varying spatial coherence. Our approach opens new ways to generate accelerating wave-packets all over the electromagnetic spectrum.

CF-P.31 SUN
Numerical investigation of broadband OPCA configurations for direct amplification of TW-level, two-cycle pulses
1ELI-ALPS, Szeged, Hungary; 2Light Conversion Ltd., Vilnius, Lithuania

In this work, broadband NOPCPA schemes were numerically investigated which are capable to amplify two-cycle bandwidth with a single-color pump only. The examined amplifier configurations are implemented in the ELI-ALPS SYLOS laser system.

CF-P.32 SUN
Dual-comb spectroscopy using a single frequency-shifting loop
V. Durán1,2, L. Djevaradjian3, and H. Guillet de Chatellus2
1GROC-UJI, Institute of New Imaging Technologies (INIT), Universitat Jaume I, 12071 Castellón, Spain; 2Univ. Grenoble Alpes, CNRS, LIPhy, 38000 Grenoble, France

We present a bidirectional frequency-shifting loop that generates two acousto-optic frequency combs with tunable line spacing. This system allows us to perform dual-comb measurements with integration times far beyond the millisecond without any stabilization mechanism.

CF-P.33 SUN
High Power, Ultrafast Yellow Laser using Fourth-harmonic Generation of Ultrafast Mid-IR Cr2+ :ZnSe Laser in MgO:PPLN Crystal
D. Yadav, A. Ghosh, R.K. Sarkaralli, and G.K. Samanta
Photonic Sciences Lab, Physical Research Laboratory, Thiruvananthapuram, Kerala, India
We report on efficient generation of ultrafast tunable optical radiation in yellow wavelength range through two-stage, single-pass, frequency-doubling of Cr2+ :ZnS laser with maximum average power of ~1 W at a conversion efficiency of 21%.

**CF-P.34 SUN**

**Design of a 10 kHz, mJ-level mid-IR OPCPA system**

- S. Töth, 1, 2 R. Nagyghimályi, 1 R. Fender, 1 B. Kiss, 1 M. Kursic, 1 L. Haizer, 1 E. Cormier, 2 and K. Osay; 2
- 1ELI-ALPS, ELI-HU Non-Profit Ltd., Szeged, Hungary
- 2CJLL, Université de Bordeaux-CNRS-CEA, Bordeaux, France

In this work a 3D OPCPA modelling software and Comsol Multiphysics was used to simulate amplification and heat load in a mJ-level, ultrafast mid-IR laser system, driven by a 2 kW picosecond pump laser.

**CF-P.35 SUN**

**Energy Scalable Self-Compression at 1 μm**

Wavelength in All-Bulk Multi-Pass Geometry

- S. Gröbner, 1 K. Frisch, 1 B. Schneider, 1 M. Poetzelberger, 1 V. Pervak, 1 J. Brons, 2 and O. Pronin; 2
- 1Max-Planck-Institut für Quantenoptik, Garching, Germany
- 2Max-Planck-Institut für Quantenoptik, Garching, Germany

We demonstrate self-compression with 300 fs input pulses in an all-bulk Herriott-type multi-pass cell yielding an output at 142 MW peak power and 1030 nm central wavelength. The concept is scalable towards millijoule pulse energies.

**CF-P.36 SUN**

**50 fs compression of UV laser using IC-HCPFC**

- M. Maurel; 1 M. Chafier; 1 F. Amrani; 1 B. Debord; 1 C. Honninger; 1 F. Gréomé; 2 E. Mottay; 1 and E. Benabid; 2
- 1GPPMM group, Xilin laboratory, Limoges, France
- 2GLOphotonics, Limoges, France
- 3Amplitude Systemes, Pessac, France

We report on self-phase-modulation spectral broadening and compression to 50 fs of 250 fs and μJ energy-scale UV laser-pulses at 343 nm using gas-filled Inhibited-Coupling hollow-core photonic crystal fiber.

**CF-P.37 SUN**

**Femtosecond Pulse Shortening Using Cascaded Quadratic Nonlinearities for High Temporal Contrast**

- V. Aleksandrov, G. Bleotu, and D. Urcescu; Extreme Light Infrastructure - Nuclear Physics, Bucharest - Magurele, Romania

Using numerical simulations, we compare two femtosecond pulse shortening techniques based on: third order and second order nonlinearity. The latter one allows reaching higher temporal contrast, crucial for experiments with high peak power lasers.

**CF-P.38 SUN**

**CEP-Stabilized, sub-18 fs, 10 kHz and TW-Class 1 kHz Dual Output Ti:Sa Laser with Wavelength Tunability Option**

- X. Chen, 1 A. Gollnicht; 1, 2 B. Bussiere, 1 E. Gontier; 1 P.-M. Paul; 1 O. Tiberghien, 1 P. d’Oliveira; 1 and J.-F. Hergott; 1
- 1Amplitude laser group, Lisses operations, Eury, France
- 2LIDYL, CEA, CNRS, Université Paris-Saclay, UMR 9222 CEA-SACLAY, Gif-sur-Yvette, France
- 3Amplitude laser group, San Jose operations, San Jose, USA

We present here a Ti:Sa based 10kHz/1 kHz hybrid laser system delivering 17.8 fs, 0.9 TW 1kHz pulses with 350 mrad shot to shot CEP noise, with wavelength tunability function.

**CF-P.39 SUN**

**Octave spanning flat-plateau white-light generation in multi-thin plates by utilizing self-steepening and induced phase modulation**

- S. Fasoli; 1 Y. Su; 1 J. Jiang; 1 H. Liu; 1 and Z. Wei; 2
- 1Institute of Physics, Chinese Academy of Sciences, Beijing, China
- 2University of Chinese Academy of Sciences, Beijing, China

We generate 0.7-mJ pulses spanning the range from 380 to 1650 nm (transform-limited pulse width of 1.5 fs, transform-limited pulses) featuring a flat plateau spanning approximately from 430 to 670 nm with a flatness of 5%.

**CF-P.40 SUN**

**High-fidelity few-cycle laser pulses generated via nonlinear ellipse rotation**

- N. Khodakovskyi; 1, 2 M. Kalashnikov; 1, 2 B. Mercier; 2 V. Pajer; 2 Z. Cheng; 2 M. Lozano; 1, 4 A. Steinert; 1, 5 P. Simon; 2 T. Nagy; 2 and R. Lopez-Martens; 2
- 1ELI-ALPS, Szeged, Hungary
- 2Max Born Institut für Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany
- 3Laboratoire d’Optique Appliquée, ENSTA-Paristech, Ecole Polytechnique, Palaiseau, France
- 4Laser-Laboratorium Göttingen e.V., Göttingen, Germany
- 5University of Kassel, Kassel, Germany

We show that nonlinear ellipse rotation driven by 30 fs pulses in a hollow fiber operated with a pressure gradient can be used to efficiently generate few-cycle pulses with more than 10³ temporal contrast enhancement.

**CF-P.41 SUN**

**Studying the Role of Nonlinear Medium Thickness in the Characterization of 1.5-Cycle Pulses Using XPW Dispersion nan**

- A. Tajalli; 1, 2 M. Ouali; 3 A. Verniet; 3 F. Böhle; 3

We present experimental results and numerical verification of soliton Raman self-frequency shifting in an all bulk-based, nonlinear multi-pass system driven by a nonlinearly compressed 15 fs, 2.5 μJ and 70 W Yb:YAG thin-disk laser oscillator.

**CF-P.47 SUN**

**The contribution has been withdrawn.**

**CF-P.48 SUN**

**Evaluation of the Coherent Artifact in Ultrashort Laser Pulses using D-scan and its Application to Broadband Fiber Lasers**

- R. Alomou, 1 S. Torres-Patrón; 2 R. Romero; 3 P.T. Guerreira; 3 H. Muñoz-Marcos; 3 P. Pérez-Millán; 2 and H. Crespo; 3
- 1Sphere Ultrafast Photonics, S.A., Portugal
- 2FLYA LASER SL, Paterna (Valencia), Spain
- 3Universidade do Porto, Porto, Portugal

We study the coherent artifact by adding different random phases to the simulated pulse train, finding that the self-calibrating d-scan is sensitive and can quantify the source decoherence, with experimental validation in a fiber laser.
CF-P.49 SUN
Sub-20 fs-duration ultra-short pulse train generation using transient SRS in H2-filled Inhibited Kagome fiber
D. Kergosien, F. Amranii, B. Debord, F. Gérôme, and F. Benabid, GPPMM group - Xlsm research institute UMR CNRS 7252, Limoges, France
We present the generation of 57 fs-period pulse train using rotational stimulated Raman scattering in transient regime, by pumping a hydrogen-filled Kagome HC-PCF with 1 micron ultra-short and powerful pulses.

CF-P.50 SUN
Arbitrary splitting ratio coupler at single photon level with sub-nanosecond switching time
V. Švarc, M. Nováková, G. Mazin, and M. Ježek, University Palacky Olomouc, Olomouc, Czech Republic
We report an ultra-fast photonic router with arbitrary tunable splitting ratio. We achieve the operation with extinction ratio exceeding 25dB and sub-nanosecond time jitter. We demonstrate qudit preparation and balanced time-multiplexed photon-number-resolving detector application.

CF-P.51 SUN
Extremely high resolution chirp measurements over an octave bandwidth with spectrally resolved interferometry
I. Seres, T. Somoskőı, Á. Bércsényi, A. Sipas, and A. Kovács P., ELLI-ALPS, ELLI-HU Nonprofit Ltd., Szeged, Hungary; 2Department of Optics and Quantum Electronics, University of Szeged, Szeged, Hungary; 3CE Optics Ltd., Szeged, Hungary
We report on 0.03 nm resolution GDD measurements of octave bandwidth positively chirped mirrors pair. A Michelson interferometer with supercontinuum source and optical spectrum analyzer provided accurate reconstruction of GDD curves based on Windowed Fourier Transform.

CF-P.52 SUN
Multicavity white light waveform synthesizer
E. Rodente, Max Planck Institute of Quantum Optics, München, Germany
A multi-channel waveform synthesizer has been used to shape the output of a hollow core fiber. The synthesizer can support pulses down to 6.6 fs centred at 1.8 um.

CF-P.53 SUN
All PM-fiber thulium-doped mode-locked fiber laser and amplifier based on nonlinear loop mirror
M. Michalska, L. Gorańek, P. Orzes, and J. Swiderski, Institute of Optoelectronics, Military University of Technology, gen. W. Urbanowicza 2, 00-908 Warsaw, Poland
We present an ultrafast thulium-doped all-PM-fiber laser with a NOLM operating at a wavelength of 1996.6 nm. The oscillator generates linearly polarized sub-ps picosecond pulses. The pulses were amplified in a single-stage thulium-doped fiber amplifier.

CF-P.54 SUN
Generation and Control of Ultrafast 10 μm Laser Pulses for Driving Chemical Dynamics
M. A. Jakub, D. M. Nambodiri, and T. Laarmann, Deutsches Elektronen-Synchrotron, Hamburg, Germany; 2The Hamburger Centre for Ultrafast Imaging, Hamburg, Germany
We demonstrate pulse shaping via acousto-optic modulation at a tunable mid-infrared source between wave-lengths of 8–15 μm. The optimised pulse shapes aim at modification of molecular wavepackets in the electronic ground state.

CF-P.55 SUN
Dependences of picosecond pulse driven supercontinuum properties on repetition rate
L. Rotkó,1,2, O. Novák,2 B. Csanková2,3, J. Matěj1,2, M. Jeleník,2, M. Smrz,3 and T. Mocik,3 HILASE Centre, Institute of Physics AS CR, Zá Malvazínskou 928, 252 41, Dohů Brzany, Czech Republic; 4Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Břevnova 7, 115 19, Prague, Czech Republic
We experimentally demonstrate a femtosecond pulse laser using a CoSb3-skutterudite-based passive mode-locker. Using 1.5 ps pulses, >300 nm pulses with a 838 fs temporal width could be obtained from a Tm-Ho co-doped fiber cavity.

CF-P.59 SUN
Experimental Demonstration of High-throughput Transmission Spectrum Measurement for Electro-absorption Modulator using the Time-stretch Method
H. Iiura,1 T. Makino1, X. Wang,2 T. Kobayashi,3 B. Jalal1, D. Capewell,1 W. Man,2 K. Tsang1, and N. Wada1, 1National Institute of Information and Communications Technology, Koganei, Japan; 2Optoquest, Ageo, Japan; 3University of California, Los Angeles, USA; 4Roguescope, Los Angeles, USA; 5Amonics Ltd., Kolwou, Hong Kong
We demonstrate high throughput measurement of the transmission spectrum of electro-absorption optical modulators with 11.7 ns refresh time and 50 pm spectral resolution based on time stretch dispersive Fourier Transform method for the first time.

CF-P.60 SUN
A pellicle coupled optical resonator
E. Fill1,2, L. Vornavin1,3, N. Lilienfeld1, and I. Pupela1,2, 1Department of Physics, Ludwig-Maximilians-Universität München, Garching, Germany; 2Max-Planck-Institut für Quantenoptik, Garching, Germany
We demonstrate a new type of laser resonator in which the laser is coupled in through a pellicle. Changing the angle of incidence on the pellicle, the finesse of the cavity can be altered without replacing components.

CF-P.61 SUN
Discovering memory ability of relaxation oscillations in mode-locked lasers
X. Liu, Y. Zhang, and Y. Cai, State Key Laboratory of Modern Optical Instrumentation, College of Optical Science and Engineering, Zhejiang University, Hangzhou, China
We measure the single-shot dynamics and evolution of pulses during raised relaxation oscillations stage in a mode-locked laser, and experimentally discover the memory ability and competitive dynamics of relaxation oscillations.

CF-P.62 SUN
Carrier Envelope Phase Dependence of High harmonic Generation from Long Duration Multi-Cycle Multi-Timescale Pump Pulses
O. Nesfeli̇d,1 A. Fleischer,1 and O. Cohen1, 1Physics Department and Solid State Institute, Technion - Israel Institute of Technology, Haifa, Israel; 2Chemistry Department, Tel Aviv University, Tel Aviv, Israel
We theoretically explore strong carrier envelope phase effects in high harmonic generation driven by long multi-cycle pulses (up to 200fs at central wavelength 800nm) that appear when the driving laser pulse exhibits multi-timescale behavior.

CF-P.63 SUN
Overcoming avalanche ionization to generate multi-octave supercontinuum pumped by a Ho:YLF regenerative amplifier
S. Cheng1,2, G. Chatterjee1, F. Tellkamp1, A. Ruehle3,4, and R.J.D. Miller1,5,6, 1Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany; 2Department of Physics, University of Hamburg, Hamburg, Germany; 3Leibniz University Hannover, QUEST-Leibniz Research School, Institute of Quantum Optics, Hannover, Germany; 4Laser Zentrum Hannover e. V., Hannover, Germany; 5Centre for Ultrafast Imaging (CUI), University of Hamburg, Hamburg, Germany; 6Department of Chemistry and Physics, University of Toronto, Toronto, Canada
We demonstrate supercontinuum generation ranging from 500 nm to 4.5 μm (to 1e-4 generated in YAG & ZnSe, driven by 3-ps pulses centered at 2.05 μm (from a Ho:YLF regenerative amplifier) by overcoming avalanche-ionization-induced damage.
Pulse doublets generated by a frequency-shifting loop containing an electro-optic amplitude modulator H. Yang1,2, M. Brunel1, ••• M. Valler1, H. Zhong3, and C. Zhao4,1 Univ Rennes, CNRS, Institut FOTON, Rennes, France; 2Beijing Institute of Technology, Beijing, China We demonstrate an original regime of picosecond doublet pulses at 1.5 μm in an all-fiber loop, where both the repetition rate and pulse interval are tunable. Experimental results agree well with a time-delayed interferometer model. CI-P.2 SUN Dynamic study of Talbot lasers U. Billard1,2, V. Crozatier1, G. Baille3, D. Dolfi2, and H. Guitel de Chastelat2,1 Thales Research and Technology, Palaiseau, France; 2Université Grenoble Alpes, CNRS, LIPhy, Grenoble, France We developed a simple model based on rate equations to understand the dynamic response of Talbot lasers. Results are in good agreement with experiments in different conditions, without parameter adjustment. CI-P.3 SUN Channel switching-switchable comb spectra for orthogonal input polarization states using polarization-diversified-loop S.-L. Lee1, J. Kim1, S. Choi1, M.S. Kim1, D.K. Kim1, J.S. Han1, and Y.W. Lee2,1 Interdisciplinary Program of Biomedical, Mechanical & Electrical Engineering, Pukyong National University, Busan, South Korea; 2School of Electrical Engineering, Pukyong National University, Busan, South Korea We propose and demonstrate a polarization-diversified-loop based optical comb filter that offers switching operation between dual transmission spectra with different channel spacings by controlling orthogonal input polarization states without changing any configuration of the filter. CI-P.4 SUN Hybrid Integrated Silicon External Cavity Laser with Integrated Modulator for Optical Interconnects P.K. Singaravelu1,2, S.M. Butler1,2,A.P. Bakoz1,2, A.A. Liles1, G.C.R. Devaraju1,2,3, R.N. Sheehan1, S.P. Hegarty1,2, and L.O. Faoulin1,2,3 Centre for Advanced Photonics and Process Analysis, Cork Institute of Technology, Cork, Ireland; 2Tyndall National Institute, Cork, Ireland; 3Scottish Universities Physics Alliance (SUPA), School of Physics and Astronomy, St Andrews, United Kingdom We demonstrate the possibility of the direct frequency modulation can convert into intensity modulation of a hybrid laser by tuning the PhC resonances using a p-n junction. CI-P.5 SUN Design of FBG-based Linear Passive All-optical NOT Gate S. Kaushal and J. Azana; INRS-EMT, Montreal, Canada We propose a phase modulation apodization technique-based fibre Bragg grating design for the realization of narrow phase only filters aimed at implementation of passive all-optical NOT gates for high speed return to zero on-off keying data signals. CI-P.6 SUN Integrated InP-based Multichannel Transmitters for WDM-PON System A. Paśniewska, S. Stopiński, and R. Piramidowicz; Warsaw University of Technology, Warsaw, Poland We report transmitters for experimental WDM-PON system realized as InP-based photonic integrated circuits. Low threshold current, good SSMR, extinction ratio and open eye diagram prove the applicability of PICs to transmitters in access systems. CI-P.7 SUN MEMS-Based Tunable Single-Passband Microwave Photonic Filter H.E. Kob1,2, M.S. Abdallah1, H. Elhehyawy2, Y.M. Sabry1,3, and H. Omran1; 1Transmission Department, National Telecommunication Institute, Cairo, Egypt; 2Laboratory of Micro Optics, Faculty of Information Engineering and Technology, German University in Cairo (GUC), New Cairo, Egypt; 3Faculty of Engineering, Ain Shams University, Cairo, Egypt; 4Optical MEMS Business Unit, Si-Ware System, Cairo, Egypt We report a tunable compact size single passband microwave photonic filter having center frequency ranging from 1.64 to 2.32 GHz. An optical interferometer based on Microelectromechanical Systems is used to tune the filter center frequency. CI-P.8 SUN Inter-channel Interference in Non-linear Frequency-division-multiplexed Networks on Fibre Links with Lumped Amplification X. Yangzheng, D. Lavery, and P. Rayvel; University College London, London, United Kingdom We estimate the inter-channel interference (ICI) in non-linear frequency-division multiplexed (NFDM) network. When the number of channels is larger than 25, ICI in NFDM networks is weaker than the ICI in the wavelength division multiplexed network. CI-P.9 SUN Generalized Spiral Transformations for Mapping Vortex Phase to Linear Phase Y. Wen1, I. Chremmos2, Y. Chen3, Y. Zhang1, and S. Yu1,2; 1Sun Yat-sen University, Guangzhou, China; 2Hellenic Electricity Distribution Network Operator S.A., Athens, Greece; 3University of Bristol, Bristol, United Kingdom A generalized spiral transformation is put forward for mapping the vortex phase of OAM modes to a linear phase of tilted plane waves, which can be used for OAM mode sorting and its performance optimization. CI-P.10 SUN Bi-directional Fiber-IVLLC Convergence with Parallel/Orthogonally Polarized Dual-Sideband Operation and Two RSOA schemes C.-W. Su1, Z.-H. Wang2, W.-S. Tsai3, C.-Y. Li1, and H.-H. Liu1; 1National Taipei University of Technology, Taipei, Taiwan; 2Ming Chi University of Technology, New Taipei City, Taiwan; 3National Taipei University, New Taipei City, Taiwan A bi-directional fiber-IVLLC convergence with parallel orthogonally polarized dual-sideband operation and two RSOAs scheme is practically illustrated. Such offered bi-directional fiber-IVLLC convergence is a prominent one for offering high downstream transmission capacity with enhanced upstream performance. CI-P.11 SUN DFT-spread Hybrid OFDM-DFMA PONs Incorporating Directly Modulated DB Laser-based ONUs Y. Dong, W. Jin, and I. Tang; Bangor University, Bangor, United Kingdom DFT-spread hybrid OFDM-DFMA PONs incorporating low-cost directly modulated laser-based ONUs is, for the first time, proposed for 5G network convergence results. downloads show that 3dB system power budget improvements are achievable due to DFT-induced PAIR reduction. CI-P.12 SUN Detector-free bidirectional symmetric communication scheme based on compound states of two mutually coupled diode lasers M. Weidmann1,2, A. Herdt3, R. Phelan2, and W. Elseßner2,1 Technische Universität Darmstadt, Institut für Ange-wandte Physik, Darmstadt, Germany; 2Eblana Photonics Ltd., Dublin, Ireland We present a detector-free bidirectional symmetric communication scheme based on two coupled 1550nm diode lasers. Information is encoded into compound states of the coupled laser system and read out utilizing DC-voltage changes at both lasers. CI-P.13 SUN From 4.2Gbps Asymmetrical Clipping (ACO)-OFDM to 8.7Gbps Layered-ACO-FBMC with Intensity-Modulation Direct-Detection for PONs S. Sarmiento1, J.A. Altabas2, S. Spadaro1, and J.A. Lazar01; 1Universitat Politècnica de Catalunya, Barcelona, Spain; 2Universidad de Zaragoza, Zaragoza, Spain ACO/LACO-FBMC/OFDM are experimentally assessed in terms of the sensitivity using a PIN-based receiver, and the spectral efficiency for optical IM/DD. Results show improvements from 4.2Gbps with ACO-OFDM to 7.2Gbps (8.7Gbps) by LACO-OFDM(FBMC) with just 2.6dB penalty. CI-P.14 SUN Improvement of resolution in orbital angular momentum detection based on beam duplication by using a Sagnac interferometer K. Yamane1, Y. Watanabe2, K. Oka2, Y. Toda1, and R. Morita1; 1Hokkaido University, Sapporo, Japan; 2Hirokawa University, Hirokawa, Japan We developed new device to greatly improve the resolution in orbital angular momentum detection based on geometrical transformation by using beam duplication technique without spoiling the advantages of the low loss and reversibility. CI-P.15 SUN Non-Orthogonal Multiple Access based on Carrierless Amplitude Phase format for coherent PON flexible resource provisioning D. Isquierdo1,2, J.A. Altabas1,2, P. Millan2, J. Clemente2, J.A. Lazar01, S. Rommel3, R. Puerta1,2, J.J. Vegas Olmos2, I. Tijer Monroy1, and I. Garces2; 1Centro Universitario de la Defensa, Zaragoza, Spain; 2Universidad de Zaragoza, Zaragoza, Spain; 3Bifrost Communications, Lynby, Denmark; 4Universitat Politècnica de Catalonia, Barcelona, Spain; 5Eindhoven University of Technology, Eindhoven, Netherlands; 6Ericsson AB, Stockholm, Sweden; 7Pontificia Universidad Javeriana, Bogotá, Colombia; 8Mellanox Technologies, Roskilde, Denmark This work was supported by the European Union through the Non-Orthogonal Multiple Access based on Carrierless Amplitude Phase (CAP) format which has been used to flexible resource provisioning in a pay-as-you-grow Passive Optical Network (PON) architecture with 10Gbps aggregate data rate using coherent detection. CI-P.16 SUN Low Noise Optical Buffering Based on Non-degenerate Phase Sensitive Parametric Amplification A. Bogris; University of West Attica, Athens, Greece An optical buffer exploiting phase sensitive amplification
Based on the high energy dissipative soliton resonance in a mode-locked thulium-doped fiber laser at 1750 nm, a maximum single pulse energy of 321.2 nJ is achieved with a fundamental repetition rate of 782 kHz.

A tandem-pumped, tunable thulium-doped fiber laser in the 2.1 μm wavelength region was demonstrated, which reached a wavelength-tuning range over 2000-2172 nm, and is tunable to another TDFL at 1908 nm located at the long-wavelength absorption tail of the Tm fiber.

Comparison of different mode-locking methods in the Ho-doped fiber laser was performed, demonstrating the potential of this phenomenon for deep understanding of light guiding mechanisms in NCHCFs.

We report on the creation of holmium-doped distributed-feedback fiber laser with a wavelength of 2.07 μm and output power up to 36.0 mW operating in single-frequency regime.

Efficient Pump Absorption in Twisted Double Clad Thulium-Doped Fibers Drawn to CO2 Laser Shaped Preform was demonstrated, showing very good agreement between numerical simulations and experimental data.

Raman soliton generation in Holmium all-fiber MOPA was reported for the first time to our knowledge. The generated soliton in all-fiber all-single-mode diode-pumped holmium MOPA solitons initially generated at 2000 nm reach 2250 nm due to self-frequency shift.

All-fiber system at 1750nm delivering 35fs 230kW peak power pulses was demonstrated, with a pulse duration of 2ps and a repetition rate of 7.6 MHz, pre-sented.

All-fiber 2.07 μm distributed feedback laser based on π-phase-shifted FBG inscribed in heavily doped holmium fiber by femtosecond laser pulses were demonstrated, producing 35 fs pulses based on solitonic effects. The source delivers pulses with 230 kW peak power at 1750 nm.

Passive Q-switch and Rectangular Mode-locked Pulses from a Dumbbell Shaped Holmium Fiber Laser was reported, demonstrating the potential of this phenomenon for fundamental air core mode in NCHCFs.

High energy dissipative soliton resonance in a thulium-doped fiber laser at 1750 nm was achieved, with an output power of 800 mW.
We present a specially-designed fiber laser at 1018 nm for Laser Science and Technology, Tehran, Iran. The fiber core reached 34% relative to the launched pump power. High powers especially designed fiber lasers operating around 1064 nm with low intensity noise are achieved in the fiber core due to the integration of all-fiber systems, Clement University, USA. We report the first all-fiber single frequency laser with high signal-to-noise ratio. We present a novel single-mode Er3+ doped phosphate fiber MOPA. P. Booker, M. Dirbeck, N.G. Boetti, D. Pugliese, S. Abrate, D. Milianese, C. Pierre, and J. Boulet. An Azur Light System, Palaiseau, France. We developed a high power all-fiber single frequency laser with low intensity noise. This MOPA, based on ytterbium-doped fiber, can emit up to 200W at 1064 nm making it suitable for next generation gravitational wave detectors. We report a coherent beam combining setup using low cost diode laser stochastic parallel gradient descent algorithm. A 300 W near diffraction limited beam is achieved by a 3 x reflective optical element. We report the development of a low-noise, all-fiber, single-frequency, linearly polarized high-power MOPA, tunable from 1017-1016 nm down to 997 nm (~3W). The noise figure exceeds 40 dB for the worst case up to more than 60 dB. We demonstrate the first 915 nm pumped 1018 nm Yb-doped all-fiber high power fiber laser system. Y. Mudil1, O.B. Efremova1, K. Svendsen, and S. Ortiz. 1National Photonics Research Center of the Russian Academy of Sciences, Moscow, Russia; 2Institute of High Purity Substances of the Russian Academy of Sciences, Nizhny Novgorod, Russia; 3College of Optical Sciences, University of Arizona, Tucson, USA; 4Moscow Institute of Physics and Technology (State University), Dolgoprudny, Russia. We propose the experimental scheme to measure the signal gain in Yb-doped fiber and develop the theoretical method to estimate the small signal gain and saturation power as a function of experimental parameters.
CJ-P.31 SUN
Rare-earth doped phosphate optical fibres and rods for compact pulsed optical amplification.
N.G. Boettli1, D. Pugliese2, D. Gallicchi Nottiani3, D. Janner4, and D. Milanese3,4,1*
Foundazione LINKS – Leading Innovation & Knowledge for Society Via F. C. Baggio 61, 10138, Turin, Italy; 1Politecnico di Torino, Dipartimento di Scienze Applicata e Tecnologia (DISAT) and RU INST, Corso Duca degli Abruzzi 24, 10129, Turin, Italy; 2Consiglio Nazionale delle Ricerche, Istituto di Fotonica e Nanotecnologie, Via alla Cassata 56/C, 38123, Trento, Italy.

With the aim of realizing short-length amplifiers in the 1 and 1.5 µm wavelength range, highly Yb3+ and Yb3+, Er3+ doped phosphate glass fibres were manufactured. Preliminary results of optical amplification are presented for single stage MOPA.

CJ-P.32 SUN
Efficient Er and Nd:Te4N6O15 ridge waveguide lasers for the development of mid infrared sources.
D. Brüser, S. Santov, C.E. R üter, and D. Kip; Helmut Schmidt University, Faculty of Electrical Engineering, Hamburg, Germany.
In this paper, we report on efficient Er and Nd:Te4N6O15 ridge waveguide lasers. For the sample fabrication we used our novel technique of three-side deposition and in-diffusion for Er/ Nd and Ti incorporation into predefined ridges.

CJ-P.33 SUN
Fluoride Glass Pulsed Laser in Middle Infrared Wavelength Range.
M.C. Falconi1, D. Laneve1, C. Clemente2, G. Ricchiuti1, A. Locomole1, V. Portol1, A. Crudeli1, G. Galzerano1, and E. Prudenzano1; 1Department of Electrical and Information Engineering, Politecnico di Bari, Bari, Italy; 2IEN-CNR, Department of Physics, Politecnico di Milano, Milano, Italy.
A finite-difference time-domain (FDTD) algorithm is developed in order to investigate the generation of optical pulses at 3.0 µm in an band pumped dysprosium-doped ZBLAN fiber laser by means of the gain switching technique.

CJ-P.34 SUN
2 W single-mode visible laser oscillation in Pr-doped double-clad structured waterproof fluoroo- aluminne glass fiber.
Y. Fujimoto1, M. Nakahara2, P. Binon2, S. Motokoshi1, O. Ishi1, M. Watanabe1, M. Yamazaki1, T. Shinozaki1, T. Sato1, and Y. Yanomori1; 1Chiba Institute of Technology, Narashino, Japan; 2Kimmon Koa Co., Ltd., Hieabashi-kaku, Japan; 3Institute of Laser Technology, Osaka, Japan; 4Sumita Optical Glass, Inc., Saitama City, Japan.
2 W single-mode visible laser oscillation in Pr-doped double-clad structured waterproof fluoroo-aluminne glass fiber is reported. The maximum output and slope efficiency were measured to be 2.0 W and 36.1%, respectively.

CJ-P.35 SUN
Structural writing on an antiresonant hollow core fiber.
Y. Zhou, J. Zang, and S. Yoo, Naranyang Technical University, Singapore, Singapore.
Structural writing on an in-house hollow-core antiresonant fiber using electric arc pulses is demonstrated to influence the modal coupling of the fiber and generate fiberlike attenuation at designated wavelengths.

CJ-P.36 SUN
Cascaded Stimulated Raman Scattering in a Chalcogenide optical fiber.
T. Cheng1, 2, S. Li1, X. Yan2, T. Suzuki2, and Y. Oishi2; 1Research Center for Advanced Photon Technology, Nagoya, Japan; 2Northeastern University, Shenyang, China.
Using a nanosecond laser operated at 1545 nm as the pump source, mid-infrared cascaded SRS up to eight orders is obtained in a 16 m As-S fiber.

CJ-P.37 SUN
Fluorescence dynamics of laseractive nanocrystals emitting in the visible.
S. Spelthann1, J. Thiem1, L. Neumann1, H.-H. Johannes2, W. Kovalski2,4, D. Kracht4, J. Neumann1,4, A. Rueth1,3, and D. Ristić1,2,4; 1Leibnitz Universität Hannover, Hannover, Germany; 2Technische Universität Braunschweig, Braunschweig, Germany; 3Laser Zentrum Hannover e. V., Hannover, Germany; 4Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering - Innovation Across disciplines), Hannover, Germany.
Multiphoton quenching of excited Ions can avoid laseroperation in nanocrystals. The fluorescence lifetime of nanocrystals emitting in the visible spectral regime has been investigated using Förster-Resonant-Energy Transfer (FRET) and Dexter-Energy Transfer (DET).

CJ-P.38 SUN
Optimisation of dispersion flatness in nanostructured core fibres.
D. Michalik1,2, T. Stefanik1,2, D. Pyz1, A. Filipkowski1, D. Buczyński1,2, and R. Buczyński1,2; 1Institute of Electronic Materials Technology, Warsaw, Poland; 2Faculty of Physics - University of Warsaw, Warsaw, Poland.
A fibre composed of pure silica nanorods and silica nanorods highly doped with Ge (concentration of GeO2 equals 20%) mol. Modification of core internal structure affects electric field distribution allowing to achieve flat dispersion profile.

CJ-P.39 SUN
Bismuth doped fiber for filtering applications.
D. Jain1, N.K. Tilparappu2, and J.K. Sahu2; 1School of Physics, University of Sydney, Sydney, Australia; 2Optoelectronics Research Center, University of Southampton, Southampton, United Kingdom.
A novel bismuth-alumina doped fiber has been developed. This offers very high suppression of the wavelengths below 1050 nm with a steep edge and act as a high pass filter.

CJ-P.40 SUN
Infrared 1000-nm-Supercontinuum by Means of Self-Frequency Shift of Raman Solitons Supported by Four-Wave Mixing.
M. Zajmaina; Aston Institute of Photonic Technologies, Birmingham, United Kingdom.
I present and numerically study a fibre-based system for generation of a 1000-nm-wide equally intense near-IR supercontinuum resulting from an interplay of self-frequency shift of Raman solitons and four-wave mixing in a highly-nonlinear fibre.

CJ-P.41 SUN
Mitigating Supercontinuum Shot-to-Shot Fluctuations in an Anomalous Dispersion Highly Nonlinear Fiber by Length Optimization.
R. Lindberg1, J. Sotor2, T. Martynkien3, V. Pasiekevicius4, and G. Sobol5; 1Department of Applied Physics, Royal Institute of Technology, Stockholm, Sweden; 2Faculty of Electronics, Wroclaw University of Science and Technology, Wroclaw, Poland; 3Faculty of Fundamental Problems of Technology, Wroclaw University of Science and Technology, Wroclaw, Poland.
We experimentally demonstrate, by employing disperser free measurements, reduced shot-to-shot fluctuations in infrared supercontinuum generated in an anomalous dispersion highly nonlinear fiber by length optimization.

CJ-P.42 SUN
Development of all-glass all-normal dispersion highly nonlinear photonic crystal fibers with introduced birefringence.
D. Dobrakowski1,2, A. Rampur1,2, G. Stepieniewski1,2, R. Kaszelaniak1,2, A. Anuszkiewicz3,4, D. Pyz5, R. Buczyński1,2, and M. Klimek5,6; 1Institute of Electronic Materials Technology, Glass Department, Warsaw, Poland; 2University of Warsaw, Faculty of Physics, Warsaw, Poland.
Development of normal dispersion, polarization maintaining nonlinear fibers is discussed. High nonlinearity, flattened normal dispersion and 103(-4) birefringence are shown in physical fibers. Lamellar core fiber variant with 103(-6) birefringence is discussed using numerical simulations.

CJ-P.43 SUN
Highly birefringent nanostructured core optical fiber compatible with SMF28 standard.
D. Michalik1,2, T. Stefanik1,2, D. Pyz5, A. Filipkowski1, R. Buczyński1,2; 1Institute of Electronic Materials Technology, Warszawa, Poland; 2Faculty of Physics - University of Warsaw, Warszawa, Poland.
We propose a new fiber design compatible with SMF28 standard but exhibiting strong birefringence. It is composed from thousand of pure silica and Ge-doped nanorods, stacked together to form low and high refractive index stripes.

CJ-P.44 SUN
Signal Amplification in CsPbBr3 Nanoparticle-Doped Photonic Crystal Fibers.
J. Navarro-Arenas1, I. Suárez2, A. Ferrando1, A. F. Gualdrón-Reyes1, J. Mora-Sérbol1, F. Gao1, W. Wang3, J. Martínez-Pastor1, and Z. Sun4; 1Instituto de Ciencia de Materiales, Valencia, Spain; 2School of Telecommunication Engineering, Fuenlabrada, Spain; 3Department d’Optica i Ionoptica i Ciències de la Visions, Valencia, Spain; 4Institute of Advanced Materials, Castelló, Spain.
The Crosstalking and birefringence of a Photonic Crystal Fiber filled with a nano-ink based on CsPbBr3 Colloid-al Nanoparticles allowing for signal amplification with a +4 dB gain figure.

CJ-P.45 SUN
Generation of Multi-gigahertz Laser Pulses in Optical Lattice-like Cladding Waveguides with PdSe2 as A New Saturable Absorber.
Z. Li1, N. Dong2, J. Wang2, J.R. Vázquez de Aldana3, H. Yu1, and F. Chen1; 1School of Physics, State Key Laboratory of Crystal Materials, Shandong University, Jinan, China; 2Laboratory of Micro-Nano Photonic Optoelectronic Materials and Devices, Key Laboratory of Materials for High-Power Laser, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, China; 3Laser Microprocessing Group, Facultad Ciencias, Universidad de Salamanca, Salamanca, Spain.
Here we present detailed modelling and characterisation of a Photonic Crystal Fiber filled with a nano-ink based on CsPbBr3 Colloidal-Nanoparticles allowing for signal amplification with a +4 dB gain figure.
We report on 9.25 GHz fundamentally mode-locked monolithic waveguide laser based on optical lattice-like cladding microstructures and palladium diselenide as a new saturable absorber.

**CJ-P.46 SUN**

Modeling of the Ultra-Stable Operating Regime in Fourier Domain Mode-Locked (FDML) Lasers
- M. Schmidt, T. Pfeiffer, C. Grill, R. Huber, and C. Jauschek
- Technical University of Munich, Munich, Germany
- Universität zu Lübeck, Lübeck, Germany

We theoretically describe the formation of a recently observed ultra-stable operation in Fourier domain mode-locked (FDML) lasers and show that perturbations such as a residual dispersion can be compensated by a passive self-stabilizing mechanism.

**CJ-P.47 SUN**

Mode re-locking in an RF detuned actively mode-locked fiber ring laser
- S. Krishnamoorthy, S. Mayor, and A. Prabhakar
- Indian Institute of Technology, Madras, Chennai, India
- National Centre for Biological Sciences, Bengaluru, India

We demonstrate coherent combining of picosecond pulsed beams from four fiber amplifiers in the LBO nonlinear crystal. Maximum combining efficiency of 49% is demonstrated and maximum combined pulse energy of 108 μJ is achieved.

**CJ-P.48 SUN**

Dual-wavelength mode-locking of waveguide Nd:YAG laser with graphene
- M. Ponarina, A. Okhrimchuk, M. Smayev, and P. Obraztsov
- Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia
- Fiber Optics Research Center of the Russian Academy of Sciences, Moscow, Russia
- Mendeleev University of Chemical Technology of Russia, Moscow, Russia

We demonstrate an all-fiber ultrafast SESAM-based optically repletion rate mode-locked oscillator concept. Pump induced refractive index change in the active erbium fiber for the precise delay line was tested. Different schemes were analyzed and compared.

**CJ-P.49 SUN**

4.37 GHz L-band Passively Harmonic Mode-locked Fiber Laser Based on Nonlinear Polarization Rotation
- Y. Ling, Q. Huang, Z. Xing, Z. Tan, and C. Mou
- Shanghai University, Shanghai, China
- Huazhong University of Science and Technology, Wuhan, China
- A National L-band passively harmonic mode-locked fiber laser based on nonlinear polarization rotation is first demonstrated. 4.37 GHz pulses with the super-mode suppression ratio of 34 dB are obtained at 712 mW pump power.

**CJ-P.50 SUN**

Compact One-octave Spanning Supercontinuum Generation by Amplification of Noise Like Pulses in Yb-doped Fiber Amplifier
- E. Aghayari, K. Ísmahlí Ghalal, M. Karimi, V. Vatani, and S.H. Sabari
- Department of physics, Azarbaijan Shahid Madani University, Tabriz, Iran
- Iranian National Center for Laser Science and Technology, Tehran, Iran

We report on a 7.5 W compact supercontinuum source with 10-dB spectral bandwidth of 1.130 nm by amplification of noise like pulses in Yb-doped fiber amplifier that operates in nonlinear regime.

**CJ-P.51 SUN**

Generation of Optical Pulses with 69-nm-Wide Broadband Spectrum Directly from a Mode-locked Yb-doped Fiber Laser
- J. Iim, S.Y. Set, and S. Yamashita
- The University of Tokyo, Tokyo, Japan

A broadband 1 μm coherent source based on the mode-locked Yb-doped fiber laser is demonstrated, which delivers a maximum 10-dB spectral width of 69 nm with the average power higher than 100 mW.

**CJ-P.52 SUN**

Optical Retrigger Rate Stabilization Techniques of Ultrafast Yb Doped All Fiber Oscillator
- K. Madeikis, Z. Xing, K. Midilli, and B. Orta
- Ekspla Ltd., Vilnius, Lithuania

Mode locking of the RF detuned actively mode-locked laser is extended for multiple inputs. Injection-lock is recovered and an increase in range of the cavity modes is achieved with two inputs.

**CJ-P.54 SUN**

µs pulsed, low repetition rate, 30 W fiber laser at 1550 nm
- S. Pavlova, E. Vogel, K. Eken, E. Tunca, and I. Pavlov
- FiberLAST, A.S., Ankara, Turkey
- Middle East Technical University, Ankara, Turkey
- Institute of Physics of the NAS of Ukraine, Kiev, Ukraine
- Hacettepe University, Ankara, Turkey

We report a µs Yb system at 1551 nm wavelength, emitting controllable rectangular-shape µs pulses with peak power up to 32 W.

**CJ-P.55 SUN**

Controllable Generation of Ultrashort Multi-bound Solitons in a Mode-locked Erbium-doped Ring Laser with a Highly-nonlinear Resonator
- Bauman Moscow State Technical University, Moscow, Russia
- Aston Institute of Photonics Technologies Aston University, Birmingham, United Kingdom

In this paper, we have experimentally demonstrated the formation of ultrashort multi-bound solitons with the controllable number of bound states by pump power variation obtained in a highly-nonlinear all-fiber ring cavity.

**CJ-P.56 SUN**

Dual-wavelength dual-comb mode locked Er-doped fiber laser based on Saganc fiber loop mirror
- Toyota Technological Institute, Nagoya, Japan

We report an all-fiber dual-wavelength dual-comb mode locked fiber laser based on a Saganc fiber loop mirror. Two asynchronous mode locked pulse trains with repetition rate difference of 218 Hz was realised.

**CJ-P.57 SUN**

The Optimization of Compact High Energy Fiber CPA System for Bio-Imaging Applications
- E. Bartulevicius, L. Villetaneuse, France

We theoretically describe the formation of ultrashort multi-boundsolitonswiththeamplificationofnoise like pulses in Yb-doped fiber amplifier that operates in nonlinear regime.

**CJ-P.58 SUN**

The Influence of Negative Cavity Dispersion on Timing Jitter of an All-PM SESAM Mode-Locked Fiber Oscillator
- K. Viskontas, K. Madeikis, R. Danilevicius, and A. Michailovas
- Ekspla, Vilnius, Lithuania
- East Technical University, Ankara, Turkey
- Middle East Technical University, Ankara, Turkey
- Institute of Physics of the NAS of Ukraine, Kiev, Ukraine
- University of Science and Technology, Wuhan, China
- Indian Institute of Technology, Madras, Chennai, India
- Center for Physical Sciences and Technology, Vilnius, Lithuania
- A compact 10 μJ energy and 26 MW peak power fiber chirped pulse amplification system together with numerical calculations for optimization of laser output parameters and mitigation of photodarkening effect is presented.

**CJ-P.60 SUN**

On modelling of NPE mode-locked fiber laser in presence of Raman scattering
- A. Bednyakova, D. Kharenko,1,3 A. Varovkov1,2
- Novosibirsk State University, Novosibirsk, Russia
- Institute of Computational Technologies SB RAS, Novosibirsk, Russia
- Institute of Automation and Electrometry, SB RAS, Novosibirsk, Russia

We demonstrate coherent combining of picosecond pulsed beams from 4 fiber amplifiers in the LBO nonlinear crystal. Maximum combining efficiency of 49% is demonstrated and maximum combined pulse energy of 108 μJ is achieved.

**CJ-P.61 SUN**

Coherent beam combining by noncollinear sum-frequency generation
- J. Úheldevičius, R. Rutkauskas, and K. Regelskis
- Center for Physical Sciences & Technology, Vilnius, Lithuania
- We demonstrate coherent combining of picosecond pulsed beams from 4 fiber amplifiers in the LBO nonlinear crystal. Maximum combining efficiency of 49% is demonstrated and maximum combined pulse energy of 108 μJ is achieved.

**CJ-P.62 SUN**

Single-mode operation with no mode-hops of a 110m long Brillouin fiber laser with non-resonant pumping G. Danion, L. Frein, D. Bacquet, E. Pillot, S. Molin, L. Morvan, G. Ducournau, M. Vallet, B. Sireffgiatan, and M. Alouini
- Universite Rennes, CNRS, Institut FOTON
CJ-P.63 SUN

Raman based power combining and wavelength conversion of multiple fiber lasers – Number scaling and limits on wavelength separation

V. Balaswamy, S. Aparanji, and V.R. Supradeepa; Centre for Nano Science and Engineering, Indian Institute of Science, Bengaluru, India

We investigate scalability of number of pumps and limits on wavelength separation in Raman based power combining and wavelength conversion. Power combining at 1.5μm with 3 independent Yb lasers with 5nm-29nm wavelength separation was achieved.

CJ-P.64 SUN

Brillouin assisted electrooptic self-narrowing of laser linewidth

G. Danjon1, M. Valler1, L. Frein1, P. Szifriges2, and M. Alouini; 1 Univ. Rennes, CNRS, Institut FOTON - UMR 6082, Rennes, France, 2 Lab. PHLAM, UMR Université de Lille 1 CNRS 8523, Lille, France

Optical phase-locking of a 1.55 μm solid state laser pumping a long Brillouin fiber laser leads to a 2Hz linewidth narrowing for the pump laser itself. The method can be extended to almost any laser.

CJ-P.65 SUN

Deep-UV extended tunable micro-plasma radiation source

E. Delahaye, F. Amrani, B. Debord, F. Gérôme, and F. Benabid; Xilim, Limoges, France

We report on the generation of deep-UV extended micro-plasma in hollow-core photonic crystal fiber and demonstrate tunable UV radiation by integrating Littrow-like configuration cavity.

CJ-P.66 SUN

Tolerance analysis for piston and tilt error in hexagonal laser phased array

P. Gontar and J.K. Jabczynski; Military University of Technology, Warsaw, Poland

Numerical analysis of the influence of beam shape on the piston and tilt error tolerances for the hexagonal array was carried out. Our results show that the Gaussian beam has a higher tolerance than top-hat.

CJ-P.67 SUN

Optimization of Signal Characteristics in Fiber Laser with Quasi-Distributed Gain

O.V. Shytirina1,2, S.A. Efremov1, L.A. Yarutkina1, A.S. Skidin2, A.V. Ivanenko1, and M.P. Fedoruk1,2; 1 Novosibirsk State University, Novosibirsk, Russia, 2 Institute of Computational Technologies SB RAS, Novosibirsk, Russia

We propose the general theoretical method to find the gain distribution in fiber laser with quasi-distributed gain and study the behavior of the output signal for various parameters of fiber laser with cavity dumping.

CJ-P.68 SUN

Different Lasing Regimes of Parity-Time Symmetric Fiber Ring Laser

S. Smirnov, M. Makarenko, and D. Churkin; Novosibirsk State University, Novosibirsk, Russia

We demonstrate a novel PT-symmetric fiber laser scheme that supports turbulent, laminar and pulsed lasing regimes. Switching between regimes of different types and symmetry can be done by adjustment of pump power and phase shift.

CJ-P.69 SUN

Design and optimization of laseractive nanoparticles for fiber lasers

J. Thiemi, S. Spielthann1, L. Neumann2, H.-H. Johann1, W. Kowalsky2, D. Kracht3, J. Neumann1,2, A. Ruhl1,3, and D. Rusti1,3; 1 Leibniz Universität Hannover, Hannover, Germany; 2 Technische Universität Braunschweig, Braunschweig, Germany; 3 Laser Zentrum Hannover e.V., Hannover, Germany

Cluster of Excellence PhoenixD (Photonics, Optics and Engineering - Innovation Across Disciplines), Hannover, Germany

The effects of fluorescence lifetime, scattering and material attenuation on the gain of a fiber laser, doped with nanoparticles consisting of a doped core and an undoped shell, have been investigated and optimized.

CJ-P.70 SUN

Cooling of Active Fibers in Lasing Conditions using Different Passive Heat Dissipation Systems

N. Terezchenko1, A. Kostrov1, N. Vanyushkin1, R. Shaidullin1,2, and O. Ryabushkin1; 1 Moscow Institute of Physics and Technology, Dolgoprudny, Russia; 2 Laboratory of Computational Technologies SB RAS, Novosibirsk, Russia

We introduce a novel technique based on radiofrequency impedance spectroscopy for measuring the temperature of active fibers in lasing conditions using LiNO3 piezoelectric resonators placed onto the fiber surface as the temperature sensors.

CJ-P.71 SUN

Investigation of longitudinal temperature distribution in active fiber under conditions of laser generation using piezoelectric crystal thermal sensors

A. Kostrov1, N. Terezchenko1, N. Vanyushkin1, R. Shaidullin1,2, and O. Ryabushkin1; 1 Moscow Institute of Physics and Technology, Dolgoprudny, Russia; 2 Laboratory of Computational Technologies SB RAS, Novosibirsk, Russia

We introduce a novel technique based on radiofrequency impedance spectroscopy for measuring the temperature of active fibers in lasing conditions using LiNO3 piezoelectric resonators placed onto the fiber surface as the temperature sensors.

CJ-P.72 SUN

Self-healing dynamically controllable micro-comb

H. Bao1, J.S. Toero Gengora2, M. Rowley3, S.T. Chu4, R.E. Little4, R. Marodrudi3,4, D.J. Moss2, M. Peccei3, M. Patz1, and A. Pasqua1; 1 University of Sussex, Brighton, United Kingdom; 2 City University of Hong Kong, Hong Kong, China; 3 Xi’an Institute of Optics and Precision Mechanics, Chinese Academy of Science, Xi’an, China; 4 NIKR, EMTE, University of Lille, Villeneuve d’Ascq, France

We demonstrate a novel PT-symmetric/micro-comb which locks the pump-Stokes detuning to a local RF oscillator, which locks the pump-Stokes detuning to a local RF oscillator.

CJ-P.73 SUN

Determining the waveguide profile using the overlap integral

A. Alberucci1, C.P. Ishi4, and S. Nolte1,2; 1 Friedrich-Schiller-Universität, Jena, Germany; 2 Fraunhofer Institut for Applied Optics and Precision Engineering, Jena, Germany

We introduce a new near-field method to determine the refractive-index distribution of a waveguide by translating the input beam. The technique is based upon the inversion of the overlap integral using deconvolution algorithms.

CJ-P.74 SUN

Phase Sensitive Amplification in a Periodically Poled Silica Fiber

M. Englebrecht1, F. De Luca1, P.-J.A. Sazio1, S.-P. Gorza1, and F. Leo2; 1 Opena-Photonics, Université libre de Bruxelles, 50 av. E.D. Roosevelt, CP194/5, B-1050, Brussels, Belgium; 2 Optoelectronics Research Centre, University of Southampton, SO17 1BJ, Southampton, United Kingdom

Phase sensitive amplification is demonstrated for the first time in a periodically poled silica fiber. A 6.7 times larger gain compared to FWM based amplification in HNL-SMF with identical length and pump power is obtained.

CJ-P.75 SUN

Demonstration of Spatial Mode Selection in a Coherently Combined Fiber Laser

J. Tilsed, W. Kunkel, and J. Leger; Department of Electrical and Computer Engineering, University of Minnesota, Minneapolis, USA

Self-phasing due to spatial mode selection is demonstrated experimentally in a passive coherent beam combining resonator. The output power and phase difference in a two-core fiber laser exhibit reduced sensitivity to induced phase error.

CJ-P.76 SUN

Intra-cavity mode-selective coupler assisted ultrafast cylindrical vector fiber laser

F. Sh1, T. Wang1, P. Cheng1, Z. Luo2, and Z. Xeng3; 1 Shanghai University, Shanghai, China; 2 Xiamen University, Xiamen, China

We demonstrate an intra-cavity mode-selective coupler assisted all fiber laser that allow direct generation of ultrafast vector beams.

CJ-P.77 SUN

Phasing and Guidance Properties of Multi-Core Fibers under Heat Load

L. Rosa1,2, S. Mckeef1, C. Molaro1, F. Poli1, S. Sellert1, L. Vincetti1, and A. Cucicott1; 1 University of Modena and Reggio Emilia, Modena, Italy; 2 Swinburne University of Technology, Hawthorn, Australia

We study the phase shift and guidance properties of 16-core Yb-doped fibers under heavy heat load conditions, employing analysis by thermal-optical simulations to develop criteria for beam stability and single-mode heated operation.

CJ-P.78 SUN

Experimental observation of anomalous RIN transfer function in ultralong random distributed feedback fiber lasers, confirming theoretical predictions
and opening up the possibility of low-frequency RIN reduction via laser design.

CJ-P.79 SUN
2.5 W, narrow linewidth, 259.0 nm, ruggedized DUV fiber laser source for remote benzene detection
• L. Desbiens, V. Roy, J.-F. Gravel, and Y. Taillon; Institut National de la Recherche Scientifique - Institut d'Optique, 1100, Avenue du Dr. A. Fournier, 78035 Chatou, France

CJ-P.80 SUN
Spectral correlations in radiation of random distributed feedback Raman fiber laser
I. Vatnik1,2, M. Gorenb02, D. Sugavanam1,2, D. Churkin1,2, and E. Podivilov3; 1Novosibirsk State University, Novosibirsk, Russia; 2Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; 3Aston Institute of Photonic Technologies, Aston University, Birmingham, United Kingdom
Spectral correlations in a multiwavelength fiber laser with randomly distributed feedback were directly measured. It was proved that correlations appear at the input of the fiber and are established by relative intensity noise (RIN) transfer.

13:00 – 14:00
JSI-P: JSI Poster session

JSI-P.1 SUN
Deep-Learning-aided 3D direct-laser-writing of the complete connectome of mushroom body from an insect brain
• H. Yu, W. Shao, Q. Zhang, F. Salm, and M. Gu; RMIT University, Melbourne, Australia
Deep-learning-aided 3D direct-laser-writing of mushroom-body from Drosophila brain with sub-micrometer feature size is demonstrated, which provides a potential pathway to replicate neuronal-circuits at larger scale and higher-level understanding of structure-function relationships in engineered neural networks.

JSI-P.2 SUN
High Performance Optical Reservoir Computing based on Spatially Extended Systems
• J. Paauwels1,2, G. Verschaffelt3, S. Massar2, and G. Van der Sande1,2; 1Vrije Universiteit Brussel, Brussels, Belgium; 2Université libre de Bruxelles, Brussels, Belgium; 3Université libre de Bruxelles, OPERA, Brussels, Belgium.
Our work proposes strategies to counter the negative effects of phase noise in a coherent photonics reservoir computer without active stabilization. Our approach uses novel training schemes and readout layer architecture.

JSI-P.3 SUN
Laser printing of a nano-imager to perform full optical machine learning
• E. Gori and M. Gu; RMIT University, Melbourne, Australia
We design a nano-imager for a full optical implementation of a multilayered artificial neural network and explore the feasibility of fabricating the nano-imager in the near infrared using a two-photon symmetry-preserving laser direct fabrication method.

JSI-P.4 SUN
High numerical aperture aberration compensation enabled by an artificial neural network
• P.B. Cumming and M. Gu; Laboratory of Artificial-Intelligence Nanophotonics, School of Science, RMIT University, Melbourne, Australia
We demonstrate the direct determination the phase aberration of a high numerical aperture optical system from a single forward propagation of two point spread function images through a multi-layer perceptron artificial neural network.

JSI-P.5 SUN
Phase noise robustness of a coherent spatially parallel optical reservoir
• R. Alata1, J. Paauwels2,3, G. Van der Sande1,2, A. Bouwere4,3, M. Haelttermann1, and S. Massar2; 1Université libre de Bruxelles, OPERA, Brussels, Belgium; 2Université libre de Bruxelles, LIQ, Brussels, Belgium; 3Vrije Universiteit Brussel, APhY, Brussels, Belgium; 4KU Leuven, MIP, Leuven, Belgium.
We propose strategies to counter the negative effects of phase noise in a coherent photonics reservoir computer without active stabilization. Our approach uses novel training schemes and readout layer architecture.

JSI-P.6 SUN
Nonlinear Activation Function Generation based on Silicon Microring Resonators for Integrated Photonic Neural Networks
• M. Cattaneo1, R. Hamerly2, N. Annavarapu3, S. Sabouri3, and K. Jamshidi2; 1Technische Universität Dresden, Dresden, Germany; 2Massachusetts Institute of Technology, Cambridge, USA; 3Technische Universität Berlin, Berlin, Germany.
Quantum dot lasers under optical injection are rich with nonlinear dynamic properties. We show that square wave dynamics can manifest from a Canard Explosion or through a subcritical Hopf. The squares can be deterministically triggered.

JSI-P.7 SUN
Inhibitory Integrate and Fire Neuron based on Quantum-Dot Intra-Band Transitions in a Semiconductor Laser
• M. Skontranis1,2, G. Sarantoglo2, and C. Mesaratikis3; 1Dept. Information and Communication Systems Engineering, University of the Aegean, Samos, Greece; 2Dept. Informatics and Telecommunications, National and Kapodistrian University of Athens, Athens, Greece.
We demonstrate results concerning optically triggered inhibitory photonic neurons based on single-section laser devices exhibiting both inhibitory functionality, offer picosecond neural spikes, whereas inhibition and excitation are encoded as quantum-dot related waveform transitions.

JSI-P.8 SUN
Type II excitability with quantum dot lasers: Canards, bistabilities and more
• M. Dillane1, J. Robertson2, D. Goulding2, A. Hurado3, and B. Kelleher2,3; 1University College Cork, Cork, Ireland; 2Université libre de Bruxelles, Brussels, Belgium; 3Cork Institute of Technology, Cork, Ireland.
Dual state quantum dot lasers provide unique opportunities for neuromorphic dynamics. We demonstrate control over the number of spikes in a bursting regime and over the refractory time in a Type I excitable regime.

JSI-P.9 SUN
Control of neurodynamic properties in two state quantum dot lasers
• M. Dillane1,2, I. Dubinkin3, N. Fedorov4, T. Erneux2, D. Goulding2, B. Kelleher2,3, and E. Viktorov4; 1University College Cork, Cork, Ireland; 2Université Nationale, Cork, Ireland; 3National Research University of Information Technologies, Mechanics and Optics, St. Petersburg, Russia; 4Université Libre de Bruxelles, Brussels, Belgium.

JSI-P.10 SUN
Noise and Consistency of Analogue Spatio-Temporal Photonic Neural Networks
• X. Porte, L. Andreoli, N. Semenova, V. Semenov, M. Jacquot, L. Larger, and D. Brunner; FEMTO-ST Institute, Besançon, France
Physical analogue implementations of neural networks represent a novel and powerful computational paradigm. We analyze in detail the impact of noise on the performance of analogue and large-scale parallel photonic neural networks.

13:00 – 14:00
JSII-P: JSII Poster session

JSII-P.1 SUN
Homodyne scanning and Heterodyne multiplex Sum Frequency spectroscopy in a shaper based nonlinear microscope
• N. Müller, T. Backup, and M. Motzkus; Physikalisch-Chemisches Institut, Heidelberg, Germany
High spectral resolution in sum frequency spectroscopy is implemented via pulse shaping of sub 10 fs NIR- and MIR-pulses in two detection schemes: homodyne MIR scanning, and heterodyne multiplex detection.

JSII-P.2 SUN
Coherent anti-Stokes Raman Fourier spectroscopy
• H. Rigneault, S. Heuke, K. Belkhir, P. Chatenet, and A. Sentenac; Aix Marseille University, CNRS, Centrale Marseille, Institut Fresnel, Marseille, France
We present a new wide field imaging scheme by means of a coherent Raman Fourier ptychography.

**JSII-P.3 SUN**

**Terahertz spectroscopy of different phenotypes of Arabidopsis thaliana**

K. Singh¹, D. Garg², A. Kataior³, Y. Mudgil³, A. Bandypadhyay⁴, and A. Sengupta⁵; ¹Department of Physics, Indian Institute of Technology Delhi, New Delhi, India; ²Department of Botany, Delhi University, New Delhi, India; ³HTD-IATC, Indian Institute of Technology Delhi, New Delhi, India.

We report the results of THz spectroscopic measurements on two different T-DNA insertion mutants in Arabidopsis thaliana. The spectrum shows several absorption peaks corresponding to water and other biochemical molecules, such as sucrose.

**JSIV-P.1 SUN**

**Heat-assisted femtosecond breakdown of plasmonic nanoparticles**

B.J. Nagy¹,², Z. Pápai³, L. Piter³, P. Priest³, J.B. Krom¹, and P. Dandridge²; ¹MTA Wigner Research Centre for Physics, Budapest, Hungary; ²ELI-ALPS Research Institute, Szeged, Hungary; ³Institut für Physik, Karl-Franzens Universität Graz, Graz, Austria.

Hot-spot melting of lithographically produced plasmonic nanoparticles induced by femtosecond pulses shows that plasmonic breakdown starts at peak field locations. Highly different damage morphologies are attributed to different peak intensities of the plasmon driving pulse.

**JSIV-P.2 SUN**

**Thermal Contact Resistance Measurement in a combined Scanning Thermal Microscope/Scanning Electron Microscope**

A. Ayari¹, D. Renahy², P. Vincent³, N. Blanchard³, E. Guert³, E.O. Chauqui³, S. Meralbi¹, and S. Gomes²; ¹Univ Lyon, CNRS, UCB11, ILM UMR 5306, F-69622, Villeurbanne, France; ²Univ Lyon, CNRS, INSA-Lyon, UCB11, CETHIL UMR5008, F-69621, Villeurbanne, France.

We will present thermal contact measurements on a combined Scanning Thermal Microscope/Scanning Electron Microscope.

**JSVI-P.3 SUN**

**In-situ Optical Temperature Measurement in Micro-Scale during Ultrafast Laser 3D Nanolithography**

S. Vanapička¹, J.B. Queiroz², D. Bazulyté-Paulavičienė², S. Sakrzanova², and M. Malinauskas²; ¹LASER Research Center, Vilnius University, Vilnius, Lithuania; ²Department of Physics, Faculty of Science and Technology, University of Coimbra, Coimbra, Portugal; ³Faculty of Chemistry and Geoscience, Vilnius University, Vilnius, Lithuania.

We propose a method and setup to monitor temperature dynamics in situ within microscopic volumes of polymer. Temperature sensing capabilities of different up-converting nanoparticles are investigated and local heating in polymer during 3D laser nanolithography demonstrated.

**JSIV-P.5 SUN**

**Mid-infrared spectroscopy and mass spectrometry combined to build a comprehensive lung cancer fingerprint of blood plasma**

L. Vornóiná¹, M. Huber¹,², P. Geyer¹, J. Muller¹, C. Leonardoná¹, M. Trubetzkoná¹, K.V. Kepesidnoná¹, F. Krassoná¹,², and M. Zigmantoná¹,²; ¹Max-Planck-Institut of Quantum Optics, Garching, Germany; ²Ludwig-Maximilians-University, Munich, Germany.

FTIR spectroscopy combined with chemical deconvolution of blood serum and plasma from cancer patients was established. Applications for enhancing cancer detection and providing coarse molecular information about cancer conditions will be discussed.

**JSV-P.2 SUN**

**Compact quantum imaging based on induced coherence**

M. Gladić-Bastoš, J.R. León Torres, and M. Gräfe; Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena, Germany.

We demonstrate quantum imaging based on induced coherence without induced emission in a compact single-crystal setup. Our first results will stimulate further work towards extreme light imaging devices for life science.

**JSVI-P.4 SUN**

**Combining broadband IR-spectroscopy with decomposition of molecular complexity for cancer detection in human blood**

C. Leonardoná¹, L. Vornóiná¹,², M. Huber¹,², M. Trubetzkoná¹, K.V. Kepesidnoná¹, F. Krassoná¹,², and M. Zigmantoná¹,²; ¹Max-Planck-Institut of Quantum Optics, Garching, Germany; ²Ludwig-Maximilians-University, Garching, Germany.

We demonstrate the opening and control of spectral almost zero transmission background.

**JSIV-P.3 SUN**

**Plasmonic Heating of Gold Nanoparticles for Controlling of Current Across Lipid Membranes in Modulating Neuronal Behavior Applications**

M.H. Seyedi Nazari¹, A. Ghorbani², P. Ahour³, J. Faheen Babest¹, A. Blaist⁴, L. Dargahi⁴, H. Latif⁴, and M.I. Zibaii¹; ¹Collaborative Research Center, Shahid Beheshti University, Tehran, Iran; ²Neuroscience Research Center and Department of Physiology, Shahid Beheshti University of Medical Sciences, Tehran, Iran; ³Neuroscience Research Institute, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

An optical stimulation technique based on local plasmonic heating of gold nanoparticles (AuNPs) was used to temperature manipulation of neural cells at the nanoscale which can be utilized to regulate membrane currents and conductance situations of membranes.

**JSV-P.3 SUN**

**We present multi-color coherent Raman imaging enabled by millisecond wavelength tuning**

M. Brinkmann¹,², T. Hellwig², and C. Fallnich¹,²; ¹Institute of Applied Physics, University of Münster, Münster, Germany; ²Refracted Laser Systems, University of Münster, Münster, Germany.

We present multi-color coherent Raman imaging with a frame rate of 8 Hz and rapid wavelength tuning within only 5 ms between successive images, enabled by a novel fiber optical parametric oscillator.

**JSIV-P.5 SUN**

**Spectral Thermal Band Gaps in the Near Field Heat Flux**

G. Parrucca, J. Perez-Rodríguez, and R. Esquivel-Survent; Instituto de Física, Universidad Nacional Autónoma de México, Mexico City, Mexico.

We demonstrate the opening and control of spectral band gaps in the near field heat flux by means of surface plasmon-surface phonon polaron coupling in bilayer nanomaterials made of semiconductors and dielectrics.

**JSVI-P.6 SUN**

**Towards Terahertz Sensing Based on Precision Measurements of the AC-Stark Effect with Cold Trapped HD⁺ Ions**

J.L. Constantini; Laboratoire PhLAM, CNRS UMR 8523, Villeneuve d’Ascq, France.

We demonstrate the operation of a single atom HD⁺ optical microscope.
Stark shifts induced on the two-photon rovibrational transitions of cold trapped HD$^+$ ions.

**JSV-P.4 SUN**

Mid-infrared sensing by induced coherence in a single nonlinear waveguide

J. Kumar, S. Saravi, T. Pertsch, and F. Setzpfandt; Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena, Albert-Einstein-Str. 15, Jena, Germany

We study photon-pair generation and induced coherence in homogeneous nonlinear waveguides using a general formalism based on Green’s functions. We demonstrate that the arising quantum interference enables mid-infrared spectroscopy without detecting mid-infrared photons.

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Quantification of NV-centres in Diamond for Room-Temperature Maser

J. Sathian$^1$, J. Breeze$^3$, B. Breeze$^3$, A. Frangeskou$^2$, G. Morley$^2$, and N. Alford$^1$; $^1$Department of Materials, Imperial College London, London, United Kingdom; $^2$Department of Physics, University of Warwick, Coventry, United Kingdom; $^3$Spectroscopy Research Technology Platform, University of Warwick, Coventry, United Kingdom

We report the spectroscopic (absorbance, fluorescence and EPR), and charge transfer studies of NV defect centres in CVD-grown diamond samples for room-temperature continuous maser. The sample concentrations vary from 0.001-2.5 ppm suitable for maser action.
We are now experiencing a revolution in optical technologies, where one can print and control massive optical circuits, on a microelectronic chip.

**Components such as non-linear gain based mid-infrared optical fibers**

**Measurements of the Nonlinear Photonics**

**We propose the generation and manipulation of graphene Plasmons**

**Hypercube states for sub-Planck sensing**

**Intense multi-terahertz fields reconciling as single-photon emitter.**

**Analyze dispersive nanoresonators**

**Lightwave valleytronics at multi-tera-hertz clock rates**

**Programming Multiphoton Entanglement: Theory and Practice**

**Graph states provide an essential language of entanglement for quantum information. We develop 4-8 photon graph state generators and experimentally implement the four-photon variant to demonstrate both kinds of four-qubit graph state entanglement.**

**Thermal Generation and Manipulation of Graphene Plasmons**

**High-power dual-comb thin-disk oscillator**

**Integrated 2D Beam-steering device assisted by fixed lens**
CM-5 Laser nanostructuring of transparent materials for advanced devices
Chair: Armin Rödlens, CNR-Institute for Photonics and Nanotechnologies, Milan, Italy
Control of Laser Induced Stress for Diffractive Optics in Transparent Media
Chair: Airán Ródenas, CNR-Institute for Photonics and Nanotechnologies, Milan, Italy

CM-5 MON 11:15
Guiding prostate cancer biopsies using time resolved 3D fluorescence tomography combined with ultrasound imaging
• C. Handschin1, C. Genevois1, S. Vidal2, G. Machner2, J. Boullet2, M. Perriiolat3, O. Redon4, P. Couillas1, and N. Grenier1;
• 1 Imaginge moléculaire et thérapies innovantes en oncoologie, EA 7435, Université de Bordeaux, Bordeaux, France;
• 2 ALPHANO, Optics and lasers technology center, Toulouse, France;
• 3 CEA-LETI, Département micro technologies pour la biologie et la santé, Grenoble, France;
• 4 CEA Tech en Nouvelle-Aquitaine, Pessac, France
We implemented an instrument based on time resolved fluorescence tomography coupled with ultrasound to localize prostate tumors. An in vivo demonstration has been carried out on a mice model to evaluate the pertinence of the method.

CM-5.2 MON 11:30
Femtosecond laser induced of Nano-gratings on a thin GaN layer grown on a sapphire substrate
• A. Halstuch and A. A. Ishaya; Ben-Gurion University, Beer Sheva, Israel
Nano-gratings with various periods
Tunable all-fiber laser for remote sensing of methane near 3.4 μm

We present a tunable all-fiber laser operating near 3.4 μm with 3 W of output power, specifically designed for remote sensing of methane via absorption lines decoupled from other atmospheric gases.

Mid-Infrared Fiber Laser Wavelength Tunable Dy:ZBLAN

We demonstrate a plug-and-play system that open storeal experimentent entirely based on off-the-shelfs fiber components. We achieve -2 dB of squeezing confirming the validity of this original approach that opens to real-world continuous-variable experiments.

Ultrafast perturbation mapping with 980 W of CW-output power and radial polarization

We report on remotely polarized laser beams with up to 980 W of output power in cw operation by integrating polarization selective highly-reflective grating-waveguide mirrors into an Yb:LuAG thin-disk laser setup.
were inscribed on the surface of a thin GaN layer grown on a sapphire substrate. These gratings are generated by illuminating the surface with 800 nm femtosecond pulses and a phase-mask.

**CM-5.3 MON (Invited) 11:45**

Low-loss geometric phase elements by femtosecond laser writing in silica glass

M. Sakakura, Y. Lei, L. Wang, Y. Yu, and P.G. Kazansky, University of Southampton, Southampton, United Kingdom

Birefringent modification with high optical transmission is produced by focusing femtosecond laser pulses inside silica glass. Geometric phase elements with negligible loss from UV to IR are demonstrated.

**CL-1.3 MON 11:45**

Field-resolved infrared spectroscopy of human blood to tackle lung, prostate and breast cancer detection

M. Huber1, L. Voronina2, W. Schweinberger2, C. Leonardi2, K.V. Kepezius3, C. Hofer4,5,6, S.A. Hussain7, M. Trubetskoy7, A.M. Azzer7, I. Pupeza7,8, F. Krausz1,2, and M. Zigman1,2

1Max Planck Institute of Quantum Optics, Garching, Germany; 2Ludwig Maxmillian University Munich, Department of Physics, Garching, Germany; 3King Saud University, Department of Physics and Astronomy, Riyadh, Saudi Arabia

We perform field-resolved spectroscopy demonstrating sub-μg/ml sensitivities and assess its applicability for cancer detection in a clinical study of 356 individuals by measuring sera of lung, breast and prostate cancer patients along with reference subjects.

**CL-1.4 MON 12:00**

Restoration of Damaged Dental Enamels using Nano-scale Iron-Calcium Phosphate Minerals and Femto-second pulsed near-IR Lasers

A. Anastasiou1, S. Strafford2, M. Malinowski3, A.P. Brown4, M.S. Duggal5, M.N. Routledge5, T.J. Edwards6, C.T.A. Brown7, and F. Krausz1,2

1Instit. of Opto-electronics, Harbin Inst. of Technology, Harbin, China; 2Natural Key Laboratory on Tunable Laser, Harbin Inst. of Technology, Harbin, China; 3Depart. of Hematology, Harbin Medical Univ. Cancer Hospital, Harbin, China; 4Depart. of Pathology, Harbin Medical Univ. Cancer Hospital, Harbin, China; 5Multi-elemental imaging of breast cancer tissues was investigated using laser-induced breakdown spectroscopy. Distribution of calcium, potassium, magnesium and sodium in the cancer tissues was obtained and analysed.

**CH-5.2 MON 11:45**

Miniaturised, Planar, Integrated Bragg Grating Spectrometer

J.W. Field, S.A. Berry, R.H.S. Bannerman, D.H. Smith, J.C. Gates, C.B.E. Gawith, and P.G.R. Smith; Optoelectronics Research Centre, Southampton, United Kingdom

We present a planar, integrated spectrometer using blazed, large-angle, chirped, Bragg gratings. These gratings were fabricated with direct UV writing in FHD silica-on-silicon. Our device has a 2.3 nm spectral resolution over 100 nm bandwidth.

**CH-5.3 MON 12:00**

On-chip photocurrent displacement sensor based on a waveguide-coupled nanomechanical photonic crystal cavity

E. Galeotti1, I. Sersic Vollenbroek1, M. Petruzziello1,2, F. Pagliano1,2, F. van Otten1,2, Z. Zobenica1,2,4, A. Mohtashami1, R. van der Heijden1,2

1Ludwig Maxmillian University Munich, Department of Physics, Garching, Germany; 2Helmholtz Institute Jena, Jena, Germany; 3Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We present a fibre-based 50-MHz laser source of Watt-scale, waveform-stable pulses, covering nearly 4 octaves in the spectral region of fundamental and overtone molecular vibrations (1.4 to 20 μm) with 3 channels.

**CE-5.3 MON 11:45**

Composite Material Antiresonant Fibre Optical Modulator with >3dB Depth

A.H. Lewis, F. De Luca, W. Belardi, C.-C. Huang, J.R. Hayes, F. Poletti, D.W. Hewak, and P.J.A. Sazio; Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom

Here, we integrate an antiresonant fibre with a 2D material, MoS2, for the creation of a CM-ARF. By applying an electrical field onto the device, we show electro-absorptive modulation, reaching a modulation depth of 3.52dB.

**CE-5.3 MON 12:00**

Experimental observation of non-orthogonal modes in tight-binding lattices

L. Macewsky, S. Weimann, M. Kremer, M. Heinrich, and A. Szameit; Universität Rostock, Institute of Physics, Rostock, Germany

The non-orthogonality of modes is often neglected yet indispensable for...
**Tuesday 24 June 2019**

**Room 1 ICM**

**Duration of 270 ns as achieved over a tunable wavelength range of 2.97 to 3.23 μm.**

**Room 2 ICM**

**Chalcogenide Glass Polarization-Maintaining Photonic Crystal Fiber for Mid-Infrared Supercontinuum Generation**

- A.N. Gusikhin
- M. Maneghetti
- C.R. Petersen
- O. Bang
- E. Brilland
- S. Venkatesh
- J. Troles
- J.M. Dudley
- T. Sylvestre
- Institut Femto-ST, CNRS, Université Bourgogne Franche-Comté, Besancon, France
- 2Glasses and Ceramics Group, ISCR UMR-CNRS 6226, University of Rennes 1, 35042 Rennes, France
- 3SolenOptics, 263 Avenue du Gal Leclerc, Campus de Beaulieu, 35700 Rennes, France
- DTU Fotonik, Dept. of Photonics Engineering, Jena, Germany
- 2University of Bristol, Bristol, United Kingdom
- National University of Defense Technology, Changsha, China
- National Innovation Institute of Defense Technology, Beijing, China
- Sun Yat-sen University, Guangzhou, China
- Peking University, Beijing, China
- The University of Western Australia, Crawley, Australia
- University of Queensland, Brisbane, Australia
- We show the first experimental demonstration of quantum steering ellipsoids with integrated photonics. Further, we show a new local filtering operation and how it can improve properties of the quantum steering ellipsoid.

**Room 3 ICM**

**Excitonic Effects in Single Layer MoS2 Probed by Broadband Two-dimensional Electronic Spectroscopy**

- M. Maierlin
- S. Dal Conte
- M. Russo
- J. Wang
- G. Savović
- D. Damico
- A. Kis
- M. Selegi
- S. Khan
- M. Richter
- A.C. Ferrari
- Politecnico di Milano, Milan, Italy
- University of Colorado, Boulder, USA
- JILA - Institute of Physics, Colorado, USA
- ICFO - Institute of Photonic Sciences, Castelldefels, Spain
- We present our latest achievements on the amplification of ultrafast transverse laser pulses. We discuss progress on plasmonic and metamaterial optical devices on silicon. Emphasis is placed on sub-bandgap hot-carrier photodetectors, high-speed intensity modulators, and non-linear devices. Surface-normal structures are of particular interest.

**Room 4a ICM**

**Surface Plasmon Optoelectronics on Silicon**

- P. Berini
- University of Ottawa, Ottawa, Canada
- We discuss progress on plasmonic and metamaterial optoelectronic devices on silicon. Emphasis is placed on sub-bandgap hot-carrier photodetectors, high-speed intensity modulators, and non-linear devices. Surface-normal structures are of particular interest.

**Room 4b ICM**

**Thin-disk multipass amplifier delivering radially polarized ultrafast pulses with an average output power of 1 kW**

- Institut füor Strahlwerkzeuge, University of Stuttgart, Stuttgart, Germany
- We present our latest achievements on the amplification of ultrafast transverse laser pulses. We discuss progress on plasmonic and metamaterial optical devices on silicon. Emphasis is placed on sub-bandgap hot-carrier photodetectors, high-speed intensity modulators, and non-linear devices. Surface-normal structures are of particular interest.

**Monday 24 June 2019**

**Room 3a ICM**

**180 W single-mode laser operation of an Yb:YAG thin disk using a robust direct-bonding process**

- L. Deyra
- R. Bello Doua
- M. Jose Millà
- J. Boulle
- P. Heu
- D. Fellman
- G. D. Cole
- A. Saci
- J.G. Brisset
- A. Courjou
- Alphanov, Talence, France
- Crystaline Mirror Solutions LLC, Santa Barbara, USA
Bound states in the continuum at THz frequencies: Resonances with infinite lifetime in gold dimer arrays


A nano-opto-electro-mechanical transducer for displacement sensing is presented. It consists of a double-membrane photonic crystal cavity integrated with electro-optical read-out and on-chip light delivery. The operation is demonstrated by atomic force microscopy actuation and photocurrent sensing.

Performance Parameter
Decoupled High Efficiency Micro Ring Laser Cavity for Biosensing
L. Chang, M. de Goeje, D. Mjikstra, C.L. van Emmerik, and S.M. García-Blanco; Optical Sciences Group, MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands.

We demonstrate a biosensing oriented micro-ring laser cavity design methodology and its preliminary experimental results. This proposed methodology dramatically improves the design optimizeability by decoupling the performance parameters into several regions in the cavity.

Understanding nanogratings elastic anisotropy: A step towards femtosecond laser-written elastic meta-crystal
P. Vluter and Y. Bellouard; Galatea Lab, STI/IMTE, Ecole Polytechnique Fédérale de Lausanne (EPFL), Neuchâtel, Switzerland.

We characterize the elastic properties of femtosecond laser-written nanogratings in fused silica. These compact integrated waveplates will be demonstrated.

CM-5.4 MON 12:15
Compact Femtosecond Laser Direct Written Integrated Retarders Based On Embedded Nanogratings
K.A. Lammers1, M. Ehrhardt2, J.P. Bérubé3, A. Alberucci3, A. Samzei2, R. Valtchev2, and S. Nolte1,4; 1Institute of Applied Physics, Abbe School of Photonics, Friedrich Schiller University Jena, Jena, Germany; 2University of Twente, Enschede, Netherlands; 3Centre d’optique, photonique et laser (COPL), Université Laval, Quebec City, Canada; 4Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany.

Using femtosecond laser direct writing we have monolithically added embedded waveplates made of nanogratings into fused silica waveguides. Full control over orientation and retardation of these very compact integrated waveplates will be demonstrated.

CM-5.5 MON 12:30
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Decoupled High Efficiency Micro Ring Laser Cavity for Biosensing
L. Chang, M. de Goeje, D. Mjikstra, C.L. van Emmerik, and S.M. García-Blanco; Optical Sciences Group, MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands.

We demonstrate a biosensing oriented micro-ring laser cavity design methodology and its preliminary experimental results. This proposed methodology dramatically improves the design optimizeability by decoupling the performance parameters into several regions in the cavity.

Understanding nanogratings elastic anisotropy: A step towards femtosecond laser-written elastic meta-crystal
P. Vluter and Y. Bellouard; Galatea Lab, STI/IMTE, Ecole Polytechnique Fédérale de Lausanne (EPFL), Neuchâtel, Switzerland.

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We present an overview of our mode-locked Cr:ZnS lasers. We develop a mode-locked Cr:ZnS laser emitting 50-fs pulses using a single walled carbon nanotube film with a resonant absorption around 2.4 μm, and realize the first observation of self-starting in CNT-based mode-locked Cr:ZnS lasers.

We characterize an Yb:YAG thin disk bonded on silicon carbide using an adhesive-free, direct-bonding process. We implement it in a laser cavity to obtain 178 W of CW output power in a single TEM00 mode beam.

We demonstrate a four-port resonant tunnelling device fabricated from a bottle microresonator with nanoscale effective radius variation. The experimentally measured spectrum of our device is in good agreement with the developed theory.

We formulate a new conceptual approach for full Stokes polarization measurement with a single metagrating, and develop novel design through advanced computational optimization of individual nano-resonator properties delivering robust operation even under strong fabrication inaccuracies.
results contribute to the understanding of laser-modified patterns and open up doors toward new types of metamaterials with unconventional elastic properties.

the treatment of vascular lesions
E. Kantola1, T. Karppinen2, A. Karppinen 2, A. Rantamäki 3, I. Leino1, J.-P. Penttinen1, S. Mordeson3, and M. Guina4; 1Optoelectronics Research Centre, Physics Unit, Tampere University, Tampere, Finland; 2Epilaser Oy, Lempäälä, Finland; 3INSERM Unité Onco THAL, Lille, France
We report an 8-W yellow (590nm) laser system designed for the treatment of vascular lesions in dermatology. The system is based on VCSEL-technology and it was successfully used to treat facial telangiectasia.

Comunicaciones, ETSI Telecommunicación, Málaga, Spain
E. Kantola1, T. Karppinen2, A. Karppinen 2, A. Rantamäki 3, I. Leino1, J.-P. Penttinen1, S. Mordeson3, and M. Guina4; 1Optoelectronics Research Centre, Physics Unit, Tampere University, Tampere, Finland; 2Epilaser Oy, Lempäälä, Finland; 3INSERM Unité Onco THAL, Lille, France
In this work we present a method for deriving the fundamental limit of detection for coherently read-out interferometric and ring resonant integrated photonic biosensors, influenced by noise and signal attenuation, and their comparison.

1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Department of Physics, University of Erlangen-Nuremberg, Erlangen, Germany
We demonstrated CEP-stable close to single-cycle pulses at 800 nm and ultraviolet dispersive wave generated in hollow-core PCF. The source provides up to 1 µW energy at 800 kHz repetition rate (0.8 W average power).
**CJ-6.2 MON 14:45**

**Laser Performance of a PLD-Grown Yb:LuAG Double-Clad Planar Waveguide**

**K. Sergey V., P. Jake J., E. Robert W., and M. Iacob L.**

Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom

End-pumped by a diode-laser bar, we demonstrate the first crystalline double-clad Yb:LuAG planar waveguide laser. An output power of $3.3\,\text{W}$ was obtained at $1030.7\,\text{nm}$ with a 20% slope efficiency.

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**EA-1.3 MON 14:45**

**Bending the Rules: Quantum Effects in the Operation of a Microscopic Heat Engine in Diamond**


Clarendon Laboratory, Department of Physics, University of Oxford, Oxford, United Kingdom; Centre for Photonics and Photonic Materials, Department of Physics, University of Bath, Bath, United Kingdom; Schuchl Faculty of Chemistry, Technion Israel Institute of Technology, Haifa, Israel; Department of Physics of Complex Systems, Weizmann Institute of Science, Rehovot, Israel

We demonstrate that quantum coherence can be used to break the classical power bound of a microscopic heat engine, implemented using nitrogen vacancy centers in diamond - a first experimental signature of effects beyond classical thermodynamics.

---

**CA-6.2 MON 14:30**

**Sub-60 fs SESAME-mode-locked Tm:Lu:YAG ceramic laser**


1 Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany; 2 Key Laboratory of Transparent and Optical Functional Inorganic Materials, Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, China; 3 Jiangsu Key Laboratory of Advanced Laser Materials and Devices, School of Physics and Electronic Engineering, Jiangsu Normal University, Xuzhou, China; 4 School of Physics Science and Engineering, Institute for Advanced Study, Tongji University, Shanghai, China; 5 Optoelectronics Research Centre, University of Oxford, Oxford, United Kingdom; 6 Department of Physics, National University of Defense Technology, Changsha, China

We present FWM experiments in a high Q-value Titanium dioxide MRR and achieve an idler power enhancement of 18.6 dB on-resonance comparing to the off-resonance, which support it as an efficient platform for nonlinear OSP.

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**CB-2.3 MON (Invited) 14:45**

**Nonhermitian physics of nano-photon molecule lasers**

**M. Khajavikhan**

CReol, University of Central Florida, USA

We analyze their capabilities for high-speed optical data transmission and find that bitrates far beyond 200 Gbit/s per channel can be expected.

---

**CB-2.2 MON 14:30**

**Ultrafast spin-lasers for optical data communication**


1 Ruhr-University Bochum, Photonics and Terahertz Technology, Bochum, Germany; 2 University of Buffalo, Buffalo, USA; 3 Ulm University, Ulm, Germany

We demonstrate ultrafast polarization dynamics in spin-lasers as an alternative to intensity modulation. We analyze their capabilities for high-speed optical data transmission and find that bitrates far beyond 200 Gbit/s per channel can be expected.

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CReol, University of Central Florida, USA

We analyze their capabilities for high-speed optical data transmission and find that bitrates far beyond 200 Gbit/s per channel can be expected.
Flexible lensless endoscopy

- H. Rigneault1, E. Andersen2, S. Strankuett1, T. Vsvirkan, Q. Vanvind1, and G. Bouwmans2

The fabrication of microstructures is obtained by multiphoton polymerization (MPP) technique with 4Pi focusing conditions. Comparison of the resulting structures is presented with the conventionally fabricated ones.

Lossy Mode Resonance Fiber-Optic Biosensing Allowing Ultra-Low Detection Limit

- E. Chiavaioli1, P. Zubieta2, I. Del Villar3, C.R. Zamarre4, A. Giannetti3, S. Tombelli5, C. Tron6, I.R. Matsinos1, F. Arregui2, and E. Baldini1

Planar plasmonic nanogap antennas are used to investigate the absorption properties of fluorescent lipid analogs in the plasma membrane of living cells and explore their architecture at the nanoscale.

Video-Rate Phase Retrieval Algorithm: a Fast and Universal Method to Retrieve Ultrashort Pulses

- G. Leitgeb1, M. Zilk1, T. Petitsch2, and F. Eilenberger1,2,3,4

We present a common pulse retrieval algorithm that can be universally applied to pulse measurement methods, such as FROG or d-scan. It compares favorably in terms of speed and accuracy to existing approaches.
EA-1.4 MON 15:00
Quantum Temporal Imaging with
Finite Time Aperture
• D. Horoshko1,2, G. Paterna1, and M. Kolobov1; 2 Université de Lille, Lille, France; 3 IMEP-LAHC, Aix-Marseille University, Marseille, France
We consider quantum temporal imaging by means of an SFG-based time lens with finite time aperture, determined by the duration of the stretched pump pulse. We determine the spectrum of squeezing of the image field.

EA-1.5 MON 15:15
The influence of spacetime curvature on quantum emission in optical analogues to gravity
• M. Jacquot1,2 and F. Koenig2; 1Vienna Center for Quantum Science and Technology (VCQ), Faculty of Physics, University of Vienna, Vienna, Austria; 2 School of Physics and Astronomy, University of St Andrews, SUPA, St Andrews, United Kingdom
We use an optical analogue to gravity to investigate the influence of the spacetime curvature on quantum emission. We find that the photon number correlations transition from complex multimode to two-mode when horizons are formed.

EA-4a MON 15:00
Ultrafast Laser Inscription and Laser Operation of Y-branch Splitters in Monoclinic Thulium-Doped Crystals
E. Kieß1,3, P. Loiko1,3, C. Romero3, J.R. Vázquez de Aldana3, V. Zakharov4, A. Veniaminov4, U. Griebner5, V. Petrov5, P. Cany5, A. Braud5, M. Aguilo6, F. Diaz7, and X. Mateos1; 1 Universitat Rovira i Virgili (URV), Tarragona, Spain; 2 Center of research on the Ions, les Matériaux et la Photonique (CIMAP), Normandie University, Caen, France; 3 University of Salamanca, Salamanca, Spain; 7 ITMO University, St. Petersburg, Russia
Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany
Depressed-index Y-branch splitters are fabricated in monoclinic Tm:KLn(WO4)2 crystal by ultrafast-laser inscription. Simultaneous CW laser operation is achieved in both branches of the Y-splitter yielding 0.46 W at ~1845 nm with a slope efficiency of 40.6%.

EA-5b MON 15:00
Thermo-opto-mechanical coupling in GaAs microdisks
• B. Benevides1, A.G. Primo1, N.C. Carvalho2, M. Ménard3, N.C. Fratessi4, G.S. Wiederhecker4, and T.F.M. Alegre5; 1 University of Campinas, Campinas, Brazil; 2 Université du Québec à Montréal, Montréal, Canada
We present a model of coupling between optomechanics and thermal relaxation of cavities. A gallium arsenide microdisk is used to show non-coventional thermo-opto-mechanical coupling which overcomes the optical spring effect.

EA-6a MON 15:00
Growth, Spectroscopy and Laser Operation of Tm,Ho:CNGG: A Promising Disordered Crystal for Mode-Locked Lasers
Z. Pan1,2, P. Loiko3, Y. Wang1, Y. Zhai1,2, H. Yuan1, X. Dai1, H. Cai1, J.M. Serres2, A. Braud5, J.L. Doualan5, P. Cany5, U. Griebner5, V. Petrov5, M. Aguilo6, F. Diaz7, and X. Mateos1; 1 Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany; 2 School of Physics and Astronomy, University of St Andrews, SUPA, St Andrews, United Kingdom; 5 ITMO University, St. Petersburg, Russia
Lasers are prototypenon-Hermitian photonic systems. We present a dual-section distributed feedback (DFB) QCL, where the lasing properties of the laser are strongly affected by the exceptional point at current densities above the first threshold.

EA-6b MON 15:00
Oscillation of Pump-induced Exceptional Point in Distributed Feedback Quantum Cascade Lasers
• M. Shahmohammadi, M.J. Suess, R. Peretti, F. Kapsalidis, M. Beck, and J. Faist; ETH, Zurich, Switzerland
Lasers are prototype non-Hermitian photonic systems. We present a dual-section distributed feedback (DFB) QCL, where the lasing properties of the laser are strongly affected by the exceptional point at current densities above the first threshold.

CB-2.4 MON 15:15
Observation of Pump-induced Exceptional Point in Distributed Feedback Quantum Cascade Lasers
• P. Hosch1,2, C. Haverkamp4,5, R. Benevides1,2, K. von Woedtke1,2, J. Kollmann6,7, M. Ménard3, N.C. Carvalho2, M. Ménard3, N.C. Fratessi4, G.S. Wiederbeck4, and T.F.M. Alegre5; 1 University of Campinas, Campinas, Brazil; 2 Université du Québec à Montréal, Montréal, Canada; 3 Université du Québec à Rimouski, Rimouski, Canada; 4 Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany; 5 ITMO University, St. Petersburg, Russia; 6 Institute of Chemistry, Material and Nanotechnology, Münster, Germany; 7 Centre for Infrared Research, University of Würzburg, Würzburg, Germany
The resonant behavior of a single plasmonic helix with circularly polarized light is investigated, both theoretically and experimentally. Our findings lead to a complete understanding of all resonant features of plasmonic helices of any geometry and material.
Stitchless Support-Free Fabrication of Free-Form Micromechanical Structures Using Femtosecond Laser 3D Lithography

L. Jonasauskas, D. Mackevičius, M. Vaičiūnas, T. Baravykas, Vilnius University, Vilnius, Lithuania

In this work we present efficient layerless stitch-free 3D structuring of functional micromechanical structures. It is achieved by synchronizing linear stages with galvo-scanners, varying focusing conditions and choosing appropriate SZ2080 photopolymer with hard-gel form.

Mueller matrix measurement system for skin polarimetry as additional module for non-contact dermatoscopy

D. Fricke, M. Wollweber, and B. Roth; Leibniz Universität Hannover, Hannover Centre for Optical Technologies, Hannover, Germany

A newly designed diagnostic camera system for dermatoscopy is presented, that takes overview images and zoomed images of skin areas. The system provides free-form geometries, control of the resolution, including sub-100 µm resolution, including Fresnel zone plates.

Fast temperature sensors for fibre-optic flow measurement in interventional cardiology

J.M. Coote, C.A. Mosse, E. Carr, M.C. Finlay, A.E. Desjardins; Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom

We have developed a plasma-mirror FROG based on reflection spectroscopy of liquid-sheet water jet. This technique enables us to characterize a UV waveform and a plasma reflectivity at high-repetition rate.

Mueller matrix measurement system for skin polarimetry as additional module for non-contact dermatoscopy

The contribution has been withdrawn.

Phased array femtosecond laser pulses through Cholesteric Liquid Crystals

S. Residori, S. Costamagna, M. Neradovskiy, A. Bek; Università di Pavia, Italy

We measured changes in spectral phase and intensity of femtosecond laser pulses passed through homemade cholesteric liquid crystals with different thickness and bandgap position. The Fourier-transform spectral interferometry and statistical data analysis technic were used.

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In-situ diagnostic of ultrashort pulses generated by Kerr-index Bragg grating

R. Meyer, C. Xie, R. Giust, C. Billet, B. Morel, and F. Courvoisier; Institut de Physique de Nice, Centre d’Études Structurales, CNRS, Valbonne, France

We generate a Kerr-index Bragg grating in dielectrics providing cross-correlation signal that we use to synchronize and characterize ultrashort probes. Straightforward compressor optimization and angular dispersion correction are experimentally demonstrated with ~30 fs probe pulses.

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Zinc Indiffused Diced Ridge PPLN Waveguides for Photorefractive Damage Resistance and Spectral Engineering
S.A. Berry1, L.G. Carpenter1, J.C. Gates1, P.G.R. Smith1,2, and C.B.E. Gawith1,2
1 Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2 Covesion Ltd., Romsey, United Kingdom
We present our latest work on zinc indiffused diced ridge PPLN waveguides. This includes: input power scaling at different temperatures, photorefractive damage response, and spectral engineering through customised poling grating apodisations.

Controlling symmetry and localization with artificial gauge fields in disordered quantum systems
C. Hainaut1, I. Manon2, J.F. Clément1, J.C. Garreau1, P. Szriftgiser1, G. Lemarie2, N. Chehror2, D. Delande1, and R. Chichereau1
1 Université de Lille, Laboratoire de Physique des Lasers Atomes et Molécules, Villeneuve d'Asq, France; 2 Laboratoire de Physique Théorique, Université de Toulouse, Toulouse, France; 3 Laboratoire Kastler Brossel, Collège de France, Paris, France
We present the realization of synthetic gauge fields in disordered, periodically-driven (Floquet) quantum systems. We also show the first experimental observation of the Coherent Forward Scattering, a novel microscopic manifestation of the Anderson localization.

Precisely Dispersion Tailored Crystalline Microresonator with a Q Exceeding 1012 Fabricated by Computer-controlled Machining
S. Fajil1, M. Fuchida1,2, H. Armano1, S. Tanaka1, R. Suzuki1, Y. Kakimura1, and T. Tanabe1
1 Department of Electronics and Electrical Engineering, Faculty of Science and Technology, Keio University, Yokohama, Japan; 2 Department of System Design Engineering, Faculty of Science and Technology, Keio University, Yokohama, Japan
We fabricated a crystalline WGM microresonator employing a computer-controlled ultraprecise machining that requires no hand polishing. MgF2 microresonators show an ultrahigh Q of 1.4 x 1014, which is the highest Q obtained without a polishing process.

Spectroscopy, Continuous-Wave and Passively Q-switched Laser Operation of Transparent Tm:LuAG Ceramics
F. Yue1,2, M.-Y. Chen1, L. Basyrov3, P. Loko4, J.M. Serres3, Y. Wang2, J. Li5, and J. Lambathan6, A. Lucianetti7, T. Mock2, S. Dai2, Z. Chen2, S.Y. Choi1, J.E. Bae1, F. Rotermund1, M. Aguiol1, F. Diaz1, U. Griebner5, V. Petrov2, and X. Mateos2
1 Institut d’Optique, Ecole Normale Supérieure, Université Paris-Saclay, Palaiseau, France; 2 ILIAS Center, University of Cambridge, Cambridge, United Kingdom; 3 Key Laboratory of Transparent and Opto-Functional Inorganic Materials, CAS Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, China; 4 Department of Physics, KAIST, Daejeon, South Korea
The synthesis, spectroscopy and efficient microchip CW and PQS laser operation of Tm:LuAG transparent ceramics are presented. In CW, 3.12 W at 2021-2035 nm with η = 60.2% is achieved. SWCNTs are used for PQS.

From nano to Crystalline Microresonator with a Precisely Dispersion Tailored System
fabricated by coupling two InP-based photonic structures realizing complex-Birefringent and Chiral systems with judiciously tailored and minimum necessary polarization-dependent losses. We experimentally demonstrate their unique properties in the amplification of small polarization differences.

Collective laser emission in coupled hybrid InP-on-SOI nanocavities
Q. Chateillier1,2,3, D. Sanchez1, and F. Raineri1,2
1 Centre for Nanoscience and Nanotechnology (C2N), Palaiseau, France; 2 Université Paris Diderot, Paris, France
The development of nanolasers integrated within a photonic platform is crucial to develop power efficient optical links. Our group is studying the collective laser emission obtained by coupling two InP-based nanolasers through a SOI wave.
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<thead>
<tr>
<th>ROOM 14b ICM</th>
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<th>ROOM 1 Hall A1</th>
<th>ROOM 2 Hall A1</th>
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<tbody>
<tr>
<td><strong>CM-7.1 MON 16:15 – 17:45</strong></td>
<td><strong>CL-2.5 MON 15:30</strong></td>
<td><strong>CH-6.5 MON 15:30</strong></td>
<td><strong>CF-6.6 MON 15:30</strong></td>
<td><strong>CE-6.5 MON 15:30</strong></td>
</tr>
<tr>
<td>New trends on laser ablation</td>
<td>3D nanoprinted high NA ultra-compact catadioptric lens for efficient collection in forward detection configuration microscopy</td>
<td>High Sensitivity All-fibre Methane Sensor with Gas Permeable Teflon/Cryptophane-A Membrane</td>
<td>Spatial Characterization of Synthesized Infrared Sub-Cycle Pulses</td>
<td>X-Ray Imaging of Functional Three-Dimensional Photonic Nanostructures with 20-nm Resolution</td>
</tr>
<tr>
<td>Chair: David Grojo, Aix-Marseille University, Marseille, France</td>
<td>• A. Bertocci, S.P. Lapiens, V.P. Rajamanickam, and C. Liberele; King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia</td>
<td>R. Ismael, A. Beaton, A. Donko, W. Tulataisong, T. Lee, T. Brotin, M. Beresna, M. Mowlem, and G. Brambilla; Opoelectronics Research Center, southampton, United Kingdom; National Oceanography Centre, southampton, United Kingdom; Laboratoire de chimie, Univ. Lyon, Lyon, United Kingdom</td>
<td>M.A. Silva-Toledo, R. Scheibel, G.M. Rossi, R.E. Mair, Y. Yang, G. Cirmi, and F.X. Kartner; Center for Free-Electron Laser Science/Deutsches Elektronen-Synchrotron, Hamburg, Germany; Physics Department, University of Hamburg, Hamburg, Germany; The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany</td>
<td>D. Grishina, C. Hartevedt, A. Pucareanu, D. Devashish, A. Lagendijk, P. Cloetens, and W. Voos; University of Twente, Enschede, Netherlands; European Synchrotron Radiation Facility (ESRF), Grenoble, France</td>
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<tr>
<td><strong>CM-7: New trends on laser ablation</strong></td>
<td><strong>CL-3: Novel lasers, instruments and technology</strong></td>
<td><strong>CH-7: Microstructured fibre sensors</strong></td>
<td><strong>CF-7: Ultrabroadband laser sources</strong></td>
<td><strong>CE-7: Advances in optical fibre configurations and materials</strong></td>
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<td>Chair: David Grojo, Aix-Marseille University, Marseille, France</td>
<td>Chair: Robert Huber, Universität von Lübeck, Lübeck, Germany</td>
<td>Chair: Lantian Chang, University of Twente, Twente, The Netherlands</td>
<td>Chair: Valentina Shumakova, University of Ottawa, Ottawa, Canada</td>
<td>Chair: Daniel Milanese, Politecnico di Torino, Torino, Italy</td>
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<td><strong>CM-3.1 MON 16:15 – 17:45</strong></td>
<td><strong>CL-3.1 MON 15:30</strong></td>
<td><strong>CH-7.1 MON 16:15</strong></td>
<td><strong>CF-7.1 MON (Invited) 16:15</strong></td>
<td><strong>CE-7.1 MON 16:15</strong></td>
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<td>Millijoule level laser system delivering 1 to 18 GHz intra-train repetition rate picosecond pulses for materials processing</td>
<td>Time-lapse intravital imaging of biomaterials integration in tissues using a multicolor multiphoton microscope</td>
<td>Continuous counting and sizing of airborne nanoparticles using hollow-core photonic crystal fibre</td>
<td>51 W, multi-GW few-cycle laser spaying 1.2 – 2.2 μm wavelength</td>
<td>Fabrication and Characterization of Tapered Single-Ring Hollow-Core Photonic Crystal Fibre</td>
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<td>Max Planck Institute for the Science of Light, Erlangen, Germany;</td>
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In this work, we demonstrate the real-time evolution of temporal and spectral profile during the counter-propagating solitons formation in a bidirectional mode-locked erbium-doped fibre laser using spatio-temporal intensity measurements and the dispersive Fourier transform technique.

**EA-2.2 MON 16:30**

**Atomic interaction via diffractive light coupling**

- T. Ackermann, A. Costa Boquet1, I. Kreuz1, G. Bais1, G. R.M. Rohb2, G.; L. Oppo1, P.F. Griffin1, G. Labeyrie1, and R. Kaiser1; 1SUPA and Department of Physics, University of Strathclyde, Glasgow, United Kingdom; 2Institute of Physics, Zagreb, Croatia; 3Institut de Physique de Nice, Universite Cote d’Azur, Valbonne, France

We discuss the spontaneous formation of ordered phases of atomic density or polar and nematic spin patterns via light induced interaction. Diffractive dephasing leads to oscillatory interactions sustaining spontaneous lattices in cavities or feedback systems.

**EA-2.3 MON 16:45**

**Single collective excitation of atoms evanescently coupled to a nanoscale waveguide**

- J. Raskop, N. Corzo, A. Chandra, A. Sheremet, B. Gouraud, J. Berroin, and J. Laurat; Laboratoire Kastler Brossel (LKB), Paris, France

Using atoms trapped along an optical nanofibre, we observe a single collective atomic excitation coupled to a nanoscale waveguide. The sub-

ions. This technique promises to speed up entanglement operations between trapped ions.

**CA-7.2 MON 16:45**

**Efficient Tm:YAG and Tm:LuAG lasers pumped by red tapered diodes**

- E. Beyalet1, B. Sumpf2, G. Erber2, and U. Demirbas3,4; 1Recep Tayyip Erdogan University, Rize, Turkey; 2Ferdinand-Braun-Institut, Berlin, Germany; 3Antalya Bilim Universitesi, Antalya, Turkey; 4Deutsche Elektronen Synchronot , Hamburg, Germany

This presentation will review the challenges associated with diode-pumping of Tisapphire and the rapid recent progress made internationally in delivering diode-pumped Tisapphire lasers of increasing utility.

**CB-3.2 MON 16:30**

**High-Power III-V-on-Silicon Semiconductor Optical Amplifier (> 50 mW) for Integrated Mode-Locked Lasers**

- K. Van Gasse1,2, R. Wang1,2, and G. Roekens1,2; 1Photonics Research Group, Ghent University - imec, Gent, Belgium; 2Center for Nano- and Biophotonics, Gent, Belgium

In this work we report a III-V-on-silicon SOA integrated on a silicon waveguide circuit with a small-signal gain of 27 dB, a record CW output power exceeding 50 mW and reduced confinement in the III-V.

**CB-3.3 MON 16:45**

**Interferometric sensing with guided-mode resonances**

- A.R. Barth and T.P. Krauss; University of York, York, United Kingdom

To overcome current limitations of guided-mode resonance based biosensing, we propose common-path interferometry as robust and simple phase probing system to measure the phase shift introduced by biomolecular bonding on the sen-
1. ROOM Osterseen ICM

We report on a GHz laser system continuously tunable from 1 to 18GHz. The source can deliver up to 1mJ burst at a repetition rate from 20kHz to few MHz with a pulse duration around 1ps.

2. ROOM 1 Hall A1

Germany

We report a system capable of counting and sizing airborne nanoparticles using a laser and a hollow-core photonic crystal fibre. Sizing of polystyrene particles of diameter between 625 nm to 2 µm with a resolution of 50 nm is demonstrated.

3. ROOM 2 Hall A1

Applied Physics, Friedrich-Schiller-Universität Jena, Jena, Germany; Helmholtz-Institute Jena, Jena, Germany; CREAT, College of Optics and Photonics, University of Central Florida, Orlando, USA; Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

By combining an ultrafast Tm-doped fiber laser system with a non-linear pulse compression stage, we have generated intense two-cycle, 130 fs pulses at 932 kHz repetition rate (51 W) and 1733 nm central wavelength.

4. ROOM 3 Hall A1

University of Erlangen-Nuremberg, Erlangen, Germany

Single-ring hollow-core photonic crystal fibres with remarkably small core diameters (<6 µm) and capillary core-wall thickness (<90 nm) can be fabricated by thermal tapering. The resulting structures and their optical properties are experimentally investigated.

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1. CM-7.2 MON 16:30

GHz-bursts and ultrafast external modulation of femtosecond fiber lasers with kW average power levels

- S. Breithaupt, M. Kienel, A. Hoffmann, M. Müller, A. Klenke, T. Eidam, and J. Limpert
- Active Fiber Systems GmbH, Jena, Germany
- Institute of Applied Physics, Jena, Germany
- Helmholtz-Institute Jena, Jena, Germany
- Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

For novel ablation schemes the generation of adjustable GHz-bursts and, ideally, pulse-to-pulse amplitude control at kW-level average power is often required. We present novel solutions for these demands based on fiber-laser technology and coherent beam combination.

2. CL-3.2 MON 16:30

1.6MHz FDM-L-MOPA Laser with 320MHz pulse repetition rate

- M. Strauch, V. Lutz, J.-P. Kolb, R. Huber, and S.N. Karpf
- Institute of Biomedical Optics, University Of Luebeck, Luebeck, Germany

We present a 1.6MHz FDM-L-MOPA at 106nm, where each sweep is modulated to 200 pulses resulting in 320MHz repetition rate. It achieves multi-Watt peak powers for spectro-temporal encoded applications in sensing, spectroscopy and high-speed imaging.

3. CH-7.2 MON 16:30

Detection and Tracking of Multiple Individual Nanoparticles in Antiresonant Hollow-Core Fibers

- M. Nissen, S. Weidlich, R. Förster, Y. Lahini, and M.A. Schmidt
- Leibniz Institute of Photonic Technology, Jena, Germany
- Helmholtz-Institute Jena, Jena, Germany
- Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We report a system capable of counting and sizing airborne nanoparticles using a laser and a hollow-core photonic crystal fibre. Sizing of polystyrene particles of diameter between 625 nm to 2 µm with a resolution of 50 nm is demonstrated.

4. CF-7.2 MON 16:45

Broadband infrared (2.7-20 µm) generation via random quasi-phase-matched intra-pulse difference-frequency generation

- F. Zhang, K. Fritsch, Q. Wang, F. Krauss, K.F. Mak, and O. Pronin
- Max-Plank-Institute of Quantum Optics, Garching, Germany
- Ludwig-Maximilians-Universität Munich, Munich, Germany
- Beijing Institute of Applied Physics, Friedrich-Schiller-Universität Jena, Jena, Germany
- Helmholtz-Institute Jena, Jena, Germany
- CREAT, College of Optics and Photonics, University of Central Florida, Orlando, USA

We discuss the fabrication conditions for suspended core fibers based on fused silica having a nano-sized central hole in the core. Drawn
Conductor optical amplifier. The oscillator operates in self-starting and stable square pulse or harmonic generation regimes tunable by the adjustment of the spectral filter offsets.

CJ-7.4 MON 17:00
All-PM fibre laser with switchable pulsed regimes driven by electrochemically gated carbon nanotube saturable absorber
Y. Gladish1, A. Mkrtchyan1, D. Kopylov1,2, R. Nyushkov2,3, A. Kokhunovsky2,3, and A.G. Nasibulin1,4; 1Skolkovo Institute of Science and Technology, Moscow, Russia; 2Novosibirsk State Technical University, Novosibirsk, Russia; 3Novosibirsk State University, Novosibirsk, Russia; 4Aalto University, Espoo, Finland
We explored electronic control of pulse regimes in an all-PM Er-fibre laser incorporating an original electrochemically gated in-line carbon nanotube saturable absorber. Reproducible voltage-induced tuning and switching of the mode-locked and Q-switched regimes are demonstrated.

EA-2.4 MON 17:00
Tunable, Narrowband, Entangled Photons interfaced with Atomic Systems
V. Prakash, L. Blanchet, N. Bruno, and M. Mitchell; ICFO-the Institute of Photonic Sciences, Barcelona, Spain
We report on a new source for correlated photon pairs, which are frequency tunable, atom-resonant, narrowband, single mode and entangled. The photons are prepared to explore nonlinear photonics through interaction with ultracold atoms.

EA-2.5 MON (Invited) 17:15
Atomic vapor confined in a nanoscale geometry: From mesoscopic to collective effects
T. Peyrot, J. Keaveney, Y. Sourtas, A. Sargsyan, J-J. Greffel, I. Hughes, C. Adams, and A. Browaeys; 1Laboratoire Charles Fabry, Institut d’Optique Graduate School, CNRS, Palaiseau, France; 2Department of Physics, Rochester Building, Durham University, United Kingdom; 3Institute for Physical Research, National Academy of Sciences, Ashkarak 2, Armenia
Spectroscopy through vapor nanocells of alkali reveals the transition between a dilute non-local to a dense collective response of the atoms to a light field.

CJ-6.4 MON 17:00
On-chip periodic arrays of optical traps based on the superposition of guided modes in silicon waveguides
C. Pin1,2, J-B. Jager2, M. Tardi2, E. Picard2, E. Hadji2, E. de Fornel2, and B. Chuzel1; 1Université de Bourgogne-Franche Comté, Laboratoire Interdisciplinaire Carnot de Bourgogne U.M.R. C.N.R.S. 6303, Dijon, France; 2Université Grenoble Alpes, C.E.A., I.N.A.C., Grenoble, France
We demonstrate on-chip parallel optical trapping and manipulation of 500 nm and 1 μm dielectric particles and cells bacteria using near-field optical lattices at the surface of a few modes silicon waveguide.

CJ-6.5 MON 17:15
Opto-mechanical ultrasound sensor based on sensitive silicon photonic split rib-type waveguide
W.J. Westerveld, M. Mahmud-Ul-Hasan, R. Jansen, X. Rottenberg, S. Severi, and V. Rochus; imec, Leuven, Belgium
We propose a new opto-mechanical ultrasound sensor (OMUS) with innovative silicon photonic split rib-type waveguide. Modeling predicts a low detection limit (2.4 Pa over 15 MHz). We also report successful realization of critical processing steps.

CA-7.3 MON 17:00
Cooling effect of Ti co-doping: increase the system efficiency and prospecting to reach the 70 K cooling temperature
G. Cittadino1, A. Di Lieto1,2, and M. Tonelli1,2; 1Dipartimento di Fisica, Università di Pisa, Largo Bruno Pontecorvo 3, 56127 Pisa, Italy; 2INSM-Institut de Nanoscience-CNR, Piazza S. Silvestro 12, 56127 Pisa, Italy
We demonstrate 30% increasing cooling efficiency of LiYF4:10%Yb:0.004%TM in comparison with Yb single-doped sample, typically used for these applications, according to the strategic interest in optical refrigeration of solids to develop a vibration-free cryo-cooler device.

CA-7.4 MON (Invited) 17:15
LED pumped transition metal lasers
P. Pichon1,2, F. Balemoins1,3, J-P. Drouin1, and P. Georges2; 1Laboratoire Charles Fabry, Palaiseau, France; 2EPFL, Les Ulis, France
Using Ce:LED pumped luminescent concentrators, we described LED-pumped lasers systems based on transition metal gain media (Alexandrite, Cr:LiSAF, Ti:Sapphire). Performance in Q-switched oscillators and in pulse amplifiers are reported.

CB-3.4 MON 17:00
Nearbroad Linewidth InGaAs Laser Diode Based on External Cavity Fiber Bragg Grating
M. Gay1, A. Congar1, D. Mamme2, L. Lablond3, R. Butte3, N. Grandjean3, P. Benard3, and S. Treboul3; 1Univ Rennes, CNRS, Institut FOTON - UMR 6082, Lannion, France; 2Institut de Physique, Ecole Polytechnique Federale de Lausanne (EPFL), Lausanne, Switzerland
We demonstrate single frequency operation of a Fiber Bragg Grating external cavity InGaAs Laser Diode emitting at 396.9 nm and exhibiting a limited linewidth of 3.2 MHz.

CB-3.5 MON 17:15
Mode-hop-free Tuning of a Chip-based Hybrid Integrated InP-Si3N4 Laser
A. van Rees1,2, D. Geskus2, E.J. Klein2, F. Fan1,2, and I.-M. van der Slot2; 1Photonics Institute, TU Wien, Vienna, Austria; 2Institute of Theoretical Physics, TU Wien, Vienna, Austria
We determine and model the impact of strain on the optical mode-hopping behavior in transition metal dichalcogenide monolayers at different excitation wavelengths and find resonances near the C-exciton energies of the investigated materials.

CB-3.6 MON 17:00
Impact of strain on the second-harmonic generation in transition metal dichalcogenide monolayers
L. Mermel1, V. Smekal2, F. Liibisch2, and T. Mueller1; 1Photonics Institute, TU Wien, Vienna, Austria; 2Institute of Theoretical Physics, TU Wien, Vienna, Austria
We demonstrate and model the impact of strain on the optical second-harmonic generation in transition metal dichalcogenide monolayers at different excitation wavelengths and find resonances near the C-exciton energies of the investigated materials.
Mechanisms of pulse to pulse pattern evolution of ultrafast Laser Induced Periodic Surface Structures observed under structured illumination microscopy

C. Maclachlan, A. Aguilar, N. Faure, J.-P. Colombier, and R. Stoian; Laboratoire Hubert Carrien UMR 5516 CNRS, Saint-Etienne, France

Using high-resolution microscopy, we report on pulse to pulse mechanisms that can stabilize or modify the LIPSS pattern during the ultrafast laser irradiation sequence. These mechanisms, based on optical feedback, are supported by FDTD calculations.

Experimental and theoretical study of ultrashort laser excitation of Nickel

T. Genieys1, M. Petrakakis2, G. Tsibidis3, M. Senti1, and O. Učka1
1Laboratoire LP1, Aix Marseille University, CNRS, Marseille, France; 2Materials Science and Technology Department, University of Crete, Heraklion, Greece; 3Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology (FORTH), Heraklion, Greece

We present a study of femtosecond laser interaction with Nickel. We demonstrate mechanisms that can stabilize or modulate the LIPSS formation and study the conditions using optical frequency domain reflectometry.

2Department of Chemistry, University of Cambridge, Cambridge, United Kingdom; 2Max Planck Institute for the Science of Light, Erlangen, Germany

We utilize optofluoroptic hollow-core photonic crystal fibers that uniquely guide light at the center of microfluidic channels for in-situ measurements of carbon nanodot based photoreduction processes. Our results are relevant to photocatalytic solar fuel generation.

Technology, Beijing, China

We present the first infrared source based on intra-pulse difference-frequency generation under random quasi-phase-matching condition. An octave-spanning infrared continuum (2.7-20 μm) at around 20 mW of average power was obtained.

Integrated Optical Fibre - Investigating the Vibrational Response Using Optical Frequency Domain Reflectometry

S.L. Scholl1, R.H.S. Bannerman1, A. Jantzen2, S.A. Berry1, A.C. Gray1, J.C. Gates1, I.J. Boyd2, P.G.R. Smith1, and C. Holmes3
1Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2Parker Aerospace, Parker Hannifin Corporation, Bristol, United Kingdom

Integrated optical fibre is a new, highly robust, low-loss platform for multiple applications including aerospace sensors. We investigate the vibration response of the devices under realistic aerospace vibration conditions using optical frequency domain reflectometry.

High-Power, Sub-Poissonian Twin-Beam Correlations at Blue and Red Wavelengths from Four-Wave Mixing in Photonic Crystal Fiber

P. Petarovíc, V. Agretz, and R. Petkovské; Faculty of Mechanical Engineering, University of Ljubljana, Ljubljana, Slovenia

Shock waves emitted during laser-based processes in ophthalmology are visualized with a technique where each frame in a shadowgraph movie is illuminated by multiply short pulses, providing in-frame visualization of the propagating shock waves.

High-Power and Sub-Two-Cycle 2.5 μm Optical Parametric Chirped Pulse Amplification System

N. Righi, J. Pupérik, S. Hrisovl, I. Gallmann, C. Phillips, and U. Keller; ETH Zurich, Zurich, Switzerland

We present a mid-infrared optical parametric chirped-pulse amplifier (OPCPA) delivering 12.6 W at 100 kHz centering at 2.5 μm. Through a time-gated pulse shaping scheme, the pulses were compressed to 14.4 fs (1.7 cycles).

Development of 3-D Printed Silica Preforms

A. Camacho-Rouale1, M. Núñez-Veluzape2, X. Zhao2, S. Yang2, and J.K. Sahu3
1Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2School of Engineering, University of Southampton, Southampton, United Kingdom

3-D printed silica preforms with complex geometries were produced by a customised SLS printer. The produced porous body was sintered before fibre drawing. An optical characterisation of the fabricated fibre is presented.
We demonstrate a novel pulse evolution in a fiber amplifier. We show that this pulse evolution is driven by a nonlinear attractor and paves the way toward simple, compact fiber systems producing high-energy, ~30-fs pulses.

We present the development of a solid-state based light-matter interface based on colour centers in nanodiamond coupled to plasmonic bullseye resonators. They facilitate strong redirection of the light emission and allow for high collection efficiencies.

We present different dual-wavelength laser layouts implemented into a Photonic Integrated Circuit using a generic InP MPW platform. We compare the attributes and limitations of each design and present experimental results under varying biasing conditions.

The contribution has been withdrawn.
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<th>ROOM 14b ICM</th>
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<td><strong>CM-7.6 MON 17:30</strong></td>
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<td><strong>CH-7.6 MON 17:30</strong></td>
<td><strong>CF-7.5 MON 17:30</strong></td>
<td><strong>CE-7.6 MON 17:30</strong></td>
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<td><em>Atomistic Modelling of the Single-Pulse Ablative Generation of Laser-induced Periodic Surface Structures in Vacuum and Liquid Environment</em></td>
<td><em>Optical neural network by dis-ordered tumor spheroids</em></td>
<td><em>Monitoring the evaporation dynamics of a water droplet inside a microcapillary with nanometre-scale precision</em></td>
<td><em>Highly efficient broadband mid-infrared generation (2.8–12.5 μm) based on a compact Cr:ZnS laser</em></td>
<td><em>Long length/small core step-index silicon core fiber fabricated by improved powder-in-tube process</em></td>
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<td><strong>Monday 24 June 2019</strong></td>
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<td><strong>NOTES</strong></td>
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**Results of a large-scale molecular dynamics simulation aimed at providing insights into mechanisms of ablative LIPSS formation in vacuum and water are presented.** The simulation performed for Cr reveals the interplay of material removal and redistribution.
CA-P.1 MON

Quasi-three-level laser performance with Nd-doped niobate crystals

K. Yan¹, X. Li², X. Yu³, F. Peng¹, Q. Zhang⁴, and B. Don¹;
¹Harbin Institute of Technology, Harbin, China; ²Anhui Institute of Optics and Fine Mechanics, Hefei, China
We demonstrated LD pumped quasi-three-level lasers around 0.9 μm with Nd:GdNbO₄ and Nd:GdYbO₄ crystals. The output power reaches 393 mW in Nd:GdNbO₄ quasi-three-level laser while it is 420 mW for Nd:GdYbO₄ 927 nm laser.

CA-P.2 MON

Diode-pumped cryogenically cooled microchip alexandrite laser operating at 680.4 nm wavelength

M. Frisch, J. Solc, and H. Jelínek; Czech Technical University in Prague, FNSPE, Prague, Czech Republic
Continuous-wave alexandrite microchip laser operating at the so-called R1-line (similar to ruby) at 680.4 nm is reported. Pump process was realized by 445 nm InGaN laser diode providing 3.5 W of output power.

CA-P.3 MON

567 ns pulses from passively Q-switched Er:YLF laser generating at 2.81 μm

R. Švejkar, J. Solc, M. Němec, and H. Jelínek; Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Prague, Czech Republic
Compact CW Q-switched Er:YLF laser at 2809 nm was tested for the first time. Using SESAM and short V-shape laser resonator the duration 567±1 ns with repetition rate 25 kHz were achieved.

CA-P.4 MON

Eye-safe Er:YAG laser Q-switched by CoSparl

M. Němec¹, J. Solc¹, H. Jelínek¹, and K. Nejezchleb²; ¹Czech Technical University in Prague, FNSPE, Prague, Czech Republic; ²Crytux, Ltd., Turnov, Czech Republic
The utilization of CoSparl as saturable absorber for eye-safe Er:YAG laser generating at 1645nm wavelength pumped by 1467nm laser diode was investigated. The Q-switched 65ns long pulses with single pulse energy of 200μJ were achieved.

CA-P.5 MON

Long Runtime Investigation of an Injection Seeded Q-Switched Ho:YAG Laser without Active Stabilisation

G. Renn; German Aerospace Center, Stuttgart, Germany
We report about a Q-switched 2.1 μm Ho:YAG injection-seeded laser running on a self-organizing operational single mode principle up to several ten minutes by just using a pre-set Piezo actuator adjusted resonator length.

CA-P.6 MON

Key technologies for the development of 100 J, 100 Hz cryogenically-cooled active-amplifier mirror

J. Oginó¹, S. Tokita¹, L. Zhouyang², N. Yamaguchi³, S. Motozoh², M. Sakamoto⁴, N. Morio⁵, K. Tsubakimoto⁶, H. Yoshida¹, K. Fujisaki¹, and J. Kawanaka¹; ¹Institute of Laser Engineering, Osaka University, 2-6 Yamadaoka, Suita, Osaka 565-0871, Japan; ²Institute for Laser Technology, 1-8-4 Utsubo-honmachi, Nishi-ku, Osaka, Japan
We are developing the 100 J, 100 Hz cryogenically-cooled active-amplifier mirror. It is necessary to develop the Key technology about cooling structure, bonding, wave front compensation. We will report a overview and currently result.

CA-P.7 MON

Gain analysis of a compact Ho:YAG slab amplifier, end-pumped by a high power Tm:YLF slab laser

D. Morris, M.E. Reilly, and M.J.D. Esser; Heriot-Watt University, Edinburgh, United Kingdom
A compact Ho:YAG slab amplifier is demonstrated, end-pumped by a high power Tm:YLF slab laser. Numerical and experimental studies include spatial and temporal analyses of the amplifier in continuous-wave, kHz ns-pulsed and MHz ultra-short-pulse operation.

CA-P.8 MON

CPA laser system based on Yb fiber seed and two cascades Yb:YAG amplifier for compact OPCPA pump source

L. Veselis¹-², T. Bartulevicius¹-², M. Jelinek¹-², D. Vykoukal¹, J. Pohanka¹, J. Kostelanský¹, and T. Bartulevica³; ¹Ekspla Ltd., Vilnius, Lithuania; ²Center for Physical Science and Technology, Vilnius, Lithuania
Compact CPA system with pulse parameters 10 ml, 1 kHz, 1 ps, M2=1.3 was demonstrated. This architecture shows potential for OPCPA systems both as a pump source for supercontinuum generation and for pumping parametrical amplifiers.

CA-P.9 MON

Cr:Fe:ZnSe laser excited by flash-lamp pumped Er:glass laser

A. Riba¹, H. Jelínek¹, M. Němec¹, M. Čech¹, M.E. Doroshenko¹, and N.O. Kovalenko²; ¹Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Karlovy Vary, Czech Republic; ²Institute of Laser Materials and Technology Research Center, Prokhorov General Physics Institute, Moscow, Russia
An extracavity parametric Raman laser CaCO₃ laser generating the third Stokes single 80-ps pulses at 1629 nm under nanosecond pumping at 1064 nm.

CA-P.10 MON

Tunable and Dual Wavelength Alexandrite Laser Using the Crystal Birefringence

G. Tawy and M.J. Danzien; Imperial College London, London, United Kingdom
Wavelength tuning from 747 to 768 nm with <30GHz linewidth and stable dual wavelength operation with 13nm separation is demonstrated from an Alexandrite laser resonator containing only the birefringent gain medium as the tuning element.

CA-P.11 MON

Population Lensing in Alexandrite Lasers

G. Tawy, J. Wang, and M.J. Danzien; Imperial College London, London, United Kingdom
Wavefront measurement of thermal lensing in an Alexandrite laser demonstrates a weakening of the lens strength when laser was compared to non-lasing, this is attributed to the population lens effect and the mechanism for observed self-Q-switching.

CA-P.12 MON

SESAM Q-switched 1535 nm microchip lasers: pulse duration, repetition rate, and peak-power optimization for LIDAR application

A. Penttinen, A.H. Tampere, Finland
The output parameter combinations of 1535 nm SESAM Q-switched Er:Yb:glass microchip lasers were studied for LIDAR applications. After optimization we obtained 1.5 ns pulses at 20 kHz repetition rate and 1.8 kW peak power.

CA-P.13 MON

Zero-dispersion phase-matched extracavity Raman CaCO₃ laser generating combined activemediumconsistedofCr:ZnSeandCr:CdS with36ps and 1629nm output parameter combinationsof 1535nm SESAM pumped Er:glass laser at 1535 nm.

CA-P.14 MON

Extension of mid-IR lasing spectral region using Cr:ZnSe and Cr:CaSe combined active medium

M. Yamato, N. Saito, and S. Wada; RIKEN, Wako, Japan
We demonstrated extension of mid-IR lasing region using combined active medium consisted of Cr:ZnSe and Cr:CaSe. Tuning range from 2.12 to 2.91 μm and maximum output energy of 2.42 mJ at 2.45 μm were achieved.

CA-P.15 MON

860-femtosecond synchronously-pumped GdVO₄ Raman laser at 1228 nm with 36 picosecond 1065 nm pumping

M. Frank¹, S.N. Smetanin², M. Jelinek³, D. Vyhliðd³, V.E. Shukshin⁴, P.G. Zverev⁵, and V. Kubeček⁶; ¹Czech Technical University in Prague, FNSPE, Prague, Czech Republic; ²Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia; ³Technological University of Denmark, Kgs. Lyngby, Denmark; ⁴Institute for Laser Technology, Osaka University, Osaka, Japan; ⁵Czech Technical University in Prague, Prague, Czech Republic
Synchronously-pumped GdVO₄ Raman laser oscillation on both stretching and bending Raman modes was investigated. The strongest 42-fold self-shortening of the combined-shift 1228 nm Raman radiation pulses down to 860 fs approaching to dephasing time was achieved.

CA-P.16 MON

Spectral luminescence properties of Ho³⁺ ions in active media codoped with Tb³⁺, Pr³⁺ and Yb³⁺ for mid IR laser development

P.G. Zverev, A.A. Konyushkin, A.A. Sirotny, and S.Y. Rasuvan; Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia
Single-crystal fibers of Gd₄O₉, Y₂O₃ and CaF₂ crystals doped with Ho³⁺ and codoped with Tb³⁺, Pr³⁺ and Yb³⁺ were grown and analyzed. The deactivation effects were investigated under 1150 nm and 970 nm LD excitation.

CA-P.17 MON

Synchronously-pumped picosecond Raman laser at 1169 and 1222 nm with single and combined Raman mode shifts in a Ca₃(VO₄)₂ crystal

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Synchronously-pumped Ca₃(VO₄)₂ Raman laser is demonstrated. SRS oscillation at 1169 and 1222nm on single and combined Raman modes was achieved. Strong self-shortening of the 1222-nm pulses down to 1.2ps due to self-mode-locking was obtained.
CA-P.18 MON

Fe2+ :Cd2+ : Mn4+ :Te (x = 0.1 – 0.76) laser generating at 5.5 – 6 μm at room temperature

H. Jelinkova1, M. Doroshenko1, M. Jelinek1, J. Sulc1, D. Vyhlidal1, M. Cech2, V. Osiko3, N. Kovalenko3, and A. Gerashchenko3; 1Czech Technical University in Prague, Prague, Czech Republic, 2Prokhorov General Physics Institute of Russian Academy of Sciences, Moscow, Russia; 3Institute for Single Crystals, Kharkov, Ukraine

We report on optical contact bonded Er:Yb:Gd:AB:Cr:Co:MALO passively Q-switched monolithic laser. The maximal pulse energy of 27 μJ with pulse duration of 2.8 ns resulting in the peak power of ~10 kW was obtained.

CA-P.23 MON

Comparison of Nd:YVO4-based monolithic microchip laser resonators for single-frequency stable, CW diode-pumped laser sources

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Comparison of two monolithic microchip resonators: Nd:YVO4/YVO4:YVO4 patented configuration and very thin Nd:YVO4 host crystal-based cavity operating at 1064 nm is presented. Output powers, conversion efficiencies, resonator temperature and single-mode operation ranges were discussed.

CA-P.24 MON

Passively mode-locked self-frequency doubling Yb:LiGdB4O10 laser

M. Porębski1, M. Kowalczyk1, L. Gheorghe2, M. Grecaleasa3, A. Brousca1, E. Voica3, and J. Soto3; 1Laser & Fiber Electronics Group, Faculty of Electronics, Wroclaw University of Science and Technology, Wroclaw, Poland; 2National Institute for Laser, Plasma and Radiation Physics, Laboratory of Solid-State Quantum Electronics, Bucharest, Romania

We report on a first mode-locked oscillator based on a novel self-frequency doubling Yb:LiGdB4O10 crystal. The paper presents a study of the operation at both fundamental and second-harmonic wavelengths depending on the crystal cut.

CA-P.26 MON

Dual-Wavelength Chirped-Pulse Regenerative Amplifier Based on Yb:LuAP Crystal

A. Rudenko1, V. Kisel2, A. Yasukevich3, K. Hovhannessian4, A. Petrovskiy4, and N. Kaleshov5; 1Center for Optical Materials and Technologies, Belarusian National Technical University, 65/17 Nezavisimosti Ave., Minsk, Belarus, Minsk, Belarus; 2Department of Crystallography and Crystal Chemistry, Moscow State University, Moscow, Russia; 3Institute for Physical Research, National Academy of Sciences, Ashkhabad-2, Armenia

Dual-wavelength chirped pulse regenerative amplifier based on Yb:LuAP crystal demonstrated with maximum output power of 5.4 W of chirped pulses and optical-to-optical efficiency of 22.5% at 1018.3 and 1041.1 nm (2.9±0.5 nm spectral width respectively) and 200 kHz PRE.

CA-P.27 MON

Picosecond Crystal Fiber Amplifier for High Average and Peak Power Compact Lasers with Diffraction Limited Output

K. Georgiev1, X. Xu1, J. Xu1, and I. Bucharov2; 1Department of Physics, Sofia University, 5 James Bourchier Blvd., BG-1164, Sofia, Bulgaria; 2Jiangsu Key Laboratory of Advanced Laser Materials and Devices, School of Physics and Electronic Engineering, Jiangsu Normal University, Xuzhou, China; 3School of Physics and Engineering, Institute for Advanced Study, Tongji University, Shanghai, China

We present a Nd:YAG microchip-oscillator/crystal fiber-amplifier single-frequency compact laser, generating 225 ps pulses with >1.2 mJ energy at 1 kHz and diffraction-limited beam.

CA-P.28 MON

A novel Diode Pumped Alexandrite Ring Laser for Doppler Lidar

J. Höppner1, J. Froh1, A. Maurer1, F. Lübben1, M. Strotkamp2, A. Munk2, and B. Jungblut2; 1Leibniz Institute of Atmospheric Physics, Kühlburgau, Germany; 2Fraunhofer Institute of Laser Technology, Aachen, Germany

Demonstration of a WTT level diode pumped Alexandrite ring laser for sub-MHz Doppler Lidar observations (10-100 km altitude) with advanced Raman/Fire cavity control for precise pulse-to-pulse GHz frequency tuning.

CA-P.29 MON

A comparative study of continuous wave Ti:Sapphire, Cr:LiSfAe, Cr:LiCAF and Alexandrite lasers in thin-disk geometry

U. Demirbaş1,2 and F.X. Kärnert3; 1Antalya Bilim University, Antalya, Turkey; 2Center for Free-Electron Laser Science, Hamburg, Germany

We have numerically investigated thin-disk laser potential of selected transition-metal-doped gain-media, and have shown that Alexandrite and Cr:LiCAF might be attractive alternatives to Yb:YAG, in applications that require sub-100-fs pulses with multi-ten-watt of average power.

CA-P.30 MON

Nd:Gd:Sr2F2 Laser Generating 600 fs Pulses at 0.9 W of Pump Power

V. Kubecek1, M. Jelink1, M. Cech1, D. Vyhlidal1, F. Mat1, D. Jiang1,2, and L. Sr1,2; 1Czech Technical University Faculty of Nuclear Sciences and Engineering, Prague, Czech Republic; 2State Key Laboratory of High Performance Ceramics and Superfine Microstructure, Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, China; 3Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, Beijing, China

Femtosecond operation of novel Nd:Gd:Sr2F2 laser with threshold absorbed pump power of 340 mW is reported. For 632 mW absorbed, the total output of 40 mW was achieved with pulse duration of 600 fs.

CA-P.31 MON

Diode-pumped Tm3+-doped sesquioxide ultrashort pulse seed oscillators for Ho-amplifiers

N.K. Stevenson1,2, C.T.A. Brown3, J.-M. Hopkins4, M.D. Dawson4,5, and A.A. Lagatsky3; 1Fraunhofer Centre for Applied Photonics, Fraunhofer UK, Glasgow, United Kingdom; 2SUPA, School of Physics and Astronomy, University of St Andrews, St Andrews, United Kingdom; 3Institute of Photonics, University of Strathclyde, Glasgow, United Kingdom

Broadly tunable diode-pumped femtosecond Tm3+-doped sesquioxide lasers are presented. Utilising a steeply diverging birefringent filter, continuous tuning over a 91 nm range has been achieved with pulses as short as 240 fs at 2080 nm.

CA-P.32 MON

Widely-tunable dual-wavelength Tm:YLF, Tm:LuAG, and Tm:YAG lasers

E. Beyahi1,2 and U. Demirbaş1,2; 1Recep Tayyip Erdogan University, Rize, Turkey; 2Antalya Bilim University, Antalya, Turkey; 3Deutsches Elektronen Synchrotron, Hamburg, Germany

Using an off-surface optic-axis crystal quartz birefringent tuning plate, we have obtained stable two-color continuous-wave laser operation in 11, 12 and 8 different wavelength pairs in Tm:YLF, Tm:LuAG and Tm:YAG lasers, respectively.
CA-P.33 MON
22mJ/50Hz 946nm Nd:YAG laser with bandwidth-limited 3ns pulses
• A. Koyarov1, A. Kornev2, and V. Pokrovskii1,2; 1Lasers and Optical Systems® Co. Ltd, Saint Petersburg, Russia; 2ITMO University, Saint Petersburg, Russia
946 nm Nd:YAG laser based on regenerative amplification of 3 ns pulse sliced from CW LD radiation was deve loped. The regenerative amplifier output energy was 22 mJ/50 Hz. High pulse shape stability was obtained.

CA-P.34 MON
• L.R. Negri1, F. Pirzio2, and A. Agnesi1,2; 1Dipartimento di Ingegneria Industriale e dell’Informazione, Università di Pavia, Pavia, Italy; 2Bright Solutions Srl, Cara Carpinone (PV), Italy
We present a Nd:YAG/Cr:YAG PQS ring laser providing single longitudinal mode, 50-ns-long almost Fourier-limited pulses (13-MHz optical bandwidth) with 34-µJ pulse energy at 0.1-6 kHz repetition rate and pulse-to-pulse jitter standard deviation <60 ns.

CA-P.35 MON
Tm3+ (LuF3: CaF2) diode pumped laser in 1.9 µm region
• K. Veselkov1, J. Sala2, H. Jelinkova1, M.E. Doroshenko2, K.A. Pierpoint3, V.A. Konyushikh1, A.N. Nakhodov1, and V.V. Oskolkov1; 1Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Prague, Czech Republic; 2A. M. Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia
The absorption spectrum and laser properties of diode pumped laser base on new thulium doped Tm3+: LuF3: CaF2 crystal was investigated for the first time with maximum output power 4.2 mJ and slope efficiency 30 %.

CA-P.36 MON
Tunable Narrowband Tm:YAP Laser Using a Transversally Chirped Volume Bragg Grating
• Q. Berthoud1,2, A. Gissard3, R. Faure3, G. Souhaitê4, E. Lallier1, A. Godard1, V. Smirnov2, and R. Vaisilyev3; 1Teem Photonics, Meylan, France; 2ONERA, Palaiseau, France; 3Thales Research & Technology, Palaiseau, France; 4OptiGrafe Corp, Oviedo, USA
A narrow-linewidth, wavelength-tunable Tm:YAP laser was realized. The spectrum was narrowed down to 0.2 nm and tuned from 1940 nm to 1960 nm thanks to a transversally chirped volume Bragg Grating.

CA-P.37 MON
DMD-Based Excitation of Transverse Laser Modes by Spatial Pump Beam Shaping
• F. Schepers1, T. Bexter1, T. Hellwig2, and C. Falnich1,2; 1Institute of Applied Physics, University of Münster, Mün ster, Germany; 2MESA+ Institute of Nanotechnology, University of Twente, Enschede, Netherlands
We present current-exterior spatial pump beam shaping based on a digital micromirror device for the selective and realignment-free excitation of nearly 1000 different single Hermite-Gaussian modes in an end-pumped Nd:YVO4 laser.

CA-P.38 MON
Monolithic integration of Al2O3:Er3+ amplifiers in SiN4 technology
• J. Mu, M. Dijkstra, and S.M. Garcia-Blanco; MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands
Double-layer monolithically integrated Al2O3:Er3+ and SiN4 optical amplifier is presented. Net gain of ~0.1 dB for a 5.9 nm fully integrated amplifier is obtained at 1532 nm wavelength with 976.2 nm pump.

CA-P.39 MON
Thermally diffusion bonded Yb:YAG/Sapphire composite active elements for thin disk lasers
• I. Mukhin, I. Kuznetsov, and M. Volkov; Institute of Applied Physics NAS, Nizhny Novgorod, Russia
A composite disk active elements from dissimilar materials (Yb:YAG/sapphire) has been developed for disk laser applications. The first experiments demonstrate a good optical quality of composite AE, suppressing of ASE and inrooing of thermal effects.

CA-P.40 MON
Single shot M2 measurement for near infrared laser pulses in real-time
• S.S. Nagisetty1,2, M. Chyla1, M. Smrž1, and T. Mocke1; 1HILASE Centre, Institute of Physics CAS, Dolní Břežany, Czech Republic; 2Czech Technical University in Prague, Prague, Czech Republic
We present a fast, compact and cost-effective single-shot technique for instantaneous measurement and real time monitoring of laser beam quality parameter M2, focus spot size and focus position shift using photosensitive glass and imaging system.

CA-P.41 MON
New phase modulator with large stroke and high bandwidth for improved coherent coupling schemes
• B. Ewers, R.-A. Lorbeer, and J. Speiser; German Aerospace Centre (DLR), Stuttgart, Germany
A WOLIT (Wedged Optical Light Interference-filter Trap) consists of a mirror and a long pass filter. It allows compact light path folding, which we utilize to enhance mechanical phase modulation in coherent coupling.

CA-P.42 MON
Mid-IR hybrid fiber/crystal laser delivering near Fourier transform limited picosecond optical pulses with fast wavelength tuning
• A. Gougna1, C.-E. Ouinten1, J.-B. Lecourt1, Y. Hernandez2, A. Peremans2, and L. Lamard3; 1Multilet Innovation Centre, Mons, Belgium; 2Centre de Recherche en Physique de la Matière et du Rayonnement (PMR), University of Namur, Namur, Belgium; 3Laserspec, Malomme, Belgium
We have developed a mid-infrared laser source based on a narrow bandwidth picosecond fiber laser with fast spatial tuning capabilities pumping a simply resonant OPCO emitting around 3.3 µm with high spectral purity (0.4 cm−1).

CA-P.43 MON
Stable 1100 – 2400 nm supercontinuum in YAG with picosecond pumping for simplified OPCPA
• P. Macková1,2, V. Girdauskas3, V. Girdauskas2, and A.M. Rodin1,2; 1Solid State Physics Laboratory, Department of Laser Technologies, Center for Sciences and Technology, Vilnius, Lithuania; 2Ekapli Ltd, Vilnius, Lithuania
The supercontinuum generated in YAG spans the wavelength range from 1100 to 2500 nm with pulse energy and beam pointing stabilities exceeding the picosecond pumping source, and simplifies the OPCPA architecture around 2 microns.

CA-P.44 MON
Highly Efficient Laser Emission from a Novel Nd:LGSB Crystal
• C.-A. Brandu1,2,3, C. Gheorghe1, S. Hau1, A. Broasca1, M. Greculescu2, F. Voicu2, L. Gheorghe2, and N. Pavel2; 1National Institute for Laser, Plasma and Radiation Physics, Solid-State Quantum Electronics Laboratory, Magurele 077125, Romania; 2Doctoral School of Physics, Faculty of Physics, University of Bucharest, Magurele 077125, Romania
Efficient 1062 nm laser emission is reported from a new Nd3+:LGSB crystal grown by Czochralski method. Efficient 1062 nm laser emission is reported from a new Nd3+:LGSB crystal grown by Czochralski method. Operation with 0.67 slope efficiency in quasi-CW mode and Watt-level CW-operation with similar slope is achieved under diode-laser pumping.

CA-P.45 MON
Comparative study of the pump beam quality effect on the slope efficiency in Kerr-lens mode-locked Ti:sapphire laser
• M.T. Jamal1, A.K. Hansen1, P.E. Andersen1, and O.B. Jensen2; 1DTU Sundhedsteknologi, Technical University of Denmark, Frederiksbergvej 399, Roskilde, Denmark; 2DTU Fotonik, Technical University of Denmark, Frederiksbergvej 399, Roskilde, Denmark
We pumped a Ti:sapphire oscillator with two spectrally combined broad area diode lasers with wavelengths centered at 488 nm and 517 nm and demonstrated stable Kerr-lens mode-locking and investigated the effects of pump beam properties.

CA-P.46 MON
Tm-doping concentration influence on Tm:GGAG lasing and tunability at 2 µm spectral region
• J. Kratochvila, P. Bokačka1, J. Šulc1, M. Němec2, M. Fribich3, H. Jelinková1, B. Trunda3, L. Hlavík3, K. Jurek3, and M. Ník3; 1Czech Technical University in Prague, FNSPE, Blv chová 7, 115 19, Prague, Czech Republic; 2Institute of physics AS CR, Division of Condensed Matter Physics, Na Slovance 2, 182 21, Prague, Czech Republic; 3Institute of physics AS CR, Division of Solid State Physics, Cukrovarnická 10, 162 53, Prague, Czech Republic
Thulium concentration dependence of lasing parameters and tunability of thulium-doped disordered garnet Gd3(5A6-XAl)2O12 was investigated. Wide tunability of 1870–2057 nm and slope efficiency of 47.7 % was achieved with available samples.

CA-P.47 MON
Numerical Simulations of Amplified Spontaneous Emission in Yb:YAG Thin-Disk Amplifiers
• J. Kruss1,2, C. Vorhol1, and J. Speiser1; 1German Aerospace Center, Stuttgart, Germany; 2Ludwig-Maximilians-University Munich, Garching, Germany
Simulations of the transient nature of Yb:YAG thin-disk amplifiers are presented. The numerical model is based on local laser rate equations and includes the temperature distribution and the spatial and spectral distribution of ASE-photon flux.

CA-P.48 MON
Alignment of Higher-Order Mode Solid-State Laser Systems with Machine Learning Diagnostic Assistance
• T. Jefferson-Brain, A. Couple, M. Burns, W. Clarkson, and P. Shardlow; Optoelectronics Research Centre, Southampton, United Kingdom
Using a trained convolutional neural network, real-world laser modal content is estimated from camera images. Accuracies of 92%, with computational times of 2 ms, are shown to provide a metric for alignment of higher-order mode lasers.
CA-P.49 MON
High-energy performance of a multi-pass Yb:YAG planar waveguide amplifier system for ultrafast pulses
• K.E. Tkalcec, H.J. Baker, and M.J.D. Eser; Heriot Watt University, Edinburgh, United Kingdom

A high-energy multi-pass planar waveguide amplifier for sub-ps pulses is presented. Suppression of amplified spontaneous emission is dependent on seed passes and seed input intensity. Pulse energies up to 8.7 μJ (seven passes) were achieved.

CA-P.50 MON
Tisapphire Thin-Disk Laser with Plano-Convex-Shaped Single-Crystal Diamond Heat Spreaders
• I.-H. Wolter1, A. Voss1, R. Balmer2, S. Riaud3, M. Antier1, C. Simon-Boisson1, T. Graf1, and M. Abdou Ahmed1; 1-Institut für Strahlwerkzeuge, Stuttgart, Germany; 2Element Six Ltd., Didcot, United Kingdom; 3Thales LAS France SAS, Élancourt, France

We report on a novel laser concept employing a Tisapphire thin-disk symmetrically cooled by single-crystal diamonds. Laser operation and a five times higher cooling capability than for a previously reported conventional thin-disk laser are presented.

CA-P.51 MON
Low power commissioning of an innovative laser beam circulator for high brightness inverse Compton scattering source
• K. Cassou1, C.F. Ndiaye1,2, and N. Beaugérard1,2; 1LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France; 2Alysum, Turbes, France; 3SEIV, Mérignac, France

We report on the optical commissioning of the high power laser beam circulator for the high brightness Compton Gamma-ray sources bringing interaction high power Yb:YAG laser from tens Watt-level to kiloWatt.

13:15 – 14:15
CB-P: CB Poster session

CB-P.1 MON
Performances of a Backpacked External cavity laser diode with CRIGF mirror
A. Monmuys1, L. Ferreris2, V. Lecocq2, E. Feuillet3, S. Denel, O. Gauthier-Lafaye2, and F. Baire3; 1LAAS-CNRS, Université de Toulouse, CNRS, Toulouse, France; 2Inoptics, Toulouse, France; 3CNES, Toulouse, France

An ECDL using a CRIGF mirror for wavelength stabilization is integrated in a medium size backpack package. Single mode emission with >10mW output power is achieved with low wavelength drift over time.

CB-P.2 MON
Tunable Semiconductor Laser with Two Acousto-Optic Filters in the External Cavity
L.N. Magdich1, A. Chamorovsky2, V.R. Shidlovsky1, M.V. Shramenko1, and S.D. Yakubovich1; 1Superlum Diodes Ltd, Cork, Ireland; 2Opton Ltd., Moscow, Russia; 3Moscow State Technical University (MIREA), Moscow, Russia

Tunable external cavity semiconductor laser with two acousto-optic filters for Doppler shift compensation was studied. At 3 mW output power stationary linewidth of 25 MHz and tuning in 815-875 nm range was demonstrated.

CB-P.3 MON
Design and characterization of a next-generation MEMS based ECDL device
• M. Hoppé1, H. Rohling1, S. Schmidtmann2, H. Tatgenhorst2, T. Milde3, and J.R. Sacher1,2; 1Sacher Lasertechnik GmbH, Marburg, Germany; 2Sensor Photonics GmbH, Marburg, Germany

We present our next-generation miniaturized tunable ECDL design based on a MEMS device. It includes the benefits of the current ECDL technology and allows an excellent improvement in terms of size and tunability.

CB-P.4 MON
Coherence Properties of Multi-Section Semiconductor Laser Frequency Swept Lasers
N. Rebрова1, K. Grigorenko2, A. Kovalyov2, E. Viktorov2, O. Slepneva1, and G. Huyet1; 1Centre for Advanced Photonics and Process Analysis & Department of Physical Sciences, Cork Institute of Technology, Cork, Ireland; 2ITMO University, Saint Petersburg, Russia; 3Université Cote d’Azur, CNRS, Institut de Physique de Nice, France

We show that optical feedback can be used to phase lock the successive mode of a frequency-swept source SDRB laser as a means to increase the coherence length.

CB-P.5 MON
High-Q Si,Ny ring resonators for locking 780nm GaAs-based distributed feedback laser
• M. Sinclair1, K. Gallacher1, R.W. Millan2, J.C. Bayley3, O. Sharp3, F. Miranda4, G. Terenti4, G. Mills3, B. Casey5, S. Hild6, and D.J. Paul1; 1School of Physics and Astronomy, University of Glasgow, Glasgow, United Kingdom; 2School of Engineering, University of Glasgow, Glasgow, United Kingdom; 3Kelvin Nanotechnology, Glasgow, United Kingdom

SiNy waveguide microring resonators have demonstrated Q values ~800,000 at 780 nm, 1 million expected with top cladding. High Q resonance offers alternative to 10Rh atomic transition MEMS cell for locking a distributed feedback laser.

CB-P.6 MON
Time Domain Traveling Wave Model of a hybrid laser for silicon photonics applications
• L. Colombo and M. Giosanu; Dipartimento di Elettronica e Telecommunicazioni, Politecnico di Torino, Torino, Italy

We study the single frequency emission stability and the dynamics of an hybrid laser based on III-V semiconductor optical amplifier and silicon photonics mirror with narrow reflectivity bandwidth using a time domain traveling wave model.

CB-P.7 MON
Precise and efficient wavelength control of a widely-tunable ring-laser implemented on a generic foundry platform
M. Škenderovas, T. Geernaert, and M. Virte; Brussels Photonics (B-PHOT), Dept. of Applied Physics and Photonics, Vrije Universiteit Brussel, Brussels, Belgium

The investigated tunable ring-laser exploits a cascade of symmetric Mach-Zender Interferometers at frequency-selective elements. This leads to erratic wavelength variations when linearly tuning the filter. We overcome this issue by developing specific command strategies.

CB-P.8 MON
Single-sideband hybrid opto-electronic oscillator
A. Thorette1, M. Romanelli1, S. Boucher1, F. Van Dijck1, M. Alouini1, and M. Vallet1; 1Univ Rennes, CNRS, Institut FOTON – UMR 6802, Rennes, France; 2III-V Lab, a joint lab of Thales Research and Technology, Nokia Bell Labs France and CEA LETI, Palaiseau, France

We present an opto-RF oscillator, based on 1.5μm monolithic DBF lasers stabilized by the combination of optical and electronic feedback. A phase noise of -75 dBc/Hz at 1kHz from a 10 GHz carrier is reported.

CB-P.9 MON
Photonic Microwave Source Based on Laser Diodes with Filtered Optoelectronic Feedback: Switching Modulation Frequencies
• A.V. Kovalyev1, M.S. Islam2,3, G. Coger1, D.S. Citron1,2, A. Locquet2,5, and E.A. Viktorov2; 1ITMO University, Saint Petersburg, Russia; 2Georgia Tech-CNRS UMI 2894, Georgia Tech Lorraine, Metz, France; 3School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, USA

We demonstrate experimentally an abrupt switching between periodic oscillations in the dynamics of a semiconductor laser subjected to optoelectronic feedback. We reproduce the results with a model taking into account filtering effects in the feedback loop.

CB-P.10 MON
The contribution has been withdrawn.

CB-P.11 MON
GaSb-based 2.55 μm External Cavity Diode Lasers Employing Ruled Diffraction Gratings and External Silicon Photonics Vernier Reflectors
• S. P. Gjønnes1, J. Vilkeris1, M. Cherchi2, N. Zia1, E. Kovaleva1, P. Karu2,3, and M. Guina1; 1Optoelectronics Research Center, Physics Unit, Tampere University, Tampere, Finland; 2VTT Technical Research Centre of Finland, Espoo, Finland; 3VTT Technical Research Centre of Finland, Oulu, Finland

GaSb-based tunable external cavity diode lasers around 2.55 μm, tuned with an external ruled grating with a wide tuning range, are compared to ones tuned with a fast-tuning compact silicon photonics reflector.

CB-P.12 MON
High Brightness 2.1 μm Direct-Diode Laser Module
• M.E. Reilly1, B.K. Fleming1, and M.J.D. Eser2; 1Institute of Photonics and Quantum Sciences, Heriot-Watt University, Edinburgh, United Kingdom; 2Leonardo MW Ltd., Edinburgh, United Kingdom

The development of a high brightness 6-emitter direct-diode laser module operating at 2.1 μm with nominal 5 W output power is presented along with performance analysis in atmospheric propagation conditions.

CB-P.13 MON
Lyt spectral filter for polarization beam combining of high-power, broad-area diode lasers: modeling, simulations, and experiments
• C. Bree1, V. Raab1, J. Montiel1, G. Garre Werner1, K. Staliunas1, U. Bandelow1, and M. Radziunas1; 1Weierstrass Institute for Applied Analysis and Stochastics, Berlin, Germany; 2Raab-Photonik GmbH, Potsdam, Germany; 3Monocrom S.L., Vilanova i la Geltrú, Spain; 4Universitat Politècnica de Catalunya, Terrassa, Spain

We discuss a beam combining scheme for broad area
diode lasers with Lyot spectrally filtered reinjection from a common external resonator. Our scheme is insensitive to thermal wavelength drift and yields high optical coupling efficiencies.

**CB-P.14 MON**

High-Power AlGaNAs/InP DFB Lasers with Low Divergence Angle

Y. Liu1, J. Wang2, Y. Huang1, R. Zhang2, H. Zhu1, and L. Hoi1; Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China; 2University of Chinese Academy of Sciences, Beijing, China; 3University of Glasgow, Glasgow, United Kingdom

131.μm AlGaNAs/InP DFB laser with high power (110mW @ 25 degree) and low divergence angle fundamental transverse mode (15.5 × 23 @ 75 degree) has been successfully demonstrated.

**CB-P.15 MON**

State-of-the-art laser diode illuminators for automotive LiDAR

A. Laugustin, C. Canal, and O. Rabot; Lumibird SA, Les Ulis, France

This paper will discuss recent advances in ultra-compact low-cost laser diode sources dedicated to solid-state lidar for ADAS. Data on the latest generation emitting 1l pulses shorter than 3ns at 1MHz will be presented.

**CB-P.20 MON**

Spatial filtering in Broad Area Diode Lasers using Photonic Crystals

S.B. Gawali1, D. Gaiilevius1,2, V. Purlys2,3, J. Trull1, C. Cocojura1, and K. Staliunas1,4; 1Universitat Politècnica de Catalunya, Barcelona, Spain; 2Vilnius University, Vilnius, Lithuania; 3Femptika LTD, Vilnius, Lithuania; 4Instituto Catalán de Recerca i Estudis Avançats (ICREA), Barcelona, Spain

In this work, we show the spatial filtering of Broad Area Semiconductor Laser using Photonic Crystal in external cavity configuration. We demonstrate decrease in M2 factor and increase in the brightness of the beam.

**CB-P.27 MON**

Tailoring Single-Frequency VCSELs for Quantum Technology Applications

J.-P. Penttinen1,2,3, S. Bur2, M. Määkkönen2, E. Kantola2,3, A. Wilss1, S. Ranta1,2, P. Hour1, D. Leibfried3, and M. Guina1,2; 1Vexlum Ltd., Tampere, Finland; 2Optoelectronics Research Centre, Physics Unit, Tampere University, Tampere, Finland; 3Time and Frequency Division, National Institute of Standards and Technology, Boulder, CO, USA

We present single-frequency VCSELs tailored for quantum technology applications, such as quantum information processing with trapped Be-ions requiring 235nm and 313nm radiation. High-power VCSELs can potentially replace many of the laser systems currently in use.

**CB-P.28 MON**

Stable DFB Ridge laser diodes at 894nm at R.T. for Cesium atomic clocks


We demonstrate single frequency, single spatial mode, DFB Ridge laser diodes with low threshold current, high efficiency and the Cs D1 line (894.35nm) obtained at room temperature, with very stable optical spectra and ageing behaviour.

CB-P.18 MON

Systematic design of photonic crystal cavities with ultra-low modal volume considering different fabrication resolutions

F. Wang, R.E. Christiansen, J. Mork, and O. Sigmund1; DTU FAM, Department of Mechanical Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark; 2DTU Fotonik, Department of Photonics Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark

We design photonic crystal cavities with ultra-low modal volume considering fabrication resolutions systematically. A parameterized ring-grating cavity configuration is established for any fabrication resolution. The performance of these cavities increases as the fabrication resolution improves.

CB-P.19 MON

A simple approach, based on coupled mode theory, to study PhC lasers

M. Saldutti1, J. Mork2, and M. Gioannini1; 1Politecnico di Torino, Torino, Italy; 2DTU Fotonik, Department of Photonics Engineering, Lyngby, Denmark

We calculate the coupling coefficients between guided Bloch modes of PhC passive waveguides perturbed by refractive index and/or gain. We find threshold condition of PhC lasers and optimize the threshold gain by PhC mirror design.

CB-P.21 MON

Submicron Size All-Semiconductor Vertical Cavities with Haxby characteristics and high differential efficiency

A. Demir1, D. Apaydin2, and H. Kurib; 1Bilkent University, UNAM – Institute of Materials Science and Nanotechnology, Ankara, Turkey; 2TOBB University of Economics and Technology, Department of Electrical and Electronics Engineering, Ankara, Turkey

We propose a novel lithographic method providing high Q-factor resonant cavity modes for submicron diame-
Quantum dot lasers at the short wavelength

A. Isakova. 
Resonances in multi-frequency diode lasers for pumping CPT resonances

Performance Optimization of InGaAs Based Quantum Well Structures for Chemical Sensing

A. Fadell, H. Omran, M. Schneider, and F. Scholz. 
Laboratory of Micro Optics, Faculty of Information Engineering and Technology, German University in Cairo (GUC), New Cairo, Egypt; Institute of Functional Nanosystems, GaN-Group, Ulm University, Ulm, Germany

In this paper, we investigate performance optimization of optically pumped InGaAs based quantum well (QW) structures with purely optical read-out for chemical sensing applications. TCA/D simulations estimate a better spectral shift at higher doping level.

Multi-frequency Diode Laser For Pumping CPT Resonances

A. Isaikina; K. Savino; and A. Dmitriev. 
Novosibirsk state technical university, Novosibirsk, Russia; Institute of laser physics of SBRAS, Novosibirsk, Russia

A method of obtaining multi-frequency optical radiation for pumping CPT resonances with microwave and RF modulation of the pump current of a diode laser is proposed and implemented.

Influence of spacer thickness on the optical properties of vertically stacked InP/AlGaAs/GaP quantum dot lasers at the short wavelength

Z. Huang, S. Hepp, R. Sittig, M. Jetter, and P. Michler; Institut für Halbleiteroptik und Funktionelle Grenzflächen (IFHG), University of Stuttgart, Stuttgart, Germany

The optical properties of the double vertically stacked InP/AlGaAs/GaP quantum dot laser at the short emitting wavelength of 660 nm are investigated by changing the spacer thickness between the quantum dot layers.

Characteristics of QD-LD with InP(311)B Substrate on Thickness of InGaAs Spacer Layers

National Institute of Information and Communications Technology, Tokyo, Japan; 2University of Glaasgow, Glasgow, United Kingdom

In this paper, we experimentally evaluated the laser characteristics by fabricating QD-LEDs with changing thickness of spacer layer of QDs for optimizing the structure and investigating the influence of the thickness dependency.

Superluminescent diodes based on asymmetric double quantum-well heterostructures

S. Ilichenko; Superlum Ltd., Moscow, Russia

It is shown experimentally that superluminescent diodes (SLDs) based on asymmetric double quantum-well heterostructures with ultrathin active layers have significant advantages over widely used SLDs based on a single quantum-well heterostructures.

Tapered Multi Section Superluminescent Diode with Tunable Spectral Asymmetry Between Narrow and Wide Face Outputs

A.F. Forrest; M. Krakowski; P. Bardella; and M.A. Cataluna. 
Institute of Photonics and Quantum Sciences, School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom; 2Previously also with the School of Science and Engineering, University of Dundee, Dundee, United Kingdom; 3III-V Lab, Palaiseau, France

We report experimental evidence of LO phonon-intersubband polariton scattering processes under resonant injection of light within two different semiconductors.

Turn-on timescale quenching in two quantum well lasers

V. Dudelev; V. Mylkin; A. Shioknik; K. Soboleva; V. Kuchinskii; D. Livshits; G. Sokolovskii; and V. Viktorov. 
Ioffe Institute, Saint-Petersburg, Russia; 2Innolume GmbH, Dortmund, Germany; 3Peter the Great St. Petersburg Polytechnic University, Saint-Petersburg, Russia; 4ITMO University, Saint-Petersburg, Russia

We find that in a pulse pumped quantum well laser the timescale of exponential growth at the ground state laser turn-on noticeably quenches when the laser turns on at the excited state wavelength.

Passive mode-locking of quantum-well semiconductor laser subject to ultra-short optical self-feedback with nanometric fine-delay

P. Neu; D. Auth; C. Weber; A. Klöhr; and S. Breuer. 
Technische Universität Darmstadt, Institute of Applied Physics, 64289 Darmstadt, Germany; 2Institute of Nanosciences and Nanotechnologies, 91120 Palaiseau, France

We developed a novel light source based on an advanced gain-switching operation of laser diodes. 586-nm nanosecond optical pulses were obtained by sum frequency generation of amplified laser pulses.

Experimental and theoretical evidences of hysteresis in passive mode-locked Quantum Dots lasers

L. Colombo; B. Bardella; D. Auth; C. Weber; and S. Breuer. 
1Dipartimento di Elettronica e Telecomunicazioni, Politecnico di Torino, Torino, Italy; 2Institute of Applied Physics, Technische Universität Darmstadt, Darmstadt, Germany

We experimentally and numerically study the bistability between pulse soliton and laser “off” state in a two sections InAs/GaAs QD tapered sources in regime of passive mode-locking.

Self-injected optical frequency comb quantum dash lasers

P. Fiala; D. Auth; C. Weber; and G. Maimaiti. 
Technische Universität Darmstadt, Institute of Applied Physics, 64289 Darmstadt, Germany; 2Centre of Nanosciences and Nanotechnologies, 91120 Palaiseau, France

We report the first experimental evidence of optical frequency comb generation in InAs/GaAs quantum-dash lasers emitting optical frequency combs around 1550 nm is experimentally reported and confirmed by a stochastic time-domain model. Feedback-strength-boundaries for multiple feedback-cavity-lengths yielding full-delay tuning are identified.

Passively mode-locked quantum-well semiconductor laser with an output pulse width shorter than 150 fs

P. Neu; D. Auth; C. Weber; and S. Breuer. 
Technische Universität Darmstadt, Institute of Applied Physics, 64289 Darmstadt, Germany; 2Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, 12489 Berlin, Germany

Wavelength-periodic dependencies of repetition rate, emission wavelength and average optical output power of an InGaAs double quantum-well passively mode-locked semiconductor laser at 1070 nm on sub-wavelength scale controlled fine-delay from short-cavity optical feedback are reported experimentally.
Symmetry Properties and Coexistence of the Mode-Locked States in Semiconductor Lasers

- A.V. Kovalyev1, K. Mergen2, A. Ramdane3, and E.A. Viktorov1, 1ITMO University, Saint Petersburg, Russia; 2Centre de Nanosciences et de Nanotechnologies, Palaiseau, France

We experimentally and numerically explore the symmetry properties of mode-locked semiconductor lasers and demonstrate coexistence, multistability and switching of translationally symmetrical mode-locked regimes which possess different repetition rates and temporal pulse profiles.

Superradiance as a Way to the Steady-State Multimode and Ultrashort Pulsed Lasing in CW Quantum-Dot Heterolasers

- V. Kocharovsky1, A. Mishin1, V. Kocharovsky1,2, E. Kocharovsky3, and A. Seleznev3, 1Institute of Applied Physics, Russian Academy of Science, Nizhny Novgorod, Russia; 2Department of Physics and Astronomy, Texas A&M University, College Station, USA

We design the pulsed quantum-dot heterolaser based on the superradiance under CW pumping and show that a few superradiant modes will emit the sequences of ultrashort pulses and support many steady-state modes which are self-locked.

Self-sustained pulse oscillations in a quantum dot laser monolithically grown on germanium

- Y. Zhou1,2, Y. Sun1, H. Huang3, C. Cao3, Q. Gong3, F. Grillo4,4, and C. Wang1, 1ShanghaiTech University, Shanghai, China; 2Telecom Paris Tech, Paris, France; 3Shanghai Institute of Microsystem and Information Technology, Shanghai, China; 4University of New-Mexico, New Mexico, USA

We show that a free-running InAs/GaAs quantum dot laser monolithically grown on germanium exhibits self-sustained pulse oscillations with one, two, and three periods at different pump currents, without incorporating any saturable absorber.

Repetition rate locking of mutually injected monolithic passively mode-locked semiconductor quantum dot lasers

- C. Weber1, D. Ansh1, I. Simos2, C. Simos3, and S. Breuer1, 1Technische Universität Darmstadt, Institute of Applied Physics, 64289 Darmstadt, Germany; 2University of West Attica, Department of Electronics Engineering, 12245 Athens, Greece; 3Technological Educational Institute of Sterea Ellada, Department of Electronics Engineering, 35100 Lamia, Greece

Repetition rate and emission wavelength locking of two mutually injected monolithic two-section passively mode-locked InAs/InGaAs-quantum-dot semiconductor lasers emitting at 1250 nm is experimentally demonstrated and theoretically explained for varying delay length and biasing conditions.

Analysis of optical frequency comb generation in gain-switched semiconductor lasers

- A. Rosado1, A. Pérez-Serrano1, J.M. García Tjoro1, A. Valle2, L. Peçques2, and I. Esquivias1, 1CEMDATIC, ETSI Telecomunicación, Universidad Politécnica de Madrid, Madrid, Spain; 2Instituto de Física de Cantabria (CSIC-Universidad de Cantabria), Santander, Spain

We have analysed experimentally and by simulations the generation of OFCs from gain-switched semiconductor lasers and theoretically demonstrated thatasmallgain ofitssingle mode CW operation.

Quasi-Linear Displacement Measurement with Laser Feedback Interferometry

- D. Choi1, M.J. Wishon1, E.A. Viktorov2, D.S. Citrin1, and A. Loquet1, 1UMI 2958 Georgia Tech-CNRS, Metz, France; 2ITMO University, Saint Petersburg, Russia

We demonstrate experimentally a displacement sensor, making use of the traditional, unmodified, laser feedback interferometry setup, that leads, in the absence of any post-processing, to a minimal detectible displacement as small as 12 nm.

Pulse compression using chirp of transistor lasers regardless of types of fiber dispersions

- C-T. Tsung1, S-W. Chang2, and C-H. Wu3, 1Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan (R.O.C.); 2Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan (R.O.C.); 3Graduate Institute of Photonics and Optoelectronics, National Taiwan University, Taipei, Taiwan (R.O.C.)

We demonstrate the small-signal chirping of transistor lasers and the reshape of the optical Gaussian pulse in fibers. It shows that the pre-chirped pulse of TLs can be compressed in both normal and abnormal dispersion.

Tailoring localization features in passively mode-locked lasers with V-shaped cavity geometry

- J. Hausen, S. Meinecke, and K. Lüdge, Institute of Theoretical Physics, TU Berlin, Berlin, Germany

We examine the influence of the distinct cavity features of a passively mode-locked laser with V-shaped external cavity geometry on localized structures, forming from a multi-stability of the off-solution and the periodic mode-locking solutions.

Optical Frequency Comb Generation Using Quantum Cascade Lasers Subject to Optical Injection

- B.-B. Zhao and C. Wang, ShanghaiTech University, Shanghai, China

We propose to produce optical frequency combs using period-one dynamics of quantum cascade lasers subject to optical injection. The comb frequency is continuously tunable via fine control of injection ratio and/or detuning frequency.

The contribution has been withdrawn.

Relative Intensity Noise of 3.4 μm Interband Cascade Laser

- Y. Deng, Y.-T. Gu, B.-B. Zhao, and C. Wang, ShanghaiTech University, Shanghai, China

We experimentally show that the relative intensity noise of a continuous-wave InAs/GaSb interband cascade laser operated at room temperature reaches as low as -130 dB/Hz.

Modelling the spatio-temporal dynamics of quantum cascade laser frequency combs

- N. Opalčak, G. Strasser1-2, and B. Schwarz1, 1Institute of Solid State Electronics, TU Wien, Vienna, Austria; 2Center for Micro- and Nanotechnologies, TU Wien, Vienna, Austria

We propose a rate equation model for interband cascade lasers, and theoretically demonstrate that a small gain stage number reduces the modulation bandwidth, the relative intensity noise, and the phase noise.

High frequency modulation characteristics of mid-infrared ring quantum cascade lasers

- B. Hinkov1, J. Hayden2, R. Szedlak1, F. Pilat1, P. Martin-Mator1, B. Jerez2, P. Acedo1, G. Strasser1, and B. Lendi1, 1Institute of Solid State Electronics, Technische Universität Wien, Vienna, Austria; 2Institute of Chemical Technologies and Analytics, Technische Universität Wien, Vienna, Austria; 3Electronics Technology Department, Université Carlos III de Madrid, Madrid, Spain

We show the high frequency modulation and single sideband characteristics of mid-infrared emitting ring-DFB QCLs up to 800 MHz, designed for spectroscopic and data transfer applications. They are investigated and compared to identical Fabry-Perot devices.
CD-P.1 MON
Brightness-Enhanced Solid-State Light Sources: From Kaleidoscope Effect to Uniform Illumination
I. Sathanthari1,2, W. Lian1, A. Minassian3, and M. Damzen1; 1Department of Physics, Photonics Group, Imperial College London, London, United Kingdom; 2Department of Materials, Maser Group, Imperial College London, London, United Kingdom; 3Institute of Standards and Science, Daejeon, South Korea
We report the successful operation of a temperature controlled (<20°C) LED-pumped Ce:YAG luminescent concentrator. Results from three different crystal coatings were analysed and the dielectric coating was the best, producing an output power of 3.5W.

CD-P.2 MON
Enhancing Performance of Ce:YAG Luminescent Concentrators for High Power Applications
J. Sathian1,2, A. Minassian3, N. Alford2, and M. Damzen1; 1Department of Physics, Photonics Group, Imperial College London, London, United Kingdom; 2Department of Materials, Maser Group, Imperial College London, London, United Kingdom; 3Institute of Standards and Science, Daejeon, South Korea
We report the kaleidoscope effect in the output of a Ce:YAG luminescent concentrator when pumped by blue laser while LED pumping resulted in a uniform illumination distribution. Both results were verified by simulations in Zemax.

CH-P.1 MON
Opportunities and Challenges of Single Protein Detection with iSCAT
C. Geerinckx, S. Kirschner, A. Muskens, and C. Vanpoucke; 1Center for Microscopy and Nanoscopy, Vrije Universiteit Brussel, Brussels, Belgium; 2Laboratory of Optical Engineering, Ghent University, Ghent, Belgium
We report an easy method to broaden the mode-locking range of an expensive femtosecond laser using a single point concentration of a carbonic anhydrase solution.

CH-P.2 MON
Photothermal gas detection of CO2 in an intracavity solid-state laser configuration
M. Ding, D.J. Richardson, and R. Slavík; 1Department of Physics, Photonics Group, Imperial College London, London, United Kingdom; 2Department of Materials, Maser Group, Imperial College London, London, United Kingdom
A photothermal gas sensor in an intracavity solid-state laser configuration is presented. The large gas concentration of the sensor is feasible, monolithic and miniature, thus can be an alternative for currently used gas detection techniques.

CH-P.3 MON
Development of SPAD based on thermoelctrically controlled silicon carbide avalanche photodiode
D. Rubino, L. Giordano, and F. Zeninari; 1Multitel Innovation Center, Monza, Milan, Italy; 2OFInstitute of Physical Chemistry, University of Milan, Milan, Italy
We have demonstrated an easy method to broaden the mode-locked fiber laser spectrum using a compact mid-infrared OPO seeded by a picosecond laser source. Preliminary results on aceton with 2970 cm⁻¹ for concentrations down to 1% are reported.

CH-P.4 MON
Development of Radiation Resistant Fiber Bragg Grating Sensors by Optimization of Grating Processing Conditions
S. Hutter, K. Czerny, and A. Gerstmayr; 1Institute for Fiber Optics, Graz University of Technology, Graz, Austria; 2Department of Physics, University of Graz, Graz, Austria
We report on the results of a comprehensive study of high temperature radiation resistant grating sensors. The investigations included a correlation study of different processes for a variety of fiber types, and the investigation of the influence of different kinds of radiation on the performance of the sensors.

CH-P.5 MON
Photothermal gas sensor in an intracavity mode-locked fiber laser configuration
A. Sultan, H. M. Dastjerdi, and H. M. Dastjerdi; 1Department of Materials, Maser Group, Imperial College London, London, United Kingdom; 2Department of Physics, Photonics Group, Imperial College London, London, United Kingdom
We report the successful operation of a temperature controlled (<20°C) LED-pumped Ce:YAG luminescent concentrator. Results from three different crystal coatings were analysed and the dielectric coating was the best, producing an output power of 3.5W.
MONday 23 June 2019

M. Arjmand, H. Saghaei, and A. Araz
Optics and Laser Science and Technology Research Center, Malek
Ashtar University of Technology, Isfahan, Iran. 2 Faculty of
Physics, Isfahan University of Technology, Isfahan, Iran
Application of an enzymatic optical fiber biosensor for
label free detection of methyl parathion pesticide in pres-
cence of acrylithocholine iodide is presented. A value of
2nM for the detection limit of MPT is achieved.

CH-P.14 MON

Photoacoustic Optical Frequency Comb Spectroscopy of
Radioactive Methane in the Mid-Infrared Region,
J. Karan, J. Tomberg, F. Senna Viera, G. Genoud, V. Hänninen,
M. Vainio, M. Mettälä, T. Hietä, S. Belf, and L. Halonen
University of Helsinki, Helsinki, Finland; 2 Umeå University, Umeå, Sweden; 3 VTT Technical
Research Centre of Finland Ltd., Espoo, Finland; 4 Tampere University, Tampere, Finland; 5 Gasera Ltd.,
Turku, Finland; 6 National Physical Laboratory, Teddington,
United Kingdom
We report the first measurement of the absorption spectr
of radioactive methane (CH4) and demonstrate the most sensitive broadband photoacoustic measure-
ment technique that could result in a foundation for in-situ
do optical detection systems for CH4.

CH-P.15 MON

InP, GaSb, IC and QC Lasers used for a comparison of the spect
ectral excitation behavior of methane by sensor applica-
tions
T. Milde, M. Hoppe, H. Tüteneng, C. Assmann, M. Honsberg, W. Schade, and J. Sacher
Sacher Lasertechnik GmbH, Marburg, Germany; 2 Technische Universität Clausthal, Clausthal, Germany; 3 Sensor
Photonics GmbH, Marburg, Germany
HITRAN promises better gas detection possibilities in the MIR wavelength region than the NIR or the visible
region because of the higher absorbencies. These promises are tested with different lasers on TDLAS and QEPAS applications.

CH-P.16 MON

Self-reference optical phase demodulation using narrow absorption/gain peak
S. Stepanov, N. Casillas, M. Ocegueda, and E. Hernandez
1 CICESE, Ensenada, Mexico; 2 UABC, En-
senada, Mexico
Phase-to-intensity modulation transformation via pass-
ing the light through medium with narrow absorp-
tion/gain peak is considered. Confirmation experiments on
detection of no phase modulation in acetylene volume
cell at mW scale of 1530nm light are reported.

CH-P.17 MON

Contaminant free end-capped acetylene PMC for sub-Doppler Spectroscopy
T. Billotte, M. Chafee, M. Maurel1, F. Amrani, F. Gérôme, B. Debord, and F. Benabid2,2 GPPMM
Group, Xilum Research Institute, CNRS UMR 7252, Uni-
versity of Limoges, Limoges, France; 2 GLOPhotonics SAS, 123 avenue Albert Thomas, Limoges, France
We report on fabrication and sub-Doppler spectroscopic characteristic of a contaminant-free C2H2 photonic
micro-cell made with new end-capping method. This
<2b loss PMC exhibits transparency features (EIT and SA)
with 17MHz width and 8% contrast.

CH-P.18 MON

Extended-Cavity-Quantum-Cascade-Laser-Voltage Intracavity Sensing and Application to Atmospheric Gas
Detection
R. Vallon, L. Bize1, B. Parvitte, G. Maisons, M. Carra2, and Z. Vennin1
1 Groupe de Spectrométrie Moléculaire et Atmosphérique, Reims, France; 2 mirSense, Palaiseau, France
We report the latest results obtained with an Extended-
Cavity-Quantum-Cascade-Laser emitting from 7.4 to
7.8 μm and its application to the detectoless detection of
molecules of atmospheric interest by intracavity sensing.

CH-P.19 MON

Using A CCD Camera Based Imaging Lidar To Profile Boundary Layer Aerosols and Determine Cloud Thickness
A. Kabir, N. Sharma, J. Barnes, C. Ovitté, J. Butt, and E. Knowles1
1 University of The Bahamas, Nassau, The Bahamas; 2 Central Connecticut State University, New
Britain, USA; 3 NOAA/ESRL/Global Monitoring Division, Boulder, USA
A CCD camera based bistatic imaging lidar was utilized to
profile boundary layer aerosols in Nassau, Bahamas.
Top of the atmospheric boundary layer, cloud base and
top heights and near ground local pollution were
detected.

CH-P.20 MON

Anisotropic Fluorescence Emission at the Surface of 1D Photonic Crystal Biochips
E. Sepe, A. Sinibaldi, N. Danz, P. Munzert, and F. Michelotti
1 SAPIENZA University of Rome, IT-00161, Rome, Italy; 2 Braunschweier Institut für Appliziert Optics
and Precision Engineering IOF, DE-07745, Jena, Germany
Experiments and theoretical modelling of the fluores-
cent emission of dyes at the surface of one-dimensional photonic crystal biochips are reported. The results show
a strong interplay between photobleaching and rotation-
al diffusion of the emitters.

CH-P.21 MON

Following the mechanisms of a single water droplet
drifting by means of photonic resonant structure
L. Garnier, H. Lhermitte, V. Vieil, H. Cournares1, O. Pin, Q. Liddell1, and B. Béchê1
1 Université Rennes 1, CNRS, Institut de physique, Rennes, France; 2 Université Rennes 1, CNRS, Institut d’Electronique et de Télécommuni-
cation de Rennes, Rennes, France; 3 Centralrække, Cesson-Sévigné, France
We have monitored the response of a photonic resonator under a drying water droplet. We demonstrate a correla-
tion between the speed of evaporation and the dynamics of
the free spectral range of the optical mode.

CH-P.22 MON

A Hyperspectral Microscope based on a birefringent ultrastable common-Path Interferometer
A. Candeo, B.E. Nogueira de Faria, G. Valentin1, A. Bassi, G. Cervello, and C. Manzoni1,1 IFN-CNR,
Physics Department, Politecnic di Milano, Milan, Italy;
2 Departamento de Física, UFMG, Belo Horizonte, Brazil
We introduce a Fourier-transform hyperspectral micro-
scope based on an ultrastable birefringent interferome-
ter. The microscope has broad spectral coverage, high
resolution, high sensitivity and short acquisition time. We present two implementations, and examples in spec-
tral imaging.

CH-P.23 MON

Loss-Induced Resonant Refractive Index Sensing Using Total Internal Reflection Phase Shift
M. Miller, R. Michalzik, K. Jeff B. Etheling, and S. Menzel1
1 University, Institute of Functional Nanosystems, Ulm, Germany
We present a novel approach on resonant refractive in-
dex sensing using total internal reflection phase shift.
The sensor principle that was proven in first mea-
surements can exceed sensitivities of 500nm/RIU and achieve high spatial resolution.

CH-P.24 MON

Measurement of viscoelasticity of Sodium Alginate by Fibre Bragg Gratings
L. Binetti, A. Stankiewicz, and L. Alwis
Edinburgh Napier University, Edinburgh, United Kingdom
A viscoelastic sensor has been made for measuring the viscoelasticity of sodium alginate in water with the use of
Fibre Bragg Grating (FBG) fibre optic sensor. The sensor offers high sensitivity and little relative error.

CH-P.25 MON

Adjustable optical path length compact spherical mirrors multipass cell optimized with genetic algorithm
A. Hudzikowski, A. Glusek, K. Krzempek, and J. Soter
Wroclaw University of Science and Technology, Wroclaw, Poland
We report a compact, four-mirror multipass cell, de-
sign and optimized with a genetic algorithm in several
different path length variants. Two of them were experi-
mentally verified through time-of-flight measurements
inside the multipass cell.

CH-P.26 MON

Viscoelasticity Measurements by an Optofluidic Micro-Rheometer
V. Vitali, G. Nava, G. Zanchetta, F. Bragheri, R. Osselma, T. Bellini1, L. Crisanti1, and P. Minzioni1
1 Department of Electrical, Computer, and Biomedical En-
ingineering, University of Pavia, Pavia, Italy; 2 Department of Medical Biotechnology and Translational Medicine, Università di Milano, Milano, Italy;
3 Istituto di Fotonica e Nanotecnologie (IFN), CNR, Milano, Italy
We present the fabrication and validation of an inte-
grated micro-opto-fluidic system allowing to fully de-
termine the viscoelastic properties of different materials
and requiring a sample volume lower than 1 microliter.

CH-P.27 MON

Coherent Fiber Optic Sensors for Impact Feature Assessment in Glass Fiber Reinforced Plastic (GFRP)
J. Di Luch, M. Ferrario, M. Brusero, P. Boffi, A. Belgeni, and C. Shurbatoffi
Politecnico di Milano, Milano, Italy
Collaborative fiber optic technology is adopted to experi-
mentally estimate and compare features of strain signals
generated by different impacting materials in Glass Fiber
Reinforced Plastic structures for SHM applications.

CH-P.28 MON

Optical Fiber Distributed Static and Dynamic Strain Sensors Base on Coherent Microwave Photonic Interferome-
ry
L. Hu, B. Cheng, S. DeWolff, L. Murdoch, and H. Xiao
Clemson University, Clemson, South Carolina, USA
Optical fiber coherent microwave photonic interferome-
try is studied for distributed sensing of static and dy-
namic strains. Cascaded intrinsic Fabry-Perot fiber interfer-
ometers are read in the microwave domain with high sensitivity and fast speed (20kHz).

CH-P.29 MON

Effective Coupling of a Plasmonic Nanorod to a Microsphere Resonator
M. Jalali and D. Erni
University of Duisburg-Essen Faculty of Engineering, Department of General and Theoret-
ical Electrical Engineering (ATE), and CENIDE – Centre for Nanointegration Duisburg-Essen, Duisburg, Germany
Plasmonic-photon coupling of a single nanorod to a
microsphere result in ultra-refractive index shift sensitivity applicable in biosensors. Nanorod orientation varies the type of coupling and hence is subjected to study to optimize the coupling.

**CH-P.30 MON**

Whispering gallery mode resonator sensors referenced to saturated absorption lines in rubidium atoms and a fs frequency comb

I. Brice, A. Atvars, R. Viter, and Y. Alins; Inst. of Atomic Physics and Spectroscopy, Uni Latvia, Riga, Latvia

We develop optical whispering gallery mode (WGM) resonators for sensing applications. To improve the long term stability we reference our laser frequency scan to rubidium saturated-absorption spectroscopy lines calibrated with a femtosecond optical frequency comb.

**CH-P.31 MON**

Birefringence Measurement of Magnetic Fluid based on Tapered Hi-Bi Fiber in Fiber Loop Mirror

A. Layeghi, M I. Zibari, and H. Hatifi; Laser and Plasma research Institute, Shahid Beheshti University, Tehran, Iran

A fiber optic based on Tapered Hi-Bi fiber in fiber loop mirror was used for measuring the birefringence of magnetic fluid which birefringence was from 0 to 3.33 x 10^-4 in the range of 0-50 mT.

**CH-P.32 MON**

Accurate and traceable determination of Raman shifts in reference material by continuous-wave stimulated Raman spectroscopy

H. Kerdoncuff, M. Lassen, and J.C. Petersen; Danish National Metrology Institute, Kogle Alle 5, 2970 Hørsholm, Denmark

We demonstrate an accurate and traceable method for measuring Raman shifts in reference samples based on continuous-wave stimulated Raman spectroscopy with high spectral resolution and shot noise limited operation.

**CH-P.33 MON**

Numerical Comparison of Robustness of Multimode and Multicore Fibre Sensitive to Fibre Bending

M. Veetikazhy, A.K. Hansen, D. Marti1, K. Dholakia2, and P.E. Andersen1; 1DTU Health Tech, Technical University of Denmark, Frederiksbergvej 399, 4000, Roskilde, Denmark; 2DTU Fotonik, Technical University of Denmark, Frederiksbergvej 399, 4000, Roskilde, Denmark; 3SUPA, School of Physics and Astronomy, University of St Andrews, Fife, KY16 9SS, Scotland, St Andrews, United Kingdom

We present a numerical simulation tool investigating electric field propagation through multimode and multicore optical fibres, with special consideration given to field propagation anomalies pertaining to fibre bending deformations.

**CH-P.34 MON**

Analysis of Operation of Photonic Integrated Interrogators for Fiber Optic Sensor Networks

A. Kazmierzak1, M. Slowikowski1,2, T. Osuch1, S. Stopinski1, and R. Piranidowicz1; 1Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Warsaw, Poland; 2Warsaw University of Technology, Centre for Advanced Materials and Technologies CEZAMAT, Warsaw, Poland; 3Warsaw University of Technology, Institute of Electronic Systems, Warsaw, Poland

In this work we present and discuss solutions of integrated photonic interrogators for application in FBG-based fiber-optic sensing system, dedicated to monitoring condition of a patient exposed to magnetic resonance imaging (MRI).

**CH-P.35 MON**

Gas Detection Using a MEMS-Based Swept Laser Source

I. Gergis1, Y. Sabry1,2, H. Omran1, and D. Khali1,2; 1Faculty of Engineering, Ain-Shams University, Cairo, Egypt; 2Optical MEMS Business Unit, Si-Ware Systems, Cairo, Egypt; 3Laboratory of Micro Optics, Faculty of Information Technology and Technology (IET), German University in Cairo (GUC), Cairo, Egypt

A MEMS swept fiber-laser is developed based on SOA, with an average resolution of 0.5 nm. The developed source is used for CO2 gas sensing over the wavelength range of 1568 to 1582 nm.

**CH-P.36 MON**

Ultra-Fast Single Troponine-T Molecule Sensing

P. Melenovic1, L. Son1,4, D. Kudryavtsev1, I. Kasheverov2, V. Tsetlin3, and V. Balakin1,2; 1Institute of Spectroscopy, Moscow, Russia; 2National Research University, Higher School of Economics, Moscow, Russia; 3Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry of the RAS, Moscow, Russia; 4Moscow Institute of Physics and Technology, Moscow, Russia

We present single-molecule-level sensing of an important coronary artery disease cardiac marker - cardiac troponin (cTnT). The approach helps to count single cTnT molecules in a solution 1000 times faster than the known approaches.

**CH-P.37 MON**

Two-dimensional Electron Energy-Loss Spectroscopy

G. Mouloudakis, R. Yu, and J.G. de Abajo1,2; ICFO, Barcelona, Spain; 1ICREA, Barcelona, Spain

We theoretically explore the dynamical interaction between ballistic electrons hosted by 2D materials and some neighbouring sample objects, revealing detailed information on their excitation spectra and opening exciting prospects for nanoscale imaging and sensing.

**CH-P.38 MON**

Optical Time Domain Reflectometer Based on Application Specific Photonic Integrated Circuit

S. Stopinski, K. Anders, S. Szotak, and R. Piramidowicz; Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Warsaw, Poland

An optical time domain reflectometer based on an application specific photonic integrated circuit is demonstrated. The chip enables detection of pulses reflected within an optical fiber link and determination of the time delay.

**CH-P.39 MON**

Investigating monolayer protein-protein binding using surface enhanced infrared spectroscopy

S. Korkmaz1,2 and S. Aske1; 1Erciyes University, Kayseri, Turkey; 2Koc University, Istanbul, Turkey

In this talk I will present a novel ultra-narrow-band perfect absorber and its applications on protein binding analysis using surface enhanced vibrational spectroscopy.

**CH-P.40 MON**

Inline Measurement of Modal Phase Differences in Optical Fibers

N.M. Lüpken, M. Schnack, and C. Fallnich; Institute of Applied Physics, University of Münster, Münster, Germany

We present an interference-based, inline-measurement technique for the phase difference between two transverse fiber modes. The excellent agreement of the measurements with an analytical model underlines the high accuracy of this technique.

**CH-P.41 MON**

Photoacoustic spectroscopy sensor with a small-gap quartz tuning fork

Y. He1, Y. Ma2, Y. Tong3, Y. Xu1, and F.K. Tittel2; 1National Key Laboratory of Science and Technology on Tunable Laser, Harbin Institute of Technology, Harbin, China; 2Department of Electrical and Computer Engineering, Rice University, Houston, USA

A highly sensitive QEPAS sensor with a custom 200 μm gap quartz tuning fork (QTF) was demonstrated. An improvement of such sensor performance was obtained when compared to a standard QTF.

**CH-P.42 MON**

Digital Holography at Restricted Conditions and Photon Counting Approach

H. Skenderović1, M. Stipčević1, and N. Deožić2; 1Institute of Physics, Bijenička cesta 46, Zagreb, Croatia; 2Institut Rudjer Bošković, CEMS - Photonics, Zagreb, Croatia

We show how the hologram recording by scanning Photon counting detectors can improve resolution and/or signal to noise ratio. Configurations which we used to test this approach were digital holographic microscopy and time-averaged digital holography.

**CH-P.43 MON**

N-Matrix Jones Analysis of a Fiber-Optic Current Sensor

A. Madauchi, M. Brunero, M. Ferrari, P. Martelli, P. Roff, and M. Martiniell; Politecnico di Milano, Dipartimento di Elettronica Informazione e Bioingegneria, Milano, Italy

A N-matrix Jones simulator has been developed to analyze the actual performances of fiber-optic current sensors based on Faraday effect, taking into account the detrimental effect of the birefringence of the sensing fiber coil.

**CH-P.44 MON**

All - Fiber Evanescent Wave Sensors for the Mid-Infrared Spectroscopy of Liquids

E. Romanova1,2, S. Korsakov1, A. Rozhnev1, N. Sukhanov2, A. Vel'muzhov2, T. Kotorev2, and V. Shyrin3; 1Saratov State University, Saratov, Russia; 2Institute of Chemistry of High Purity Substances of RAS, Nizhny Novgorod, Russia

For design and creation of chalcogenide fiber-based evanescent wave sensors for the analytical mid-infrared spectroscopy of liquid substances, a technological and material base, as well as a computational approach, have been developed.

**CH-P.45 MON**

Field-resolved infrared transmission spectroscopy of strongly absorbing samples

M. Huber1,2, S. Schweinberger2,3, S.A. Hussain2, M. Trubetskoy1, C. Hofer1, M. Zigman1,2, F. Krauss1,2, and M. Pupeza1,2; 1Max Planck Institute of Quantum Optics, Garching, Germany; 2Ludwig Maximilian University Munich, Department of Physics, Garching, Germany; 3King Saud University, Department of Physics and Astronomy, Riyadh, Saudi Arabia

Field-resolved spectroscopy in the mid-infrared region offers unique intensity dynamic range and detection sensitivity. We show that those properties can be exploited to obtain low limits of detection, even after passing through strongly absorbing samples.
CH-P.46 MON

Time-domain Measurement of the Complex Chiro-Optical Susceptibility by an Ultra-stable Common-path Interferometer

A. Perri1, S. Ghosh1, F. Preda1, J. Réhault2, C. Manzon1, J. Helling1, G. Cerald1, and D. Poll1; 1Politecnico di Milano, Milan, Italy; 2Universität Bern, Bern, Switzerland; 3University of Zurich, Zurich, Switzerland

We introduce a novel configuration for the broadband measurement of molecular optical activity, combining time-domain detection with heterodyne amplification. Our compact, low-cost setup accepts ultrashort light pulses, thus paving the way for transient optical activity.

CH-P.47 MON

Optical Gas Sensing Based on Free Carrier Absorption in Metal Oxides

X. Wu, X. Zhang, S. Amrein, and T. Wagner; Paderborn University, Paderborn, Germany

We demonstrate that tungsten oxide photonic crystals can be used for hydrogen sensing due to its refractive index change originating from free carrier absorption. This transducing concept can be generalized to other semiconducting metal oxides.

CH-P.48 MON

"Cartesian Light": How does Light Propagate in a 3D Superlattice of Photonic Bandgap Cavities

S.A. Hack1, J.W. van der Vegt1, and W.L. Vos1; 1Complex Photonic Systems (COPS), MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands; 2Mathematics of Computational Science (MACS), MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands

We explore theoretically and numerically a 3D superlattice of cavities in an inverse woodpile photonic crystal. We find that light hops only in a few high-symmetry directions including the Cartesian (x,y,z) directions.

13:15 – 14:15

Hall B0

CL-P: CL Poster session

CL-P.1 MON

Confocal Raman Microscopy in VIS for Analysing Conformational Changes in Channel Proteins

A.-K. Knigge1, D. Schmidt1, C. Zeilinger1, and B. Roth1,2; 1Leibniz Universität Hannover, Hannover Centre for Optical Technologies, Hannover, Germany; 2Leibniz Universität Hannover, Naturwissenschaftliche Fakultät, Centre of Biomolecular Research (BMWZ), Hannover, Germany

We report on a novel confocal Raman microscopy setup with 532 nm excitation for analysing conformational changes in channel proteins using a twophoton excitation approach.

CL-P.2 MON

Humans as islands of stability: A longitudinal breath study of a small healthy cohort by means of mid-infrared spectroscopy

K.S. Matt1, M. Lewlon1, E. Fili2, and A. Apolonski1,2,3; 1Max-Planck-Institut fuer Quantenoptik, Garching, Germany; 2Department fuer Physik, Ludwig-Maximilians-Universität München, Munich, Germany; 3Novosibirsk State University, Novosibirsk, Russia

We report on 13-month breath study of a small healthy cohort by using mid-infrared FTIR spectroscopy. First, the individuals demonstrate stable breath content and second, there are effects temporally or permanently changing their stable content

CL-P.3 MON

Optical Signal Recording from Optogenetic Stimulation of Human Pulp Dental Cells Using Twin-Core Fiber Optic Biosensor Based On Mach-Zender Interferometer

F. Akbari1, A. Layeghi1, M.H. Seyed Nazari1, A. Ghorbani2, H. Demidov3, P. Chovan1, L. Dargahi1, O. Foroozani1, J.L. Santos1, H. Latifi1, and M.I. Zibaii1; 1Laser and Plasma Research Institute, Shahid Beheshti University, Tehran, Iran; 2Neuroscience Research Laboratory, Shahid Beheshti University of Medical Sciences, Tehran, Iran

We develop a compact, low-cost setup for optical and thermal therapy evaluation. The optical and thermal features of the sensors are characterized using different detection wavelengths.

CL-P.4 MON

Perspective on exploring metallic gold dimers in photothermal therapy

K.V. Kepesidis1,2, T. Yamamoto3, I. Fatta-Keller1,2, M. Beck1,2, M. Trubetkov3, F. Krauss2,4, and M. Zegan2,5; 1Ludwig-Maximilians-Universität München (LMU), Garching, Germany; 2Max-Planck-Institut fuer Quantenoptik (MPQ), Garching, Germany

We demonstrate the use of semiconductor-based sensing dimeric photonic crystal structures for medical applications.

CL-P.5 MON

Brownian Motion in Markov Nanocommunications’ Systems Driven by Effects of Electric Potentials: The Classical Path Integral Approach

H. Nieto-Chauqui; Universidad de Ciencias y Humanidades, Lima, PERU

We investigate the effect of electric fields on bacteria aggregation through the classical Path Integral as suggested by Richard Feynman. We assume brown movement achieved by bacteria.

CL-P.6 MON

Optical Signal Recording from Optogenetic Stimulation of Human Pulp Dental Cells Using Twin-Core Fiber Optic Biosensor Based On Mach-Zender Interferometer

F. Akbari1, A. Layeghi1, M.H. Seyed Nazari1, A. Ghorbani2, H. Demidov3, P. Chovan1, L. Dargahi1, O. Foroozani1, J.L. Santos1, H. Latifi1, and M.I. Zibaii1; 1Laser and Plasma Research Institute, Shahid Beheshti University, Tehran, Iran; 2Neuroscience Research Laboratory, Shahid Beheshti University of Medical Sciences, Tehran, Iran

We develop a compact, low-cost setup for optical and thermal therapy evaluation. The optical and thermal features of the sensors are characterized using different detection wavelengths.

The use of gold dimers (nanorods linked end-to-end by a thin dielectric or by a metallic junction) on photothermal therapy was evaluated. The optical and thermal features of the sensors are characterized using different detection wavelengths.

CL-P.7 MON

Air-cooled Thulium Fiber Laser: an efficient laser litholocht

A. Pal1, D. Pal1, S.D. Chowdhury2, R. Sen3, and K. Maiti3; 1CSR - Central Glass and Ceramic Research Institute, Kolkata, India; 2IPGMER and SKSM hospital, Kolkata, India

A compact air-cooled diode-pumped thulium fiber laser at 1.94μm is developed to operate in CW as well as quasi-CW mode to fragment urinary stone of any size and composition at fragmentation rate of up to 40mg/min.

CL-P.8 MON

Do infrared molecular fingerprints of individuals exist? Lessons from spectroscopic analysis of human blood

K.V. Kepesidis1,2, T. Yamamoto3, I. Fatta-Keller1,2, M. Beck1,2, M. Trubetkov3, F. Krauss2,4, and M. Zegan2,5; 1Ludwig-Maximilians-Universität München (LMU), Garching, Germany; 2Max-Planck-Institut fuer Quantenoptik (MPQ), Garching, Germany

We show that broadband infrared spectroscopy provides reproducible molecular fingerprints of human blood serum, which are sufficiently distinct to identify individuals and to form a base for health and treatment monitoring applications.

CL-P.9 MON

Online Detection and Sorting of Single-Unit Recordings Using Low-Cost Optical Techniques

A. Ghorbani1, M.H. Seyed Nazari1, F. Akbari1, Z. Futahi1, A. Haghparast2, L. Dargahi1, H. Latifi1, and M.I. Zibaii1; 1Laser and Plasma Research Institute, Shahid Beheshti University, Tehran, Iran; 2Neuroscience Research Institute, Shahid Beheshti University of Medical Sciences, Tehran, Iran

We develop a compact, low-cost setup for optical and thermal therapy evaluation. The optical and thermal features of the sensors are characterized using different detection wavelengths.

The use of gold dimers (nanorods linked end-to-end by a thin dielectric or by a metallic junction) on photothermal therapy was evaluated. The optical and thermal features of the sensors are characterized using different detection wavelengths.

CL-P.10 MON

Realistic determination of the thermal effects generated in human skin during laser-skin thermal treatment

J.F. Tomas, W. Bachir, and M. Sayem El-Daher; Damascus University, Damascus, Syria

We take in vivo measurements of the optical parameters of human skin, to couple them to a simulation model to predict heat distribution in skin during actual laser-skin treatments. The results are verified with thermal measurements.

CL-P.11 MON

Sram Spectroscopic Evaluation of Human Myocardial Infarction

T. Iminnabavan1,2, T. Yiamamoto3, Y. Harada3, Y. Yamaoka3, H. Tanaka3, H. Viets3, and T. Takahata3; 1Tokushima University, Tokushima, Japan; 2PRESTO, Tokushima, Japan; 3Kyoto Prefectural University of Medicine, Kyoto, Japan; 4Suga University, Suga, Japan

We propose a label-free evaluation method of myocardial infarction in patients undergoing cardiac surgery by Raman spectroscopy. We realize the discriminant sensitivity and specificity of these tissue species are 99.98% and 99.92% without any staining.

CL-P.12 MON

Photothermic Fiber-Optics Endoscope for Oncology

S. Govets1, K. Dukelskii2, N. Nikonov1, and V. Demidov1; 1ITMO University, Saint-Petersburg, Russia; 2The Bonch-Bruevich Saint-Petersburg State University of Telecommunications, Saint-Petersburg, Russia

We develop a compact, low-cost setup for optical and thermal therapy evaluation. The optical and thermal features of the sensors are characterized using different detection wavelengths.

The use of gold dimers (nanorods linked end-to-end by a thin dielectric or by a metallic junction) on photothermal therapy was evaluated. The optical and thermal features of the sensors are characterized using different detection wavelengths.

The use of gold dimers (nanorods linked end-to-end by a thin dielectric or by a metallic junction) on photothermal therapy was evaluated. The optical and thermal features of the sensors are characterized using different detection wavelengths.
New photovactive fiber-optics medical endoscope for oncology has been developed. New endoscope has photoactive transparent tip able to generate singlet oxygen under near UV radiation spreading through optical fibers.

**CL-P.13 MON**

**Tissue Decellularization Assisted by Direct Laser Interference Lithography**

- Institute of Optoelectronics MUS, Warsaw, Poland
- Institute of Metallurgy and Material Science PAS, Cracow, Poland
- Heart Prothesis Institute, Bioengineering Laboratory, Zabrze, Poland

Described are preliminary results of laser decellularization of aortic and pericardium animal tissues using direct laser exposure and laser interference lithography. The last method resulted in significantly improved removal of cells.

**CL-P.14 MON**

**Avoidance of Cross-Phase Modulation in Femtosecond Stimulated Raman Scattering**

- T. Wieten, N. Irwin, and C. Fallnich
- Institute of Applied Physics, University of Münster, Münster, Germany
- MESSA+ Institute of Nanotechnology, University of Twente, Enschede, Netherlands
- Cells-in-Motion Cluster of Excellence (EXC 1003 CIM), Münster, Germany

We present the avoidance of spectral XPM artefacts in femtosecond stimulated Raman scattering, based on a systematic study varying the pump pulse duration in the high pulse energy regime.

**CL-P.15 MON**

**Production of drug particles using pulsed laser ablation in liquid (PLAL) technique**

- Department of Optics and Quantum Electronics, University of Szeged, Szeged, Hungary
- MTA-SZTE Research Group on Photoacoustic Spectroscopy, University of Szeged, Szeged, Hungary
- Department of Optics and Quantum Electronics, University of Szeged, Szeged, Hungary
- Institute of Physical Technology and Regulatory Affairs, University of Szeged, Szeged, Hungary

Pulsed laser ablation in liquid is an innovative, chemical free and effective particle size reduction technique in drug formulation. After specifying ideal parameters stochometric matching, size distribution and further investigations were done to characterize samples.

**CL-P.16 MON**

**THz pulses stimulate the tail segment regeneration of the earthworm Eisenia Andrei**

- M. Abufadla, A. Erdégly, G. Kozsán, J. Heibling, J. Fülöp, and L. Molnár
- Physics, Pecs, Hungary

THz pulses stimulate the tail segment regeneration of the earthworm Eisenia Andrei.

**CL-P.17 MON**

**Experimental evaluation of pulse 1550 nm laser system for welding of heart tissue**

- K. Livišnová, M. Chrenyševa, I. Kudelín, S. Khlaimanenko, and E. Levyč
- Astor Medical Research Institute, Aston University, Birmingham, United Kingdom
- Aston Institute of Photonic Technologies, Aston University, Birmingham, United Kingdom
- First Moscow State Medical University (Sechenov University), Moscow, Russia
- Cardiology Department, Queen Elizabeth Hospital, Birmingham, United Kingdom

Laser welding is an effective method for wound closure and healing without sutures. Heart wall dissections were successfully welded using pulse 1550 nm laser. Autofluorescence demonstrated the molecular changes in tissues after the heat treatment.

**CL-P.18 MON**

**Perfusion measurement and static mixing scattering**

- T. Smáus, B. Kondás, MTASZTE Research Group on Photoacoustic Spectroscopy, University of Szeged, Szeged, Hungary
- Institute of Physical Technology and Regulatory Affairs, University of Szeged, Szeged, Hungary
- MTA-SZTE Research Group on Photoacoustic Spectroscopy, University of Szeged, Szeged, Hungary
- Institute of Optics and Quantum Electronics, University of Szeged, Szeged, Hungary
- Institute of Physical Chemistry, Warsaw, Poland

LASCA measurements were performed on skin models consisting of microsphere emulsion and scattering layers. Exposure time-contrast dependence was studied to estimate the effect of static, dynamic and mixed scattering on the measured perfusion values.

**CL-P.19 MON**

**Production and characterization of ibuprofen Particle Layer generated by Pulsed Laser Deposition (PLD)**

- Department of Optics and Quantum Electronics, University of Szeged, Szeged, Hungary
- MTA-SZTE Research Group on Photoacoustic Spectroscopy, University of Szeged, Szeged, Hungary
- Institute of Pharmaceutical Technology and Regulatory Affairs, University of Szeged, Szeged, Hungary

Ibuprofen particle layers were prepared by Pulsed Laser Deposition (PLD) at various pressures by the application of nanosecond and femtosecond laser pulses. We studied the chemical composition and the crystal structure of the deposited films.

**CL-P.20 MON**

**LASCA perfusion histogram on tissue specimens composed of bimodal speed distribution scattering centers**

- B. Kondás, B. Hopp, and T. Smáus
- Department of Optics and Quantum Electronics, University of Szeged, Dóm tér 9., H-6720 Szeged, Hungary
- MTA-SZTE Research Group on Photoacoustic Spectroscopy, University of Szeged, Dóm tér 9., H-6720 Szeged, Hungary

Tissue phantom with bimodal particle speed distribution was produced from mixture of different sizes microsphere suspensions. Histograms of the inverse correlation time measured by Laser Speckle Contrast Analysis (LASCA) was compared to the unimodal cases.

**CL-P.21 MON**

**Label-free Optical Readout of Bacteria Density in Nanoliter Droplets**

- J. Boguszewski, N. Pachoła, M. Horka, Y. Promovych, P. Garęs, and M. Wojtkowski
- Institute of Physical Chemistry, Warsaw, Poland

Optofluidic platform for label-free screening of bacteria growth in nanoliter droplets is presented. We show that based on droplet’s scattering properties we can perform a reliable readout and verify it by simultaneous recording of fluorescence.

**CL-P.22 MON**

**Fast multiphoton microscope based on polymer lenses array using a 3D printed mold**

- D. Závilo, A. Tripál, and E. Rebollo
- Institute of Bioengineering of Catalonia (IBEC), Barcelona, Spain
- Molecular Biology Institute of Barcelona-CSIC, Barcelona, Spain

We have designed and built a fast multiphoton microscope that allowed for deep imaging of fluorescently labeled drosophila embryos and fast measuring of fluorescent spheres injected in the blood stream of the chicken embryo.

**CL-P.23 MON**

**Point Spread Function measurement of a home-made structured illumination microscope using non-fluorescent large object imaging**

- M. Chertab Jabbari, A.H. Baradaran Ghasemi, M. Ghandi Monfared, and H. Latifi
- Shahid Beheshti University, Tehran, Iran

In this research, the point spread function (PSF) of a home-made structured illumination (SI) microscope are measured by an experimental and analytical method using the maximum likelihood estimation algorithm with a non-fluorescent large particle.

**CL-P.24 MON**

**Impact of presowing laser irradiation on germination and sowing qualities of coniferous seeds**

- A. Iakovlev
- St. Petersburg State Forestry University

We present the impact of presowing laser source at 280 or 295 nm which can be triggered up to 80 MHz and compare the results of lifetime measurement of HSA obtained with a 280 nm pulsed LED.

**CL-P.26 MON**

**Ultrashort pulsed laser resection for colorectal cancer treatment**

- Institute of Photonics and Quantum Sciences, Heriot-Watt University, Edinburgh, United Kingdom
- Leeds Institute of Medical Research, University of Leeds, Leeds, United Kingdom
- Leeds Institute of Cancer and Pathology, University of Leeds, Leeds, United Kingdom

Picoscopic laser resection is presented on cancerous and healthy ex-vivo colon tissue. The impact of the process parameters and strategies for cavities with a well-defined depth and minimal thermal damage to the surrounding tissue are discussed including high-speed imaging.

**CL-P.27 MON**

**Persistent luminescence materials at various sizes and their applications**

- B. Viana
- PSL Research University, Chimie ParisTech, CNRS, Institut de Recherche de Chimie Paris, , Paris, France

In the persistent luminescence materials, the emission could last several hours after the end of the excitation. Bioimaging is a recent application at nanosize, but innovative and property-enhanced materials by sizing effects could be envisioned.
CM-P-1 MON

Generation of Vector Bessel Beams and Their Application for Laser Microprocessing of Transparent Materials. J. Biritovskis1, 2, O. Ulinica1, 2, T. Gertius1, 2, V. Jukna1, 2, and S. Orlov1 1, 2. Center for Physical Sciences and Technology, Vilnius, Lithuania; 1, 2. Workshop of Photonics, Altechna R&D, Vilnius, Lithuania. In this work we present generation of Vector Bessel Beams using an e-plate (radial polarization converter) together with an axicon and application of generated beam and its transverse components for laser microprocessing of transparent materials.

CM-P-2 MON

Double pulse experiment with dielectrics: From basic mechanisms to enhanced ablation efficiency. S. Guizard, Laboratoire Interactions Dynamiques Lasers, Gif Sur Yvette, France. A double pulse scheme allows to better understand laser dielectric (SiO2) interaction, by controlling independently plasma density and temperature. The setup was extended to demonstrate IR assisted direct ablation in the VUV at 32nm.

CM-P-3 MON

Wavelength and Energy Scaling of Deposited Energy Density During Microstructuring of Transparent Materials. E. Migal1, E. Mareev1, E. Smetanina2, G. Duchateau3, and F. Potekhin1. 1. Faculty of Physics and International Laser Center M.V. Lomonosov Moscow State University, Moscow, Russia; 2. Department of Physics, University of Gothenburg, Gothenburg, Sweden; 3. University of Bordeaux - CNRS - CEA, Centre Lasers Intenses et Applications, Talence, France. We present detailed measurements of deposited energy density under femtosecond microstructuring of bulk fused silica for different wavelengths and energies. The comparison of initial ionization mechanisms and the influence of avalanche ionization are also given.

CM-P-4 MON

Macroscopic electron-hole distribution calculated by the time-dependent density functional theory and Maxwell equation. T. Otobe, Kansai Photon Science Institute, QST, Kyoto, Japan. Macroscopic electron-hole distribution around the surface of the Si and 4H-SiC are calculated by using the program SALMON. Although the quasi-temperatures are damped exponentially at the surface, they have finite value in deeper region.

CM-P-5 MON

Nonlinear Optical Properties in Femtosecond Laser Processing of Nd:YAG Waveguides. F. Arteaga-Sierra1, T. Feng1, C. Dorner1, and J. Qiao1. 1. Aktiwave LLC, Rochester, USA; 2. Chestor F. Carlson Center for Imaging Science, Rochester Institute of Technology, Rochester, USA. We study the propagation of tightly focused femtosecond laser pulses in Nd:YAG for direct laser writing of waveguides, demonstrating the impact and interplay of linear diffraction, nonlinear self-focusing, and plasma formation with different laser parameters.

CM-P-6 MON

Improvements on characterization of the threshold and productivity in femtosecond laser ablation of bone. M. Rico1, M. Jubera2, A. San Blas3, L. Roso1, A. Lazkos1, and J. Arregui1. 1. Centro de Laseres Pulidos (CLPU), 2. Departamento de Tecnologias de la Información y las Comunicaciones, 3. Deneb Medical, Donostia-San Sebastián, Spain. Ablation rate has been measured for Ti:Sapphire and Yb:KGW lasers, maximum values obtained in each case are 0.7 mm3/min and 3.2 mm3/min respectively. Although less fluence used with Yb:KGW laser, higher ablation rate have been observed.

CM-P-7 MON

Temperature evolution in the thin silica film on industrial glass due to treatment with ns UV laser. D. Guevera1, 2, C. Chacón1, 2, E. Goetzky1, E. Barimah1, 2, and E. Potekhin1. 1. Faculty of Physics and International Laser Center M.V. Lomonosov Moscow State University, Moscow, Russia; 2. Department of Physics, University of Gothenburg, Gothenburg, Sweden. We report a numerical study of laser-induced evolution of sample temperature and experimental validation through the actual laser treatment. Substrate temperature can locally reach values higher than the glass transition temperature.

CM-P-8 MON

In situ diagnostic for multi pulse processing of transparent materials. F. Zimmermann1, M. Jenne1, S. Hecker2, D. Flamm1, M. Kaiser1, J. Kleiner1, and M. Schäfer1. 1. TRUMPF Laser- und Systemtechnik GmbH, Ditzingen; 2. TRUMPF Laser GmbH, Schramberg, Germany. In situ pump-probe diagnostic of ultrashort pulse induced modifications is presented. To develop industrial applications under high throughput advanced process strategies such as alternative beam shapes and temporally modulated laser parameters are studied.

CM-P-9 MON

New Type Metal-Azides for Low Threshold Laser Initiation. A.M. Rodin1, 4, J. Sarulauskas2, J. Tamuliene1, and E. Kaudys1. 1. Center for Physical Sciences and Technology, Vilnius, Lithuania; 2. Vilnius University, Life Science Centre, Institute of Biochemistry, Vilnius, Lithuania; 3. Vilnius University, Institute of Theoretical Physics and Astronomy, Vilnius, Lithuania; 4. Ekspla Ltd, Vilnius, Lithuania. Nontrivial and well-known energetic materials based on azides were synthesized and investigated to reduce the threshold of laser initiation. Critical laser parameters were determined and reliable initiation with a threshold below 0.4mJ was demonstrated.

CM-P-10 MON

Laser patterning of electrode-electrolyte interfaces of Solid Oxide Fuel Cells (SOFCs). R. Lahoz1, J.A. Cebollero2, J. Silva2, M.A. Lagana-Bercero2, and A. Larrea3. 1, 2. Centro de Química y Materiales, 3. Centro de Análisis y Física de Sistemas y Materiales (CEFMA), University of Zaragoza-CSIC, Zaragoza, Spain; 4. Instituto de Ciencias de Materiales de Aragón (ICMA), University of Zaragoza-CSIC, Zaragoza, Spain. Laser tailoring has been used for increasing the active area of the yttria stabilised zirconia (YSZ) electrolyte interface in solid oxide fuel cells to reduce the polarisation losses and improve the cell electrochemical performance.

CM-P-11 MON

Femtosecond Laser Deposited Er3+ Doped Zinc-Sodium Tellurite Glass Films. T. Mann1, E. Barimah1, R. Mathieson1, M. Murray1, B. Richards1, Z. Ikonie2, P. Steenson1, C. Russell2, and G. Jose1. 1. School of Chemical and Process Engineering, University of Leeds, Leeds, United Kingdom; 2. School of Electronic and Electrical Engineering, University of Leeds, Leeds, United Kingdom. The physical and optical properties of fluorines films deposited on silicon substrates via femtosecond laser (40 fs, 800 nm) ablation of Er3+-doped zinc-sodium tellurite glasses in dependence of laser fluence is presented.

CM-P-12 MON

Spectroscopic and Structural Properties of Yb3+-Doped and Undoped 2D-MoS2 Thin Films for Optoelectronic and Photonic Device Applications. A. Jha1, C. Maddi2, A.J. Scott3, J.R. Ashwin4, and K.V. Adarsh1. 1. Faculty of Engineering, University of Leeds, Leeds, United Kingdom; 2. Department of Physics, Indian Institute of Science Education and Research (IISER), Bhopal, India. The structural, spectroscopic and nonlinear optical properties of liquid phase epitaxial, and femto-second pulsed laser deposited Yb3+-doped and undoped MoS2 on silica substrates are analysed for engineering 2-D optoelectronic and photonic devices.

CM-P-13 MON

Lean-Mixture Operation of a Passenger Car Gasoline Engine Ignited by Passively Q-switched Nd:YAG/Cr4+:YAG Laser Spark Plugs. N. Pavel1, R. Chiriac2, A. Birta2, N. Boicel3, F. Draghić1, G. Croitoru1, and M. Dinca1. 1. National Institute for Laser, Plasma and Radiation Physics, Solid-State Quantum Electronics Laboratory, Magurele 077125, Romania; 2. University Politehnica of Bucharest, Faculty of Mechanical Engineering, Bucharest 060042, Romania; 3. Renault Technologie Roumaine, Voluntari 077190, Ilfov, Romania. Passively Q-switched Nd:YAG/Cr4+:YAG laser spark plugs were used to operate a passenger-car gasoline engine showing improved performances in power, efficiency and combustion stability at lean-mixture operation (lambdα~1.25) in comparison with classical electrical spark plugs ignition.

CM-P-14 MON

Femtosecond Laser Microfabrication of Pancharatnam-Berry Phase Elements for the Formation of Optical Needles in Transparent Materials. P. Gotskov1, S. Orlov1, 2, T. Gertius1, 2, and O. Ulinica1, 2. 1. Center for Physical Sciences and Technology, Industrial Laboratory for Photonic Technologies, Vilnius, Lithuania; 2. Workshop of Photonics, Altechna R&D, Vilnius, Lithuania. Vectorial geometrical phase elements with independent amplitudes are designed and implemented using nanogratings inscribed in the glass. We encode vector phase masks for generation of an optical needle with given axial profile.

CM-P-15 MON

Humidity sensor using polypimide carbonization with a UV pulse laser. J.-U. Lee1, Y.-w. Ma1, S.-y. Jeong2, and B.-s. Ma1. 1. Department of Cogno Mechatronics Engineering, Busan, South Korea; 2. Department for Advanced Innovative Manufacturing Engineering, Busan, South Korea. Humidity patterns can be fabricated using 2-D CAD and depth can be controlled by laser power and speed. It is applied this pattern to fabricate the humidity sensor.
A flexible and high sensitive strain sensor with carbonized polyimide film via ultraviolet laser


1Interdisciplinary Department for Advanced Innovative Manufacturing Engineering, Pusan National University, Pusan, South Korea; 2Department of Optics and Mechatronics Engineering, Pusan National University, Pusan, South Korea

The sensor was fabricated by embedding a carbonized patterned-polyimide(PI) irradiating a laser on the Poly-
dimethylsiloxane(PDMS). The minimum sheet resistance is 250Ω/square. We fabricated a wearable device capable of measuring joint motion.

Spatial Filters in Glass Using Bessel Beams

V. Purlys

CM-P.16 MON

CM-P.17 MON

Ultrafast laser filament - assisted microstructuring of polymers

B. Stećak1, A. Antoničak1, and U. Klotzbach2,3

1Wrocław University of Science and Technology, Wrocław, Poland; 2Fraunhofer Institute IWS Dresden, Dresden, Germany

We applied ultrafast laser filamentation for fabrication of microchannels in PMMA and PLLA polymers. The influence of laser parameters on microstructure length was investigated. The possibility of thermal properties control of biodegradable PLLA is presented.

CM-P.18 MON

Structural reproducibility enhancement of optical resonance arrays produced by two-photon polymerization

A. Saetchnikov1,2,3, V. Saetchnikov1, E. Tcherniavskaia1, and A. Osten dorf1

1Ruhr University Bochum, Bochum, Germany; 2Belarusian State University, Minsk, Belarus

In the work an approach to enhance structural reproducibility of the optical resonance arrays produced in the modified illumination scheme of two-photon polymerization is discussed and verified via numerical simulations and experimental results.

CM-P.19 MON

Direct Laser Writing of Large Scale Photonic Crystal Spatial Filters in Glass Using Bessel Beams

V. Purlys1,2,4, D. Gulevicius1,2, and K. Staliun13,4

1Vilnius University Laser Research Center, Vilnius, Lithuania; 2UAB "Femtika", Vilnius, Lithuania; 3Department of Física e Enginyeria Nuclear, Universitat Politècnica de Catalunya, Terrassa, Spain; 4Instituto Catalán de Reserva e Estudos Avançados (ICREA), Barcelona, Spain

We demonstrate that using Bessel beam direct laser writing enables fabrication of large scale photonic crystals in glass for light filtering applications. Such filters can replace filtering with pinholes especially in miniature devices.

CM-P.20 MON

Femtosecond Laser Induced Surface Micro-Structure Building by Material Ejection and Ablation on Cu and Al

X. Sedao1,2, M. Lenzi1, A. Rudenko3, A. Pascale-Hamri2, J.-P. Colombier1, and C. Masclaux1,2

1Laboratoire Hubert Curien UMR 5316 CNRS, Saint-Etienne, France; 2GIE Manutech-USD, Saint-Etienne, France; 3Univ Lyon, IMT Mines Saint-Etienne, Saint-Etienne, France

We report on the generation of microstructures built from the redeposited material during surface ablation with scanned ultrafast laser pulses. Experimental realisations relying on the scanning strategy are achieved and analysed on Cu and Al.

CM-P.21 MON

Femtosecond writing of waveguides and waveguide network components.

D. Perevinock1,2, and U. Morgne1,2,3,4

1Institute of Quantum Optics, Leibniz Universität Hannover, Hannover, Germany; 2Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering - Innovation Across Disciplines), Hannover, Germany; 3Laser Zentrum Hannover e.V., Hannover, Germany; 4Hannoversches Zentrum für Optische Technologien, Leibniz Universität Hannover, Hannover, Germany

In this work we present different geometries of waveg- uides in polymers such as surface sensitive or Y-splitters. They have a great potential of being implemented in waveguide networks or sensing applications.

CM-P.22 MON

A study of laser-grafting surfaces portability on polymer for the automotive industry

A. Bouland1,2, P. Durand1, D. Farage2, M. Géloé2, P. Mansourelle1, and J-P. Renaud1

1IMRE, CE, CNRS, Université Paris-Saclay, Gif sur Yvette, France; 2Renault S.A.S. Gayancourt, France; 3DEN – SEARS, CE, Université Paris-Saclay, Gif sur Yvette, France; 4LIDYL, CE, CNRS, Université Paris-Saclay, Gif sur Yvette, France

Laser-grafting’s for decorative application in the auto- motive industry has emerged as an innovative technology. However, it can’t be applied on the cost of quality. This Study begin to answer which engraving parameters are important.

CM-P.23 MON

Additive Fiber optic Probe technology for Precise Trimming of High-performance Lithium Niobate Photonic Integrated Circuits

A. Trone1,2, M. Parfenov1,2,3, P. Agruzov1, I. Ilichev2, and A. Shamrai4

1NIMBE, CEA, CNRS, Université Paris-Saclay, Gif sur Yvette, France; 2Institut d’Optique et Mathématiques, University of Modena and Reggio Emilia, Reggio Emilia, Italy; 3Department of Physics and Astronomy, University of New Mexico, Albuquerque, USA

In this paper, picosecond-LIPSS were imprinted on Si surface in regime of strong ablation partially using method HR-LIPSS. Moreover, regimes of uniform and burst-mode were investigated and discussed in terms of material, morphological and mechanical properties.

CM-P.24 MON

Ultrafast Laser Texturing on Si with Burst-mode Picosecond Laser Pulses

L. Gómez-Arandazi1,2, V. Gruzdiev1, and L. Orazi1,2

1LPC "NoviNano", Lviv, Ukraine; 2Lyon Polytechnic National University, Lyon, Ukraine; 3University of Modena and Reggio Emilia, Reggio Emilia, Italy; 4Department of Physics and Astronomy, University of New Mexico, Albuquerque, USA

Ultrafast laser texturing of Si with burst-mode picosecond laser pulses demonstrated the possibility of efficient top&bottom surface ablation along the propagation axis of the light to mimic physical dual-focus lenses.

CM-P.25 MON

An Increase in Refractive Index Contrast in A Waveguide Inscribed in Tellurite Glass by Means of Sub-Nanosecond Pulses

A. Okhrimchuk1,2,3, M. Smayer1, A. Gladishev4,5, and V. Dorofeev1,2,3

1D. Mendeleev University of Chemical Technology of Russia, Moscow, Russia; 2Fiber Optics Research Center of RAS, Moscow, Russia; 3G.G. Devyatikh Institute of Chemistry of High-Purity Substances of RAS, Nizhny Novgorod, Russia

It is found that burst of femtosecond IR pulses with a sub-nanosecond inter-pulse interval is a tool for direct laser writing of high-index contrast cladding waveguides with re- fractive index contrast increased in comparison with ordi- nary writing.

CM-P.26 MON

Fabrication of tuned LIPSS-based metallic polarization gratings

A. San Blas1,2, N. Casquero1,2, M. Martínez-Calderón1,2,3, J. Bueno-Barea1, L. M. Sánchez-Brea1, J. del Hoyo1, M. M. Olatzola4, A. Rodríguez1,2,4, and M. Gómez-Arandazi1,2,3

1CEIT-I4, San Sebastián, Spain; 2Universidad de Navarra, San Sebastián, Spain; 3Universidad Complutense de Madrid, Madrid, Spain

We report the fabrication of polarization gratings based on LIPPS in metallic surfaces. Their application as re- flective waveplates is demonstrated from the relation be- tween LIPPS geometry and properties of the reflected light.

CM-P.27 MON

The contribution has been withdrawn.

CM-P.30 MON

The contribution has been withdrawn.

CM-P.31 MON

Faster femtosecond laser processing using a dual-focus SLM emulated lens

L. Barber, J. Low, S. Ashforth, C. Agueraray, and C. M. Simpson

The Photon Factory, the University of Auckland, Auckland, New Zealand

The dual-focus lens emulated using our SLM is config- ured to adjust the distance between two focal spots en- abling efficient top-bottom surface ablation along the propagation axis of the light to mimic physical dual-focus lenses.

CM-P.32 MON

Influence of pressure history on jet dynamics in LIFT processes: simulation and experimental analysis

J.J. Moreno Labella, M. Morales Parro, D. Muñoz Martín, A. Márquez, and C. Molpeceres Álvarez

Centro Láser
Effect of front-contact laser texturing in thin-film solar cells
D. Canteli 1, I. Torres 2, S. Fernández 3, J.D. Santos 1, M. Moral 1, and C. Molpeceres 1; 1 Centro Láser, Universidad Politécnica de Madrid, Madrid, Spain; 2 División de Energías Renovables, Energía Solar Fotovoltaica, CIEMAT, Madrid, Spain


Increasing Two-Photon Polymerization Fabrication Speed of 3D Structures for Cell Interaction Studies
C. Mailbohm 1, O.F. Silvestre 2, J. Borne 2, M. Sinou 1, K. Heggarty 1, and J.B. Nieder 1; 1 Department of Nanophotonics, Ultrafast Bio- and Nanophotonics, INL - International Iberian Nanotechnology Laboratory, Braga, Portugal; 2 Department of Quantum Energy Materials, INL - International Iberian Nanotechnology Laboratory, Braga, Portugal; 3 Department of Physics, Queens College of the City University of New York, New York, USA

Low light absorption in two-dimensional (2D) materials hampers their widespread use in photodetectors. Herein, we present a hybrid plasmonic structure to overcome this issue in the long-wave infrared (LWIR) region.

Novel Mid-infrared Multiple Coherent Emissions for Gas Sensing
Y. Abubakar 1, 2, K. Li 1, 2, N. Copner 3, D. Qiao 1, and Y. Gong 1; 1 Faculty of Computing, Engineering and Science, University of South Wales, Pontypridd, United Kingdom; 2 Foshan Huaxiang Optoelectronics Ltd., Foshan, China; 3 School of Physics and Astronomy, Cardiff University, Cardiff, United Kingdom

In this letter, we demonstrate that multiple coherent emissions can be achieved in mid-infrared by the novel design of metallic grating with narrow air slit on Bragg grating.

Generation of broadband deep-ultraviolet light source by rectangular plasmonic nanoholes with multi-resonances
M. Shtereva 1, 2, E. Omeida 3, U. Morgo 1, 2, and M. Kovačev 1, 2; 1 Institut für Quantenoptik, Leibniz Universität Hannover, Hannover, Germany; 2 Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering-Innovation Across Disciplines), Hannover, Germany; 3 Hannover Centre for Optical Technologies, Hannover, Germany; 4 Department of Physics, Queens College of the City University of New York, New York, USA

We present intracavity plasmonic laser spectroscopy using a plasmonic distributed feedback laser created from a periodically-perforated silver film with a liquid gain medium. We demonstrate intracavity detection of an absorptive dye at a 70 ppb level.

Mode cooperation in plasmonic lasers
A. Zyablovsky 1, 2, N. Nefedkin 1, A. Andrianov 1, A. Pukhov 2, and A. Vinogradov 1, 2; 1 Dukhov Research Institute of Automatics (VNIIA), Moscow, Russia; 2 Moscow Institute of Physics and Technology, Dolgoprudny, Russia; 3 Institute for Theoretical and Applied Electromagnetics, Moscow, Russia; 4 Queens College of the City University of New York, New York, USA

We propose the Raman spaser that utilizes the Raman active molecules and coherent light. We show that the lasing in the Raman spaser is followed by the coherent molecular vibration generation in the molecules.

Dramatic decrease of the Joule losses in the coupling between a crystalline gold film colloidal and single CdSe/CdS nanocrystals at 4K
A. Coste 1, S. Bull 2, X. Quelin 3, G. Colas des Fracs 4, L. Moreaud 1, 2, D. Eujardin 1, and J.-P. Hermier 1; 1 Groupe d’Etude de la Matière Condensée (GEMaC), Université de Versailles Saint-Quentin-en-Yvelines, CNRS UMR 8635, Université Paris-Saclay, Versailles, France; 2 Laboratoire Interdisciplinaire Carnot de Bourgogne (L2CBo), URFCAS 6933, Université Bourgogne Franche-Comté, Dijon, France; 3 CEMES CNRS UPR 8011 and Université de Toulouse, Toulouse, France

We present a new approach of synchronizing linear stages and galvo-scanners for rapid and stitch-free 3D printing of functional microoptics with overall size up to mm and precision down to nm.

Two beam initiation threshold measurements of photo-initiators for laser writing of biocompatible 3D structures
D. Ludik 1, 2, M. Farsari 1, and D. Gray 1, 2; 1 ISEL-FORTH, Heraklion, Greece; 2 Department of Physics, University of Crete, Heraklion, Greece

We present our latest work on the investigation of new photo-initiator materials using two beam initiation threshold (2-BIT). Their suitability for biocompatible 3D structures is also investigated primarily with direct laser writing.
We show that the optical losses observed in the coupling between colloidal thick-shell CdSe/CdS nanocrystals and a flat gold film can be strongly reduced by using crystalline gold and by operating at 4K.

**EH-P.8 MON**

**Plasmonic optical trapping combined with time-resolved fluorescence microscopy**

Q. Jiang, J.-B. Claude, and J. Wenger, Aix Marseille Univ, CNRS, Institut Fresnel, Marseille, France

We combine a fluorescence microscope with an optical trapping system. This approach offers the advantage of having a better signal to background ratio due to the near-zero background on the fluorescence channel.

**EH-P.9 MON**

Shaping the emission pattern of organic light emitting diodes by using plasmonic Ag nanoparticles arrays

1. Hamdad, Laboratoire de Physique des Lasers CNRS UMR 7538, Université Paris 13, Sorbonne Paris Cité, Villeurbanne, France

This work concerns the utilization of plasmonic periodic nano-ordered structures to model the emission pattern, and enhance the properties of organic light emitting diode devices in terms of emission rate, efficiency and directionality.

**EH-P.10 MON**

Evaluation of plasmonic enhancement and quenching of Ag nanoparticles in organic light-emitting diode

1. Thierno Diallo, M. Chakaroun, S. Hamdad, S. Khadir, J. Espana-Villa, A. Maître, and A. Boudrioua, Laboratoire de Physique des Lasers CNRS UMR 7538, Université Paris 13, Sorbonne Paris Cité, Villeurbanne, France

2. S. Khadir and Dipankar Ghosh, Dipankar Ghosh

**EH-P.11 MON**

Amplifying SP-enhanced SHG with NLO polymers grown on Ag films

1. Sugita, K. Mochizuki, K. Kikuchi, A. Ono, W. Inami, and Y. Kawata, Shizuoka University, Hamamatsu, Japan

35-fold amplifications of SP-enhanced SHG were gained with NLO polymer layer grown on Ag films in Kretschmann geometry. Degree of amplifications was determined by balance nonlinear interaction length and multiple reflections inside polymer layers.

**EH-P.12 MON**

Synthesis of gold nanodroplets with field enhancement of 10^5 at their tips using a simple wet-chemical method


2. Chemistry, Indian Institute of Gandhinagar, GANDHINAGAR, India

We report the synthesis of gold nanodroplets, a new nanostructure that has a sharp tip and a spherical base. The longitudinal plasmon resonance is tunable and numerical simulations show field intensity enhancement of 10^5.

**EH-P.13 MON**

Investigation of the Lower Limit of the Applicability of Effective Medium Approximation for Hyperbolic Metamaterials

1. Sukham, O. Takayama, M. Mahmoodi, S. Sychev, A. Bogdanov, S.H. Tavassoli, A. Lavrinenko, and R. Malureanu, Department of Photonics Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark

2. Laser and Plasma Research Institute, Shahid Beheshti University, Tehran, Iran

3. Saint Petersburg National Research University of Information Technologies, Mechanics and Optics, St. Petersburg, Russia

We theoretically and experimentally investigate the limits of the effective medium theory with respect to the minimum number of periods and its dimensions. We show that this limit is high, even for very small structures.

**EH-P.14 MON**

Magnetic Near-field enhancement in THz Multilayer Fano Metamaterial

1. S. Karmakar, R.K. Varshney, and D. Roy Chowdhury, Indian Institute of Technology Delhi, Delhi, india

2. Mahindra Ecole Centrale Hyderabad, Hyderabad, India

We report a highly localized magnetic field enhancement in Fano resonance based multilayered metamaterial in THz frequency domain. Nearly two order of magnitude enhancement has been obtained at Fano resonance frequency.

**EH-P.15 MON**

All optical manipulation of photonic metasurfaces in microfluidic environments

1. Di Falso, S.J. Gough, School of Physics and Astronomy, University of St Andrews, St Andrews, United Kingdom

We discuss the all optical trapping and manipulation of holographic photonic metasurfaces in microfluidic environments for sensing and bio-photonics applications.

**EH-P.16 MON**

Multilattice Structures for Dynamic Beam Forming and Steering

A.N.M. Hussain and I. Tsukerman, The University of Akron, Akron, Ohio, USA

The novel feature of our tunable metaguide/surface is two or more resonating lattices in a host medium. Changing the index of the host, one activates a particular lattice, which produces radiation at the corresponding angle.

**EH-P.17 MON**

VO2 phase change control of Au nanorod emission enhancement of magnetic dipolar emitters

1. Petronijevic, M. Centini, T. Cesca, G. Mattei, and C. Sibilia, SBAP Department, Sapienza University of Rome, Rome, Italy

2. Physics and Astronomy Department, University of Padova, Padova, Italy

We investigate the emission control of dipoles sandwiched between Au nanorods and a thin phase change material VO2, which changes from semiconductor to metallic state. This work could lead to tunable efficient integrable nanosource applications.

**EH-P.18 MON**

Light Manipulation with Plasmonic Structures using Phase Change Materials

1. A. Uskov, Mahindra Ecole Centrale Hyderabad, Hyderabad, India

2. School of Physics, CRANN and AMBER, Trinity College Dublin, Dublin, Ireland

Here, we report on the reversible manipulation of plasmonic and photoluminescence properties of hybrid nanostructures, consisting of quantum emitters and gold nanorod arrays on vanadium dioxide (VO2), through the phase change of VO2.

**EH-P.19 MON**

Waveguide stopped light mediated by mode transitions

1. P. Pujol-Closa, J. Gomis-Díaz, and D. Artigas, The Institute of Photonic Sciences, Castelldefels, Spain

2. University of California Davis, Davis, USA

3. Universitat Politècnica de Catalunya, Barcelona, Spain

We show that symmetric three layer waveguides with Type II hyperbolic metamaterials lack cut-off. Instead, modes transit from parallel to orthogonal propagation with respect to the optical axis. This transition process results in stopped light.

**EH-P.20 MON**

Landau damping in plasmonic nanoantennas behind quasistatic approximation: broadening of quadrupole resonance

1. Ukhov, R. Khisamov, and I. Protosenko, N. Lebedev Physical Institute, Russian Academy of Sciences, Moscow, Russia

2. National Research University Higher School of Economics, Moscow, Russia

We develop theory of Landau damping in spherical plasmonic nanoparticles behind quasistatic approximation. In particular, we firstly consider Landau damping of quadrupole plasmonic resonance and show that it can be substantial.

**EH-P.21 MON**

The Optical Properties of AuZr Intermetallic Alloys

1. Littlehales, W. Hendren, S. Drakeley, R. Bowman, and F. Huang, School of Mathematics and Physics, Queens University Belfast, Belfast, United Kingdom

2. Intermetallic alloys are increasingly attracting attention as alternative plasmonic materials, owing to their refractory properties. Presented are the detailed studies of the synthesis of high quality AuZr and the rigorous characterisation of its optical properties.
All-fiber source for generation of tunable broadband fem-to-mid-IR pulses for laser spectroscopy applications

- Institute of Photonics and Nanostructures, Politecnico di Torino, Turin, Italy
- Dipartimento di Elettronica e Telecomunicazioni, Politecnico di Torino, Turin, Italy
- Instituto Nanoscienze-CNR and Dipartimento di Scienze e Tecniche, Università di Pavia, Pavia, Italy
- 1E.U. of Applied Physics, Friedrich-Schiller-Universität, Jena, Germany
- 2Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany
- 3Department of Technical Physics, Technical University of Munich, Munich, Germany

We present a cold damping scheme to cool the motion of an optically levitated nanoparticle to the micro-Kelvin regime. We determine the imprediction-backaction product of our system and outline the prospects for ground-state cooling.

Noise evolution in all-normal dispersion supercontinuum generation

- E. Genier, P. Bowen, T. Sylvestre, J. M. Dudley, P. M. Moselund, and O. Bang
- 1NKT Photonics, Birkerød, Denmark
- 2FEMTO-ST, Besançon, France
- 3DTU Fotonik, Lyngby, Denmark

We demonstrate levitation of a nanodiamond containing a single nitrogen vacancy center in a Paul Trap.

Levitation and Optical Interrogation of a Feedback-Cooled Nitrogen Vacancy Center in a Paul Trap

- A. W. Schoffl, G. P. Conangla, R. A. Rica, and R. Quidant
- 1ICFO-Institut de Científics Fotòniques, Castelldefels, Spain
- 2Central European Institute of Technology, Brno University of Technology, Brno, Czech Republic
- 3Department of Applied Physics, School of Sciences, University of Granada, Granada, Spain
- 4IERA-Institut Catalana de Recerca i Estudis Avançats, Barcelona, Spain

We demonstrate levitation of a nanodiamond containing a single nitrogen vacancy center in high vacuum. Further, feed-back cooling of its center of mass motion is applied.

Observation of Brillouin optomechanical strong coupling with an 11 GHz mechanical mode


MoSe2 and WSe2 embedded in Bragg-Cavities with high Q-factors enabling strong exciton-polariton coupling in 2D systems

- H. Knopp, C. Ruprecht, U. Schulte, C. Schneider, and F. Eitenberger
- 1Institute of Applied Physics, Friedrich-Schiller-University, Jena, Germany
- 2Fraunhofer Institute of Applied Optics and Precision Engineering IOF, Jena, Germany
- 3Max Planck School of Photonics, Jena, Germany
- 4Department of Technical Physics, Technische Universität Kassel, Kassel, Germany

We present novel surface-emitting IR-SLEDS completely fabricated on wafer-level as arrays with significant advantages over conventional edge-emitters. In our approach, a radial arrangement results in very symmetric far fields with FWHM <15° in all directions.

Record-High Power Spectral Density CW Tapered Quantum-Dot Superluminescent Diode

- A. F. Forrest, M. Krakowski, P. Bardellía, and M. A. Cataldi
- 1Institute of Photonics and Quantum Sciences, School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom
- 2Previously also with the School of Science and Engineering, University of Dundee, Dundee, United Kingdom
- 3II-VI Ltd, Palaiseau, France
- 4Dipartimento di Elettronica e Telecomunicazioni, Politecnico di Torino, Turin, Italy

We present a CW, two-section, taperd, chirped quantum-dot SDL which achieved a record-high power spectral density (6.5 mW/nm) as well as a record high output power (137.5 mW) in the 1.15 – 1.35 µm spectral region.

Surface-emitting superluminescent diode arrays

- B. Jentzsch, A. Gomez-Iglesias, A. Tomkiewicz, and B. Wittigmann
- 1Universität Kassel, Kassel, Germany
- 2OSRAM Opto Semiconductors, Regensburg, Germany

We present novel surface-emitting IR-SLEDS completely fabricated on wafer-level as arrays with significant advantages over conventional edge-emitters. In our approach, a radial arrangement results in very symmetric far fields with FWHM <15° in all directions.

Blue Superluminescent Diode on c-Plane GaN Beyond Gigahertz Modulation Bandwidth with Visible Light Communication


We present a cold damping scheme to cool the motion of an optically levitated nanoparticle to the micro-Kelvin regime. We determine the imprediction-backaction product of our system and outline the prospects for ground-state cooling.

Condensation and expansion of cavity polaritons based on two-dimensional crystals

- C. Schneider, M. Waldherr, N. Lunde, M. Klaus, L. Dasanowski, A. Kavokin, and S. Hofling
- 1Technische Physik, Universität Würzburg, Germany
- 2WIAS, Shilonghan Road, Cloud Town, Hangzhou, China
- 3Hangzhou, China

We discuss the formation of a bosonic condensate driven by excitons hosted in an atomically thin layer of MoSe2. Furthermore, we discuss the observation of the anomalous Hall effect of monolayer-based exciton-polaritons.

Room 4a ICM

- C. Sotor, T. Hellwig
- Institute of Applied Physics, Friedrich-Schiller-University, Jena, Germany

We demonstrate numerically how all-fiber covered the ~8 µm spectral region. Based on difference frequency generation, driven by an Er-doped fiber oscillator. Non-complex pulse repetition tuning enables using the source in Vernier gas spectrometers.

Joule-class 500 Hz cryogenic Yb:YAG Chirped Pulse Amplifier

- 1Center for Free-Electron Laser Science, Deutsches Elektronen Synchrotron, Hamburg, Germany
- 2Department of Physics & The Hamburg Center for Ultrafast Imaging, Hamburg, Germany

A cryogenic Yb:YAG composite-thin-disk laser driver has demonstrated long-term stable operation with 1-joule, 1/2 ns chirped pulse output at 500 Hz. Data will be presented. The output pulses (FWHM 0.35nm) may be compressed to <5ps.

Multi-Watt Multi-Pass Amplification in a 42-mm-long Yb:LuLiF₃ Single Crystal Fiber Grown by the Micro-Pulling-Down Method

- 1 Dipartimento di Ingegneria Industriale e dell’Informazione, Università di Pavia, Pavia, Italy
- 2 NEST Istituto Nanoscienze-CNR and Dipartimento di Fisica, Università di Pisa, Pisa, Italy
- 3 Gemmological Institute, China University of Geosciences, Wuhan, China
- 4 Bright Solutions Srl, Curà Carpignano (PV), Italy

We present a 100-W cw-pumped, 1-W seeded, 4-passes amplifier based on a 42-mm-long, 2%-Yb²⁺-LuLiF₃ birefringent crystal fiber grown for the first time by the micro-pulling-down method. Small-signal gain G₀ = 35 and 8.4-W output power (M² = 1.1) were obtained.
Towards semiconductor-based Metasurfaces

1 Institute of Photonics and Nanotechnologies, IFN-CNR, Milan, Italy; 2 Department of Physics, Politecnico di Milan, Milan, Italy; 3 CIBIO, University of Trento, Trento, Italy; 4 Department of Bioscience, University of Milan, Milan, Italy

We propose a dual-color fluorescence microscope fabricated by femtosecond laser micromachining on a glass chip. The device allows high throughput three-dimensional imaging of single breast cancer cells with high resolution.

Optical Control in a 3D Flow-Focusing Microfluidic Sorting System

Y. Lyu, A. Gildie, and H. Yin; University of Glasgow, Glasgow, United Kingdom

Here we implement an optical sensing strategy for hybrid plug-and-play microfluidic devices that couples events in a 3D hydrodynamic focusing module to those in a downstream sorting module, so triggering the actuation required to sort cells/beads.

Integrated Plasmonic Nanoantenna

B. Leroy①, G. Magna①, D. Barat②, L. Prudere②, and B. Dagens①; Centre de Nanosciences

Optical routing of nanospheres on plasmonic rails

S. Yin, F. He, N-G. Green, and X. Fang; School of Electronics and Computer Science, University of Southampton, Southampton, UK

Characterization of 8 fs Deep-UV Pulses Using XPW Dispersion Scan

A. Tajalli①, T.K. Kalousdian①, M. Kretschmann①, S. Kleinert①,②, U. Morgner①,②,③, and T. Nügy①; 1 Institute of Quantum Optics, Leibniz Universität Hannover, Hannover, Germany; 2 Cluster of Excellence Phoenix21 (Photonics, Optics, and Engineering – Innovation Across-
We report the fabrication of highly nonlinear photonic crystal fiber from UV-grade glass and experimentally demonstrate nearly 100% frequency conversion over 350-395 nm by pumping at 790 nm with picosecond pulses.

Gigahertz Quantum Dot Optomechanics in the Resolved Sideband-Regime

M. Weiff, M. Nägele, K. Müller, J. Finley, and H.I. Krener; Institut für Physik, Universität Augsburg, 86159 Augsburg, Germany

Here we present the parametric excitation of a single quantum dot dynamically strained by a surface acoustic wave (SAW) in the resolved sideband regime.

Spin-Layer- and Spin-Valley-Locking due to Symmetry in Differently-Stacked Tungsten Disulfide Bilayers

L.M. Schneider, J. Kuhner, S. Schmitz, U. Hütter, L. Meckbach, T. Struckenschneider, S.W. Koch, W. Heimbach, S. Fei, X. Wang, K. Kang, E.-H. Yang, and A. Rahimi-Imani; Department of Physics and Materials Science, Center, Philipps-Universität Marburg, 35032 Marburg, Germany

We demonstrate a direct evidence of free excitons and an optical-to-optical efficiency of 976 nm is presented. A maximum output power of 11 W with a slope efficiency of 75% at 1086 nm is achieved.

We investigated the spectroscopic properties and the laser performances of Yb(2Lxy(1-x))3O3 ceramics with different Y/Lu balances.
et de Nanotechnologies, CNRS, Univ. Paris-Sud, Université Paris-Saclay, CN2, Palaisios, France; 2 Group PSA, Direction Scientifique, Centre technique de Vélizy, Villacoublay, France

Plasmonic nanoantenna chains gratings are integrated near silicon nitride waveguides to extract and emit light beam with full control of the directivity and optical power. Numerical demonstration and first experimental validation are presented.

Projected Free-Space Light with Arbitrary Polarization by a Photonic Chip Integrated with a Metasurface

A. Yakovlev1, W. Zhi1, C. Zhang1, D.A. Westley1, H.J. Lezec, A. Agrawal2, and V. Aksyuk1; 1 Physical Measurement Laboratory, National Institute of Standards and Technology, Gaithersburg, MD, USA; 2 Maryland Nanocenter, University of Maryland, College Park, MD, USA

We demonstrate single-mode photonic coupling to free-space radiation with arbitrarily engineered light phase and polarization. The photonic-to-free-space coupling is realized by integrating a photonic chip expanding waveguide modes into wide collimated beams and a planar metasurface.

Autonomous Photonic Biosensor based on Guided Mode Resonance

A. Drayton, C. Reardon, and T. F. Krauss; Physics Department, University of York, York, United Kingdom

We present a cost-effective and autonomous biosensor with a refractive index sensitivity of 4 x 10-5 RIU based on Chirped Guided Mode Resonance with fully enclosed source and detector.

Breath signatures of cervical palsy patients revealed with mid-infrared FTIR spectroscopy

K.S. Maiti1, S. Roy1, R. Lampe1,2, and A. Aplonski1; 1 Max Planck Institute of Quantum Optics, 82435 Garching, Germany; 2 Ludwig Maximilian University Munich, Chair of Experimental Physics – Laser Physics, Faculty of Physics, Am Coulombwall 1, D-85748 Garching, Germany

We present our technique using chirped grating micromechanical diaphragms for the patterning of thick silicon nitride layers, followed by silicon micromachining. Subsequent deep etching is demonstrated and a comparison with traditional micromechanical cleanroom fabrication will be made.

Mobile Based In situ Detection of Live/Dead and Antibiotic Resistant Bacteria by Silver Nanorods Array Sensor Fabricated by Glancing Angle Deposition

S. Gahlaut1,2, K.S. Maiti1,2, A. Kageyama1,2, A. K. Bohara1,2, and M. T. Umemoto2; 1 Department of Engineering Science, Faculty of Engineering, University of Southampton, Southampton, United Kingdom; 2 Parker Hannifin Corporation, Bristol, United Kingdom

We demonstrate that by using short (5-7 fs) driving pulses, optical soliton dynamics can be obtained in hollow capillary fibres less than 35 cm in length, generating sub-ps ultrafast UV pulses with high efficiency.

Spectral of Southampton, Sotthington, United Kingdom

We present our technique using chirped Bragg gratings to measure propagation loss in integrated direct UV-written waveguides in silica-on-silicon. We achieve this using rapid chirp rates of up to 13 nm/mm in 15 mm long gratings.

Mobile Based In situ Detection of Live/Dead and Antibiotic Resistant Bacteria by Silver Nanorods Array Sensor Fabricated by Glancing Angle Deposition

S. Gahlaut1,2, K.S. Maiti1,2, A. Kageyama1,2, A. K. Bohara1,2, and M. T. Umemoto2; 1 Department of Engineering Science, Faculty of Engineering, University of Southampton, Southampton, United Kingdom; 2 Parker Hannifin Corporation, Bristol, United Kingdom

A rapid and low cost laser-based fabrication technique for the patterning of thick silicon nitride to mask silicon for subsequent deep etching is demonstrated and a comparison with traditional micromechanical cleanroom fabrication will be made.

360° on chip optical beam steering based on superposition of planar spiral orbital angular momentum waves

S. Zheng1, Y. Zhang2, J. Zhai2, Z. Wu1, Y. Chen1, and S. Yu1; 1 Sian Yat-sen University, Guangzhou, China; 2 University of Bristol, Bristol, United Kingdom

We report an integrated optical phased array consisting of concentric micro-ring orbital angular momentum emitters. The device is capable of 360°-degree beam steering and beam-shaping for potential applications in optical communications and Lidar.

Mobile Based In situ Detection of Live/Dead and Antibiotic Resistant Bacteria by Silver Nanorods Array Sensor Fabricated by Glancing Angle Deposition

S. Gahlaut1,2, K.S. Maiti1,2, A. Kageyama1,2, A. K. Bohara1,2, and M. T. Umemoto2; 1 Department of Engineering Science, Faculty of Engineering, University of Southampton, Southampton, United Kingdom; 2 Parker Hannifin Corporation, Bristol, United Kingdom

A rapid and low cost laser-based fabrication technique for the patterning of thick silicon nitride to mask silicon for subsequent deep etching is demonstrated and a comparison with traditional micromechanical cleanroom fabrication will be made.

Light and slow-neutron diffraction properties of holographic nanodiamond composite gratings

Y. Tomita1, A. Kageyama1, Y. Iso1, K. Umeno1, J. Klepp1, C. Pruner1, and M. Fally2; 1 Department of Engineering Science, University of Electro-Communications, Tokyo, Japan; 2 Central Research Center, Daiclel Corp., Hyogo, Japan; 3 Faculty of Physics, University of Vienna, Vienna, Austria; 4 Department of Material Science and Physics, University of Salzburg, Salzburg, Austria

We report on efficient control of light and slow-neutron beams by newly developed holographic nanodiamond composite gratings. Diffraction efficiencies near 100% and 22% at readout wavelengths of 633 and 4.5 nm, respectively, are demonstrated successfully.
Tuesday – Orals

ROOM 1 ICM

10:30 – 12:30
Plenary

Photonic Entanglement: from Foundations to Applications

- A. Zeilinger, Vienna Center for Quantum Science and Technology University of Vienna, Vienna, Austria; Institute for Quantum Optics and Quantum Information, Vienna, Austria

Entangled photons have become an essential workhorse for experiments on the foundations of quantum mechanics. Tests of Bell’s Inequality (cf. the Einstein-Podolsky-Rosen Paradox) have with increasing sophistication ruled out more and more alternative views to quantum mechanics.

Prize and Award Ceremonies

- (2) EPS Fresnel Prizes
  - The 2019 Fresnel prize for fundamental aspects is awarded to Carlos Hernández-García, University of Salamanca, Spain. The prize is awarded to Carlos Hernández-García for pioneering contributions to the theory of high harmonic generation, uncovering new regimes of attosecond and zeptosecond waveforms and designer beams with orbital and spin angular momentum.
  - The 2019 Fresnel prize for applied aspects is awarded to Matteo Lucchini, Politecnico di Milano, Italy. The prize is awarded to Matteo Lucchini for pioneering contributions in the field of attosecond science. In particular for seminal contributions in the investigation of attosecond electron dynamics in solid state materials.

ROOM 1 ICM

14:30 – 16:30

Single ion atom theodolite

- V. Tugay, J.-P. Lkifoon, S. Guibal, and L. Guclan; Université Paris Diderot, Sorbonne Paris Cité, Paris, France

We describe and experimentally implement a single trapped-ion local thermometry technique with absolute sensitivity adaptable to all laser-cooled atomic ion species.

ROOM 1 ICMB

17:00 – 19:00

Single atomic ion thermometry

- P. Altmann, Z. Wang, M. Paur2, T. Müller, S. Dal Conete, and G. Gerul†; Politecnico di Milano, Milan, Italy; TU Wien, Vienna, Austria; IFN-CNR, Milan, Italy

We report static and dynamic absorption measurements on a gated MoS2 monolayer. A transition from uncharged to charged excitons is observed with increasing electron density. With an optical pump, the charged exciton is always present.

ROOM 1 ICM

15:30 – 17:30

Gate-tunable exciton and trion dynamics in a MoS2 monolayer

- P. Albrodt, J. Hampsell, M. Niemeyer2, P. Crump, P. Georgescu, and G. Lucas-Leclin1; Laboratoire Charles Fabry, Institut d’Optique Graduate School, CNRS, Université Paris Saclay, Paris, France; Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Berlin, Germany

We demonstrated coherent combining of tapered amplifiers in pulsed regime. We reached 13 W peak power in a nearly diffraction-limited beam with >70% combining efficiency. Additionally, dynamics in the μs and ms-regime are investigated.

ROOM 1 ICM

16:00 – 18:00

Super/filaments spatial dynamics

- L. Jonsson, J. Schröder, and G. Bernhard; Braunschweig Institute, Leibniz Institute for Solid State Research, Jena, Germany

We present a tunable Holmium-doped fibre laser optimised for efficient long wavelength operation between 2.15-2.2 μm and report for the first time watt-level (4.1 W) output from a single fibre laser at 220 nm.
Three-dimensional Vectorial Holography

Varun Sharma, Physical Research Laboratory, Ahmedabad, India, Institute of Technology-Gandhinagar, Ahmedabad, India. Optical vortex generation from an anti-resonant-ring picosecond optical parametric oscillator, (Wednesday, CD-8.5, 17:15-17:30, room 13b ICM)

OSA Awards and Honours

The Optical Society (OSA) will recognize newly elected Fellow Members, present the 2019 Herbert Walther Award and the 2019 Emmett N. Leith Medal during the Awards Ceremony.

OSA fellow members:

Saara Bajt, DESY, Germany
Daniele Faccio, University of Glasgow, United Kingdom
Lukas Gallmann, ETH Zurich, Switzerland
Min Reina Guina, Tampere University, Finland
Rupert Huber, University of Regensburg, Germany
Animesh Jha, University of Leeds, United Kingdom
Zhongping Lee, University of Massachusetts Boston, United States
Uli Lemmer, Karlsruhe Institute of Technology, Germany

Jeremy Raskop, Laboratory Kastler Brossel (LKB), Paris, France, Single collective excitation of atoms evanescently coupled to a nanoscale waveguide (Monday, EA-2.3, 16:45-17:00, room 1a ICM)

Varun Sharma, Physical Research Laboratory, Ahmedabad, Indian Institute of Technology-Gandhinagar, Ahmedabad, India. Optical vortex generation from an anti-resonant-ring picosecond optical parametric oscillator, (Wednesday, CD-8.5, 17:15-17:30, room 13b ICM)

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Animesh Jha, University of Leeds, United Kingdom
Zhongping Lee, University of Massachusetts Boston, United States
Uli Lemmer, Karlsruhe Institute of Technology, Germany

Jérémie M. Hilaire, National Institute for Laser, Plasma, and Radiation Physics, Romania

Roberto Rosellone, CNR-Institut de Fotonica e Nanotecnologia, Italy

Ekmel Ozbay, Bilkent University, Turkey

Francesco Saverio Pavone, University of Florence, Italy

Concita Sibilia, Università degli Studi di Roma La Sapienza, Italy

Christine Silberhorn, Universität Paderborn, Germany

Adrian Stern, Ben Gurion University of the Negev, Israel

Yan Zhang, Capital Normal University, China

Herbert Walther Award

The award commemorates Max Planck Institute of Quantum Physics Professor Herbert Walther’s groundbreaking innovations in quantum optics and atomic physics as well as other wide-ranging contributions to the scientific community. The Herbert Walther Award, administered jointly by OSA and DPG, recognizes distinguished contributions in quantum optics and atomic physics as well as leadership in the international scientific community.

The Optical Society (OSA) and the Deutsche Physikalische Gesellschaft (DPG) have named Sir Professor Peter Knight, Kavli Royal Society International Centre, United Kingdom, the 2019 recipient of the Herbert Walther Award. Knight is recognized for remarkable and varied contributions to quantum optics and related fields, especially in the areas of quantum mechanics, quantum optics, and quantum information science.

2019 Emmett N. Leith Medal

The Medal, established in 2006 in honour of Emmett N. Leith, a world-renowned scientist in holography and optical information processing, recognizes seminal contributions to the field of optical information processing, including sensing and analog signal processing as well as computing (classical and quantum) and optical storage. The Optical Society (OSA) will present the 2019 Emmett N. Leith Medal to Wolfgang Oxen, Universität Stuttgart, Germany, for extending the limits of optical metrology by integrating digital image processing with modern optical measurement techniques.

C17 Awards

IUPAP Young Scientist Prizes (YSP) will be remitted during the CLEO®/Europe-EQEC 2019 Award Ceremony to take place on Tuesday morning 25 June 2019. Commission 17 (C17) on Laser Physics and Photonics of the International Union of Pure and Applied Physics (IUPAP) chaired by Tsuneyuki Ozaki, INRS-EMT, Montreal, Canada, is happy to announce the remittance of its 2019 prizes. C17 commission awards these prizes every two years to excellent young researchers in laser physics and photonics in recognition of their outstanding contribution.

C17 is pleased to announce the award of IUPAP Young Scientist Prizes in Laser Physics and Photonics to Sergey Kruk, Alireza Marandi and Jinyang Liang, in recognition of their outstanding contribution to the areas of physics within the remit of the Commission. Further information available at http://iupap.org/commissions/c17-laser-physics-and-photonics/c17-news/

Consult the separate brochure on these Prizes and Awards.
CI-5: Phase and spectrum manipulation for photonic devices

Chair: Alessandro Tonello, University of Pecs, Pecs, Hungary

EE-4.1 TUE 14:00

Detecting and quantizing pulse train instabilities with d-scan

P. Escotó, D. Gerlich, B. Hofmann, G. Leuchs, M. Kamara, and H.G.L. Schwefel:

1. Department of Physics, University of Otago, Dunedin, New Zealand, 2. Institute of Science and Technology Austria, Klosterneuburg, Austria, 3. Max Planck Institute for the Science of Light, Erlangen, Germany, 4. Institute for Optics, Information and Photonics, University Erlangen-Nürnberg, Erlangen, Germany, 5. Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod, Russia, 6. The Dodd-Walls Centre for Photonic and Quantum Technologies, Dunedin, New Zealand

We demonstrate electro-optic frequency comb generation in a whispering gallery mode disk resonator made of lithium niobate. The comb has more than 180 lines with a spacing of 8.9 GHz centred at 193.5 THz.

CI-5.2 TUE 14:15

Widely tunable regenerative Talbot laser

V. Billaud, V. Crozatier, M. Schwarz, G. Feugnet, G. Baili, P. Nouchi, D. Dolfi, and H. Guillot de Chatellus:

1. Thales Research and Technology, Palaiseau, France, 2. Université Grenoble Alpes, CNRS, UJPhy, Grenoble, France

A novel architecture of high purity oscillator based on the Talbot effect is proposed and demonstrated. This simple set-up produces high repetition rate pulse trains (>GHz) with mW power, low phase noise and broadband tunability.

CB-5: High-power semiconductor lasers

Chair: Michel Krakowsk, III-V Lab, Palaiseau, France

EE-5.1 TUE 14:00

High peak Power Laser Diodes for Eye Safe LiDAR with Integrated Wavelength Locking Element

J. Virtanen, J. Reunan, J. Lytikainen, and M. Guina:

1. Faculty of Science and Engineering, Tampere University, Tampere, Finland, 2. Optoelectronics Research Center, Physics Unit, Tampere University, Tampere, Finland

We present high power wavelength stabilized laser diodes operating at 1.5 μm eye-safe wavelength band. Demonstrated stable spectroscopy enable efficient filtering of ambient light from LiDAR signal without reducing other performance merits of the laser.

EE-5.2 TUE 14:15

Exciton relaxation pathways in CdSe nanorods revealed by two-dimensional electronic spectroscopy

F.A. Camargo, T. Nagahara, M. Russo, U. Banin, and G. Gerulaitis:

1. IFN-CNR, Department of Physics, University of Rome, Italy, 2. Kyoto Institute of Technology, Department of Chemistry and Materials Technology, Kyoto, Japan, 3. The Hebrew University of Jerusalem, Jerusalem, Israel

We study the exciton relaxation pathways in CdSe nanorods with two-dimensional electronic spectroscopy. Global analysis reveals a two-stage process, with the high energy excitons relaxing through the intermediate ones before reaching the low-energy bandgap states.
Elastic Interconnection of Optical Fibers Using Self-Written Waveguides

G. Violaš, A. Bogris1,2, S. Pisapakis, B. Loppinet, and S. Piasaškus1
1Foundation for Research and Technology Hellas (FORTH), Institute of Electronic Structure and Laser (IESL), N. Plastira 100, 70013, Heraklion, Greece; 2Department of Materials Science and Technology, University of Crete, 70013 Heraklion, Crete, Greece; 3NHKEF, Theoretical and Physical Chemistry Institute, 11635 Athens, Greece

A self-written waveguide has been produced using polyisoprene solution to elastically connect two single mode optical fibers. After the waveguide formation, the baseline signal increase between the two fibers was of the order of 3.4dB.

Towards femtosecond laser writting of non-conventional waveguide Bragg gratings in silver-containing glasses

R. Laberasque1, Y. Petit1,2, H. Fares3, A. Abou-Khalil1, S. Danto1, I. Manek-Honninger1, T. Cardinal2, and L. Canioni1; 1University of Bordeaux, CNRS, CEA, CELIA, UMR 5107, Talence, France; 2University of Bordeaux, CNRS, ICMCB, UPR 9048, Pessac, France

New type of Direct Laser Writing allows to form silver clutters (inner features around 100 nm) embedded in glass matrix. Challenging waveguide Bragg gratings have been fabricated for the visible range: demonstration is under study.

Label-free photoplankton analysis by high-throughput quantitative phase imaging cytometry and machine learning

Q.T.K. Lai, K.C.M. Lee, K.K.Y. Wong, and K.K. Tsi; The University of Hong Kong, Hong Kong, China

We report a new type of high-throughput (>10,000 cells/sec) quantitative phase imaging cytometry for high-dimensional label-free (~100 features) photoplankton analysis assisted by machine learning, showing promises in large-scale taxonomic analysis and lipid-content screening of photoplankton.

Label-free photoplankton analysis by high-throughput quantitative phase imaging cytometry and machine learning

H. Katori, The University of Tokyo, Tokyo, Japan

We report recent progress of optical lattice clocks in our group, which includes investigation of operational magic intensity for strontium atoms, transportable clocks, and determination of the magic wavelength for cadmium.

Magic conditions for optical lattice clocks to operate at 10⁻¹⁰ uncertainty

M. Matthews1, F. Morales2, A. Patas1, A. Lindinger1, J. Gates1, N. Berti1, S. Hermelin1, J. Kasparian1, A. Lindinger1, J. Kasparian1, M. Richter2, T. Bredtmann2, A. Bogris2, S. Hermelin1, J. Kasparian1, M. Matthews1, F. Morales2, A. Patas1, A. Lindinger1, J. Gates1, N. Berti1, S. Hermelin1, J. Kasparian1, M. Richter2, T. Bredtmann2, A. Bogris2, S. Hermelin1, J. Kasparian1
1Max-Born-Institut, Berlin, Germany; 2Universität zu Berlin, Berlin, Germany; 3Departamento de Química, Módulo 13, Universidad Autónoma de Madrid, Madrid, Spain; 4Blackett Laboratory, Imperial College London, London, United Kingdom

We present new opportunities for enhancing and controlling lasing inside laser filaments. The novel, general mechanism relies on laser-dressed states in neutral atoms and uses shaped laser pulses to control their population and seed gain.
Tuesday – Orals

ROOM 1 ICM

EA-4.2 TUE (Invited) 14:30
Shaping of coherent state superpositions via deterministically created Schrödinger-cat states

• S. Dais, B. Hacker, S. Welte, A. Shaukat, S. Ritter, L. Li, and G. Rempe; Max-Planck-Institut für Quantenoptik, Garching, Germany

We report the deterministic creation of Schrödinger-cat states where one atom is entangled with a coherent laser field. We use atomic manipulation and detection to shape a plethora of optical coherent-state superpositions.

ROOM 4a ICM

CI-5.3 TUE 14:30
Versatile Amplitude and Phase Filtering in an Optical Tapped Delay Line Structure

• J. Hu1, S.J. Fahrbri2, C.-B. Huang2,3, and C.-S. Bros1; 1École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; 2National Tsing-Hua University, Hsinchu, Taiwan; 3Academia Sinica, Taipei, Taiwan

We demonstrate that the optical tapped delay line structure can implement temporal Talbot effect and combined amplitude and phase filtering schemes. The temporal Talbot operation is confirmed by a proof-of-concept experiment using delay line interferometer.

ROOM 4b ICM

EE-4.3 TUE 14:30
Conical intersection dynamics of pyrimidine nucleosides tracked with sub-20 fs UV pulses

• R. Borrego-Varillas1, A. Nenov1, L. Ganzer2, I. Conti2, A. Oriana1, L. Delfino1, C. Marsano1, M. Garavelli1, and G. Cerullo1; 1INFN-CNRR, Dipartimento di Fisica, Politecnico di Milano, Milano, Italy; 2Dipartimento di Chimica Industriale, Università di Bologna, Bologna, Italy

We report the deterministic creation of Schrödinger-cat states where one atom is entangled with a coherent laser field. We use atomic manipulation and detection to shape a plethora of optical coherent-state superpositions.

ROOM 13a ICM

CB-5.5 TUE 14:30
Efficient Narrow Stripe Ridge Waveguide Lasers for Single-Spatial Mode Ocation up to 2.5 W

• M. Wilkens, G. Ebert, H. Wenzel, A. Maassdorff, J. Frick, P. Ressl, A. Krugge, and P. Crump; Ferdinand-Braun-Institut Leibniz-Institut für Höchstfrequenztechnik, Berlin, Germany

We present results of ridge waveguide lasers at 970 nm with optimized vertical and lateral waveguide structures for single-spatial mode operation up to 2.5 W output power with 55% conversion efficiency and low lateral divergence.

ROOM 13b ICM

CD-5.2 TUE 14:30
Hot electrons modulation of third harmonic generation in graphene

• G. Soavi1, G. Wang2, H. Rostami3, A. Tomadin1, O. Balci2, I. Paradinas3, E.A.A. Pogna2, A. Tomadin1, E. Lidorkis1, M. Polini1, and A.C. Ferrari2; 1Institut für Festkörperphysik, Friedrich Schiller Universität Jena, Germany; 2Cambridge Graphene Centre, University of Cambridge, Cambridge, UK; 3Nordita, KTH Royal Institute of Technology and Stockholm University, Stockholm, Sweden

We present results of ridge waveguide lasers at 970 nm with optimized vertical and lateral waveguide structures for single-spatial mode operation up to 2.5 W output power with 55% conversion efficiency and low lateral divergence.

ROOM 14a ICM

EE-1.3 TUE (Invited) 14:30
Nonlinear Mie-resonant meta-optics and metasurfaces

• Y. Kisvihar; Australian National University, Canberra, Australia

We review the recent advances in the field of nonlinear meta-optics and metasurfaces based high-index dielectric nanostructures. We discuss the emerged field of nonlinear topological photonics with applications to nonlinear imaging of topological edge states.

Tuesday – Orals

150
CK-8.4 TUE 14:45
Periodic Poling with Short Period for Thin Film Lithium Niobate Waveguides
M. Younes¹, P. Kumar³, B.J. Staniek², R. Geiss¹, W.-K. Chung¹, Y.-H. Chen¹, ², F. Setzfandl¹, and T. Pertsch¹
¹Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University, Jena, Germany; ²Empa, Dübendorf, Switzerland; ³Brain Research Center, National Tsinghua University, Hsinchu, Taiwan; ²Department of Optics and Photonics, National Central University, Jhongli, Taiwan; ²Center for Astronautical Physics and Engineering, National Central University, Jhongli, Taiwan

We realize short-period quasi-phase-matching structures by electric-field poling of thin-film lithium niobate suitable for fabricating nanowaveguides. Using optimized poling pulses, we reach poling periods down to 1 μm with high quality of the poling pattern.

CL-5.3 TUE 14:45
Pocket linear electro-optic microscopy (PLEOM) for cell biology
P. Didier¹, B. Haji³, R. Ghasemi¹, F. Andre², J. Zys¹, J. Lecloux³, and C. Lafargue¹
¹Quantum and Molecular Photonics Laboratory (LPQM), Ecole Normale Supérieure Paris Saclay, Cachan, France; ²Vectorology and anti-cancerous therapeutics (UMR 8203), Villejuif, France; ³Institute Curie (UMR 168), Paris, France

Electro-optic microscopy is adapted to image cell membranes with a contrast mechanism linked to the membrane potential. Possible applications in neurophysiology or cell treatments are considered.

ED-1.2 TUE 14:45
A 1808 km Long Interferometric Optical Fibre Link PTB-MPQ-PTB for Chronometric Levelling with a Transportable Optical Clock
A. Kuhl¹, G. Vishnyakova²,³, T. Waterholter¹, S. Koke¹, R. Holzwarth¹, and G. Grosche¹
¹Physikalisch-Technische Bundesanstalt, Braunschweig, Germany; ²Max Planck Institute of Quantum Optics, Garching, Germany; ³Institute Curie (UMR 168), Paris, France

We demonstrate enhanced THz emission using a shallow-bounce configuration. R. Li, Y. Zheng, D. Spence, H. Pask, and X. Lee; Macquarie University, North Ryde, Australia

We demonstrate enhanced THz emission and extended frequency tuning range from a frequency-tunable THz polarization laser based on stimulated polaron scattering, which uses a shallow-bounce configuration, in comparison to conventional linear and surface-emitting configurations.
CI-5.6 TUE 15:00

Investigation of granting assisted mode-selective few-mode fused fiber couplers

- K. Bremer 1, S. Schlangen 1, S. Böhmi 1, F. Wollmann 1, M. Steinké 1, J. Neumann 1, B. Roth 2,3, and L. Overmyer 1,2,3

1 Hannover Centre for Optical Technologies, Hannover, Germany; 2 Laser Zentrum Hannover e.V, Hannover, Germany; 3 Cluster of Excellence PhoenixD, Hannover, Germany

We will present our latest work towards the development of granting assisted mode-selective fiber couplers that can be applied for mode division multiplexing in few-mode fiber optic communication links.

EE-4.5 TUE 15:00

Superluminal spatial dynamics and energy deposition under varying focusing conditions

- D. Pushkarev 1, E. Mitina 1, D. Uryupina 1, N. Zhidkova 2, G. Gospodinov 2, R. Volkov 2,3, Q. Kosareva 1,2, and A. Savel’ev 1,2

1 Physics Department, Lomonosov Moscow State University, Moscow, Russia; 2 International Laser Center of Lomonosov Moscow State University, Moscow, Russia.

We conducted a comprehensive study of superluminal propagation using a wide range of techniques, tracing all stages of superluminal evolution. We showed the large increase in energy deposition within superluminals and revealed additional focusing conditions for effective superluminal formation.

EE-4.6 TUE 15:15

Wavelength scaling of THz emissions by two-color filaments in air

- A. Berg 1, A. Nguyen 1, K. Kalten Becker 1, J.-C. Delagnes 1, B. Zhou 1, E. Cormier 1, N. Fedorov 1, B. Bouillaud 1, D. Descamps 1, I. Thiele 1, S. Skupin 1, and P. U. Jepsen 1

1 CEA-DAM, DIF, Arpajon, France; 2 DTU Photonics, Department of Photonics Engineering, Technical University of Denmark, Lyngby, Denmark; 3 Univ. Bordeaux - CNRS - CEA, Centre Lasers Intenses et Applications, Talence, France

We introduce a novel all-optical frequency conversion process. We experimentally investigate the polarization properties of chalcogenide crystals and wave-front shaping in frequency conversion process.

CB-5.6 TUE 15:15

Optimization of 808 nm DBR RW Laser Bars for Operation at Low Noise and High Reliability

- K. Häusler 1, W. Wenzel 1, J. Frick 1, S. Kremetzmann 1, and A. Knigge 1,2,3

1 Ferdinand-Braun-Institut f. Höchstfrequenztechnik, Gustav-Kirchhoff-Str. 4, 12489 Berlin, Germany; 2 DBR lasers to pump Nd:YAG lasers for communications between space satellites were optimized for reliable continuous operation and low noise. Stable operation with relative intensity noise smaller than 0.5% at 45°C is predicted for 15 years.

EF-1.5 TUE 15:15

Efficient nonlinear metasurfaces using multiresonant high-Q plasmonic arrays

- M.I. Huttunen 1, O. Reshef 2, T. Stoh 3, K. Dolgaleva 2, R.W. Boyd 2,3, and M. Kauranen 2,3,4

1 Photons Laboratory, Physics Unit, Tampere University, Tampere, Finland; 2 Department of Physics, University of Ottawa, Ottawa, Canada; 3 School of Electrical Engineering and Computer Science, University of Ottawa, Ottawa, Canada; 4 The Institute of Optics and Department of Astronomy, University of Rochester, Rochester, USA

We numerically investigate second-harmonic generation (SHG) from plasmonic metasurfaces simultaneously supporting two high-quality-factor surface lattice resonances. We estimate that an over million-fold enhancement of the emitted SHG intensity is possible with doubly-resonant conditions.
We demonstrate photonic 2D and 3D devices for controlling of Bloch surface waves in 1D photonic crystals. Waveguides for studying multimode interference, Mach-Zender interferometers and micromirrors implementing Otto configuration are fabricated by two-photon polymerization.
Nonlinear optics exploiting the spatial dimension

S. Ramachandran, Boston University, Boston, USA

Nonlinear optics with spatial modes requires conservation of spin and orbital angular momentum in addition to linear momentum (i.e. propagating phase). We review the principles of, and unique applications afforded by, this emerging platform.

Optical shielding of ultracold 39K-Cs collision

T. Xie1, A. Orban2, O. Dulieu1, and N. Bouloufa-Maafa2; 1Laboratoire Aimé Cotton, CNRS/ Université Paris-Sud/ ENS Cachan, Orsay, France; 2Institute for Nuclear Research, Hungarian Academy of Sciences (ATOMKI), Debrecen, Hungary

Our theoretical work aims to find ways to suppress inelastic or reactive processes between colliding particles in ultracold quantum gases, using laser field detuned to the blue of a relevant transition.

Ultrafast Deep and Vacuum Ultraviolet Gas-Filled Hollow-Core Fibre Sources for Time-Resolved Photoelectron Spectroscopy

F. Belli1, N. Kotsina1, S.-f. Gao2, Y.-y. Wang2, P. Wang2, J. Travers1, and D. Townsend1,2; 1School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom; 2Beijing Engineering Research Centre of Laser Technology, Institute of Laser Engineering, Beijing University of Technology, Beijing, China; 3Institute of Chemical Sciences, Heriot-Watt University, Edinburgh, United Kingdom

We demonstrate time-resolved photoelectron velocity-map imaging using tunable DUV pulses generated through resonant dispersive-wave emission in gas-filled photonic-crystal fibres, and explain the potential of this source for time-resolved ultraviolet spectroscopy of molecules and condensed-matter physics.

Influence of Different Gases on Ionisation-Induced Refractive Index Changes in Gas-Filled Hollow-Core PCF

J.R. Koehler1, F. Kötting1, F. Tam2, and P.J.S. Russell1,2; 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Department of Physics, University of Erlangen-Nuremberg, Erlangen, Germany

Long-lived ionisation-related index changes, caused by self-compressed femtosecond pulses in gas-filled hollow-core photonic crystal fibre, are monitored interferometrically by a counter-propagating probe beam. The system is used to study the response of argon and neon.

All-optical switching in microresonators using the Kerr nonreciprocity

L. Del Bino1,2, N. Moroney1,3, M.T.M. Woodley1,2, F. Copie1, J.M. Silver1,4, S. Zhang1, and P. DeHaye1; 1National Physical Laboratory, Teddington, United Kingdom; 2CDT in Applied Photonics, Heriot-Watt University, Edinburgh, United Kingdom; 3Imperial College London, London, United Kingdom; 4City, University of London, London, United Kingdom

We study the dynamics of the interaction of counter-propagating light in microresonators via the Kerr-effect. Our work enables all-optical memories and logic gates at bitrates of 10 Gbps and power levels down to 1 µW.
Third Order Dispersion in Optical Time Delayed Systems: The case of Mode-Locked Vertical External-Cavity Surface-Emitting Lasers

C. Schelle1,2, P. Camelin2, G. Huyet3, M. Marcom2,3, M. Giudici1, J. Sagnes1, G. Beaudoin1, A. Garnache4,5, S. Gurevich3, and V. Baltuska6,7
1University of Neuchâtel, Switzerland; 2Geneva Observatory, University of Geneva, Switzerland; 3ETH Zürich, Zürich, Switzerland; 4SNIC, Stockholm, Sweden; 5University of Montpellier, Montpellier, France; 6ITM Company, Munich, Germany; 7Austria University of Technology, Graz, Austria

We demonstrate experimentally and theoretically that third order dispersion in the perpendiculardirection of the laser field. We observed a delayed pulse formation process induced by the third order dispersion. This effect is observed in a wide range of laser parameters and can be used for time delay generation in optical systems.

Delayed Systems:

Chair: Gian-Luca Oppo, University of Strathclyde, Glasgow, United Kingdom

ED-2.2 Invited

ED-2.2 TUE 16:00

Tests of Fundamental Physics using Ramsey-Comb Spectroscopy on the Hydrogen Molecule

C. Roth, J.S. Drennen, E.L. Grünende, J.J. Krauth, M. Favier, E.J. Salomons, W. Ubachs, and K.S. Eikema; LaserLab, Vrije Universiteit Amsterdam, Amsterdam, Netherlands

We aim to improve the measurements of the EF-X, Q and Q transitions in molecular hydrogen as well as the fundamental ground state transition of the accuracy level of 10 kHz with Ramsey-comb spectroscopy for fundamental tests.
Solitons and droplets in two-component Bose–Einstein condensates
C.R. Cabrera, J. Sanz, A. Fröjland, C. Chisholm, P. Thomas, B. Naylor, L. Tanzi, P. Cheiney, and L. Tarruell; ICFO-The Institute of Photonic Sciences, Castelldefels, Spain
Self-bound states result from a balance between attractive and repulsive forces. We experimentally explore two types of self-bound states, stemming from repulsive forces of different origins, in two-component Bose–Einstein condensates: bright solitons and liquid droplets.

Single-mode Kilowatt Fibre Laser with Adjustable Beam Profile and M2
N. Vukovic1,2, J. Chas1, C. Codemard1,2, M. Zervos1,2, S. Keen1, V. Ruseva3, R. Jesser4, I. Botheroyd3, and M. Greenwood3; 1Advanced Laser Laboratory, Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2SPI Lasers UK Ltd, Southampton, United Kingdom
We report on a kW-class fibre laser with a singlemode output from a multimode delivery fibre with adjustable beam profile using a dynamic mode coupler. The M2 of the output beam varies from 1.12 to 7.

Einstein condensates: bright solitons and droplets in different origins, in two-component Bose–Einstein condensates.
E. Grigorenko, C. Brahms, F. Belli, and J. Travers; School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom
We demonstrate soliton self-compression and VUV dispersive-wave emission in argon- and krypton-filled hollow capillary fibre. We observe plasma-related frequency shifts in the dispersive wave as well as VUV generation, even below two-photon resonances.

Ring Interband Cascade Lasers for Environmental Monitoring
H. Knutš1, B. Henkov2, M. Holzbauer3, R. Szeidler2, H. Dets2, R. Weih4, S. Holting5, W. Schrenk6, J. Koeth5, J.P. Wachtler5, B. Lendl5, and G. Strasser4; 1Institute of Solid State Electronics and Center for Micro- and Nanosystems, TU Wien, Vienna, Austria; 2Austrian Academy of Sciences, Vienna, Austria; 3nanoplus Nanosystems and Technologies GmbH, Gerbrunn, Germany; 4Physikalisch–Technische Bundesanstalt, Braunschweig, Germany; 5Physikalisches Institut und Wilhelm Conrad Röntgen–Research Center for Complex Material Systems, University Würzburg, Würzburg, Germany; 6Institute of Chemical Technologies and Analytics, TU Wien, Vienna, Austria
We present latest results on ring-shaped interband cascade lasers with a second order distributed feedback grating for substrate emission. They are designed for better heat transport and suppression of higher order lateral modes.
Symmetry breaking: balancing asymmetries
B. Garbin1,2, J. Fatome3, G.-L. Oppo3, S.G. Murdoch1,2, M. Erkintalo1,2, and S. Coen1,2; 1Department of Physics, University of Auckland, Auckland, New Zealand; 2The Dodd Walls Centre for Photonic and Quantum Technologies, Auckland, New Zealand; 3Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303 CNRS-UBFC, Dijon, France; 4SUPA and Department of Engineering, University of Strathclyde, Glasgow, United Kingdom.

The robustness of spontaneous symmetry breaking against controlled asymmetries is experimentally investigated in a fibre Kerr resonator. We remarkably find that different asymmetries can balance each other, resulting in the restoration of symmetry breaking phenomena.

Experimental Observation of Chimera-like States in a Passive Kerr Resonator
A.U. Nielsen1,2, M. Ferre3, M.G. Clerc3, S. Coen1,2, S.G. Murdoch1,2, and M. Erkintalo1,2; 1Department of Physics, University of Auckland, Auckland 1010, New Zealand; 2The Dodd Walls Centre for Photonic and Quantum Technologies, Auckland, New Zealand; 3Department of Física and Millenium Institute for Research in Optics, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Casilla 487-3, Santiago, Chile

We report on the first experimental observation of chimera-like states in a passive Kerr fiber ring resonator. The states can simultaneously and independently be excited and erased at will.

Symmetry-breaking: balancing asymmetries
B. Garbin1,2, J. Fatome3, G.-L. Oppo3, S.G. Murdoch1,2, M. Erkintalo1,2, and S. Coen1,2; 1Department of Physics, University of Auckland, Auckland, New Zealand; 2The Dodd Walls Centre for Photonic and Quantum Technologies, Auckland, New Zealand; 3Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303 CNRS-UBFC, Dijon, France; 4SUPA and Department of Engineering, University of Strathclyde, Glasgow, United Kingdom.

The robustness of spontaneous symmetry breaking against controlled asymmetries is experimentally investigated in a fibre Kerr resonator. We remarkably find that different asymmetries can balance each other, resulting in the restoration of symmetry breaking phenomena.

Integrated Echelle Gratings as Compact Spectrometer for VIS and NIR Astronomy
Y. Wang1,2, J. Liu1, K. Sun1, B. Roth2, and Z. Zhang1,2; 1InnoFSPEC, Leibniz-Institute for Astrophysics Potsdam (AIP), Potsdam, Germany; 2Hannover Centre for Optical Technologies (HOT), Leibniz University Hannover, Hannover, Germany; 3School of Engineering, Westlake University, Hangzhou, China; 4Institute of Advanced Technology, Westlake Institute for Advanced Study, Hangzhou, China

In this work, several integrated Echelle gratings are developed on a 'silica on silicon' platform that is transparent for the spectral range from 450 nm to ~ 2 μm.

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Towards quantum simulations with circular Rydberg atoms
R. Cortinas, B. Ravon, M. Haigher, T. Cantat-Molrejch, J.-M. Raimond, C. Sayerin; Laboratoire Kastler Brossel, Paris, France
My presentation will focus on our recent experiment that prepares and characterizes circular Rydberg atoms in a cryogenic environment. I will also present early results of laser-trapping of these atoms towards realization of quantum simulations.

Adiabatic preparation of magnetically ordered and entangled states with cold atoms in optical lattices
A. Venegas-Gomez1, W. Ketterle2, and A.J. Daley1; University of Strathclyde, Glasgow, United Kingdom; 2MIT-Harvard Center for Ultracold Atoms, Cambridge, USA
We propose and explore new protocols to prepare quantum states with a very low entropy using adiabatic state preparation, modelling these techniques for realistic experimental parameters using numerical methods based on tensor networks.

Extreme Events Prediction in Optical Fibre Modulation Instability Using Machine Learning
L. Salmela1, M. Nahr1, J. Toivonen1, C. Lapre1, C. Bille7, J.M. Dudley1, and G. Genty1; 1Photonics Laboratory, Physics Unit, Tampere University, 33014 Tampere, Finland; 2Institut FemtoST, Université Bourgogne Franche-Comté CNRS UMR 6174, 25000 Besançon, France
We apply techniques of machine learning to predict the emergence of extreme rogue waves in ultrafast modulation instability from high dynamic range single-shot spectral intensity measurements.

Radially-Poled Stoichiometric Lithium Tantalate Microresonators for Nonlinear-Optical Applications
M. Uludag1, J. Szabados1, I. Brenig1,2, and K. Bas11; 1Laboratory for Optical Systems, Department of Microsystems Engineering, IMTEK, University of Freiburg, Freiburg im Breisgau, Germany; 2Fraunhofer Institute for Physical Measurement Techniques IPM, Freiburg, Germany
We report on successful generation of radially-poled quasi-phase-matching structures in stoichiometric lithium tantalate crystals employing calligraphic pilling. Whispering-gallery-resonators are fabricated out of such structures, and quality factors as well as the nonlinear-optical performance are evaluated.
Light bullets in passively mode-locked lasers: Dynamics and Instabilities

S. Gurevich

Lasers: Dynamics and Instabilities

Light bullets in passively mode-locked lasers.

We present a review of recent theoretical and modelling studies regarding the analysis of LBs in semiconductor passively mode-locked lasers.

Spectral holes in rare earth doped crystal for laser locking in terahertz quantum cascade lasers.

M. Riesch, V. Pistore, F. Wang, S. Dhillon, and C. Fraschek

Technical University of Munich, Munich, Germany;
Laboretoire de Physique de l'Ecole normale superieure (ENS), Paris, France

We investigate self-starting harmonic mode locking in terahertz quantum cascade lasers using Maxwell-Bloch simulations. We demonstrate that our theoretical model could provide a plausible explanation of the harmonic behavior discovered in recent experiments.

Optical attolock using terahertz radiation


Institute of Quantum Optics, Leibniz University Hannover, Germany;
Cluster of ExcellencePhoenix21 (Photonics, Optics, and Engineering Innovation Across Disciplines), Hannover, Germany;
Max Born Institute, Berlin, Germany;
Laser Research Center, Vilnius University, Vilnius, Lithuania;
Hannover Centre for Optical Technologies, Hannover, Germany

We show that the polarization of the terahertz radiation from 2-color ionizing field allows to access ionization-induced attosecond-long delays. Further information about the ionization dynamics can be obtained from the 3rd harmonic.

Non-equilibrium Green's function simulation of group-IV terahertz quantum cascade lasers


IHP, Frankfurt (Oder), Germany;
University of Glasgow, Glasgow, United Kingdom;
Università di Roma La Sapienza, Roma, Italy;
Università di Pisa, Pisa, Italy

We theoretically investigate the performances of a Germanium-based terahertz (THz) quantum cascade laser (QCL) using non-equilibrium Green's functions (NEGF). The Ge-based THz QCL is found to be much more robust to temperature increase compared to an equivalent GaAs/AlGaAs design.
Tereszahn, Germany

Frequency conversion of broadband mid-IR carbon monoxide monodetected radiation into THz range
A. Ionin, I. Kinyaevskiy, Y. Klimachev, Y. Mityagin, A. Sagitova, S. Savinov, and D. Sintsyev, P.N. Lebedev Physical Institute of Russian Academy of Sciences, Moscow, Russia

Numerical and experimental study of non-selective multi-line CO laser frequency conversion to the THz range has shown the difference frequency generation in the ZnGeP2 crystal was carried out (RFBR 18-52-16019)

On the role of the phase in field-resolved spectroscopy of molecular vibrations
• M. Trubetskov1, M. Hube2,1, M. Zigman1,2, F. Krausz2,1, and I. Pupcea1,2, 1Max Planck Institute of Quantum Optics, Garching, Germany; 2Ludwig-Maximilians-Universität, München, Germany

Quality and robustness of class separation are improved due to the presence of phase information in field-resolved spectroscopic measurements. Numerical simulations and two experiments: serum spiking and sugar mixture in water are discussed.

A Comparison of Photocoherent Semiconductors with Long and Short Charge Carrier Lifetimes for Pulsed and CW Terahertz Generation and Detection
• D. Kobltev, I. Kolesnovka, R. Redkin, and S. Sarkisov, Tomsk State University, Tomsk, Russia

This work presents research results of photocoherent dipole antennas based on LT-GaAs and Si-GaAs for generation and detection of terahertz radiation, as well as influence of the semiconductor base parameters to the emission and detection ability.

Design of a THz-based Sub-100-fs Electron Source
• S. Turnier1, B. Kovács1, J.A. Fülöp2,3, G. Almási1,2, J. Hebling3,4, and Z. Tibai2,1, 1Institute of Physics, University of Technology and Economics, Budapest, Hungary; 2University of Szeged, Szeged, Hungary; 3Institute of Physical Research, Tbilisi, Georgia; 4Institute of Bioengineering, University of Stuttgart, Stuttgart, Germany

Optical Pump-terahertz probe studies on silicon and organic solar cells
• P. Han, X. Wang, T. Chen, H. Zhang, and Y. Zhang, Capital Normal University, Beijing, China

Optical pump-terahertz probe measurements are performed to study the effects of surface nanostructure and additional acceptor materials on the ultrafast dynamic processes of photo-excited carries in silicon and organic solar cells, respectively.

Spatial Structure of Focused Modes of Terahertz Laser Resonator
A. Degtyarev, M. Dubinin, V. Maslov, and K. Muntean1; V. N. Karazin Kharkiv National University, Kharkiv, Ukraine; V. N. Karazin Kharkiv National University, Kharkiv, Ukraine

A sub-micron SiO2-LiNbO3-SiO2 slab waveguide is investigated for the generation of terahertz radiation, which is emitted as Chenenko waves. The sub-wavelength LiNbO3 core minimizes phonon mode losses, allowing for the generation of wideband terahertz radiation.

Numerical simulations of THz generation with two-color mid-infrared laser pulse and relative phase control
• R. Flender1,2, A. Borzsonyi1,2, V. Kiss1, and V. Chikan1,3; 1ELI-ALPS, Szeged, Hungary; 2University of Szeged, Szeged, Hungary; 3Kansas State University, Manhattan, USA

We examined in theory the THz generation from MIR two-color laser pulse induced gas plasma in the spectral range between 2.5µm and 4.0µm and the relative phase control with a single common thin plate.

Theoretical investigation of the optimal nonlinear crystal thickness for THz generation from two-color laser pulse ionized gas under different laser pulse parameters
• R. Flender2, A. Borzsonyi1,2, and V. Chikan1,3; 1ELI-ALPS, Szeged, Hungary; 2University of Szeged, Szeged, Hungary; 3Kansas State University, Manhattan, USA

We examined the nonlinear crystal thickness effect on the THz generation from two-color laser pulse induced gas plasma. It was found that at given pulse parameters there is an optimal thickness.

Surface-Field Terahertz Emission Enhancement via 2D-materials
• I. Peters1, J. Tunics1, S. Ogilvie2, J.S. Tötero Gongora3, M. Large1, A. Pasquazi2, A. Daltón, and M. Peccianti2; 1Emergent Photonics, University of Sussex, Brighton, United Kingdom; 2Material Physics Group, University of Sussex, Brighton, United Kingdom

We explore the role of graphene in the enhancement of surface Terahertz Emission. Upon contact the surface-potential of the semiconductor is changed, resulting in an enhancement of the band-bending in proximity of the surface.

Generation of Few- and Subcycle Radiation at Combination Frequencies of Ultrashort Multicolor Ionizing Laser Pulse
V. Kostenko1,2, and N. Vedenkov1,2; 1Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod, Russia; 2University of Nizhny Novgorod, Nizhny Novgorod, Russia

Ionization-induced generation of strong few- and subcycle radiation in a broad spectral range (from terahertz to ultraviolet) at combination frequencies during plasma
production by multicolor femtosecond pulses is studied analytically and numerically.

CC-P.18 TUE

Tfz Generation in Superlattice Multipliers
• M. Fernandez-Pereira and A. Apolatos; Institute of Physics of the Academy of Sciences of Czech Republic, Prague, Czech Republic

This paper addresses power-conversion efficiency of harmonic generation in irradiated semiconductor superlattices. Good agreement is obtained for odd harmonics and the design of even harmonic output power by controlling the interface quality is demonstrated.

CC-P.19 TUE

THz Time-Domain Reflection Spectroscopy of KTiOPO4
• F.M. Matthei1, H. Laasler3, T. Sorgard4, C. Canalias5, V. Pasiekevicus1, F. Laurell3, and U. Oesterberg1,2
1Department of Electronic Systems, Norwegian University of Natural Science and Technology, Trondheim, Norway; 2Department of Applied Physics, Royal Institute of Technol- ogy, KTH, Stockholm, Sweden; 3Division of Atomic Physics at the Faculty of Engineering (LTH), Lund University, Lund, Sweden; 4Department of Physics, Norwegian University of Science and Technology, Trondheim, Norway

Time-domain reflection measurement of the frequency dependent absorption and refractive index of KTiOPO4 between 0.5 to 7 THz is reported. The data show promise for the development of high-field THz sources and functional metasurfaces.

CC-P.20 TUE

Optically-Induced Dynamic Terahertz Metamaterials
• F. Tunick1, L. Peters1, J.S. Ttero Gongyo1,2, A. Pasqua1, A. Fratulochi2, and M. Peccianti1
1Emergent Photonics Lab, University of Sussex, Brighton, United Kingdom; 2PRIMALIGHT, King Abdullah University of Science and Technology, Thuwal, Saudi Arabia

Plasmonic metamaterials enable access to extremely nonlinear regimes with a broad array of applications. We experimentally investigate how a semiconductor nanostructure exhibits a controllable and dynamic plasmonic response upon photo-excitation by an external pump pulse.

CC-P.21 TUE

Novel self-referencing time-domain THz ellipsometer for measurement of samples in aqueous environments
• S. Smith, E. Rohwer, and P. Neethling; Stellenbosch University, Stellenbosch, South Africa

We demonstrate initial measurements from a novel, broadband self-referencing time domain THz ellipsome- ter for material characterization, enabling the measure- ment of samples in aqueous environments. We describe the setup and show proof of principle measurements.

CC-P.22 TUE

Semiconductors as Highly Efficient Single and Multicycle Terahertz Sources
• G. Krzisz1,2, N.M. Mbiti1,2, G. Polonyi1,2, G. Töth1, M. Mechler1, J. Hebling2,3,4, and J.A. Fülöp1
1University of Pécs, Pécs, Hungary; 2Szentagothai Research Centre, University of Pécs, Hungary; 3ELI-ALPS, Szeged, Hung- ary; 4MTA-PTE High-Field Terahertz Research Group, Pécs, Hungary

We will discuss the prospects and design of semiconductor terahertz sources pumped beyond the three- photon vibrational absorption wavelength including optimal pump- ing, phase-matching condition and contact-grating de- signs for single and multicycle THz pulse generation.

CC-P.23 TUE

CW Terahertz Laser Emitting Beams with Azimuthal Polarization
• O. Gurin1, M. Dubinov1, M. Legenjok1, V. Rybaklya1, and V. Senyuta1
1V. N. Karazin Kharkiv National University, Kharkiv, Ukraine; 2V. N. Karazin Kharkiv National University, Kharkiv, Ukraine; 3V. N. Karazin Kharkiv National University, Kharkiv, Ukraine; 4V. N. Karazin Kharkiv National University, Kharkiv, Ukraine

We report about azimuthal polarized laser beams in cw operation generating by integrating polarization-selective diffraction gratings as reflective large-scale or partly transmissive small-scale mirrors in an optically pumped waveguide HCOOH laser setup.

CC-P.24 TUE

Generation of ellipsoidal laser pulses with periodic intensity modulation for photoionizers
• I. Kazmin1, E. Gacheva1, S. Mironov1, A. Potemkin1, E. Khazanov1, M. Krushnikov1, and E. Stepian1
1Federal Research Center Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russia; 2Deutsches Elektronen-Synchrotron, Zeuthen, Germany

The possibility of generation of ellipsoidal laser pulses with periodic intensity modulation is demonstrated. Modulation of the laser pulses is performed by a spatial light modulator (SLM).

CC-P.25 TUE

Single-layered Metasurfaces as Spectrally Tunable Terahertz Half- and Quarter-wavesplates
• W.T. Eristry1, N. Lee1, J.H. Kang1, B.J. Kang1, Q.-H. Park2, and F. Rotermund1
1Department of Physics, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea; 2Department of Physics, Korea University, Seoul, South Korea; 3Department of Physics and Astronomy, Seoul National University, Seoul, South Korea; 4Department of Mechanical engineering, Korea Adv- anced Institute of Science and Technology (KAIST), Dae- jeon, South Korea

We proposed single-layered metasurfaces as spectrally tunable terahertz (THz) half- and quarter-waveplates, in which the phase retardation and the spectral tunability can be controlled by tight coupling of the elementary ring resonators.

CC-P.26 TUE

THz Band Electron Acceleration Using the Combination of Metallic Horn-gun and Dielectric Laser Accelerator
• B. Kovács1, S. Tóth1, J.A. Fülöp2,3,4, G. Almási1,3, J. Hebling2,3,4, and Z. Tibai3
1Institute of Physics, University of Pécs, Pécs, Hungary; 2MTA-PTE High-Field Terahertz Research Group, Pécs, Hungary; 3Szentagothai Research Centre, University of Pécs, Pécs, Hungary

We simulate a THz pulse driven accelerator setup combining metallic horn-gun and dielectric structure. Applying 2x1 mJ THz energy we can achieve 20% energy gain from 1 MeV initial energy in case of one electron.

CC-P.27 TUE

Spurious-Free THz Frequency Measurement Using Modulator-Based Optical Comb Source
• M. Morohoshi, N. Sekine, A. Kasamatsu, and I. Hosoako; National Institute of Information and Communications Technology, Tokyo, Japan

We report on comparison of detection bandwidths in the THz frequency measurement between two cases: one is using a Mach-Zehnder-modulator-based flat comb generator and the other is using a mode-locked fiber laser.

CC-P.28 TUE

Frequency-domain terahertz spectrometer based on a compact fiber optical synthesizer
• J. Robinson-Tait, Y. Mazylin, K. Dutzi, R. Wilk, and T. Puppe; TOPICTA Photonics AG, Gräfelfing, Germany

The optical synthesizer consist of a tunable laser phase- locked to a frequency-shifting comb spectrum. Com- bined with a fixed laser it produces comb-referenced differ- ent frequency frequencies 0-3 THz at scan-rates >300 GHz/s driving a high-precision frequency-domain terahertz spectrometer.

CC-P.29 TUE

Terahertz Time-Domain Spectroscopy of healthy and carious dental tissues
• D. Lopes1, W. Souza2, B. Araujo3, and A. Gomes1,2
1Graduate Program in Dentistry, Federal University of Pernambuco, Recife, Brazil; 2University of Pernambuco, Arcoverde Campus, Arcoverde, Brazil; 3Federal Institute of Education, Science and Technology of Sertão Pernambu- cano, Salgueiro, Brazil; 4Laboratory of Biomedical Opt- ics and Imaging, Federal University of Pernambuco, Re- cife, Brazil; 5Department of Physics, Federal University of Pernambuco, Recife, Brazil

Healthy and carious human teeth samples were evalu- ated using Terahertz Time-Domain Spectroscopy sys- tem, in a transmission mode setup. Absorption coeffi- cient and the refractive index of dry and wet samples were determined.

CC-P.30 TUE

Terahertz generation setups using segmented tilted-pulse-front excitation
• G. Töth1, L. Pálfali1, J.A. Fülöp2,3,4, L. Tokodi1, G. Krzisz1,3, N.H. Mattila1, G. Almási1,3, and J. Hebling2,3,4
1Institute of Physics, University of Pécs, Pécs, Hungary; 2MTA-PTE High-Field Terahertz Research Group, Pécs, Hungary; 3Szentagothai Research Centre, University of Pécs, Pécs, Hungary; 4ELI-ALPS, Élünk! Kft, Noémi ut 1, 7624, Székesfehérvár, Hungary; Center for Free-Electron Laser Science, Deutsches Elektronen Synchrotron, Hamburg, Germany

Nonlinear-echelon-slab based energy scalable lithium- niobate terahertz sources were simulated. These sources generate mJ-level THz pulses with excellent beam qual- ity. The efficiency of both the plane-parallel and the imaging-free configurations make possible overcoming earlier serious limitations.

CC-P.31 TUE

Design of a Waveguide Structure-based Electron Source Using TFz Pulses
• S. Tóth1, B. Kovács1, J.A. Fülöp2,3,4, G. Almási1,3, J. Hebling2,3,4, and Z. Tibai3
1Institute of Physics, University of Pécs, Pécs, Hungary; 2MTA-PTE High-Field Terahertz Research Group, Pécs, Hungary; 3Szentagothai Research Centre, University of Pécs, Pécs, Hungary

We propose an electron acceleration setup for producing ultrashort (100 fs) electron bunches using single-cycle TFz pulses. We show that THz pulses with around 100 pJ energy are sufficient to generate relativistic electron bunches.

CC-P.32 TUE

Terahertz Supercontinuum in the Biatomic Photonic Crystal Fiber
• V. Kumar, R. Varshney, and S. Kumar; Indian Institute of Technology Delhi, Delhi, India

We have reported generation of Terahertz supercontinuum in the photonic crystal fibers. We consider two de-
sign configurations and shown that efficient super-connector
can be produced with radially biatomic photonic

tCRYSTAL FIBERS.

**CC-P.33 TUE**

Terahertz for Non-Destructive Quality Control of Laser Assisted Metals-Joints

*D. Nguyen*, A. Henrotin
t, J. Patars, and Y. Hendanzade; 1Multitool A.S.B.L. Mons, Belgium; 2Lasea S.A., Liege, Belgium

Hybrid plastic-metal joint is the structures of choice for reducing energy consumption. Its fabrication process involves

a large number of steps. This paper presents THz application for quality control of Lasers assisted plastics-metal joining products.

**CC-P.34 TUE**

Single-shot Measurement of THz pulses at Megahertz Rates Using Photonic Time-Stretch

E. Roussel, C. Szwaj, C. Evain, M. Natile, M. Hanna, and P. Georges; 1Amplitude Laser Group, Pessac, France; 2Laboratoire Charles Fabry, Palaiseau, France

We demonstrate a hybrid dual-stage nonlinear compres-
sion scheme allowing to compress 330 fs pulses gener-
ated from a high-energy fiber amplifier down to 6.8 fs pulse duration, with an overall transmission of 61%.

**CG-P.1 TUE**

High efficiency, high energy few-cycle driver at 1 pm

F. Guichard, L. Lavenu, M. Natte, X. Délens, Y. Zanouter, M. Hanna, and P. Georges; 1Amplitude Laser Group, Pessac, France; 2Laboratoire Charles Fabry, Palaiseau, France

We describe a hybrid dual-stage nonlinear compres-
sion scheme allowing to compress 330 fs pulses gener-
ated from a high-energy fiber amplifier down to 6.8 fs pulse duration, with an overall transmission of 61%.

**CG-P.2 TUE**

Multi-Scale Symmetries and Selection Rules in High Harmonic Generation

G. Lerosey, H. Hass, G. Shogule, O. Neufeld, E. Bordo, A. Bababud, and O. Cohen; 1Physics Department and Solid State Institute, Technion – Israel Institute of Technology, Haifa, Israel; 2Department of Physical Electronics, School of Electrical Engineering, Tel-Aviv University, Tel-Aviv, Israel

We formulate a general theory and demonstrate experimentally selection rules by multi-scale dynamical sym-

metries, involving both microscopic and macroscopic symmetries. This theory is applicable to harmonic generation of polychromatic, twisted, vector beams in structured media.

**CG-P.3 TUE**

Multiple plate continuum and dispersion compensa-
tion driven by optical parametric chirp pulse

amplifier at 1.55 µm

Y.-H. Tseng, A.-Y. Liang, J.-Y. Guo, M.-W. Lin, S.-D. Yang, and M.-C. Chen; 1Institute of Photonics and Technologies, National Tsing Hua University, Hsinchu, Taiwan; 2Institute of Nuclear Engineering and Science, National Tsing Hua University, Hsinchu, Taiwan

We demonstrate multiple plate continuum (MPC) and dispersion compensation at 1.55 µm by using a home-
built optical parametric chirp pulse amplifier. To the best of our knowledge, it is the first MPC compensation at 1.55 µm.

**CG-P.4 TUE**

VEGA Petawatt laser: influence of large Ti:Sapphire crystal quality in final laser energy distribution

C. Méndez, E. García, O. Varela, I. Hernández, J.D. Pisonero, J. García, J.L. Sagredo, M. Oliver, and L. Roso; Centro de Láseres Pulsados, Villamayor / Salamanca, Spain

We describe photon-photon cross sections inside of the

Hartemann-Kerman theory to perform predictions in a photon collider working in the high intensity scale and GeV scale.

**CC-P.35 TUE**

High-Transmittance 2 Pi Electrically Tunable Terahertz Phase Shifter Based on Silicon Electrodes

C.-S. Yang, H.-W. Zhang, C.-T. Wang, T.-H. Lin, and C.-K. Lee; 1Institute of Electro-Optical and Science and Technology, National Taiwan Normal University, Taipei, Taiwan; 2Department of Photonics, National Sun Yat-sen University, Kaohsiung, Taiwan

By applying Si as substrates, the electrically controlled 2 Pi THz phase shifter was demonstrated. This is the first time that Si can be used to fabricate THz phase shifter without transparent conductive film as electrodes.

**CC-P.36 TUE**

Intense Broadband Terahertz Generation from Organic Crystal and Near-Infrared Pump

L. Zhang, H. Zhao, Y. Zhang, G. Steinfeld, C. I. Chang, and M. Shalaby; 1Key Laboratory of Terahertz Optoelectronics, Beijing Advanced Innovation Center for Photonics and Optoelectronics, Beijing University of Posts and

Telecommunications, Beijing, China

We present a method allowing THz pulses to be recorded in single-shot at tens of MHz repetition rates and long record lengths, using a combination of the time-stretch data acquisition and electro-optic sampling techniques.

**CC-P.37 TUE**

Broadband Terahertz Generation from Mid-Infrared 3.9 µm OPOC and Organic Crystals

C. Golbert, E. Kakski, C. Brodeur, V. Shumakova, A. Baltuskas, A. Paglysz, and M. Shalaby; 1Photonics Institute, Vienna, Austria; 2Swiss Terahertz Research-Zurich, Zurich, Switzerland; 3Center for Physical Sciences & Technology, Vilnius, Lithuania; 4Key Lab of Terahertz Optoelectronics, Beijing, China

We report on broadband terahertz generation using or-

ganic crystals pumped by an OPCPA at 3.9 µm. Com-
pared to conventional pump schemes, we found an order of magnitude increase in the damage and optical-THz conversion saturation thresholds

**CC-P.38 TUE**

Low-voltage tuning of the terahertz passband transmission using a tungsten-doped VO2-based metamaterial

S.-P. Han1, J.-H. Shin2, M. Song3, S. Kim1, and M. Song2; 1Electronics and Telecommunications Research Institute, Daejeon, South Korea; 2Kyungpook National University, Daegu, South Korea

We demonstrate that the 1.2 at.% W-doped VO2 thin film-based square-loop metamaterial can precisely control and continuously tune the amplitude in the range of 0.3–0.6 THz at low voltages below 2 V.

**CC-P.39 TUE**

Ultra-Thin Terahertz Spatial Phase Modulator Based on Metamaterial-Enhanced Liquid-Crystal Cell

O. Buchner1, N. Podolak1, K. Kaltenecker2, M. Walter1, M. Kaczmark1, and V. Fedotov1; 1University of Southampton, Southampton, United Kingdom; 2Technical University of Denmark, Lyngby, Denmark; 3University of Freiburg, Freiburg, Germany

We demonstrate experimentally a thin THz spatial phase modulator based on planar metamaterials hybridized with a liquid-crystal cell. Our approach enables a new family of LC-enabled compact THz devices for efficient control of THz wavefronts.

**CC-P.40 TUE**

Forced Quantization and Possible Misinterpretation of the Dirac-Delta Function in Intense-Field Electrodynamic

H. Nieto-Chauvis; Universidad de Ciencia y Hu-

manidades, Lima, Peru; I. Gutiérrez; Universidad Nacional Agraria de Lima, Peru

We demonstrate that the interpretation of field quantiza-
tion in the argument of the Dirac-delta function is also obtained in fully classical electrodynamics. As example we take the classic Compton Scattering through the Hartemann-Kerman formalism.

**CG-P.4 TUE**

Useage of the Hartemann-Kerman Theory to Describe Nonlinear Photon-Photon Interactions in a GeV Photon Collider

H. Nieto-Chauvis; Universidad de Ciencia y Hu-

manidades, Lima, PERU

We describe photon-photon cross sections inside of the

Hartemann-Kerman theory to perform predictions in a photon collider working in the high intensity scale and GeV scale.

**CG-P.5 TUE**

VEGA Petawatt laser facility: current system capabilities and near future beamlines management

C. Göckler1, C. Tsai1, J. G. García, J. L. Sagredo, M. Oliver, and L. Roso; Centro de Láseres Pulsados, Villanmayor / Salamanca, Spain

A detailed description of VEGA user laser facility at the CLPU laser centre in Spain together with key parameters for efficient and reproducible performance are presented. Highlights for future laser outputs reorganization are also addressed.

**CG-P.6 TUE**

Commissioning of the 3-PW, 1Hz ATLAS-3000 Ti:Sa laser at the Center for Advanced Laser Application (CALA), Garching

S. Karsh1,2, H. Ding1, L. Doyle1, M. Fürster1, J. Gebhardt1, M. Giljohann1, H. Gütrief1, D. Haffa1, J. Hartmann1, O. Jahn1, F. Krauss2, G. Schilling2, S. Schindler1, M. Speicher1, and J. Schreiber1; 1Ludwig-Maximilians-Universität München, Garching, Germany; 2Max-Planck-Inst. f. Quantenoptik, Garching, Germany
We present the status of Germany’s most powerful high-intensity laser system ATLAS-3000, which is currently under commissioning as the Centre for Advanced Laser Applications (CALA). We will give performance data, and depending on the commissioning status, also present first application results.

CG-P.9 TUE
Tailoring caustics in high-harmonic generation with phase-controlled multi-colour fields
K. Mitra 1,2, S. Biswas 1, J. Scholz 1,2, B. Förtsch 1, W. Ockel 1, G. A. Kavare 1, M. Häge 1,2, I. Puepe 1, P. Wink 1,2, and M. F. Kling 1,2
1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.10 TUE
Tailoring caustics in high-harmonic generation with phase-controlled multi-colour fields
K. Mitra 1,2, S. Biswas 1, J. Scholz 1,2, B. Förtsch 1, W. Ockel 1, G. A. Kavare 1, M. Häge 1,2, I. Puepe 1, P. Wink 1,2, and M. F. Kling 1,2
1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.12 TUE
Tailoring caustics in high-harmonic generation with phase-controlled multi-colour fields
K. Mitra 1,2, S. Biswas 1, J. Scholz 1,2, B. Förtsch 1, W. Ockel 1, G. A. Kavare 1, M. Häge 1,2, I. Puepe 1, P. Wink 1,2, and M. F. Kling 1,2
1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.13 TUE
Tailoring caustics in high-harmonic generation with phase-controlled multi-colour fields
K. Mitra 1,2, S. Biswas 1, J. Scholz 1,2, B. Förtsch 1, W. Ockel 1, G. A. Kavare 1, M. Häge 1,2, I. Puepe 1, P. Wink 1,2, and M. F. Kling 1,2
1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.14 TUE
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1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.15 TUE
Tailoring caustics in high-harmonic generation with phase-controlled multi-colour fields
K. Mitra 1,2, S. Biswas 1, J. Scholz 1,2, B. Förtsch 1, W. Ockel 1, G. A. Kavare 1, M. Häge 1,2, I. Puepe 1, P. Wink 1,2, and M. F. Kling 1,2
1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.16 TUE
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1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.17 TUE
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1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.18 TUE
Tailoring caustics in high-harmonic generation with phase-controlled multi-colour fields
K. Mitra 1,2, S. Biswas 1, J. Scholz 1,2, B. Förtsch 1, W. Ockel 1, G. A. Kavare 1, M. Häge 1,2, I. Puepe 1, P. Wink 1,2, and M. F. Kling 1,2
1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.19 TUE
Tailoring caustics in high-harmonic generation with phase-controlled multi-colour fields
K. Mitra 1,2, S. Biswas 1, J. Scholz 1,2, B. Förtsch 1, W. Ockel 1, G. A. Kavare 1, M. Häge 1,2, I. Puepe 1, P. Wink 1,2, and M. F. Kling 1,2
1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.

CG-P.20 TUE
Tailoring caustics in high-harmonic generation with phase-controlled multi-colour fields
K. Mitra 1,2, S. Biswas 1, J. Scholz 1,2, B. Förtsch 1, W. Ockel 1, G. A. Kavare 1, M. Häge 1,2, I. Puepe 1, P. Wink 1,2, and M. F. Kling 1,2
1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Department of Physics, Ludwig-Maximilians-University, Garching, Germany. We report on new findings showing the route to robust single mode operation of non-adiabatic dynamics at the A 4/B 3 conical intersection of NO 2.
Tuesday 25 June 2019

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Hall B0

Tuesday – Posters

Talence, France; 3 Department of Physics, University of Gothenburg, SE-412 96, Göteborg, Sweden; 4 Department of Physics, Chalmers University of Technology, SE-412 96, Göteborg, Sweden
We develop an Optical Bloch Equations-based model of laser matter-interaction which includes field-induced ionization, impact ionization and relaxation processes in dielectrics. The model is applied to describe the electron dynamics induced by intense femtosecond pulses.

CG-P.23 TUE

Light-waveform-sensitive multiphoton absorption in solids
M. Qasim 1 and V.S. Yakovlev 2,3; 1 Max-Planck-Institut für Quantenoptik, Garching b. München, Germany; 2 Ludwig-Maximilians-Universität, München, Germany

CG-P.24 TUE

Theoretical Investigation of Resonant High-Harmonic Generation in Transition Metal Plasma
I.S. Wahiyyatama 1, T. Satō 1,2,3, and K.L. Ishikawa 2,3,1; 1 Department of Nuclear Engineering and Management, School of Engineering, The University of Tokyo, Tokyo, Japan; 2 Photon Science Center, School of Engineering, The University of Tokyo, Tokyo, Japan; 3 Research Institute for Photon Science and Laser Technology, The University of Tokyo, Tokyo, Japan
We theoretically investigate resonant HHG using TD-CASSCF and TD-ORMAS methods on manganese plasma. We successfully reproduce the enhancement at 51 eV and find that the enhancement is a result of constructive interference between 3p-3d transitions.

CG-P.25 TUE

Angularly Resolved RABBITT at 2ω: Attosecond Pulses Measurement & Attosecond Signature in the 1s3p Resonance of Helium
V. Lorioit, A. Marciniak, G. Karras, M. Hervé, A. Scognamiglio, E. Constant, and P. Lépine; Institute of Light and Matter, Lyon, France
Angularly resolved RABBITT method tested by a 2ω field provides a similar information as the original RABBITT method. The attosecond pulse train is measured and macroscopic effects around the 1s3p resonance of Helium are highlighted.

CG-P.26 TUE

High-Harmonic Generation from Crystalline Solids under Carrier Envelope Phase Controlled Pulse
Y. Shinoohara 1, S. Yamamura 2, and K.L. Ishikawa 2,3; 1 School of engineering, the University of Tokyo, Tokyo, Japan; 2 Faculty of engineering, the University of Tokyo, Tokyo, Japan; 3 Research Institute for Photon Science and Laser Technology, The University of Tokyo, Tokyo, Japan
We study carrier-envelope-phase dependent high-harmonic spectra by solving the time-dependent Schrödinger equation for a one-dimensional model crystal. A trajectory analysis in the momentum space explains the spectral features from field shapes and the band structure.

CG-P.27 TUE

Quasi-Phase Matching in High Harmonic Generation Using Structured Plasmas
M. Wüstmann 1, V. Kärcher 1, and H. Zacharias 1,2; 1 Center for Nanotechnology, Münster, Germany; 2 Center for Soft Nanoscience, Münster, Germany
Quasi-phase matching in high harmonic generation is controlled by carefully adjusting the structure of a laser-produced plasma. Thereby phase-matching is tailored for different regions of the harmonic spectrum with the overall efficiency optimized.

CG-P.28 TUE

Strong-field-driven dynamics and high-harmonic generation in interacting 1D systems
S. de Vega 1, J.D. Cox 1, F. Solé 2, and E.J. García de Abajo 1,2; 1 ICFO – Institut de Ciencies Fotoniques, Castelldefels, Spain; 2 Departamento de Física de Materiales, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, Madrid, Spain; 3 ICREA – Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain
We elucidate the roles of electronic structure and collective excitations in the optical response of linear atomic chains driven by intense optical fields, emphasizing extreme optical nonlinearities associated with high-harmonic generation.

CG-P.29 TUE

Decomposition of harmonics: how spectral interference reveals the structure of XUV pulse trains
D. Kornin 1, G. Ma 2, I. Földes 1, and L. Veisz 2,3; 1 Ludwig-Maximilians-Universität München, Garching, Germany; 2 Max-Planck-Institut für Quantenoptik, Garching, Germany; 3 Shenzhen SoC Key Laboratory, Peking University Shenzhen Institute & PKU-HKUST, Shenzhen–Hong Kong Institution, Shenzhen, China; Center for Free-Electron Laser Science, DESY, Hamburg, Germany; 2 Wigner Research Centre for Physics, Hungarian Academy of Sciences, Budapest, Hungary; 1 Department of Physics, Umeå University, Umeå, Sweden
We apply a modified spectral interferometry method to high-order harmonics generated from relativistic solid surfaces. This procedure identifies isolated attosecond pulses for the first time from relativistic plasmas and provides information about their generation mechanism.

CG-P.30 TUE

High vacuum compatible wave front sensor for focal spot diagnostics and optimization
S. Douzé 1, B. Wattelier 2, and L. Moignier 1; 1 Phasics, Brest, France; 2 LULI, Palaiseau, France
We report on time-resolved soft X-ray absorption spectroscopy of nitric oxide using high harmonics in the water window. Both electron and nuclear dynamics are imprinted in the observed absorption spectra.

CG-P.31 TUE

Polarization control of high-harmonic pulses generated in gapless graphene
R. Boyero-García 1, O. Zarron-Cifuentes 1, C. Hernandez-García 1, A. Picón 1, and L. Plaja 1; 1 University of Salamanca, Salamanca, Spain; 2 Universidad Autónoma de Madrid, Madrid, Spain
We disentangle the photon-spin conversion rules of high-harmonic generation in single-layer graphene, showing a novel control of the polarization of high-order harmonics with rather simple configurations, driven by linear-to-elliptically polarized infrared pulses.

CG-P.32 TUE

Real-Time Observation of Electron and Nuclear Dynamics in Nitric Oxide with High Harmonics in the Water Window
N. Saito, H. Sannohe, N. Ishii, T. Kanai, and J. Itatani; the Institute for Solid State Physics, the University of Tokyo, Kashiwa, Chiba, Japan
We report on time-resolved soft X-ray absorption spectroscopy of nitric oxide using high harmonics in the water window. Both electron and nuclear dynamics are imprinted in the observed absorption spectra.

CG-P.33 TUE

Optical lasing during laser filamentation in the Nitrogen molecular ion: ro-vibrational inversion
F. Morales 1, M. Lytova 2,3, M. Spanner 2,3, M. Richter 1, O. Smirnova 1, and M. Ivanov 1,2; 1 Max-Born-Institut, Berlin, Germany; 2 National Research Council of Canada, Ottawa, Canada; 3 Blackett Laboratory, Imperial College London, London, United Kingdom
We present a theoretical study of the mechanisms that lead to lasing of filaments in air at the 391 nm and 428 nm lines (nitrogen ion), based on the interplay of several physical effects.

CG-P.34 TUE

Simple route to enhancement of soft X-ray high harmonic generation sources
B. Brunner 1, T. Arut-Parpas 2,3, M. Krüger 1, and N. Dudovich 1; 1 Weizmann Institute of Science, Rehovot, Israel; 2 NRC Soreq, Yavne, Israel
We demonstrate up to two orders of magnitude enhancements in high harmonic generation efficiency in the soft X-ray region. The enhancement spans over a 250 eV bandwidth with pulse energies reaching the pJ level.

CG-P.35 TUE

Single-shot Carrier-envelope Phase (CEP) Measurements and the Focal Phase Effect in Strong-Field Ionization
Y. Zhang 1,2, D. Zille 1,2, D. Hoff 1, P. Wüstelt 1, S. Kruszwicz 1,2, A.M. Sayer 1,2, and G.G. Paulus 1,2; 1 Institute of Optics and Quantum Electronics, Jena, Germany; 2 Helmholtz Institute Jena, Jena, Germany
We demonstrate significant phase averaging effects in strong-field ionization due to the focal phase of few-cycle pulses. This is of practical relevance for pulse duration measurement with a carrier-envelope phasemeter (CEPM).
Coherent control is a method for controlling the shape of a wave packet using quantum path interferometry. Here, we discuss the interferences in quantum paths in interaction of free-space electron wave packets with light and localized photonic states.

EE-P.5 TUE

Mapping mid-infrared dispersion landscape onto near-infrared and visible through filamentation of laser pulses at 3.9um in air

P. Polynkin1, C. Goliner2, V. Shumakov2, A. Pugayev2, and A. Baltuskas2
1University of Arizona, Tucson, USA
2Photons Institute, Vienna University of Technology, Vienna, Austria

We record angularly-resolved spectra of odd harmonics generated through filamentation of ultrashort laser pulses at 3.9um in air. Morphology of these spectra carry information about the 4.2um anomalous dispersion edge due to the CO2 content.

EE-P.6 TUE

Femtosecond dynamics in excited NO2: A theoretical study

T. Schnappinger and R. de Vivie-Riedle
Department of Physics and International Laser Center M.V. Lomonosov State University, Moscow, Russia

In this work we want to simulate the quantum dynamics of NO2 after photoexcitation in the 2B1 state and control the relaxation process via several conical intersections also including the electronic motion.

EE-P.7 TUE

Shedding light on the nature of excited states in a hydrogen generating supramolecular RuP catalyst by ultrafast x-ray spectroscopy

A. Huisjen1, Q. Pan1, D. Van Duinen1, M. Laursen2, A. El Nabulsi3, P. Chaberska4, K. Zhang2, K. Haldrup2, W. Brown2, G. Smolentsev5, and J. Uhlig6
1University of Twente, Enschede, Netherlands; 2Technical University of Denmark, Copenhagen, Denmark; 3Lund University, Lund, Sweden; 4Argonne National Laboratory, Chicago, USA; 5University of Groningen, Groningen, Netherlands; 6Paul Scherrer Institute, Villigen, Switzerland

Photoinduced electronic and structural changes of a hydrogen generating supramolecular RuP photocatalyst are studied by ultrafast optical and x-ray spectroscopy. This work focuses in particular on the processes at the catalytic Pt moiety.

EE-P.8 TUE

Interstation cross correlation in thiosubases proceeds by a dark intermediate state

R. Borrego-Varril1, D.C. Teles-Ferreira1, A. Neves1, I. Conti1, G. Amaral1, C. Manzoni1, A.M. de Paula3, M. Garavelli2, and C. Geraldi3
1IFN-CNR, Dipartimento di Fisica, Politecnico di Milano, Milano, Italy
2Dipartimento de Fisica, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil
3Dipartimento di Chimica Industriale, Università di Bologna, Bologna, Italy

We present transient absorption spectroscopy measurements of 4-thiouracil with sub-20 fs UV pulse and ab initio simulations evidencing that the photoexcited electron relaxation pathways for intersystem crossing originate from a dark intermediate state.

EE-P.9 TUE

Spin-orbit characterization of the electric field of breathers in an optical fiber

C. Naveau1, P. Szriftgiser1, A. Kudinik1, M. Conforti1, S. Trillo2, and A. Mussol1
1University of Lille, CNRS, UMR 8523 - PhLAM, Lille, France; 2Department of Engineering, University of Ferrara, Ferrara, Italy

We report the full-field longitudinal characterization in an optical fiber of breather dynamics in the time domain via non-destructive measurements in phase and intensity of their main frequency components.

EE-P.10 TUE

Tracking Homogeneous and Heterogeneous Carrier Multiplication via Singlet Fission in Solution

N. Wollscheid1, J.L. Perez-Lustres1, O. Kerer1, T. Buckup2, and M. Mottke1,2
1Physikalisch-Chemisches Institut, Universität Heidelberg, Heidelberg, Germany; 2Centre for Advanced Materials, Heidelberg, Germany

A sequential singlet fission mechanism in solution is unravelled by time resolved spectroscopy, where oxygen takes part as catalyst in the initial energy transfer as well as in the final heterogenous singlet fission.

EE-P.11 TUE

Isomerization Dynamics of Wild Type and Mutated Anabaena Sensory Rhodopsin Mapped by Time-Resolved Coherent Raman Spectroscopy

P.P. Roy1, D. Van Duinen1, W. Schweinberger2, and T. Buckup2
1Universität Heidelberg, Heidelberg, Germany
2Centre for Advanced Materials, Heidelberg, Germany

The excited-state evolution of the vibrational modes of retinal chromophore was mapped by impulsively vibra
tional spectroscopy. Pre-distortion in the ground-state structure was found to play a major role in the acceleration of the isomerization dynamics.

EE-P.12 TUE

Generation of single-cycle pulses in mode-locked laser with sub-terahertz repetition rate

A. Arkhipov1,2, M. Arkhipov3, I. Babushkin4,5, M.Arkhipov3, I.Babushkin4,5, A. Bychkov6, E. Frolov7, and A. Mussol1
1University of Lille, CNRS, UMR 8523 - PhLAM, Lille, France; 2University of St. Petersburg, St. Petersburg, Russia; 3Aalto University, Espoo, Finland; 4St. Petersburg State University, St. Petersburg, Russia; 5Center of Excellence PhoenixD (Photonics, Optics, and Engineering – Innovation Across Disciplines), Hannover, Germany; 6Max Born Institute for Nonlinear Optics and Quantum Dynamics, Berlin, Germany; 7Vavilov State Optical Institute, St. Petersburg, Russia

In this talk, passive mode-locking based on coherent light matter interactions in a laser is investigated theoretically and experimentally. A single-cycle pulse generation with sub-terahertz repetition rate provided by an extremely small cavity length.

EE-P.13 TUE

The contribution has been withdrawn.

EE-P.14 TUE

Pressure Optimization of Strong Field Low Order Harmonics Generated in Xenon Microplasma in Tight Focusing Regime

E. Migal, F. Potemkin, and V. Garshonkin; Faculty of Physics and International Laser Center M.V. Lomonosov State University, Moscow, Russia

Generation of the third (413 nm) and fifth (248 nm) harmonics in tight focusing regime (NA = 0.1) is considered experimentally and theoretically. Efficiency as high as 1.1x10^-3 and 4.4x10^-4 in xenon is demonstrated.

EE-P.15 TUE

Molecular Mechanism Of Non-Photochemical Quenching In LHCSR3 Protein Of Chlamydomonas Reinhardtii

G.J. de la Cruz Valbuena1,2, F. Valduga De Almeida Camargo3, R. Borrego-Varril2, F. Persicent3, C. D’Andrea1,2, M. Ballottari1, and G. Cersoli1;1Politecnico di Milano, Dipartimento di Fisica, Milano, Italy; 2Center for Nano Science and Technology, Istituto Italiano di Tecnologia, Milano, Italy; 3Università di Verona, Dipartimento di Biotecnologie, Verona, Italy

The fastest short-term photoprotection mechanism in Chlamydomonas Reinhardtii called non-photochemical quenching was studied in an in vitro stress-related protein, LHCSR3, using a combination of time-resolved photoluminescence and transient absorption techniques.

EE-P.16 TUE

Interferometric delay tracking for mechanically chopped Mach-Zehnder interferometers

W. Schweinberger1,2,3, L. Vamos4,5, J. Xu6, S.A. Hussain1,3, C. Baune2, S. Rode2, and I. Pupeza1
1Ludwig-Maximilians-Universität München, Garching, Germany; 2Technische Universität München, Garching, Germany; 3Max Planck Institute for Quantum Optics, Garching, Germany; 4Universität Oldenburg, Oldenburg, Germany; 5Technische Universität Dresden, Dresden, Germany

The fastest short-term photoprotection mechanism in Chlamydomonas Reinhardtii called non-photochemical quenching was studied in an in vitro stress-related protein, LHCSR3, using a combination of time-resolved photoluminescence and transient absorption techniques.
Germany; 2 King Saud University, Department of Physics and Astronomy, Riyadh, Saudi Arabia; 3 Max-Planck-Institut für Quantenoptik, Garching, Germany; 4 ICFOM-The Institute of Photonic Sciences, Barcelona, Spain; 5 SmaarAct GmbH, Oldenburg, Germany

Interferometric delay tracking demonstrates sub-attosecond, and for single mechanical scans sub ten attoseconds, repeatability for a 1-meter-long Mach-Zehnder interferometer (1 meter). This precision is maintained when choosing one arm, allowing the combination with lockin amplification.

EE-P.17 TUE
Spins dynamics across metal-insulator transition in FeSe4 films

1 J. Panigrahi, 1 E. Terrier, 2 S. Cho, 2 and V. Halté 3
2 IPCMS-CNRS Université de Strasbourg 23 rue du Loess BP 43 67034, strasbourg cedex, France; 3 Physics Department, Ulsan University, Ulsan, South Korea

We explore Verwey transition (TV) in magnetite films through ultrafast pulses and charges dynamics. Both show non-trivial behaviors of their main temporal features across TV, correlated to a transient mixed phase induced by ultrashort pulses.

EE-P.18 TUE
Sub-bandgap states in lead-halide perovskites revealed by two-dimensional electronic spectroscopy

1 F.V.A. Camargo 1, T. Nagahara 1,2, J.M. Richter 1, R.H. Friend 1, 2, G. Geraldo 1, and F. Deschler 1, 2
1 IEN-CNRS, Department of Materials Science and Technology, Kyoto, Japan; 2 Cavendish Laboratory, University of Cambridge, Cambridge, United Kingdom

Lead-halide perovskites seem to have surprisingly few defects. We discuss how two-dimensional electronic spectroscopy can be used to study traps and report data revealing sub-bandgap states on high-quality bromide and iodide perovskites.

EE-P.19 TUE
Relationship between photoionization of chiral molecules and interband transitions in topological solids

1 A. Ordonez 1, 2 and G. Sminová 1, 2
1 Max-Born-Institut, Berlin, Germany; 2 Technische Universität Berlin, Berlin, Germany

We show the mapping between photoelectron circular dichroism in photoionization of chiral molecules and Berry-curve induced circular photogalvanic effect in topological solids.

EE-P.20 TUE
Pressure waves generated by various pulsed lasers in water

1 S. Albert, V. Jukna, B. Mahieu, A. Mysyrowicz, and A. Houard; Laboratoire d’Optique Appliquée, ENSTA ParisTech, École Polytechnique, CNRS, Palaiseau, France

We investigate energy deposition and pressure wave generation in water through laser energy deposition of different pulse duration. We determine the best laser parameters for acoustic applications.

EE-P.21 TUE
Dependence of Filamentation in Air upon Femtosecond Laser Repetition Rate

1 P. Walch 1, B. Mahieu 1, T. Prodait 2, G. Schimmel 3
1 Max-Planck-Institut für Quantenoptik, Garching, Germany; 2 Advanced Research Center for Nanolithography, Amsterdam, Netherlands; 3 Vrije Universiteit, Amsterdam, Netherlands

By a combined theoretical and experimental effort, we demonstrate quantitative extraction of multiple electronic and acoustic properties of thin metal films by ultrafast laser induced ultrasound and least-squares model fitting.
We theoretically investigate a weakly birefringent all-site Kerr Brussel, Bruxelles, Belgium. We show analytically and numerically that the non-instantaneous Raman resonance stabilizes traveling cavity solitons. We illustrate this mechanism on Kerr optical resonators and on a generic bistable model.

EF-P.7 TUE
Generating novel waveguides for stimulated Brillouin scattering with genetic algorithms
J. Håkansson1,2 and D. Van Thourhout1,2; 1 Ghent University, Gent, Belgium; 2 Center for Nano and Biophotonics, Gent, Belgium
Designing waveguides for stimulated Brillouin scattering is difficult because one must combine good mechanical and optical properties with a strong coupling between them. Using genetic algorithms we have found several novel and competitive waveguide designs.

EF-P.8 TUE
Spontaneous Symmetry Breaking and Nonlinear Population Inversion Grating in a Low-Q CW Laser
V. Kocharovsky1, I. Koryukin1, E. Kocharovsky-Kaya1, V. Kocharovsky2,3, I. Rybinin1, and S. Tarasov1; 1 Institute of Applied Physics, Russian Academy of Science, Nizhny Novgorod, Russia; 2 Department of Physics and Astronomy, Texas A&M University, College Station, USA
We find a new effect of superadiabatic lasing in a low-Q symmetric cavity, namely, the asymmetry of counter-propagating waves and the profiles of the field, polarization and population inversion owing to the nonlinear population inversion grating.

EF-P.9 TUE
Polarization properties of cavity solitons in Kerr resonators
E. Averland1,2, K. Panajotov2,3, and M. Tlidi1; 1 Université Libre de Bruxelles, Bruxelles, Belgium; 2 Vrije Universiteit Brussel, Brussels, Belgium; 3 University of Buenos Aires, Argentina
We theoretically investigate a weakly birefringent all-fiber cavity subject to linearly polarized optical injection. We show that vector cavity solitons exhibit multistability involving different polarization states with different energies.

EF-P.10 TUE
Random Mode Coupling Assists Kerr Beam Self-Grating in a Graded-Index Multimode Optical Fiber
O. S. Sidelnikov1, E. V. Podivilov1,2, M. P. Fedoruk1,2,3, and S. Wabnitz1,2; 1 Novosibirsk State University, Novosibirsk, Russia; 2 Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; 3 Institute of Computational Technologies SB RAS, Novosibirsk, Russia; 4 Dipartimento di Ingegneria dell’Informazione, Elettronica e Telecomunicazioni, Sapienza Università di Roma, Roma, Italy
In this paper, we numerically investigate the process of beam self-cleaning in graded-index multimode optical fibers using the coupled-mode model. The results of numerical investigations are in complete agreement with our experimental data.

EF-P.11 TUE
Delay-induced dynamics of pinned cavity soliton in an inhomogeneous Kerr resonator
E. Tabbert1, S. Garevich1, K. Panajotov2,3, and M. Tlidi1; 1 University of Munster, Munster, Germany; 2 Vrije Universiteit Brussel, Brussels, Belgium; 3 Institute of Solid State Physics, Sofia, Bulgaria; 4 Université Libre de Bruxelles, Bruxelles, Belgium
The influence of inhomogeneity and time-delayed feedback on cavity solitons is investigated. Depending on the strength of the inhomogeneity, a single cavity soliton can undergo either an Andronov-Hopf bifurcation or escape from the defect.

EF-P.12 TUE
Spectral properties of cascaded second-order nonlinear processes induced by high-gain parametric down-conversion
D. A. KAPOLOV1, E. Y. Spasibko1,2, A. V. Raspuntov1, T. V. Martzen1, and M. V. Chekhova2,3,1,3; 1 M.V. Lomonosov Moscow State University, Moscow, Russia; 2 Max Planck Institute for the Science of Light, Erlangen, Germany; 3 University of Erlangen-Nuremberg, Erlangen, Germany
We study, experimentally and theoretically, the spectral properties of visible radiation generated through cascaded second-order nonlinear processes that are induced by bright squeezed vacuum.

EF-P.13 TUE
Generation of rogue-like pulses via stimulated soliton collision in dispersion-oscillating optical fiber
A. Konikho1, A. Syslatis2, and L. Melnik2; 1 Saratov State University, Saratov, Russia; 2 Prokhorov General Physics Institute, Moscow, Russia; 3 Saratov State Technical University, Saratov, Russia
An approach for the generation of high-intensity pulses via inelastic collision of solitons in dispersion variable fiber is proposed. The rogue-like pulse arises due to stimulated soliton collisions and non-adiaibatic variation of the fiber dispersion.

EF-P.14 TUE
Effect of Initial Chirp on Soliton Pulse Compression in the Ionization Regime
Y. Wan and W. Chang; Nanyang Technological University, Singapore, Singapore
We investigate the effect of initial chirp on soliton pulse compression in the ionization regime in a gas-filled hollow-core fiber. A positively-chirped pump undergoes a stronger effect of the ionization caused by the enhanced compression.

EF-P.15 TUE
Swift-Hohenberg equation with third order dispersion for optical resonators
M. Tlidi1, B. Kotlet1, A. Hariz2, L. Balhoul1, L. Cherbi3, M. Clerc4, M. Fere4, and K. Panajotov2,3,1; 1 Université Libre de Bruxelles, Bruxelles, Belgium; 2 Institute of Solid State Physics, Sofia, Bulgaria; 3 Vrije Universiteit Brussel, Brussels, Belgium; 4 Institute of Solid State Physics, Sofia, Bulgaria
A generalized Swift-Hohenberg equation with a third order dispersion is derived for the photonic crystal fiber resonators. Moving temporal localized structures often called cavity solitons and their speed are analyzed numerically and analytically.

EF-P.16 TUE
Controlling the temporal trajectory of solitons in silver nanowire hollow fiber
S. Bote1,2, G. Steinmeyer1, U. Morgner1,2, and A. Demircan1,2,3; 1 Institute of Quantum Optics, Leibniz University, Hannover, Germany; 2 Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering-Innovations Across Discipline), Hannover, Germany; 3 Max-Born-Institut , Berlin, Germany; 4 Hannover Centre for Optical Technologies, Hannover, Germany
We investigate different regimes of soliton propagation dynamics in fibers containing a variable zero-nonlinearity point, allowing control of the soliton trajectories during supercontinuum generation process.

EF-P.17 TUE
Nonlinear Fourier Transform for Analysis of Coherent Structures in Dissipative Systems
I.S. Chekhovskoy1,2, O.V. Shyryanov1,2, M.P. Fedoruk2,3, S.B. Medvedev1,2, and S.K. Turitsyn1,2; 1 Novosibirsk State University, Novosibirsk, Russia; 2 Institute of Computational Technologies, SB RAS, Novosibirsk, Russia; 3 Aston Institute of Photonic Technologies, Aston University, Birmingham, United Kingdom
Using the example of the cubic Ginzburg-Landau equation, we show how the nonlinear Fourier transform can be used to characterize coherent structures in dissipative nonlinear systems and reduce the number of effective degrees of freedom.

EF-P.18 TUE
Nonlinear Sculpituring of Optical Pulses in Fibre Systems
S. Boscolo1, I. Oukar2, A. Tomello1, and C. Finot1; 1 Aston Institute of Photonic Technologies, School of Engineering and Applied Science, Aston University, Birmingham, United Kingdom; 2 Moscow Institute of Physics and Technology & Skolkovo Institute of Science and Technology, Moscow, Russia; 3 Laboratoire XLIM, UMR 7252 CNRS - Université de Limoges, Limoges, France; 4 Laboratoire Interdisciplinaire Carnot de Bourgogne, UBM 6303 CNRS - Universite’ Bourgogne Franche-Comté, Dijon, France
We present a general method for the design of fibre-based nonlinear pulse shaping. By combining direct numerical simulations with machine-learning strategies, we efficiently identify the optimal working parameters for steering a given pulse target.

EF-P.19 TUE
Tunable self-pulsations in a quantum-dot external-cavity laser emitting across the excited state
E. V. Podivilov1,2, M.A. Catalá3,4, and M.A. Catalá1,3; 1JOPL Publishing, Bristol, United Kingdom; 2 Previously also with the School of Science and Engineering, University of Dundee, Dundee, United Kingdom; 3 Institute of Photonics and Quantum Sciences, School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom
Self-sustained optical pulsations were observed from a tunable external-cavity quantum dot laser using a single-section amplifier, emitting solely in the excited state. The pulsations were tunable both in wavelength (1160-1196 nm) and frequency (3.78-3.82 GHz).

EF-P.20 TUE
Phase evolution of Peregrine-like solitons in nonlinear fiber optics
G. Xu1, K. Hammann1, A. Chabchoub2, J. Dudley3, B. Kibler1, and C. Finot1; 1 Laboratoire Interdisciplinaire Carnot de Bourgogne, Dijon, France; 2 The University of Sydney, Sydney, Australia; 3 Institut FEMTO-ST, Besançon, France
We report the longitudinal evolution of the temporal phase profile of Peregrine-like solitons in optical fibers. The experimental results reveal the phase difference between the central part of the pulse and the continuous background.
Impact of higher-order dispersion on geometric parametric instability in GRIN multimode fibers

A. Kudlinski, A. Bendahmane, O. Vanvincq, C. Mas Abati, A. Mussot, and M. Conforti; University of Lille, Lille, France

We show that geometric parametric instability in multimode fibers is strongly influenced by higher-order dispersion. By measuring the output spectrum for different core radii, we distinguish peaks generated by GPI from other nonlinear phenomena.

Multimode Solitons in Hollow-Core Fibres: Dynamics and Features

B. López Zubieta, A. Crego, E. Conejero Jarque, J.I. Sola, and J. San Roman; Grupo de Investigación en Aplicaciones del Laser y Fotónica, Departamento de Física Aplicada, University of Salamanca, Salamanca, Spain

A new type of multimode soliton is observed in the non-linear propagation of a laser pulse in hollow-core fibres, showing an ultrashort temporal self-compression supported by an ultra-broadband spectrum (from the ultraviolet to the infrared).

Radially and angularly accelerating optical wave-packets

A. Brimi1,2, M. Makris3, and D. Papazoglou1,2; 1Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology - Hellas, Heraklion, Greece; 2Materials Science and Technology Department, University of Crete, Heraklion, Greece; 3Physics Department, University of Crete, Heraklion, Greece

Light that twists and accelerates both over the radial and the angular dimension is generated by superimposing vortex ring-Airy beams that are tuned to abruptly auto-focus at overlapping focal regions while following distinct trajectories.

Space-time evolution of noise-driven modulation instability in optical fibers experiments

A. Kryzh1, D.S. Agafontsev2, S. Randoaux3, and P. Saret4; 1University of Lille, CNRS, UMR 8523 - Physique des Lasers Atomes et Molecules (PHLAM), Lille, France; 2P.P. Shirshov Institute of Oceanology, Moscow, Russia

We investigate noise-driven modulation instability in optical fibers. By using a recirculating fiber loop, we report the first experimental recording of the space-time dynamics. Experiments also reveal the quasi-periodic transient regime of the statistical properties.

Two dimensional experimental Airy beam propagation behavior in biased photorefractive medium

T. Bouchet1,2, N. Marsal1, M. Sciamanna1,2, and D. Wolferberger1,2; 1Chaire Photonique, LMOPS EA-4423 Laboratoire CentralSupélec, Université Paris-Saclay, Metz, France; 2Chaire Photonique, LMOPS EA-4423 Laboratoire CentralSupélec, Université de Lorraine, Metz, France

We investigate experimentally the behavior of 2D Airy beam propagation in a biased nonlinear medium - a photorefractive crystal. We obtain distinct propagation behaviors for different values of applied external electric field and beam power.

Kerr frequency comb generation and soliton dynamics caused by forward-backward wave interaction in WGM microresonators

N. Kondratiev, A. Cherkenov, and V. Lobanov; Russian Quantum Center, Moscow, Russia

We demonstrate that forward-backward wave coupling in optical microresonators may affect Kerr frequency comb generation and dynamics. It may influence soliton repetition rate at anomalous group velocity dispersion and provide comb generation at normal dispersion.

Spatial Kerr-beam self-cleaning in Yb-doped multimode fiber taper

A. Niang1, T. Mansuryan2, K. Krupa1,3, A. Tonello1, M. Fabret1, P. Leproux1, D. Modotto2, G. Millot3, V. Courid1, and S. Wabnitz1; 1Département d’Ingénierie de l’Information, Université degli Studi di Brescia, Viale Branze 38, 25123, Brescia, Italy; 2Laboratoire dePhysique des Lasers, Atomes et Molécules (LPL), Université de Bourgogne, 9 Avenue A. Thomas, 89060 Limoges, France; 3University of Lille, XLIM, UMR CNRS 7252, 123 Avenue A. Thomas, 80760 Limoges, France

We experimentally demonstrate self-cleaning in a long doped multimode fiber taper in both passive (without gain) and active configurations. Supercontinuum generation with a spectral domain extending from the visible to mid-infrared is obtained.

Giant pulse at 2 μm in polarization maintaining silica step-index fiber

P. Morin1, S. Boivinet4, J.-P. Yehoussi1,2, and A. Kudlinski; 1,2UniversitéBourgogneFranche-Comté,ICB,UMRCNRS;3UniversitéBourgogneFranche-Comté,ICB,UMRCNRS;4Laboratoireof Physics, University of Lille, Lille, France

We experimentally demonstrate the generation of a giant pulse based on the interaction between two Raman solitons in polarization maintaining silica step-index fiber at 2 μm.

Direct Measurement of Cross-Phase Modulation in Microresonators

G.N. Ghahani1,2, J.M. Silver1,3, L. Del Bino1,4, N.P. Moroney1,2, M.T.M. Woodley1,2, A. Svelto1,2, S. Zang1, and P. DeHaye1; 1National Physical Laboratory (NPL), Teddington, United Kingdom; 2Imperial College London, London, United Kingdom; 3City, University of London, London, United Kingdom; 4Heriot-Watt University, Edinburgh, United Kingdom

We developed a new spectroscopy method to directly measure cross-phase-modulation (XPM) in ultra-high-Q microresonators. This provides a basis for understanding phenomena including nonlinear interaction of solitons and symmetry breaking of counterpropagating light in whispering-gallery microresonators.

Experimental evidences of non-hermitian mode-locking in fibre laser

A. Kuznetsov1,2, A. Pergo3, D. Churkin1,2, and K. Staliunas4,5; 1Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; 2Novosibirsk State University, Novosibirsk, Russia; 3Aston University, Birmingham, United Kingdom; 4Instituto Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain; 5UniversitéPolitecnica Catalunya (UPC), Barcelona, Terrassa, Spain

We propose and realize experimentally the nonhermitian active mode-locking of fiber laser, via the dephased amplitude- and phase modulation of the laser resonator.

Soliton combs generation due to parametric up and down conversion in a microring resonator with quadratic nonlinearity

A. Villas and D.V. Skryabin; Department of Physics, University of Bath, Bath, United Kingdom

We report existence of the soliton and quasi-soliton frequency combs in a ring microresonator with quadratic nonlinearity operating in the regimes of the second harmonic generation and parametric down conversion.

Soliton combs generation due to parametric up and down conversion in a microring resonator with quadratic nonlinearity

A. Villas and D.V. Skryabin; Department of Physics, University of Bath, Bath, United Kingdom

We report existence of the soliton and quasi-soliton frequency combs in a ring microresonator with quadratic nonlinearity operating in the regimes of the second harmonic generation and parametric down conversion.

Localized structures in dispersive doubly resonant optical parametric oscillators

P. Parra-Rivas1,2, L. Gelsen2, and E. Leo1; 1OPERA-photonics, Université libre de Bruxelles, 50 Avenue F. D. Roosevelt, CP 194/5, B-1050, Brussels, Belgium; 2Laboratory of Dynamics in Biological Systems, KU Leuven Department of Cellular and Molecular Medicine, University of Leuven, B-3000, Leuven, Belgium

In this work we study the formation and bifurcation structure of localized dissipative structures in dispersive optical parametric oscillators. We show that these states undergo collapsed snaking and characterize their dynamics.

Symmetry breaking of optical vortex in bacteriorhodopsin suspensions

K. Masuda1, T. Yohizawa1, T. Akiyama1, Y. Okada-Shudo2, T. Murata3, T. Koyoda3,4, K. Miyamoto5,6, and T. Omatsu1,7; 1Graduate School of Advanced Integration Science, Chiba University, Chiba, Japan; 2Department of Electronic Engineering, The University of Electro-Communications, Chofu, Japan; 3Molecular Chirality Research Center, Chiba University, Chiba, Japan

We discover that bacteriorhodopsin suspensions enable the breaking of a right-handed (left-handed) optical vortex mode into a clockwise (anti-clockwise)-rotating twin mode with two bright spots.

Impact of High-Order Effects on Soliton Explosions in the Complex Cubic-Quintic Ginzburg-Landau Equation

A. Curevcic1,2, C. Schelle1,2, and J. Javaloyes3; 1Institute for Theoretical Physics, University of Münster, Münster, Germany; 2Nonlinear Wave Group, Universitat de les Illes Balears , Palma de Mallorca, Spain

In this work we employ path-continuation techniques and show how third-order dispersion, self-steepening and self-frequency shift impact the onset of soliton explosions in the complex cubic quintic Ginzburg-Landau equation.
Kerr beam self-cleaning in the telecom band
V. Couderc, M. Fabert, L. Lavoute, A. Tonello, K. Krupa, M. Fabert, G. Millot, S. Février, S. Wabnitz, and V. Couderc
1 Université de Limoges, XLIM, UMR CNRS 7252, Limoges, France; 2 Université de Bourgogne Franche-Comté, ICB, UMR CNRS 6303, Dijon, France
We demonstrated efficient Kerr-beam self-cleaning in the anomalous dispersion regime of a GRIN-MMF. The power threshold for mode cleaning is found to be more than one order of magnitude lower than the one reported previously.

Observation of Soliton Explosions in an Anomalous-Dispersion Fibre Laser
Z.-W. Wei, M. Liu, S.-X. Ming, A.-P. Luo, W.-C. Xu, and Z.-C. Luo
South China Normal University, Guangzhou, China
We reported the first experimental evidence of coherent soliton explosion in a fiber laser with anomalous dispersion. These results will be attractive to the communities dealing with ultrafast lasers and nonlinear optics.

Multiple switchable generation between noise-like pulse and dissipative soliton in an Er-doped fiber laser based on nonlinear polarization rotation
X. Cheng, Q. Huang, C. Zou, C. Mou, B. Qin, Z. Yan, and L. Zhang
Shanghai University, Shanghai, China; 2 Huazhong University of Science and Technology, Wuhan, China; 3 Aston University, Birmingham, UK
The multiple switchable generation between noise-like pulse and dissipative soliton only by increasing pump power in a nonlinear polarization rotation mode-locked Er-doped fiber laser is firstly experimentally investigated.

Threshold effects and metastability in solitary refractive index wells
O. Melcher, I. Babushkin, U. Morgner, and A. Demircan
1 Institute of Quantum Optics, Leibniz University Hannover, Hannover, Germany; 2 Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering - Innovation Across Disciplines), Hannover, Germany; 3 Hannover Centre for Optical Technologies, Hannover, Germany
We demonstrate threshold effects, akin to transmission anomalies in quantum mechanics, and a novel mechanism for generating optical metastable states with controllable decay times within the refractive index well formed by a soliton.

Reversible and Irreversible Transformations of 3D-Tangle Laser Solitons
N.N. Rosanov, S.V. Fedorov, and N.A. Veretennikov
1 Vavilov State Optical Institute, St. Petersburg, Russia; 2 ITMO University, St. Petersburg, Russia; 3 AIP, Institute, St. Petersburg, Russia
Coexisting of different types of 3D-topological solitons in lasers with saturable absorption enables various transformations of their internal structure. We present such transformations due to slow variations of medium gain and due to their collisions.

Desynchronization of Pulsed Driving in the Formation of Soliton Kerr Frequency Combs
I. Hendry, B. Garbin, S. Coen, and M. Erkintalo
1 The Dodd-Walls Centre for Photonic and Quantum Technologies, Auckland, New Zealand; 2 Department of Physics, The University of Auckland, Auckland, New Zealand
We have numerically investigated pump-cavity desynchronization in soliton based Kerr frequency combs. We find that desynchronization can be leveraged to ensure single-soliton operation, and we present a theoretical formula for the soliton locking range.

Spontaneous Symmetry Breaking, Oscillations, and Chaotic Regimes in Bidirectionally-Pumped Ring Resonators
M.T.M. Woodley, I.M. Silver, J. Hill, F. Copie, L. Del Bino, S. Zhang, G.-L. Oppo, and P. Del’Haye
1 National Physical Laboratory, Teddington, United Kingdom; 2 Heriot-Watt University, Edinburgh, United Kingdom; 3 City University of London, London, United Kingdom; 4 University of Strathclyde, Glasgow, United Kingdom
We present a model for the nonlinear Kerr behaviour of counter-propagating light in ring resonators, predicting rich phenomena, including chaotic regimes. This will be useful for many future devices, including all-optical oscillators and soliton microcombs.
Wednesday – Orals

ROOM 4b ICM

8:30 – 10:00
EI-3: Optical spectroscopy of 2D materials
Chair: Alexander Holleitner, Technical University of Munich, Munich, Germany

Determinations of the dipole orientation of a single defect in hexagonal boron nitride using vector beam
H. Takashima1, K. Ishihara2, H. Maruya3, T. T. Tran4, I. Ahanorovich5, and S. Takeuchi2, 1Kyoto University, Kyoto, Japan; 2Central European Institute of Technology, Brno, Czech Republic; 3University of Technology Sydney, Sydney, Australia

We report on the three-dimensional determination of the orientation of the single defects in hexagonal boron nitride using a vector beam

EI-3.2 WED

Investigation of the Spectroscopic Properties of Single Defects in Hexagonal Boron Nitride
A. W. Schell1,2,3, H. Takashima2, T. T. Tran4, I. Ahanorovich5, M. Swedendahl1,5, R. Quidant1, and S. Takeuchi2, 1Central European Institute of Technology, Brno University of Technology, Brno, Czech Republic; 2Department of Electronic Engineering, Kyoto University, Kyoto, Japan; 3ICFO-Institut de Ciencies Fotoniques, Castelldefels, Spain; 4School of Mathematical and Physical Sciences, University of Technology Sydney, Sydney, Australia; 5KTH Royal Institute of Technology, Stockholm, Sweden

We investigate the optical properties of recently found emitters in hexagonal boron nitride for this, we perform multiphoton excitation on single defects and vary the excitation wavelength finding a wavelength dependent quantum efficiency.

8:30 – 10:00
CB-7: Wavelength control of QCLs
Chair: Augustinas Vizbaras, Brolis Semiconductors UAB, Vilnius, Lithuania

Large Area Surface-Emitting Photonic Crystal Quantum Cascade Laser
Z. Wang1, Y. Liang1, B. Meng1, Y. Sun1, G. Omanakuttan2, E. Gini3, M. Beck3, I. Sergachev4, S. Lourdudoss5, J. Faiss1, and G. Scalari4, 1ETH Zurich, Institute for Quantum Electronics, Zurich, Switzerland; 2KTH Royal Institute of Technology, Department of Applied Physics, Stockholm, Sweden; 3FIRST laboratory ETH Zurich, Zurich, Switzerland; 4Wyss Zurich, Zurich, Switzerland

We present a large-area (1.5 mm × 1.5 mm) photonic quantum cascade laser, with 1 W surface-emitting peak power at room temperature (289 K), and narrow beam shape.

CB-7.1 WED (Invited)

8:30
Large Area Surface-Emitting Photonic Crystal Quantum Cascade Laser
Z. Wang1, Y. Liang1, B. Meng1, Y. Sun1, G. Omanakuttan2, E. Gini3, M. Beck3, I. Sergachev4, S. Lourdudoss5, J. Faiss1, and G. Scalari4, 1ETH Zurich, Institute for Quantum Electronics, Zurich, Switzerland; 2KTH Royal Institute of Technology, Department of Applied Physics, Stockholm, Sweden; 3FIRST laboratory ETH Zurich, Zurich, Switzerland; 4Wyss Zurich, Zurich, Switzerland

We present a large-area (1.5 mm × 1.5 mm) photonic quantum cascade laser, with 1 W surface-emitting peak power at room temperature (289 K), and narrow beam shape.

8:30 – 10:00
CIK-10: Plasmonics and antennas
Chair: Corin Gawaih, University of Southampton, Southampton, United Kingdom

Plasmonic Doppler Grating and Photoluminescence-driven Broadband Directional Optical Nanoantennas
J.-S. Huang1, 2, 3, K.-M. See1, F.-C. Lin1, T.-Y. Chen1, Y.-X. Huang2, C.-H. Huang2, and A.T.M. Yeildy1, 1Leibniz Institute of Photonic Technology Jena, Germany; 2Department of Chemistry, National Tsing Hua University, Hsinchu, Taiwan; 3Department of Electrophysics, National Chiao Tung University, Hsinchu, Taiwan; 4Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan

We present the design of azimuthal angle-dependent plasmonic Doppler grating and it application in sensing. We also demonstrate broadband directional emission from photoluminescence-driven plasmonic directional nanoantennas.

8:30 – 10:00
EF-3: Photon fluids and Hawking-like effect
Chair: Peter Banzer, Max Planck Institute for the Science of Light, Erlangen, Germany

Analog Hawking like effect enhanced by 4th-order dispersion phase matching
S. J. Robertson1, C. Ciraf, S. -P. Gorza1, S. Masar1, and R. Parentani2, 1Laboratoire de Physique Théorique (UMR 8627), CNRS, Université Paris-Sud, Université Paris-Saclay, 91405 Orsay, France; 2Laboratoire de Photonique d’Angers EA 4464, Université d’Angers, 2 Bd. Lavoisier, 49000 Angers, France; 3Laboratoire de Photonique d’Angers EA 4464, Université d’Angers, 2 Bd. Lavoisier, 49000 Angers, France; 4Laboratoire d’Information Quantique CP 224, Université libre de Bruxelles (ULB), Av. F. D. Roosevelt 50, 1050 Bruxelles, Belgium; 5Laboratoire d’Information Quantique CP 224, Université libre de Bruxelles (ULB), Av. F. D. Roosevelt 50, 1050 Bruxelles, Belgium

We show numerically that the analog Hawking radiation emitted by a soliton propagating in a silicon nitride waveguide is dramatically enhanced by 4th-order dispersion phase matching, thereby rendering its experimental observation much more achievable.

8:30 – 10:00
EF-3.1 WED

Observation of Branched Flow of light
A. Patsyk1, M. Bandres2, U. Struv1, and M. Segov1, 1Physics Department and Solid State Institute, Technion-Israel Institute of Technology, Haifa, Israel; 2College of Optics & Photonics-CREOL, University of Central Florida, Orlando, USA

We present the first study of optical branched flow. As light propagates in thin dielectric films it experiences scattering from inhomogeneities, forming bundles displaying the features and statistics of the phenomenon known as branched flow.
### ROOM 14b ICM

**CM-8: Microfluidics and novel applications of laser micromachining**  
Chair: Mangirdas Malinauskas, Vilnius University, Vilnius, Lithuania

**CM-8.1 WED 8:30**  
Buried microchannels in alumino-borosilicate glass by femtosecond laser pulses and chemical etching  
- A. Crespi1,2, R. Osellame3, and F. Bragheri2  
  1Dipartimento di Fisica - Politecnico di Milano, Milano, Italy;  
  2Istituto di Fotonica e Nanotecnologie - Consiglio Nazionale delle Ricerche (IFN-CNR), Milano, Italy
We show that femtosecond laser irradiation followed by chemical etching allows to produce buried microchannels in EagleXG (Corning) alumino-borosilicate glass. This will enable quick fabrication of microfluidic devices, directly interfaced with complex low-loss photonic circuits.

### ROOM 1 Hall A1

**CM-8.2 WED 8:45**  
Non-volatile Microfluidics Controlled Switch Fabricated in Fused Silica by Femtosecond Laser Inscription  
  1Ghent University - IMEC, Department of Information Technology, Photonics Research Group, Ghent, Belgium;  
  2Ghent University - IMEC, Department of Electronics and Information Systems, Centre for Microsystems Technology, Ghent, Belgium;  
  3CommScope Connectivity Belgium, Kessel LO, Belgium
Femtosecond laser written cross-bar optical switch in fused silica is demonstrated. The switch combines crossed waveguides and a microfluidic channel at the waveguide crossing. The switching is controlled by changing fluid in the channel.

### ROOM 2 Hall A1

**EA-6.1 WED 8:30**  
A Reconfigurable Silicon Generator of Four-Photon Entangled States  
- C. Viglier, J.C. Adcock, R. Santagati, J.W. Silverstone, and M.G. Thompson; Quantum Engineering Technology Labs, University of Bristol, Bristol, United Kingdom
We show a programmable quantum silicon photonic chip able to create all the existing four-qubit graph state classes. For the first time, four on-chip generated photons are used to encode information, showing computational capabilities.

### EA-6.2 WED 8:45**

**Silicon Quantum Photonics in the Short-Wave Infrared: A New Platform for Big Quantum Optics**  
- J.W. Silverstone, L.M. Rosenfeld, D.A. Salway, B.D.J. Sayers, J. Biele, G.F. Sinclair, D. Sahin, L. Kling, J.C.F. Matthews, M.G. Thompson, and J.G. Rarity; Quantum Engineering Technology Labs, University of Bristol, Bristol, United Kingdom
Silicon photonics is the best hope for large-scale quantum technology with photons, but at 1.55 μm it has fundamental limitations. We show how silicon in the 2-1.1 μm short-wave infrared could unlock big quantum optics.

**EA-6.3 WED 8:30**  
Optical Control of Quantum Feedback Networks  
- M. Francke, L. Bosco, M. Beck, E. Mavrona, and J. Faist; Institute for Quantum Electronics, ETH Zürich, Zürich, Switzerland
In this talk, we present a new approach to control multi-qubit feedback networks by using a single active element. We demonstrate the control of a single qubit, photonic, and a superconducting qubit in a feedback network. The active element is a high-finesse cavity, which is coupled to the active elements of the feedback network. This allows for a simple and efficient control of the feedback network.

**EA-6.4 WED 8:30**  
Optically Tunable Terahertz Quantum Cascade Random Lasers  
- S. Schönhuber1,2, B. Limbach1,2, M.A. Kainz1,2, A.M. Andrews3, J. H. Dettz4, G. Strasser2,3, J. Darma1,3, and K. Unterrainer1,2  
  1Photonics Institute, Vienna, Austria;  
  2Center for Micro and Nanostructures, Vienna, Austria;  
  3Institute of Solid State Electronics, Vienna, Austria;  
  4Central European Institute of Technology, Brno, Czech Republic
We demonstrate optical tunability of terahertz quantum cascade random lasers by illumination with an additional, external 813 nm source. Our results pave the way towards a continuously tuneable terahertz light source.
We present dual-comb spectroscopy of acetylene with a single, free-running dual-comb MIXSEL generating two frequency combs:

- J. Nürnberg1, C.G.E. Alferi1, Z. Chen2, D. Waldburger3, M. Göll1, N. Piqué4, and U. Keller1; 1Institute for Quantum Electronics, ETH Zürich, Zürich, Switzerland; 2Max-Plank Institute of Quantum Optics, Garching, Germany

We present dual-comb spectroscopy of acetylene with a single, free-running dual-comb MIXSEL at 1030 nm (290 THz). The laser provides more than 10 nm of optical bandwidth usable for spectroscopic interrogations with a resolution of 2.73 GHz.

Intravally spin-flip relaxation dynamics in single-Layer WS2:
- Z. Wang1, A. Molina-Saizh2, P. Altmann3, D. Sangalli3, D. De Fazio4, G. Sover5, U. Sass6, F. Bottegini7, F. Cicciacc1, M. Finazzi1, L. Wirtz2, A. C. Ferrari8, A. Marini1, G. Cerullo9, and S. Dal Conte10; 1Department of Physics, Politecnico di Milano, Milano, Italy; 2Institute of Materials Science(ICMUV), University of Valencia, Valencia, Spain; 3INR-ISM, Division of Ultrafast Process in Materials (FLASHit), Monterotondo Scalo, Italy; 4Cambridge Graphene Centre, University of Cambridge, Cambridge, United Kingdom; 5Université de Luxembourg, Luxembourg City, Luxembourg; 6IFN-CNR, Milano, Italy

We use two-color helicity-resolved pump-probe spectroscopy to track intravally scattering dynamics in monolayer WS2. Results show that spin-polarized carriers scatter within the valley by reversing their spin orientation on a sub-ps timescale.

Nanostructured MoS2 Monolayers for Spatial Control of Second-harmonic Generation:
- R. Löhnc1, R. Mupparapu1, M. Steiner2, A. George2, A. Turc1, A. Tschisch2, T. Pertsch2, L. Staud1, and F. Setzpfandt1; 1Institute of Applied Physics, Friedrich Schiller University Jena, Jena, Germany; 2Institute of Physical Chemistry, Friedrich Schiller University Jena, Jena, Germany; 3Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We realize one-dimensional gratings in MoS2 monolayers by focused-ion-beam milling and observe second-harmonic generation and nonlinear diffraction. Our results demonstrate that atomically thin semiconductors are a promising platform for the realization of functional nonlinear surfaces.

Quantum-cascade lasers with U-shaped resonator: single frequency generation at room temperature:
- V. Dudelev1, A. Babichev1, D. Mikhailov1, A. Gladyshev2, S. Losev2, E. Kogovszkaya3, I. Novikov3, S. Slipchenko3, A. Lyutetskiy3, N. Pikhtin4, L. Karachinsky5, A. Egorov6, and G. Sokolovskii7; 1Joffe Institute, Saint-Petersburg, Russia; 2Connector Optics LLC, Saint-Petersburg, Russia; 3FTMO University, Saint-Petersburg, Russia

In this paper, we demonstrate the room-temperature generation of the quantum cascade lasers with U-shaped resonator and present the approach for realization of the continuous frequency-swept light source in the mid-infrared range.

Integrated plasmonic tweezers for efficient nanoparticle trapping:
- E. Cernot1, G. Magna1, X. Leroux1, D. Dagens1, and Y. Yam; Centre de Nanosciences et Nanotechnologies, Palaiseau, France

We show numerically and experimentally that integrated plasmonic tweezers enable ultra-efficient trapping of dielectric nanobeads thanks to the existence of a strong coupling between gold nanoparticle chain with a monomode SOI waveguide.
Laser inscription of microfluidic devices in the bulk of fused silica

A.N. Giakoumaki, V. Bharadwaj, R. Ramponi, G. Bergamini, and S.M. Eaton

We present the fabrication and functionalization of buried glass microfluidic devices made by femtosecond laser inscription. The devices enable the interface, interaction and separation of two fluids with minimum mixing for applications in chemistry.

High Performance Thermal Emitters Based on Laser Engineered Surfaces

S. Zolotovskaya, S. Wackerow, H. Neupert, M. Barnes, L. V. Cañón, B. Teissandier, and A. Abdolvand

We demonstrate a substantial increase in emissivity of metal surfaces following surface structuring. Emissivity values exceeding 0.9 were achieved after nanosecond pulse laser structuring of steel in the 2.5-12 um spectral region.

Nonlinear Quantum Devices

C. Silberhorn; Paderborn University, Paderborn, Germany

Non-linear waveguide structures allow the realization of quantum devices with multiple functionalities, including efficient photon pair generation and electro-optical elements such as a controllable time delay. Here we present our latest progress in this field.
**Room 4b ICM**

**ED-3.4 WED 9:30**

**Static and dynamic measurements in an**

<table>
<thead>
<tr>
<th>**<strong>Static and dynamic measurements in an electro-optic crystal</strong></th>
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<tbody>
<tr>
<td><strong>M.A. Abbas, A. Khodaabakhsh, J. Mandon,</strong></td>
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<tr>
<td><strong>Q. Pan, and F.J.M. Harren; Institute of</strong></td>
</tr>
<tr>
<td><strong>Molecules and Materials, Radboud Univer-</strong></td>
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<tr>
<td><strong>sity, Nijmegen, Netherlands</strong></td>
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</table>

We use mid-infrared dual-comb spectroscopy for time-resolved monitoring of the products of methane under discharge, as well as measuring the collisional relaxation of three molecular excited states of methane with microsecond time resolution.

**EI-3.5 WED 9:30**

**Nonlinear microscopy of lead iodide**

<table>
<thead>
<tr>
<th><strong>Nonlinear microscopy of lead iodide nanosheets</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>J.Y. Yan, Q. Ou, Q. Bao, and D.N. Neshev;</strong></td>
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<tr>
<td><strong>Nonlinear Physics Centre, Research School of</strong></td>
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<tr>
<td><strong>Physics and Engineering, Australian National</strong></td>
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<tr>
<td><strong>University, ACT, Australia; 2 Department of</strong></td>
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<tr>
<td><strong>Materials Science and Engineering, ARC</strong></td>
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<tr>
<td><strong>Centre of Excellence in Future Low-Energy</strong></td>
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<tr>
<td><strong>Electronics Technologies (FLEET), Monash</strong></td>
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<td><strong>University, Victoria, Australia</strong></td>
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</table>

We demonstrate nonlinear microscopy of PbI₂ nanosheets. By using the polarization and thickness dependence of the nonlinear harmonic emissions, we can precisely determine their thickness and crystalline orientation with a non-invasive optical technique.

**EI-3.6 WED 9:45**

**Coupling 2D Materials to an Elastomer**

<table>
<thead>
<tr>
<th><strong>Coupling 2D Materials to an Elastomer Waveguide</strong></th>
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<tbody>
<tr>
<td><strong>F. Auskatz1, D. Vella2, J. Verzhbitsky2, K.F.</strong></td>
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<tr>
<td>*<em>Ng3, Y.W. Hu3, <em>J.A. Griese1, I. Vysma-</em></em></td>
</tr>
<tr>
<td><strong>Gome3, G. Eda2, A. Ling1,2; 1Centre for</strong></td>
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<tr>
<td><strong>Quantum Technologies, Singapore, Singa-</strong></td>
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<tr>
<td><strong>pore; 2Department of Physics, National Uni-</strong></td>
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<td><strong>versity of Singapore, Singapore, Singa-</strong></td>
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<tr>
<td><strong>pore; 3Department of Advanced 2D Materials,</strong></td>
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<tr>
<td><strong>Singapore, Singapore; 4Department of</strong></td>
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<tr>
<td><strong>Chemistry, National University of Singa-</strong></td>
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<td><strong>pore, Singapore</strong></td>
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</table>

We developed a new dispersive spectrometer with using an immersion grating for direct frequency comb spectroscopy at 8-10μm. We carefully characterized its performance and achieved highest frequency resolution of 460 MHz in this wavelength region.

**CB-7.4 WED 9:30**

**Wavelength stabilized External Cavity**

<table>
<thead>
<tr>
<th><strong>Wavelength stabilized External Cavity Quantum Cascade Lasers using Cavity</strong></th>
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<tbody>
<tr>
<td><strong>Resonator Integrated Grating Filters</strong></td>
</tr>
<tr>
<td><strong>A. Monnayrant1, S. Auge2, S. Gluckho2,</strong></td>
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<tr>
<td><strong>A.-L. Fehrenbach2, E. Popov3, T. Anton2,</strong></td>
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<tr>
<td><strong>S. Pelloquin1, A. Arnaud1, G. Maisons3,</strong></td>
</tr>
<tr>
<td><strong>and O. Gauthier-Lafaye4; 1LAAS-CNRS,</strong></td>
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<tr>
<td><strong>Université de Toulouse, CNRS, Toulouse,</strong></td>
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<tr>
<td><strong>France; 2Institute of Industrial Science and</strong></td>
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<tr>
<td><strong>LIMS/CRNS, The University of Tokyo, Tokyo,</strong></td>
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<tr>
<td><strong>Japan; 3Aix-Marseille Univ, CNRS, Centra-</strong></td>
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<tr>
<td><strong>le Marseille, Institut Fresnel, Marseille, France;</strong></td>
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<tr>
<td><strong>3Laboratoire de Photonique Quantique et</strong></td>
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<td><strong>Moléculaire, CentraleSupélec, Ecole Normale</strong></td>
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<tr>
<td><strong>Supérieure Paris-Saclay, Université Paris-</strong></td>
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<tr>
<td><strong>Saclay, Gif-sur-Yvette, France; 4lmitSense,</strong></td>
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<tr>
<td><strong>Pulsein, France</strong></td>
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</table>

An external cavity with a QCL and a Cavity-Resonator-Integrated-Grating-Filter (CRIGF) shows single mode operation with 20mW output power at 4.65 μm. Standard active layer in the QCL allows tunability with CRIGF period over 70 cm-1.

**CB-7.5 WED 9:45**

**Advances in MOEMS-based External**

<table>
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<tr>
<th><strong>Advances in MOEMS-based External Cavity QCLs</strong></th>
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<tbody>
<tr>
<td><strong>Y.Y. Flores1, M. Haertelt1, S. Hugger1,</strong></td>
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<tr>
<td><strong>L. Butschek2, C. Schilling2, A. Merten2,</strong></td>
</tr>
<tr>
<td><strong>M. Schwarzenberg3, A. Dreyhaupt4,</strong></td>
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<tr>
<td><strong>J. Gruhnmann5, M. Rattunde1, and R.</strong></td>
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<tr>
<td><strong>Ostendorf1; 1Fraunhofer Institute for</strong></td>
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<tr>
<td><strong>Applied Solid State Physics, Freiburg,</strong></td>
</tr>
<tr>
<td><strong>Germany; 2Fraunhofer Institute for Photonic</strong></td>
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<tr>
<td><strong>Microsystems, Dresden, Germany</strong></td>
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</table>

We present miniaturized MOEMS-based external-cavity QCLs for mid-IR spectroscopy: A non-resonant, versatile version for setting arbitrary emission wavelengths and a fast, resonant variant with cavity length control for real time measurements with high spectral resolution.

**EF-3.5 WED 9:45**

**Dynamics of photon fluid flows driven**

<table>
<thead>
<tr>
<th><strong>Dynamics of photon fluid flows driven by optical pistons</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>A. Berdahman2, G. Xu1, M. Conforti2,</strong></td>
</tr>
<tr>
<td><strong>A. Kudlinski1, A. Messori1, and S. Trillo2;</strong></td>
</tr>
<tr>
<td><strong>2Lille University, Lille, France; 3University of Fer-</strong></td>
</tr>
<tr>
<td><strong>rara, Ferrara, Italy</strong></td>
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</table>

We investigate the optical analogs of the piston shock problem in gas dynamics. Using fast temporal measurements, we recorded dispersive shock waves formed by the propagation of a bi-chromatic photon fluid along an optical fiber.

**EF-3.6 WED 9:45**

**Turbulent flow and soliton interaction in**

<table>
<thead>
<tr>
<th><strong>Turbulent flow and soliton interaction in resonantly-driven polaritons superfluids</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>S. Pigeon, A. Maitre, G. Lerario, E. Glo-</strong></td>
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<tr>
<td><strong>cobino, Q. Glorieux, and A. Bramati; Labo-</strong></td>
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<tr>
<td><strong>ratoire Kastler Brossel, Sorbonne University,</strong></td>
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<tr>
<td><strong>CNRS, Paris, France</strong></td>
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</table>

An all-optical method is presented overcoming typical limitations of polariton superfluids resonantly driven. Its experimental implementation is reported showing a turbulent stream of polaritons and interacting solitons over more than 100μm.
Achievement of very smooth cavity sidewalls by UV picosecond laser micromachining
M. Sentis, A. Sikora, G. Costallier, and T. Sarret; LP3 - CNRS-AMU, Marseille, France
The effects of the laser pulse overlap, focal spot size and fluence on the roughness of ps laser micromachined cavity sidewalls are investigated experimentally and theoretically. Roughness lower than 40 nm is demonstrated.

Laser engineered surface structures for custom design of secondary electron yield
D. Bajek1,2, J. Guidi1, B. Di Girolamo1,2, S. Calatroni1,2, B. Di Girolamo1,2, and S. Wackerow1,2;1 University of Technology, Haifa, Israel; 2 Keio University, Yokohama, Japan; 3 University of Fukui, Fukui, Japan
We report the generation of near-1R non-degenerate correlated photon pairs in a 13-cm-long optical nano-fiber. The coincidence-to-accidental ratio (CAR), 400 has been achieved at average pump power of 70 μW.

A modular source of entangled photon pairs in femtosecond-laser written waveguide circuits
S. Atzeni1,2, A.S. Rab1, G. Corrielli2,1, E. Polino1, M. Valeri2, P. Mataloni3, N. Spagnolo1,2,3, R. Crespi1,2,3, P. Scarranno1,2, and R. Osellame1,3;1 Dipartimento di Fisica - Politecnico di Milano, Milano, Italy; 2 Istituto di Fotonica e Nanotecnologie - Consiglio Nazionale delle Ricerche (IFN-CNR), Milano, Italy; 3 Dipartimento di Fisica - Sapienza Università di Roma, Roma, Italy
We demonstrate an on-chip source of single-photon pairs, based on femtosecond laser written waveguides on hybrid substrates. Different combinations of optical chips can be cascaded, to generate either separable states or polarization entangled ones.

Electric-Dipole based Chiral Sensitivity in High Harmonic Generation by Dynamical Symmetry Breaking Spectroscopy
O. Neufeld1,2,3,4, D. Ayova1,2, P. DeLeva1,3, M. Ivanov1,2,4, and O. Cohen1,2,3;1 Physics Department and Solid State Institute, Technion - Israel Institute of Technology, Haifa, Israel; 2 Max-Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany; 3 Dipartimento di Scienze Chimiche e Farmaceutiche, Università degli Studi di Trieste, Trieste, Italy; 4 Department of Physics, Imperial College London, London, United Kingdom
Using group-theory dynamical symmetry considerations, we propose and numerically demonstrate a new ultrafast chirality spectroscopy technique based on non-collinear high harmonic generation, which relies only on electric-dipole interactions, and leads to a huge chiral response.

High speed THz imaging using atomic vapour
L. Downes, A. MacKellar, D. Whiting, C. Bourgenot, C. Adams, and K. Weatherill; Durham University, Department of Physics, South Road, Durham, United Kingdom
We present a sensitive technique for full-field THz imaging that operates at high speed at room temperature. By using atomic vapour as a THz-to-optical converter we achieve a 100-fold improvement over the current state-of-the-art.
First Demonstration of VUV Ramsey-Comb Excitation Based on HHG; Towards 1S-2S He⁺ Excitation

**ED-4.1 WED 10:30**

**First Demonstration of VUV Ramsey-Comb Excitation Based on HHG; Towards 1S-2S He⁺ Excitation**

- Institute of Physics and Astronomy, Aarhus University, Palassis, and M. Drewsen

We demonstrate Ramsey-comb spectroscopy on xenon in the VUV based on HHG for the first time. This is an important step towards measuring the 1S-2S transition in He⁺ for tests of fundamental physics.

**ED-4.2 WED 10:45**

Direct frequency-comb-driven Raman spectroscopy of the 3d⁻¹D½ - 3d⁻¹D½ transition in Ca⁺ ions: isotope shifts and the search for new physics beyond the Standard Model

- C. Solaro, S. Meyer, K. Fisher, M.V. DePalatis, and M. Drewsen; Department of Physics and Astronomy, Aarhus University, DK-8000 Aarhus C, Denmark

Present high-resolution frequency-comb-driven Raman spectroscopy of a terahertz transition in five calcium isotopes. These measurements together with precise measurements of the clock transition allow for improved bounds on new physics beyond the standard model.
A Hyperspectral Camera based on a Birefringent Ultrastable common-Path Interferometer

A. Perri1,2, B.E. Nogueira de Faria3, D.C. Teles Ferreira1, F. Preda1,2, D. Polli1,2, A.M. de Paula3, D. Comelli3, G. Valentini3, G. Cerallo1,2, and C. Manzoni1

1IFN-CNR, Physics Department, Politecnico di Milano, Milan, Italy; 2INRIM S.R.L., Milan, Italy; 3Department of Física, UFMG, Belo Horizonte, Brazil.

We introduce a compact Fourier-transform hyperspectral camera based on an ultrastable birefringent interferometer. The camera has broad spectral coverage and resolution, wide angular acceptance, high sensitivity and short acquisition time. Example spectral images are presented.
Fourier transform spectroscopy and retrieve cavity-enhanced optical frequency comb of entire molecular bands using direct and We perform high-precision measurements.

Room 4b ICM
11:00

Precise Comb-Based Fourier Transform Spectroscopy for Line Parameter Retrieval A.C. Johansson1, L. Rutkowski1,2, P. Maslowski3, A. Filipsson1, T. Hausmanninger1, G. Zhao1, O. Axner1, and A. Foltynowicz3, 1Department of Physics, Umeå University, Umeå, Sweden; 2Univ Rennes, CNRS, IPR (Institut de Physique de Rennes)-UMR 6251, Rennes, France; 3Institute of Physics, Nicolaus Copernicus University in Torun, Torun, Poland We perform high-precision measurements of entire molecular bands using direct and cavity-enhanced optical frequency comb Fourier transform spectroscopy and retrieve absorption line parameters with precision beyond the Voigt profile.

Room 4a ICM
11:15

Broadband Optical Cavity Mode Measurements at Hz-Level Precision With a Comb-Based VIPA Spectrometer G. Kowzan, D. Charczun, A. Cygan, R.S. Trawiński, D. Lisak, and P. Maslowski; Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University in Torun, Torun, Poland We present cavity mode width and frequency measurements over 60-cm-1 range at Hz-level precision. We utilize a near-infrared frequency comb and a VIPA spectrometer to retrieve absorption and dispersion of a CO-N2 sample in a high-finesse cavity.

Room 13a ICM
11:00

High average power, multiterawatt femtosecond laser chain enabling 10.19 W/cm2 at 100 Hz • R. Clady, A. Ferre, O. Amsterdam, Y. Hua1,2,3,4; 1Center for Nanotechnology Innovation, University of California, San Francisco, USA; 2Laboratoire de Photonique d’Angers, Université d’Angers, Angers, France; 3Photonics Research Group, Gent, Belgium; 4Photonics Research Group, Ghent University-IMEC, Gent, Belgium We present the characterization of a high average power (>22W), high peak power (>9TW) laser chain. A control of the thermally induced distortions allows to reach peak intensities above 10.19W/cm2 on target at 100 Hz.

Room 13b ICM
11:00

160-m Cryogenically-Cooled Yb:YLF Amplifier System at 1019 nm • H. Cankaya1,2,3,4, U. Demirbaş1,4, M. Perγe1, M. Hemmer1, Y. Hua1,2,3,4; 1Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany; 2Physics Department, University of Hamburg, Hamburg, Germany; 3The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany; 4Laboratory for Nanotechnology, Antalya Bilkent University, Antalya, Turkey We demonstrate 160-m pulses from a cryogenically cooled Yb:YLF amplifier system at 1019 nm. The amplifier consists of an Yb fibre front-end, a regenerative amplifier and two four-pass amplifiers.

Room 14a ICM
11:15

Experimental Observation of Second Harmonic Generation Enabled by Longitudinal Components in Indium Gallium Phosphide Nanowires • N. Poulvellar1,2,3, U. Dave1, K. Alexander1, G. Ciret4, S.-P. Gorza1, F. Raineri5, S. Combrié6, A. De Rossii, G. Roelkens1,2, S.-P. Gorza1,2, and F. Leo1; 1OPERA-Photonics, Université libre de Bruxelles, Brussels, Belgium; 2Photonics Research Group, Department of Information Technology, Ghent University-IMEG, Ghent, Belgium; 3Department of Electrical Engineering, Columbia University, New York, USA; 4Laboratoire de Photonique d’Angers, Angers, France; 5Laboratoire de Photonique et de Nanostructures, CNRS, Marcoussis, France; 6Thales Research and Technology, Palaiseau, France We demonstrate second harmonic generation in Indium Gallium Phosphide waveguides through the mixing of transverse and longitudinal components of the electric field. We confirm the excitation of an antisymmetric second harmonic mode through modal imaging.
Disorder-induced acceleration of condensation in multimode fibers

A. Fasano\textsuperscript{1}, J. Ganier\textsuperscript{2}, K. Krupa\textsuperscript{3,4}, G. Millot\textsuperscript{1}, and A. Piccozi\textsuperscript{1}

\textsuperscript{1}Laboratoire Interdisciplinaire Carnot de Bourgogne, CNRS, Universit\`e Bourgogne Franche-Comt\`e, Dijon, France; \textsuperscript{2}Centre de Matem\'aticas Aplicadas, Eole Polytechnique, Palaiseau, France; \textsuperscript{3}Dipartimento di Ingegneria dell’Informazione, Universit\`a di Brescia, Brescia, Italy.

We show that disorder in multimode fibers is responsible for a dramatic acceleration of optical condensation, which explain the effect of spatial beam self-cleaning. Our experiments report the observation of the transition to light condensation.

Single-photon induced correlation with integrated quantum frequency combs

Y. ZHANG\textsuperscript{1}, M. Kues\textsuperscript{1,2}, P. Roztocki\textsuperscript{1}, C. Reimer\textsuperscript{2,3}, B. Fischer\textsuperscript{1}, B. MacLelland\textsuperscript{1}, L. Caspani\textsuperscript{1}, B. Little\textsuperscript{1}, S. Chu\textsuperscript{1}, D. Moss\textsuperscript{1}, and R. Morandotti\textsuperscript{1,4,5,6}

\textsuperscript{1}INRS-EMT, Montreal, Canada; \textsuperscript{2}School of Engineering, University of Glasgow, Glasgow, United Kingdom; \textsuperscript{3}Department of Engineering, Aarhus University, Aarhus, Denmark; \textsuperscript{4}HyperLight Corporation, Cambridge, USA; \textsuperscript{5}Institute of Photonics, University of Strathclyde, Glasgow, United Kingdom; \textsuperscript{6}Xi’an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, Xi’an, China; \textsuperscript{7}City University of Hong Kong, Hong Kong, China; \textsuperscript{8}Centre for Micro Photonics, Swinburne University of Technology, Victoria, Australia; \textsuperscript{9}ITMO University, St. Petersburg, Russia; \textsuperscript{10}University of Electronic Science and Technology of China, Chengdu, China.

We demonstrate single-photon induced correlation through exploiting orthogonal polarization modes in an integrated device, allowing two different four-wave mixing processes to occur simultaneously with the same signal frequency mode but different idler frequency modes.

Optically driven attosecond electron dynamics in III-V semiconductors

F. Schlapfer\textsuperscript{2}, M. Lucchini\textsuperscript{1}, S.A. Sato\textsuperscript{3}, M. Volkov\textsuperscript{1}, L. Kasmi\textsuperscript{1}, N. Hartmann\textsuperscript{1}, A. Rubio\textsuperscript{2}, L. Gallmann\textsuperscript{1}, and U. Keller\textsuperscript{1}

\textsuperscript{1}Department of Physics, ETH Zurich, Zurich, Switzerland; \textsuperscript{2}Max Planck Institute for the Structure and Dynamics of Matter and Center for Free-Electron Laser Science, Hamburg, Germany; \textsuperscript{3}Center for Computational Quantum Physics (CCQ), The Flatiron Institute, New York, USA.

We experimentally investigate electron dynamics in transition metals with attosecond transient absorption spectroscopy. With ab-initio simulations, we find that light-induced electron localization induces ultrafast modification of optical properties by changing electronic screening properties.
Room 4b ICM

11:30
Frequency Comb Generation at 2 μm with Electro-Optic Modulators for Spectroscopic Applications

A. Parrinello, K. Hammani, and G. Millo,
Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR 6303 CNRS-Université Bourgogne Franche Comté, Dijon, France

We experimentally demonstrate two ways of generating frequency combs around 2 μm. Based on the electro-optic modulation of a continuous wave laser, we show the advantages of each techniques for spectroscopic applications.

Room 4a ICM

11:45
Gas sensing over plasmonic nanostructures based on a frequency comb

Y.-J. Kim1, D.A. Nguyen1, B.J. Chum1, and S. Kim1, 1Nanyang Technological University, Singapore, Singapore; 2Pusan National University, Busan, South Korea

We report that a frequency comb can be utilized for highly sensitive gas detection over plasmonic metal nanostructures with a high update rate.

Room 5a ICM

11:45
Thermoelectric Terahertz Detectors Based on Layered Two-Dimensional Materials

L. Viti1, D.G. Purdie2, A. Politano3, A. Lombardo1, X. Yang3, A. Vorobiev4, A.C. Ferrari5, and M.S. Vitello6, 1NEST, Istituto Nanoscienze - CNR and Scuola Normale Superiore, Piazza San Silvestro 12, 56127, Pisa, Italy; 2Cambridge Graphene Centre, University of Cambridge, Cambridge, United Kingdom; 3Department of Physical and Chemical Sciences, University of L'Aquila, via Vetoio, 67100, L'Aquila, Italy; 4Department of Microtechnology and Nanoscience, Chalmers University of Technology, Gothenburg, Sweden

We report on the recent progresses on room temperature terahertz detectors realized with layered two dimensional materials and operating via the photo-thermoelastic effect. The cases of selenium-doped black phosphorus and hBN encapsulated graphene are presented.

Room 13a ICM

11:30
High repetition rate, wavelength-tunable mid-IR source driven by ps-pulses from a Ho:YLF amplifier at 2 μm

M. Hinkelmann1, D. Wandel2, U. Morgner1,2, J. Neumann2, K. Zawiszk1, P. Schunemann1, and D. Kracht1, 1Department, Ultrafast Photonics Group, Zentrum Hannover, Hannover, Germany; 2Institut für Quantenoptik, Leibniz Universität Hannover, Hannover, Germany; 3BAE Systems, Nashua, USA

We present a ZGP-based OPG/OPA tandem, which generates µJ-level, sub-10 ps pulses at pulse repetition rates up to 100 kHz covering the mid-IR spectral range. This compact laser source exhibits a remarkably simple experimental scheme.

Room 13b ICM

11:30
Coupling Ideality Optimization of High-Q Deuterated Silicon Nitride Microresonator

Z. Xu1, Z. Wu1, Y. Chen1, Y. Zhang1, S. Yu1,2,1Sun Yat-sen University, Guangzhou, China; 2University of Bristol, Bristol, United Kingdom

We perform coupling idealty optimization of the high-Q deuterated silicon nitride microresonators with varying bus waveguide’s geometry and coupling gaps. A high coupling idealty can be achieved with a proper coupling region design.

Room 14a ICM

11:45
Demonstration of Suspended Aluminum Nitride-on-Silicon Subwavelength Waveguides for Near-Infrared Operation

M.S. Mohamed1, A. Lemaître2, F. Babouc1, M.I. Amanti1, and S. Ducile; 1Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot, Sorbonne Paris Cité, Paris, France; 2Centre de Nanosciences et de Nanotechnologies, CNRS/Université Paris Sud, Palaiseau, France

We present our results on frequency quantum states of light generated with AlGaNas chips; the manipulation of the wavefunction symmetry allows to obtain both bosonic and fermionic behaviors opening the way to a large variety of applications.

Room 14b ICM

11:45
Generation and Manipulation of Quantum Frequency States of Light with AlGaNas Chips

S. Francescom1, G. Malteese1, F. Appas2, A. Lemaître3, F. Babouc1, M.I. Amanti1, and S. Ducile; 1Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot, Sorbonne Paris Cité, Paris, France; 2Centre de Nanosciences et de Nanotechnologies, CNRS/Université Paris Sud, Palaiseau, France
**ROOM Osterseen ICM**

**ROOM 14b ICM**

**CH-9.4 WED 11:30**

**Multiphoton Microscope with a Rapid Broadband CARS Modality**

• F. Sionjab1, K. Hashimoto1,2, V.R. Badarla1, Y. Nagashima1, and T. Ideguchi1,2

1 Department of Physics, University of Tokyo, Tokyo, Japan; 2 Japan Aerospace Exploration Agency, Tokyo, Japan; 3 Department of Neurology, University of Tokyo, Tokyo, Japan; 4 PRESTO Japan Science and Technology Agency, Tokyo, Japan

We present a microscope based around a single mode-locked 10 femtosecond Ti:Sapphire laser source, capable of imaging multi-photon fluorescence, second- and third-harmonic generation, and high-resolution broadband coherent anti-Stokes Raman spectroscopy with sub-millisecond dwell times.

**ROOM 2 Hall A1**

**CG-4.5 WED (Invited) 11:30**

**Petahertz Magnetization Dynamics**

• J.A. Gessner1, F. Siegrist1,2, M. Ossiander1, C. Denker1, Y.-P. Chang1,2, M.C. Schröder1,2, A. Giuggioli1,2, Y. Cui1, J. Walowski1, U. Martens1, J.K. Dewhurst1, U. Kleineberg1,2, M. Münzenberg1, S. Sharma1, and M. Schulze1,2

1 Max-Planck-Institute of Quantum Optics, Garching, Germany; 2 Fakultät für Physik, Ludwig-Maximilians-Universität München, Garching, Germany; 3 Institut für Physik, Universität Greifswald, Greifswald, Germany; 4 Max-Planck-Institute of Microstructure Physics, Halle (Saale), Germany; 5 Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany

We experimentally demonstrate the generation of nonclassical correlations between two optical systems containing macroscopic mean photon numbers. The robustness of the produced entanglement allows to investigate the role of quantum mechanics in the macroscopic domain.

**ROOM 1 Hall A1**

**EA-7.5 WED 11:30**

**Entanglement generation by delocalized single-photon addition**

• N. Biagi1,2, L.S. Costanzo1,2, M. Bellini1,2, and A. Zavatta1,2

1 Istituto Nazionale di Ottica (CNR-INO), Florence, Italy; 2 LENS and Department of Physics & Astronomy, Florence, Italy

We experimentally demonstrate the generation of nonclassical correlations between two optical systems containing macroscopic mean photon numbers. The robustness of the produced entanglement allows to investigate the role of quantum mechanics in the macroscopic domain.

**EA-7.6 WED 11:45**

**Controllable Photon-Pair Spectral Correlations**

• M. Cordier1, B. Debrois2, F. Gérome2, P. Delaye2, F. Benabid1, and I. Zaquine1

1 Télécom ParisTech, Paris, France; 2 XLIM, Limoges, France; 3 Charles Fabry Laboratory, Paris, France

We report on a photon-pair source whose states can be controlled from separable to spectrally correlated. The source is based on four-wave mixing nonlinear effect within a gas-filled hollow-core photonic crystal fiber.
High performance ultrafast thulium-doped fiber lasers

Withulium-doped fiber lasers, we report on 140 fs pulseduration. We generated kW-class average power or efficiency of 67% was achieved. The laser was created. Average power of up to 6 W with optical-to-optical efficiency of 67% was achieved.

Control of light-matter interaction in two-dimensional materials

We will discuss the control of light-matter interaction in two-dimensional materials using photonic structures ranging from microcavities to metasurfaces. Realization of strongly coupled exciton polaritons in these systems will be presented.

Spatial Akhmediev Breathers in Slab Waveguides

An optical film waveguide served as new platform for the investigation of Akhmediev Breathers. Using the interplay between third-order and cascaded second-order optical nonlinearities breathers in a wide nonlinearity regime were characterized.

Experimental validation in optical fibers of multiple Fermi-Pasta-Ulam-Tsingou recurrences theory

We experimentally demonstrate self-injection locked laser diode to a high-Q Si3N4 microresonator using butt-coupling technique allows developing an ultra-compact current-initiated soliton microcomb source. This approach paves the way for a fully integrated microcomb source for high-volume applications.

Growth and characterization of high-melting sesquioxides for 3 μm lasers

We report the using of crucible free-floating zone technic (OFZ) for growing high melting point Er-doped sesquioxides. This growth method allows for cost-reduced high crystalline quality gain media for 3μm laser operation.

Adiabatic Frequency Conversion in Non-Centrosymmetric High-Q Optical Microresonators

We present adiabatic frequency conversion by employing the Pockels effect in high-Q-whispering-gallery microresonators made of lithium niobate. Compared with previously published configurations, our approach is considerably simpler. Tuning of several tens of GHz is feasible.

Enhancing Magnetic light emission with optical nanoantennas

We experimentally demonstrate that properly designed photonic nanoantennas can selectively manipulate the magnetic versus electric emission of luminescent nanocrystals.
Quantum storage of frequency-multiplexed heralded single photons

A. Serti1, D. Lago-Rivera1, G. Corrielli2, A. Lenhard3, R. Osellame4, M. Mazzera5, and H. de Riedmatten1,2, 1ICFO-Institut de Ciencies Fotoniques, The Barcelona Institute of Technology, Castelldefels, Spain; 2Istituto di Fotonica e Nanotecnologie (IFN) - CNR and Dipartimento di Fisica - Politecnico di Milano, Milano, Italy; 3ICREA-Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain

We demonstrate for the first time the quantum storage of single photons, using a rare-earth doped waveguide. Our results open prospects for massively multiplexed integrated quantum memories for single photons.

Ultra-low Phase Noise Microwave Synthesis with a Kerr Frequency Comb used as Transfer Oscillator

M. Cao, F. Hoffet, K. Huang, P. Vernaz-Gris, A. Sheremet, and J. Laurat; Laboratoire Kastler Brossel, Sorbonne Université, Paris, France

We report on a quantum memory for polarization qubits with efficiency of 68%, thereby demonstrating a reversible qubit mapping where more information is retrieved than lost. We recently pushed this number to about 85% at the single photon level.
Ultrasound Holmium-doped Fiber Laser with Metallic Carbon Nanotube-based Saturable Absorbers

- M. Pawlowska1, A. Dużyńska2, M. Zdrojek2, and J. Sotor1
- 1Laser & Fiber Electronics Group, Faculty of Electronics, Wroclaw University of Science and Technology, Wroclaw, Poland
- 2Faculty of Physics, Warsaw University of Technology, Warsaw, Poland

We demonstrate an ultrafast holmium-doped fiber laser based on metallic carbon nanotube saturable absorber. In stretched-pulse dispersion regime the generated 212 fs pulses centered at 2058 nm reach energy of 3.79 nJ.
Spatial spin-wave modulator in multimode cold rubidium memory
A. Leszekiak1,2, M. Lipka1,2, M. Mazelane1,2, M. Artzeni1,2, M. Dumkow1,2, I. G. Galli1,2, M. Beck1,2, and W. Wasilewski1
At present moment, rubidium atoms are the only cold atoms which can be cooled into the ground state by using standard cooling technics. They can be used in Maser or Microwave lasers, atomic clocks, atomic thermometers, quantum memory, and other applications. We present a novel cold rubidium quantum memory with a spatial spin wave modulator. The memory is based on the strong spin-wave coupling of the atoms, which allows for their manipulation using an external spin wave. The spin-wave excitation is provided by an optical pump laser. To demonstrate the feasibility of this approach, we use a 77K thermal cloud of atomic Rb with 84% polarization. We demonstrate the storage of 1.2MHz 2π spin wave pulses for 1000ns and retrieval of a 5% spin wave signal. We also demonstrate the retrieval of spin waves with lower duty cycles (40% and 10%). We also present a model of spatial spin wave memory and analyze the noise. This is a collaborative project with the University of Warsaw, Poland, and IMRA America, Inc., USA.

Analytical Modeling of Graphene Plasmons
R. Yu1, J. Cox1, J. Saavedra1, and J. Garcia de Abajo1,2, ICFP-Instituto de Ciencias Fotonicas, The Barcelona Institute of Science and Technology, Castelldefels, Spain; 1ICREA-Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain
We present an analytical formalism describing a broad range of 2D polaritonic behavior. Closed-form expressions are provided for their extinction spectra, involving only two real parameters for each plasmon mode and graphene morphology.

Phase locking of a tunable OEO to an optical frequency comb for microwave synthesis from an optical reference
A. Rolland1, N. Kase1, and M. Fernandez2, Boulder Research Laboratory, IMRA America, Inc., Longmont, USA; 2IMRA America, Inc., Ann Arbor, USA
We present the stabilization of a tunable optoelectronic oscillator to a chosen harmonic of a photodetected pulse train generated by a femtosecond oscillator. Phase locking of the OEO exhibits frequency instability lower than $10^{-15}$.

Ultrafast Relaxation Processes in Ethylene Cation Investigated by sub-15-fs Extreme-Ultraviolet Pulses
F. Cappelli1, G. Camp1, I. Galli1, 2, M. Zacc1,3, A. Camp1, M. Siciliano di Camm1, P. Canico Past1,2, R. Eramo1, R. Meschek1, G. Scaller1, J. Fais1, P. De Natale1, and S. Bartalini1,2
1Department of Physics, Politecnico di Milano, Milano, Italy; 2Institute for Photonics and Nanotechnologies, IFN-CNR, Milano, Italy; 3Institute for Photonics and Nanotechnologies, IFN-CNR, Padova, Italy; 1Physikalisch-Chemisches Institut, Universität Heidelberg, Heidelberg, Germany
Ultrafast internal relaxation processes in ethylene cation are investigated by sub-15-fs extreme-ultraviolet pulses. Selective excitation of the first four cationic states and the use of numerical simulations gave unprecedented access to the entangled energy-conversion mechanisms.

A Novel Saturable Absorber: Transparent Glass-Ceramics Based on Co2+:Li(Al,Ga)5O8 Spinel Nanocrystals
O. Dymshits1, P. Loiko2, V. Vikhan1, I. Alexeeva1, M. Tietzer1, A. Khubetsov1, A. Polischuk2, A. Volokitina1, J.M. Serres3, X. Mateos1, and A. Zhilin1
1Vavilov State Optical Institute, St. Petersburg, Russia; 2ITMO University, St. Petersburg, Russia; 3Universitat Rovira i Virgili (URV), Tarragona, Spain
Transparent glass-ceramics based on Co2+:Li(Al,Ga)5O8 spinel nanocrystals exhibit low saturation intensity at 1.54 μm (0.5 J/cm2) and high laser-induced damage threshold. An Er,Yb:glass laser passively Q-switched by glass-ceramic-based saturable absorber generated 7.4 ns/1.34 mJ pulses.

Deep red and near infrared persistent luminescence in Yb3+,Cr3+ co-doped ZnGa2O4 nano glass-ceramics
V. Castaing1, A. D. Sonntag1, A. Fernández Carrion2, M. Alli2, and B. Viana2
1ICRP - UMR247 CNRS, Paris, France; 2CEMHTI - UPR3079 CNRS, Orléans, France
Aiming at developing and evaluating new persistent luminescence nanophotonic materials, we elaborated ZnGa2O4:Cr3+,Yb3+ nano glass-ceramics. Outstanding persistent luminescence is observed both in the deep red and near infrared ranges, in two biological windows.
Wednesday June 26, 2019

**CJ-10.4 WED ICM**

Ultrafast Tm-doped fiber amplifier with 1 kW average output power
  - Institute of Applied Physics, Jena, Germany
  - Helmholtz Institute, Jena, Germany
  - Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We present a thulium-doped fiber amplifier with 1150 W average output power. After pulse compression to 260 fs duration, the system delivers 1060 W average-output power with diffraction-limited beam quality (RIN<0.4%).

**CJ-10.5 WED ICM**

Compact thulium FCPA system delivering 11 MW, 530 fs pulses
- D. Gaponov, L. Lavoute, N. Ducros, P. Parisi, A. Heikur, and S. Fevrier
  - NOWAE, Aix-en-Provence, France
  - XLIM CNRS UMR 7252, Limoges, France

We report on a compact thulium fiber CPA system providing 530 fs pulse with 10.4 µJ of total energy at 100 kHz repetition rate. The corresponding peak power of 11 MW was retrieved.

**EF-3.4 WED ICM**

Terahertz polarisation modulator by electronic control of graphene loaded chiral metamaterial device
  - Cavendish Laboratory, University of Cambridge, Cambridge, UK

A terahertz polarisation modulator was realised by integrating a chiral metamaterial array with graphene, demonstrating 20 degrees linear polarisation rotation at 1.75 THz, with ellipticity below 0.1 and reconfiguration speed > 5 MHz.

**EF-3.5 WED ICM**

Brightness enhancement in Non-Hermitian VCSELs
- W.W. Ahmed, R. Herrero, M. Botey, Y. Wu, and K. Stalinas
  - Division of Computer, Electrical and Mathematical Sciences and Engineering, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia
  - Department of Physics, University of Sydney, Sydney, Australia
  - National Institutes of Natural Sciences, National Institute of Fusion Science, Toki, Japan

We present a pathway to convert near-infrared high-repetition-rate frequency combs to the ultra-violet, visible and mid-infrared using synchronously pumped high-Q (ch) microresonators. Furthermore, first results towards achieving combs based purely on (ch) nonlinearities are discussed.

**CA-10.4 WED ICM**

Passively mode-locked high-repetition rate Er:YLF laser at 2.81 µm generating 72 ps pulses
- R. Švěťkar, J. Šůc, M. Němec, and H. Jelínek
  - Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Prague, Czech Republic
  - Institute of Optics, University of Science and Technology, Krakow, Poland
  - Optoelectronics Group, University of Gothenburg, Gothenburg, Sweden
  - Department of Physics, Chemistry, Biology, and Environmental Science, Linköping University, Linköping, Sweden

Using Eribium-doped fiber laser mode-locked with carbon nanotubes, we demonstrated 20 degrees linear polarisation rotation at 2.81 µm with 72 ps full width at half maximum (FWHM) pulses, with 0.4% relative intensity stability (RIN).
Noise Suppression via Atomic Absorption in a Raman Quantum Memory

T.M. Hird1,2, S.E. Thomas1,3, J.H.D. Munns1,3, B. Brecht4, D.J. Saunders1, J. Nunn1,3, L.A. Walmsley1,3, and P.M. Ledgroom1

1University of Oxford, Oxford, UK; 2University College London, London, UK; 3Imperial College London, London, UK; 4Paderborn University, Paderborn, Germany.

We propose and demonstrate a scheme to strongly suppress four-wave mixing noise on the output of a Raman quantum memory. We show that heralded single-photon states can be recalled non-classically using our device.

**ED-2.4 WED 15:00**

Completely Positive Trace Preserving Numerical Methods for Long-Term Generalized Maxwell-Bloch Simulations

J. Hillbrand1, A.M. Andrews2, H. Detz2, C. Strasser1, and B. Schwartz2

1Institute of Solid State Electronics, TU Wien, Vienna, Austria; 2Center for Micro- and Nanostructures, TU Wien, Vienna, Austria; 3CEITEC, Brno University of Technology, Brno, Czech Republic.

We evaluate numerical methods for the generalized Maxwell-Bloch equations with respect to performance. Here, we focus on completely positive trace preserving methods that are suitable for long-term simulations of the quantum cascade laser dynamics.

**ED-5.5 WED 15:00**

Coherent control of quantum cascade laser frequency combs via electrical injection locking

J. Hillbrand1, A.M. Andrews2, H. Detz2, C. Strasser1, and B. Schwartz2

1Institute of Solid State Electronics, TU Wien, Vienna, Austria; 2Center for Micro- and Nanostructures, TU Wien, Vienna, Austria; 3CEITEC, Brno University of Technology, Brno, Czech Republic.

Coherent electrical injection-locking allows to reference the repetition frequency of quantum cascade laser frequency combs to an external RF oscillator. We investigate the dynamics of the injection-locked QCL comb and demonstrate its applications in dual-comb spectroscopy.

**CG-5.6 WED 15:00**

Probing molecular influence on photoemission delays

S. Balasubramaniam1, B. Forró1,2, J. Schütz1,2, W. Schweinberger2, L. Ortman1, T. Zwickl1,2, W. Pfeifer1, D. Baykusheva1, H. Masood1, J. Liontos1, A. Kamal1, N. Kling1, A. Alharbi1, M. Alharbi1, A. Azzeer1, H.-J. Wörner1, A. Landsman1, and M. Kling1,2

1Physics Department, Ludwig Maximilians Universität, München, Germany; 2Max-Planck Institute for Quantum Optics, München, Germany; 3Attosecond Science Laboratory, Physics and Astronomy Department, King Saud University, Riyadh, Saudi Arabia; 4Max Planck Institute for the Physics of Complex Systems, Dresden, Germany; 5Department of Mathematics, ETH Zurich, Zurich, Switzerland; 6Laboratory of Physical Chemistry, ETH Zurich, Zürich, Switzerland; 7King Abdullah City for Science and Technology, Riyadh, Saudi Arabia.

We report on the measurement of the frequency noise power spectral density of a quantum cascade laser-pumped 1.073 terahertz molecular laser using a 1560nm frequency comb. From these measurements we determine the phase-locking of the frequency noise power spectral density of a quantum cascade laser-pumped 1.073 THz molecular laser, and demonstrate its phase-locking to the harmonic of the repetition rate of a 1560 nm frequency comb.
Wednesday – Orals

16:00 – 17:30

**JSVI-1: 50 Years of integrated optics I**
Chair: Valdas Pasiskevicius, KTH Stockholm, Sweden

**JSVI-1.1 WED** (Tutorial) 16:00
Quantum Dot Lasers Epitaxially Grown on Si.

- J. Bowers, University of California, Santa Barbara, Santa Barbara, USA
- InAs quantum dot lasers epitaxially grown on Si show promise for achieving lower threshold, higher temperature, reduced reflection sensitivity and lower cost. Optimization of the buffer layers on Si reduces dislocation densities and improves lifetimes.

16:00 – 17:30

**EH-4: Metasurfaces and metadevices**
Chair: Rupert Oulton, Imperial College London, London, United Kingdom

**EH-4.1 WED** 16:00
High-Efficiency, All-dielectric Metasurfaces down to the Deep Ultraviolet
- C. Zhang1,2, S. Divit1,2, Q. Fan2, W. Zhu1,2, A. Agrawal1,2, T. Xu1, and H.J. Lezec1; 1Physical Measurement Laboratory, National Institute of Standards and Technology, Gaithersburg, USA; 2Maryland Nanocenter, University of Maryland, College Park, USA; 2College of Engineering and Applied Sciences, Nanjing University, Nanjing, China

**EH-4.2 WED** 16:15
Ultra-thin Plasmonic Metasurfaces Based on Carbon Nanomembranes
- Y.D. Srynma1,2, S. Fassol2, C. Neumann3, Z. Tang4, T. Pertsch1,2,4, A. Turchanin2,3,5, and I. Staudt1,2; 1Institute of Applied Physics, Friedrich Schiller University Jena, Jena, Germany; 2Abbe Center of Photonics, Friedrich Schiller University Jena, Jena, Germany; 3Institute for Theoretical Physics, University of Tübingen, Tübingen, Germany; 4Institute of Physics, University of Rostock, Rostock, Germany; 5Laboratoire Interdisciplinaire Carnot de Bourgogne, Dijon, France

**EH-4.3 WED** 16:30
Tailoring nonlinear optical metasurfaces: from metasurfaces to nonlinear metasurface holograms
- T. Wolfer, J. Hoogstraten, M. Pollak, R. Yan, C. Le Dantec-Sauvage, H. Lin1, and B. Kibler; 1Laboratoire de Physique des Solides, Université de Paris-Saclay, Gif-sur-Yvette, France

16:00 – 17:30

**EF-6: Soliton molecules**
Chair: Miro Erkintalo, University of Auckland, Auckland, New Zealand

**EF-6.1 WED** 16:00
Optical Soliton Molecular Complexes in Ultrafast Fiber Lasers
- N. Kanagaraj1,2, Z. Wang2,3, A. Coillet1, P.T. Dinda1, and P. Greb1; 1Laboratoire ICB, UMR 6303 CNRS, Université Bourgogne - Franche-Comité, Dijon, France; 3UPE Insti- tute of Photonics and Electronics, Prague, Czech Republic; 2Nanjing University of Posts and Telecommunication Services, Nanjing, China

**EF-6.2 WED** 16:15
Theoretical and experimental studies of breather wave molecules
- G. Xu1, A. Gelash2,3, A. Chadov2, V. Zakharov2,4,5, and B. Kibler2; 1Laboratoire Interdisciplinaire Carnot de Bourgogne, Dijon, France; 2Novosibirsk State University, Novosibirsk, Russia; 3Institute of Thermophysics, Novosibirsk, Russia; 4The University of Technology, Tampere, Finland

16:00 – 17:30

**CA-11: Nonlinear frequency conversion**
Chair: Valentin Petrov, Max-Born Institute, Berlin, Germany

**CA-11.1 WED** 16:00
High-Power Single-Frequency 620 nm Laser Based on Diamond Raman and Intracavity Frequency Doubling
- X. Yang1,2,3, O. Kitzler1, D.J. Spence1, R.J. Williams1, S. Sars1, L. Zhang2, Y. Feng3, and R.P. Mildren1; 1Macquarie University, Sydney, Australia; 2Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, China; 3Center of Materials Science and Optoelectronics, Engineering University of the Chinese Academy of Sciences, Beijing, China

**CA-11.2 WED** 16:15
9 W average power, 150 kHz repetition rate diamond Raman laser at 1519 nm, pumped by a Yb fibre amplifier
- L. Dziechciarczyk1, T.W. Hawkins2, M. Dziechciarczyk1, T. Pertsch1,2,4, A. L’Huillier1, and B. Kibler2; 1Institut für Mikro- und Nanotechnologie, Universität Hamburg, Hamburg, Germany; 2Abbe Center of Photonics, Friedrich Schiller University Jena, Jena, Germany; 3Institute of Applied Physics, Friedrich Schiller University Jena, Jena, Germany; 4Institute of Physics, University of Tübingen, Tübingen, Germany

16:00 – 17:30

**CD-8: Spatio-temporal manipulation of light**
Chair: Mikko Huttunen, Tampere University of Technology, Tampere, Finland

**CD-8.1 WED (Invited)** 16:00
Phase manipulation with nonlinear metasurfaces
- N. Pholchay1 and T. Zentgraf2; 1Department of Industrial Physics and Medical Instrumentation, King Mongkut’s University of Technology North Bangkok, Bangkok, Thailand; 2University of Paderborn, Department of Physics, Paderborn, Germany

Tailoring the nonlinear optical phase of the frequency converted light at spatially distributed meta-atoms, we will demonstrate nonlinear metasurface holograms and nonlinear imaging with metalenses. The concept can be used for nonlinear functional surfaces.

16:00 – 17:30

**EG-2: Ultrafast and strong field nano-optics**
Chair: Silvia Vignolini, Cambridge University, Cambridge, United Kingdom and Mathieu Miville, Institut des Nanosciences Paris, France

**EG-2.1 WED** 16:00
Revisiting the Photon-Drag Effect in Metal Films
- J.H. Strait, G. Holland, W. Zhu, C. Zhang, A. Agrawal, D. Pacifici, and H.J. Lezec; National Institute of Standards and Technology, Gaithersburg, MD, USA

We demonstrate that the sign of the photon-drag effect in smooth gold films is crucially dependent on the surface environment and contrary to the prevailing intuitive model of direct momentum transfer to free electrons.

**EG-2.2 WED** 16:15
Towards Photoemission Electron Microscopy Using a 200 kHz High-order Harmonic Source
- J. Vogelsang1, L. Wittenbecher3, S. Mikaelsson1, C. Guo4, D. Wang2, I. Sytsevich1, F. Langer1, C.L. Arnold1, A. L’Huillier1, and A. Mikkelsen2; 1Department of Physics, Lund University, Lund, Sweden; 2TU Ilmenau, Institut für Werkstofftechnik und In- stitut für Mikro- und Nanotechnolo-
A nuclear quantum memory enabled by strain

E. Denning1,2, D. Gangloff3, G. Étlich-Majcher1,2, C. Lang1, J. Bodey1, D. Jackson1, J. Mark1, C. Le Gall1, and M. Atalique3; 1Department of Photonics Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark; 2Cavendish Laboratory, University of Cambridge, Cambridge, United Kingdom
We demonstrate coherent manipulation of the mesoscopic nuclear spin ensemble in a semiconductor quantum dot mediated by a single electron. From these experimental results, we propose a novel scheme for a nuclear quantum memory.

ED-6: Frequency combs: Sources and characterization II
Chair: Pascal Del’Haye, National Physical Laboratory, Teddington, United Kingdom

ED-6.1 WED 16:00
Ultimate quantum noise limit of frequency comb measurements
R. Liao1, Y. Song2, and G. Steinmeyer1; 1Max-Born-Institut, Berlin, Germany; 2Tsinghua University, Tianjin, China
Precision frequency comb measurements typically rely on the optical clockwork, e.g., of an f-2f interferometer. We discuss a previously unrecognized limitation of this frequency transfer mechanism imposed by Schawlow-Townes noise.

ED-6.2 WED 16:15
Train of ultrashort mid-infrared pulses with sub-mrad carrier-envelope phase stability
S.A. Hussain1,2, W. Schweinberger2,3, T. Buberl1, C. Hofer1,2, and I. Pupeza1,2,3; 1Max Planck Institute of Quantum Optics, Garching, Germany; 2Ludwig-Maximilians-Universität München, München, Garching, Germany; 3King Saud University, Riyadh, Saudi Arabia
We present a new method for broadband measurement of carrier-envelope-phase (CEP) jitter of ultrashort-pulse trains, based on interferometrically-tracked electro-optic sampling, and report

ED-7: Applications of frequency combs
Chair: Thierry Ruchon, CEA-LIDYL, Gif-sur-Yvette, France

ED-7.1 WED 16:00
Controlled Asymmetric Photoelectron Emission Using Electron Wavepacket Interference
S. Mikaelsson, Y.-C. Cheng, S. Nandi, L. Rämisch, C. Guo, A. Harth, J. Vegelsang, M. Miranda, C.R. Arnold, A. L’Huillier, and M. Gisselbrecht; Department of Physics, Lund University, Lund, Sweden
We demonstrate control of two-color photoionization asymmetry, without changing the delay of the few-cycle dressing infrared probe field, by modulating a short attosecond pulse train.

ED-7.2 WED 16:15
Interferometric attosecond lock-in measurement of extreme ultraviolet circular dichroism
O. Kneller1, D. Azoury1, M. Krueger2, B.D. Brunner1, O. Cohen1, Y. Mairesse2, and N. Dudovich3; 1Department of Physics of Complex Systems, Weizmann Institute of Science, Rehovot, Israel; 2Solid State Institute and Physics Department, Technion, Haifa, Israel; 3Max-Planck-Institut für Quantenoptik, Garching, Germany
Si/SiO2 dispersive multilayer spans
We demonstrate a new platform based on Carbon Nanomembranes (CNMs) to form ‘genuine’ flat optical devices. Nanometer-thick, carbon-based membranes are fabricated and utilized as a support of a square array of U-shaped gold nanoresonator metasurfaces.

**EF-6.3 WED 16:30**

**Active Control of Femtosecond Soliton Molecules**

- E. Kurtz, C. Ropers, and G. Herkül
- IV. Physical Institute, University of Göttingen, Göttingen, Germany
- 2. Experimental Physics VIII, University of Bayreuth, Bayreuth, Germany

Bound states of femtosecond solitons are generated and controlled in a commercial Kerr-lens mode-locked oscillator. Using real-time imaging time-streak oscilloscope, we resolve the resonance of vibrating soliton molecules and demonstrate all-optical switching between stable doublet states.

**CA-11.3 WED 16:30**

**All Passive KGW/ Tm:YAP Raman Laser**

- E. Perez, U. Shentop, G. Marcus, and S. Noakh
- 1. Jerusalem College of Technology, Jerusalem, Israel
- 2. The Hebrew University of Jerusalem, Jerusalem, Israel

All Passive External cavity Raman laser based on KGW/Tm:YAP crystals emitting at 2270nm and 2350nm is presented. The efficient use of KGW for 2μm region is demonstrated. Maximum energy of 0.18mJ was achieved.

**EF-6.4 WED 16:45**

**Heteronuclear soliton molecules in optical microresonators**

- 1. EPFL, Lausanne, Switzerland
- 2. Swiss Center for Electronics and Microtechnology, Neuchâtel, Switzerland
- 3. Geneva Observatory, University of Geneva, Versoix, Switzerland

We enter the multi-stability regime of free electrons in optical near-fields for the quantitative mapping of the polarization-dependent local optical response in tailored nanostructures. Furthermore, sequential phase-locked interactions facilitate the generation of attosecond pulse trains.

**CA-11.4 WED 16:45**

**Shaping of Picosecond Pump Pulses by SHG Depletion for Wide-Bandwidth TW-class NOPCPA**

- P. Mackonis, A. M. Rodin, A. Petrunenas, and V. Girdauskas
- 1. Solid State Laser Laboratory, Department of Laser Technologies, Centre for Physical Sciences and Technology, Vilnius, Lithuania
- 2. Ekspla Ltd, Vilnius, Lithuania

We combine photoemission electron microscopy (PEEM) with few-cycle laser pulses to investigate the spatio-temporal dynamics of randomly localized light in a single gold nanospot. First results towards attosecond XUV-IR pump-probe PEEM experiments are shown.
We demonstrate a medium with single-photon non-linearity based on cold Rydberg atoms, suitable for the mapping of a paired single photon. This opens the door to quantum interactions between single photons.

EA/EB-2.3 WED 16:30
Energy-time entanglement between a photon and a spin-wave in a multimode solid-state quantum memory
K. Kattler1,2, E. Distante1, B. Casabone1, S. Duranti1, M. Mazza1, and H. de Riedmatten1,2
1ICFO – Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, Barcelona, Spain; 2ICREA-Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain
We present the direct generation of entanglement between a photon and a collective spin excitation using rare earth ion doped crystals. Entanglement is demonstrated by violating a Bell inequality by more than two standard deviations.

EA/EB-2.4 WED 16:45
Interfacing Quantum Dot Emission with Alkali Ensembles: Optimal Coherent Filtering for Single Photons
P.M. Ledingham1, S. Gao3, C. Weinzel1, O. Lazo-Arjona1, B. Brecht1, K.T. Kaczmarek3, T. Weinhold1, J. Becker2, S.E. Thomas3,4, J. Nunn3, D. Saunders1, and I.A. Walmsley1,2, 4Clarendon Laboratory, University of Oxford, 3National Institute of Chemistry, Pahor, Slovenia; 4Helmholtz-Institute Jena, Germany
We develop a new method to build a 3D hydrodynamic code solving the complex two-fluid plasma sub-mrad CEP noise for a train of pulses obtained via intrapulse difference-frequency generation.

ED-6.3 WED 16:30
Broadband Laser Frequency Comb based on Electro-Optic Modulation for Astronomical Spectrograph Calibration
E. Obrzud1, M. Rainer1, B. Chazelas2, M. Cecconi1, A. Ghezina1, E. Molinaro1, S. Kundermann1, V. Braschi1, S. Leconte1, F. Pepe2, F. Wildi3, F. Bouchy4, and T. Herr1
1Centre Suisse d’Electroménagerie et de Microtechnique (CSEM), Neuchâtel, Switzerland; 2Observatoire de Genève, Université de Genève, Versoix, Switzerland; 3National Institute of Astrophysics (INAF), Astronomical Observatory of Brera, Milan, Italy; 4National Institute of Astrophysics (INAF), Foundation Galileo Galilei, Brera, Italy
We propose a novel scheme for generation of intense sub-cycle pulses in laser-driven wakefields. The scheme ensures their CEP-tunability without requiring CEP-stable high-intensity laser driver and allows for tunability from mid-IR to extreme UV.

EA/EB-2.3 WED 16:30
Generation of isolated CEP-tunable intense sub-cycle pulses in laser-driven wakefields
I. Thiele1 and E. Siminos2
1Department of Physics, Chalmers University of Technology, Göteborg, Sweden; 2Department of Physics, University of Gothenburg, Göteborg, Sweden
We present a novel scheme for generation of intense sub-cycle pulses in laser-driven wakefields. The scheme ensures their CEP-tunability without requiring CEP-stable high-intensity laser driver and allows for tunability from mid-IR to extreme UV.

EA/EB-2.4 WED 16:45
New simple composite algorithm for solving multidimensional two-fluid plasma equations
B. Morel, B. Giusti, K. Ardanuh, R. Meyer, and F. Courvoisier; FEMTO-ST Institute, CNRS and Université Bourgogne Franche-Comté, Besançon, France
We developed a new method to build a 3D hydrodynamic code solving the complex two-fluid plasma of (-200 fs2). Unprecedented reflectance exceeding 99.6% allows applications of the coating inside the Cr:ZnSe/Cr:ZnS emerald lasers.

ED-E.3 WED 16:45
Towards a Visible to Mid-Infrared Astrocomb for the Extremely Large Telescope
Y-S. Cheng1, M. Xiao2, R.A. McCracken3, and D.T. Reid1
1Scottish Universities Physics Alliance (SUPA), Institute of Photonics and Quantum Sciences, School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh EH14 4AS, United Kingdom; 2CAS
We study the nonlinear optical behavior of transition metal dichalcogenides MoS2, WS2, NbS2 and ZrTe2 using Z-Scan technique (femtosecond regime). Novel ZrTe2 material shows positive third-order response and NL absorption was only observed for NbS2.

ED-6.4 WED 16:45
Polarization-resolved High Harmonic Spectroscopy of Interlocked Attosecond Bursts
E. Borda1, O. Kfir1, S. Zasyka2, O. Neufeld1, A. Fleischer1, C. Ropers1, and O. Cohen1
1Solid State Institute and Technical Department, Haifa, Israel; 24th Physical Institute, University of Göttingen, Göttingen, Germany
We demonstrated a medium with single-photon non-linearity based on cold Rydberg atoms, suitable for the mapping of a paired single photon. This opens the door to quantum interactions between single photons.

ED-6.4 WED 16:45
XUV coherence tomography with nanoscale resolution driven by high harmonic generation
S. Fuchs1,2, M. Wünsche1,2,3, J. Nathanael1,2, J.J. Abel1, J. Reinhardt1,2, F. Wiesner1,2, S. Kruszewicz3, C. Rüdel1,2, and G.G. Paulus1
1Institute of Optics and Quantum Electronics, Friedrich Schiller Universität Jena, Jena, Germany; 2Helmholtz Institute Jena, Germany
We establish an extreme ultraviolet lock-in detection scheme, allowing the isolation and amplification of weak chiral signals, by achieving a direct time-domain polarization control. We demonstrate it by a phase-resolved measurement of magnetic circular dichroism.

CG-6.3 WED 16:30
Nonlinear Refraction and Nonlinear Absorption in Layered Transition Metals Dichalcogenides
L. Menezes1, M. Neto2, M. Maldonado1, C. Araújo1, A. Jawad1, A. Hazzah-R. Vo1, and A. Gomes2
1Departamento de Física, Universidade Federal de Pernambuco, Recife-PE, Brazil; 2Graduate Program in Materials Science, Universidade Federal de Pernambuco, Recife-PE, Brazil
We present the direct generation of entanglement between a photon and a collective spin excitation using rare earth ion doped crystals. Entanglement is demonstrated by violating a Bell inequality by more than two standard deviations.

CG-6.4 WED 16:45
Study of Tm-doped Aluminosilicate for Integration of Lasers on a SOI Silicon Photonics Platform
C. Mitchell1, A. Tong1, J. Wilkinson1, and J. Mackenzie1
1University of Southampton, Southampton, United Kingdom
We study the nonlinear optical behavior of transition metal dichalcogenides MoS2, WS2, NbS2 and ZrTe2 using Z-Scan technique (femtosecond regime). Novel ZrTe2 material shows positive third-order response and NL absorption was only observed for NbS2.

CE-10.3 WED 16:30
Materials and Manufacturing Directorate, Air Force Research Laboratory, Dayton, USA
We propose a novel scheme for generation of intense sub-cycle pulses in laser-driven wakefields. The scheme ensures their CEP-tunability without requiring CEP-stable high-intensity laser driver and allows for tunability from mid-IR to extreme UV.

CE-10.4 WED 16:45
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C. Mitchell1, A. Tong1, J. Wilkinson1, and J. Mackenzie1
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Almost lossless spectral bandwidth is achieved by shaping of depleted ps pump pulses after the SHG and NOPA stages, while energy recycling also increases pump-to-signal conversion efficiency in a compact TW-class VIS-IR wavelength range NOPCPA.

Perfect soliton crystals in optical microresonators

We demonstrate the existence of perfect soliton crystal states and develop the deterministic procedure for their excitation in $\text{Si}_3\text{N}_4$ microresonators. We show that despite exceptional symmetrical properties, their behavior is strongly linked to the chaotic regimes of the microresonator.

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of an optical microresonator to generate heteronuclear soliton molecules. Ultrafast electro-optical sampling reveals the bound structures of such soliton molecules, despite comprising solitons of dissimilar amplitudes, durations and frequencies.

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model equations for plasmonics or laser-plasma interaction. This robust but simple code gives excellent results against difficult test problems.

EJ-3.4 WED 17:00

A 3D full vector finite element model for waveguide-based plasmonic sensors in the infrared

• G. Renversez and G. Deméy; Aix-Marseille Univ, CNRS, Institut Fresnel, Marseille, France

We propose a new full vector 3D model based on the finite element method taking into account the real input propagating mode. This model is used to design an efficiently integrated plasmonic sensor for the infrared.

ED-6.5 WED 17:00

Hot Cavity Spectroscopy of Dark Pulse Kerr Combs in Microresonators

• E. Nazemisadat¹, A. Fülöp², O. B. Helgason³, P.-H. Wang⁴, Y. Xuan⁴, D. E. Leaird⁴, M. Qi⁴, E. Silvestre⁴, A. M. Weiner⁴; J. V. Torre Company⁴; ¹Photonics Laboratory, Department of Microtechnology and Nanoscience (MC2), Chalmers University of Technology, Göteborg, Sweden; ²School of Electrical and Computer Engineering, Purdue University, IN 47907-2035, West Lafayette, USA; ³Department of Optics-ICMUV, University of Valencia, Valencia, Spain

Dark-pulse comb dynamics in silicon nitride microresonators is investigated. Our measurements show that the formation of these combs is associated with the appearance of an extra resonance, attributed to the intensity-dependent Kerr phase shift.

CG-6.5 WED 17:00

Spatiotemporal coupling of attosecond pulses

• J. Arndt¹, H. Wikmark², C. Guo³, P. W. Smorenburg⁴, H. Couder-Almeira¹, J. Lathi³, J. Pesche³, P. Rudawski³, H. Ducass³, S. Carlströmer¹, S. Macdon³, M. B. Gaarde³, P. Johnson³, and A. L'Huillier⁴; ¹Physics Department, Lund University, Lund, Sweden; ²ASML Netherlands B.V., Veldhoven, Netherlands; ³Max Born Institute, Berlin, Germany; ⁴Department of Physics and Astronomy, Louisiana State University, Baton Rouge, USA

We present a Gaussian optics model to study spatiotemporal couplings of attosecond pulses produced via high harmonic generation. Understanding these couplings is crucial for applications relying on focusing to small spot size and high intensity.

CE-10.5 WED 17:00

Integration of Metal-GaAs-Metal Photodetectors on Si using Thin Ge Buffer Layers for Applications in Visible Photonics

• G. Dushaq and M. Rasras; New York University, Abu Dhabi, UAE

This paper presents metal-GaAs-metal photodetectors integrated on Si by MOCVD. The device architecture is based on GaAs active layer grown on Si via thin, low temperature and direct growth of Ge buffer layers on Si.
Wednesday – Orals

**ROOM 13a ICM**

**EF-6.6 WED 17:15**

Stochastic Soliton Quantization in Mode-locked Fibre Laser

- **J.I. Khaishi** and S.V. Sergeyev, Aston Institute of Photonics Technologies, Aston University, Birmingham, United Kingdom

Soliton quantization is a self-localized pulses formation in nonlinear systems; it has many potential applications from communications to data storage. Here, we report a quantized temporal separation of stochastic soliton in mode-locked fiber laser.

**PD-1.1 WED 19:00**

Compressors: I. Dancus, L. Nomura and D. Neshev

**PD-1.2 WED 19:10**

Meeting of edge detection by a single dielectric metasurface. We utilise the metasurface spatial dispersion when operating at the wavelength of the magnetic Mie-type resonance.

**CA-11.6 WED 17:15**

Characterization of supercontinuum pulses generated using a 2 μm thulium-based regenerative amplifier

- **S.A. Rezvani**, K. Ogawa, Y. Nomura and T. Fuji, 1 center for mesoscopic sciences, institute for molecular science, 38 nishigomakaj, myodaiji, okazaki, Japan; 2 fiberlabs inc., kld laboratories, 2-1-15 ohara, fujinomiya, Japan; applying 2 μm pulses from a thulium-based regenerative amplifier, supercontinuum has been achieved and characterized, in both bulk YAG and, for the first time, in polarization-maintained ZBLAN fiber. Characterization has been done using XFROG.

**PD-1.3 WED 19:20**

Generation of 0.3-70 μm pulse by biological media

- **S. Bartalini** and C. Giarrasi, 1 National Institute of Metrology, Gandhinagar, Gandhinagar, India; 2 Indian Institute of Technology Gandhinagar, Gandhinagar, India; 3 Radiantis Poligon Canale, Barcelona, Spain; and 4 ICFO-Institut de Ciencies Fotòniques, The Barcelona Institute of Science and Technology, Barcelona, Spain

We report on the generation of optical vortices through mode conversion of output from an anti-resonant-ring synchronously-pumped picosecond optical parametric oscillator. Generated optical vortices are tunable across 1457-1647 nm with maximum power of 538 mW.

**PD-1.4 WED 19:30**

Modelocked THz source driven by a sub-100 fs high-power thin-disk laser

- **F. Meyer**, N. Hekmat, T. Vogel, A. Omar, S. Manzourzadeh, F. Fobbe, M. Hoffmann, Y. Wang, and C. Saraceno; Ruhr-University Bochum, Bochum, Germany

We demonstrate ultrashort pulses from a thulium-based regenerative amplifier, exceeding 10.9 PW power of 538 mW.

**PD-1.6 WED 19:50**

Mid infrared frequency comb from a ring quantum cascade laser

- **B. Meng**, M. Beck, and J. Faist; ETH, Zurich, Switzerland

Mid-infrared frequency comb from ring cavity quantum cascade laser has been demonstrated. Both intermode beating (less than 1 kHz linewidth) and multiheterodyne spectra verify the frequency comb nature of the device.

**PD-1.7 WED 20:00**

Birefringence Surface Geometries for Ultrafast Spin-VCSELs

- **P. Tusch**, P. Debernard, M. Lindenmann, N. C. Gerhardt, M. Hofmann, and R. Michalzik; 1 Functional Nanostructures, Ulm, Germany; 2 IEET, Turin, Italy; 3 Photonics and Terahertz Technology, Bochum, Germany

We present the first truly integrated approach for incorporating birefringence in a VCSEL cavity to enable spin-based ultrafast optical communications. Up to 98 GHz polarization mode splitting is achieved using a tailored surface grating.
**PD-1.8 WED 20:10**

**Quantitative phase microscopy with molecular vibrational sensitivity**

- M. Tamamitsu, K. Toda, R. Horisaki, and T. Ideguchi

We propose and demonstrate quantitative phase imaging method that yields label-free molecular-vibrational spectroscopic contrasts in the molecular-fingerprint region, which works by measuring the optical-phase-delay change induced upon molecular-vibrational absorption of a mid-infrared optical pulse.

**PD-1.9 WED 20:20**

**A silicon photonic design concept for a chip-to-fibre orbital angular momentum mode-division multiplexer**

- J.M. Baumann, K. Ingerslev, Y. Ding, L.H. Frandsen, L.K. Oxenløwe, and T. Morioka

PD-2.2 WED 19:10

**The First Quantum Interference in the Mid-infrared is on a Silicon Chip**

- L.M. Rosenbladt, D.A. Salway, M.G. Thompson, J.W. Silverstone, Quantum Engineering Technology Labs, H. H. Wills Physics Laboratory and Department of Electrical and Electronic Engineering, University of Bristol, BS8 1FD, UK, Bristol, United Kingdom

In quantum optics, loss of a single photon is a loss of irrecoverable quantum information. We report the first measurement of quantum interference in the low-loss mid-infrared, pointing towards truly scalable quantum photonics.

**PD-2.3 WED 19:20**

**Birefringent cavities: effects and applications of a new paradigm in CQED**

- T. M. Rolland, T.H. Doherty, B. Yuan, and A. Kuhn

Novel intra-cavity polarisation dynamics engender the first observation of single photons with time-dependent polarisation state, emitted from an atom coupled to a birefringent cavity. This offers a route to surpassing previous limitations of Purcell-enhanced emission.
We theoretically explore the generation of surface plasmon-polariton pairs in the process of spontaneous parametric down-conversion of light by a nonlinear nanoparticle located near the metal-dielectric interface. We numerically demonstrate how to obtain topological lasing from a uniformly pumped topological array of optical cavities, by exploiting the naturally frequency-dependent gain that stems from light-matter interaction on a single site.

**PD-2.6 WED 19:50**

**Chip-scale optical standard with 2×10⁻¹² stability**

- Z. Newman¹, V. Maurice², M. Hummon², I. Kitching³, S. Dickerson², M. Mescher², and C. Johnson²; ¹National Institute of Standards and Technology, Boulder, USA; ²Charles Stark Draper Laboratories, Cambridge, USA

We report on the development of a compact optical standard using the rubidium two-photon transition. The physics package has a volume of 35cm³, consumes ~500mW of power and demonstrates a fractional frequency instability of 1×10⁻¹³.

**PD-2.8 WED 20:10**

**Multistability-Enabled Composite Soliton and Soliton Collision in a Bichromatically-Pumped Microresonator**

- W. Weng, R. Bouchand, and T. Kippenberg; Swiss Federal Institute of Technology Lausanne, Lausanne, Switzerland

We demonstrate through realistic theoretical simulations that graphene plasmons can be efficiently excited via electron tunneling in planar heterostructures of graphene, hBN and metals.

**PD-2.9 WED 20:20**

**Observation of exceptional points in passive plasmonic nanostructures**

- B. Kanté, J. Park, and A. Ndao; University of California Berkeley, Berkeley, USA

We propose a novel approach to exceptional points (EPs) and report their first observation in plasmonics at room temperature. The new platform is shown to enableatto-molar immune-assay nanosensing.
CK-P.9 WED
Enhanced direct optical excitation of an NV center using a nanoBragg-cavity: A numerical simulation
T. Tashima, H. Takashima, and S. Takeuchi, Kyoto University, Kyoto, Japan
We propose to harness the nanoBragg cavity to use direct optical excitation of a nitrogen-vacancy center in nanodiamond by light via a nanoBragg, alternative to the use of conventional confocal laser microscopy systems.

CK-P.10 WED
Design Algorithm for Adiabatic Photonic Components using a Constant Coupling Approach
I. Abdo, A. Boes, T. Nguyen, G. Ren, and A. Mitchell, School of Engineering, RMIT University, Melbourne, Australia
We present a design algorithm for adiabatic photonic devices using a constant coupling approach. We utilized the algorithm to design a compact adiabatic TM0/TE1 vices using a constant coupling approach. We utilized the algorithm to design a compact adiabatic TM0/TE1 vices using a constant coupling approach. We utilized the algorithm to design a compact adiabatic TM0/TE1 vices using a constant coupling approach. We utilized the algorithm to design a compact adiabatic TM0/TE1 vices using a constant coupling approach. We utilized the algorithm to design a compact adiabatic TM0/TE1 vices using a constant coupling approach.

CK-P.11 WED
Microwave power dependent resonance shifts in Silicon ring modulators for continuous wavelength tuning and bandwidth scaling of on-chip, electro-optic, optical frequency combs
K.P. Nagarajan, P. Raj, V. Jeyaseelan, S.K. Selvaraja, and V.R. Supradaenp; Indian Institute of Science, Bangalore, Bengaluru, India
We demonstrate continuous centre frequency tunability of optical frequency combs generated in silicon ring modulators using microwave power induced resonance shifts. Using this effect we further accomplish bandwidth-scaling of the combs by cascading two ring modulators.

CK-P.12 WED
Hyperuniformity and Local Self-Uniformity in Photonic Networks
M. Florescu, S. Sellers, C. Wang, and W. Man, Advanced Photonics Institute and Department of Physics, University of Surrey, Guildford, United Kingdom; 2, Department of Physics and Astronomy, San Francisco State University, San Francisco, USA
The hyperuniformity and local self-uniformity establish a fundamental link between geometrical, topological and photonic properties of dielectric networks and provide novel design strategies for advanced photonic functionalities including photonic band gaps, localisation, and photon transport.

CK-P.13 WED
Reconfigurable Dielectric Metasurface-based Spatial Light Modulator
We design and fabricate a phase-only spatial light modulator with tunable metasurfaces achieving dynamically controllable beam steering with a 36% beam deflection efficiency and a FOV of 22°, corresponding to a pixel size as small as 1.14 microns.

CK-P.14 WED
Optical resonances in a 3D superlattice of cavities in a 3D photonic band gap
M. Adhikary1, R. Uppu1,2, S.A. Huck1, C.A.M. Hartvelde1, and W.L. Vos1, 1,2 Complex Photonic Systems (COPS), MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands; 3, Niels Bohr Institute, Københavns Universitet, Copenhagen, Denmark
We study silicon three-dimensional (3D) photonic band gap crystals containing a 3D superlattice of cavities. In reflectivity and lateral scattering, we observe resonances that are interpreted as novel hopping modes on the superlattice.

CK-P.15 WED
An optical probe of a 3D photonic band gap
M. Adhikary1, R. Uppu1,2, C.A.M. Hartvelde1, and W.L. Vos1, 1,2 Complex Photonic Systems (COPS), MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands; 3, Niels Bohr Institute, Københavns Universitet, Copenhagen, Denmark
We perform wide-angle-averaged polarization resolved reflectivity measurements on silicon inverse woodpile 3D photonic crystals. It is verified that the measured stopband is the photonic band gap, with excellent agreement with theory.

CK-P.16 WED
Tunneling waves in the gap of a photonic crystal
R. Uppu1,2, M. Adhikary1, C.A.M. Hartvelde1, and W.L. Vos1, 1,2 Complex Photonic Systems (COPS), MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands; 3, Niels Bohr Institute, Københavns Universitet, Copenhagen, Denmark
We perform optical wavefront shaping of telecom light in the gap of a 2D silicon photonic crystal. We observe that light can controllably tunnel up to 8 Bragg lengths into the medium.

CK-P.17 WED
Warning gallery microlaser fabrication using Er+ doped silica based on dip coating
Z. Chenari1,2, H. Navab1, and H. Latifi1, 1 Laser and Plasma Research Institute, Shahid Beheshti University, Tehran, Iran; 2 Science department, Islamic Azad University (Science and Research Branch), Tehran, Iran
We propose a microlaser based on the Er3+ doped microsphere cavity, which can avoid the conventional sol-gel method drawbacks for surface coating of active silica on silicon and exhibit excellent performance.

CK-P.18 WED
Adiabatic transitions between supersymmetric structures as a tool to design integrated photonic devices
G. Queraltó, V. Añfingen, and J. Mompart; Departament de Física, Universitat Autònoma de Barcelona, E-08193 Bellaterra, Spain
We introduce adiabatic transitions between supersymmetric structures as a systematic way to engineer efficient and robust integrated photonic devices by modifying the refractive index profile along the propagation direction.

CK-P.19 WED
A Solvable Quantum Model of Dynamic Nuclear Polarization in Optically Driven Quantum Dots
T. Nutz1, E. Barnes2, and S.E. Economou2; Imperial College London, London, United Kingdom; 2, Virginia Tech, Blacksburg, USA
We present a model of dynamic nuclear polarization in quantum dots induced by continuous wave laser driving. The model captures experimentally observed line-negativ behaviour and predicts a novel nuclear polarization effect.

CK-P.20 WED
Electron multi-injector: a strategy for improving quantum efficiency of infrared photodetectors
S. Bianconi and H. Moisveni; Northwestern University, Evanston, USA
We developed a novel detector architecture that allows for a 2-fold increase the fill factor, at no apparent costs for the responsivity and speed of the devices, thanks to the modest increase in electronic area.

CK-P.21 WED
Magneto-plasmonic effects for non-reciprocal waveguides
S. Abadian; Centre de NanoSciences et de Nanotechnologies (C2N), Palaiseau, France
Our numerical work has shown that when a TE mode magneto-optical Bismuth Iron Garnet waveguide is coupled to a neighboring gold grating, surface plasmon polarizations can enhance the transverse magneto-optical Kerr effect achieving non-reciprocal transmission.

CK-P.22 WED
Large Q-factors in small WGM resonators
N. Acharyya1,2 and G. Koyreff3; 1 Max-Born-Institut für Nichtlineare Optik und Kurzzeitpektroskopie, Berlin, Germany; 2 Optique Nonlineaire Theorique, Universite Libre de Bruxelles (UL.B.), CP 231, Campus de la Plaine, Bruxelles, Belgium
We propose a cavity design that is compatible with existing technologies and that can suppress radiation by WGM resonators. Material-limited Q could be achieved with much lower volume, thus drastically increasing the ratio Q/V.

CK-P.23 WED
Electrical control of lifetime-limited quantum emitters using 2D materials
C. Ciancioso; IFCO – The Institute of Photonic Sciences, Castelldefels (Barcelona), Spain
Integrating single photon sources with nanophotonic elements is one of the main interests of quantum nanophotonics. We present results obtained on a tunable hybrid device which integrates lifetime-limited single emitters and 2D materials at sub-wavelength separation.

CK-P.24 WED
Anomalous Transparency in Photonic Crystals and its Dependence on the Refractive Index Difference
T. Bogdasharyan, T. Geernaert, H. Thienpont, and P. Berghmans; Vrije Universiteit Brussel (VUB), Brussels, Belgium
We identify photonic crystals that behave as isotropic and transparent material for TE polarized light above the first band gap region, where the wavelength starts to be comparable with the features of the lattice.

CK-P.25 WED
Optical pulses propagating within SNAP microresonators on the surface of optical fibers
Z. Han1, E. Klotz2, I. Vatnik1, and D. Charakin1; 1 Novosibirsk State University, Novosibirsk, Russia; 2 Institut d’Optique Graduate School, Paris, France
We experimentally demonstrated transmission of optical pulses within whispering gallery modes as far as several millimeters along the fiber axis, and also utilized the pulses for time domain reflectometry.

CK-P.26 WED
Laser Written Nano-Antenna and Waveguides devoted to Stationary Wave Sampling in Integrated Optic Spectrometers for the Near Infrared
M. Bonduelle1, G. Martin1, A. Morand2, G. Zhang2,1

A novel stationary wave spectrometer in the near infrared is presented, based on ultrafast laser written waveguides and nano-scattering centers. We study flux extraction efficiency as a function of distance and laser to the waveguide.

**Surface plasmons in metamaterial heterostructures**

- T. Gric1,2, O. Hess, and E. Rafailov1,2 Department of Electronic Systems, Vilnius Gediminas Technical University, Vilnius, Lithuania; 3Semiconductor Physics Institute, Center for Physical Sciences and Technology, Vilnius, Lithuania; 4The Blackett Laboratory, Department of Physics, Imperial College London, London, United Kingdom; 5Aston Institute of Photonic Technologies, Aston University, Birmingham, United Kingdom

We identify the key factors influencing dispersion, propagation length of surface plasmon polaritons at the boundary of metamaterial heterostructures along with the absorption enhancement highly desirable in design of terahertz photonic antennas.

**Laser Induced Quantum Dots generation**

1L. Orazi, F. Antin, R. Reggiani, and L. Gaitisky1; 1University of Modena and Reggio Emilia, Department of Sciences and Methods for Engineering, Reggio Emilia, Italy; 2ENEA, Fusion and Nuclear Security Department, Photonics Micro and Nanostructures Laboratory, Frascati (Rome), Italy; 3ENEA, Fusion and Nuclear Security Department, Photonics Micro and Nanostructures Laboratory, Frascati (Rome), Italy; 4LLC ‘Novi Nano Lab’, Lviv, Ukraine

The present work deals with the formation of the micro Quantum Dots in polymer films for photonic applications nano-, pico- and femtosecond laser pulses.

**Photonic Crystal Spatial Filters fabricated by Physical Vapor Deposition**

1D. Galevčič1,2; L. Grinevič, C. Babaygī, E. Bor3, M. Turdý4, V. Purlys2, T. Toleinis2, H. Korti,2 and K. Stalbovič2; 1Laser Research Center, Vilnius University, Vilnius, Lithuania; 2Femtika LTD, Vilnius, Lithuania; 3Center for Physical Sciences and Technolgy, Vilnius, Lithuania; 4Department of Electrical and Electronic Engineering TOBB University of Economics and Technology, Ankara, Turkey; 5Department of Electric- cal and Electronic Engineering TED University, Ankara, Turkey; 6Institutio Catalana de Recerca i Estudis Avan- cats (ICREA), Barcelona, Spain; 7Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

Here we present a new type of photonic crystal based on sub-wavelength conformal multilayer structure. A numerical analysis is presented with an experimental demonstration on how to build such structures using physical vapour deposition.

**Antibio-Stokes Cryoluminescence in Nanomaterials**

1A. Kadynska2, A. Belyanin2, V. Borisov2, M. Karpon2, N. Tcherniegia3, and K. Zemskov1; 1PN. Lebedev Physical Institute of the RAS, Moscow, Russia; 2CNITI Technomash, Moscow, Russia; 3Scobeltsyn Institute of Nuclear Physics, Moscow, Russia; 4FSUE VNIIA, Moscow, Russia

Strong electromagnetic emission in nanomaterials under low laser excitation was registered in a wide spectral range (from green-blue till soft X-ray). For visible light two types of temporal dependence of intensity were detected.

**Zero-Birefringence Silicon Slot Waveguides with L-Rails**

1S. A. Samad and S. Talabatulla; Indian Institute of Science, Bengaluru, India

High index contrast, narrow cross section photonic waveguide suitable for high birefringence. We present the design of a novel sub-micron silicon slot waveguide with L-rails optimized for zero-birefringence and greater tolerance to sidewall modulation.

**Intermodal group delay in multimode waveguides on LNOI and SOI for Optical Interconnects**

1A. Kaushalram and S. Talabatulla; Indian Institute of Science, Bengaluru, India

Intermodal group delay is crucial to the performance of multimode waveguides as optical interconnects employing on-chip mode-division-multiplexing. This parameter is numerically evaluated for multimode waveguides in lithium niobate on insulator (LNOI) and SOI photonic platforms.

**Strong FRET effect in colloidal semiconductor nanocrystal superparticles**

1A. Cost1, V. Blondol1, C. Arrold1, S. Bull1, X. Quelin1, A. Bogicevic2, T. Pons1, N. Lequeux1, J.-J. Greffet1, and J.-P. Hermier2; 1Group d’Etude de la Matière Condensée (GEMaC), University de Versailles Saint-Quentin-en-Yvelines, CNRS UMR 8635, Université Paris-Saclay, Versailles, France; 2Laboratoire de Physique et d’Etude des matériaux, ESPCI-PariTech, PSL Research University, CNRS UMR 8213, Sorbonne Université, UPMC, Paris, France; 3Laboratoire Charles Fabry, Institut d’Optique Graduate School, CNRS, Université Paris-Saclay, Palaiseau, France

We synthesized photostable superparticles consisting in aggregates of CdSe/CdS/CdZnS/ZnS core/multishell colloidal nanocrystals. The photoluminescence is ana- lyzed through an effective medium model and an enhanced FRET is demonstrated.

**Short Pulse Dynamics in Dispersive Quasi-PT-Symmetric Medium**

1D. Tsvetkov1; 1V. Bushuev1; V. Komotov1; 4M. Antabli2; 2Department of Physics, M. V. Lomonosov Moscow State University, Moscow, Russia; 3Centre de Physique Teorica e Computacional and Departamento de Fisica, Faculdad de Ciencias, Universidad de Lisboa, Lisbon, Portugal

Using spectral method we study analytically short broadband pulse dynamics in quasi-PT-symmetric dispersive medium. As an example, we described the several quasi-PT-symmetric optical phenomena for pico-second spatially localized optical pulse propagating in quasi-PT-symmetric photonic crystal with material dispersion.

**Nanocellulose-based random laser**

1G.C.M. Germano1; 3Y.D. Machado1; L. Martinho1; G.K.B. Costa2; 2S.N. Fernandes3; 2M. Godinho3; J. Fontana1; A.S.L. Gomes1; J.C.S. Carvalho1; 1Pontifical Catholic University of Rio de Janeiro, Rio de Janeiro, Brazil; 2Federal Rural University of Rio de Janeiro, Rio de Janeiro, Brazil; 3Universidade NOVA de Lisboa, Lisbon, Portugal; 4Naval Research Laboratory, Washington, USA; 5Federal University of Pernambuco, Recife, Brazil

We investigated the random laser action spectral analysis of the composite rhodamine6G in ethylene glycol soluction with cellulose nanocrystals as scatters. Another area to architecure places the composite on a glass slidesubstrate presenting lower laser threshold.

**Properties of Broadband Soliton Microcombs in Pulse-Driven Integrated Microresonators**

1M. Anderson1, R. Boucound1, J. Liu1, E. Obrazov2,3, T. Herr1, and T. Kippenberg3; 1Institute of Physics (IPHYS), Ecole Polytechnique Federale de Lausanne (EPFL), Lausanne, Switzerland; 2Swiss Centre for Electronics and Microtechnology (CSEM), Tim, and frequency, Neuchatel, Switzerland; 3Geneva Observatory/PlanetS, Department of Astronomy, University of Geneva, Geneva, Switzerland

We present the theoretical modelization, technological realization and optical characterisation of a susended Fabry-Perot cavity with a middle Sub-Wavelength Grating waveguide. We believe this structure can be used for cavity optomechanics applications.

**Thermal re-entrance noise in silicon nitride based microresonators**

1G. Huang1, E. Luca1, J. Liu1, A. Baja1, G. Libacher2,3, M.L. Gorodetsky2,3, N.J. Engelsen1, and T. Kippenberg3; 1Institute of Physics (IPHYS), Ecole Polytechnique Federale de Lausanne, 1015 Lausanne, Switzerland; 2Faculty of Physics, M.V. Lomonosov Moscow State University, 119991 Moscow, Russia; 3Russian Quantum Centre, 143025 Skolkovo, Russia

Thermodynamic noise limits the frequency stability of resonators. Here, we present the characterization of thermo-re-entrance noise in Si$_3$N$_4$ microresonators. The measurements are in good agreement with theoretical analysis and FEM simulation of the structures.

**On-chip Sub-Waveleigh Grating Fabry-Perot cavity, toward integrated cavity optomechanics applications**

1B. Taurel, P. Laeye, J.-M. Fedeli, and L. Durafour; Univ. Grenoble Alpes, CEA, LETI, Grenoble, France

We present the theoretical modelization, technological realization and optical characterisation of a susended Fabry-Perot cavity with a middle Sub-Wavelength Grating waveguide. We believe this structure can be used for cavity optomechanics applications.

**Properties of Broadband Soliton Microcombs in Pulse-Driven Integrated Microresonators**

1M. Anderson1, R. Boucound1, J. Liu1, E. Obrazov2,3, T. Herr1, and T. Kippenberg3; 1Institute of Physics (IPHYS), Ecole Polytechnique Federale de Lausanne (EPFL), Lausanne, Switzerland; 2Swiss Centre for Electronics and Microtechnology (CSEM), Tim, and frequency, Neuchatel, Switzerland; 3Geneva Observatory/PlanetS, Department of Astronomy, University of Geneva, Geneva, Switzerland

Broadband single-soliton based frequency combs, with the comb model linewidth.
Micro-/Nanostructure-Stabilized Liquid-Crystalline Blue-Phase

- Y.-L. Ho\(^1\), M.P.C. Taverne\(^1\), P. Jiang\(^2\), S.-A. Jiang\(^2\), J.-D. Lin\(^2\), C.-R. Lee\(^3\), and J.G. Rarity\(^4\);
  \(^1\)Department of Electrical and Electronic Engineering, University of Bristol, Bristol, United Kingdom;
  \(^2\)H H Wills Physics Laboratory, University of Bristol, Bristol, United Kingdom;
  \(^3\)Department of Photonics, National Cheng Kung University, Tainan, Taiwan

We create ideal single-crystals of blue phase liquid crystals, stable over a 40 °C range using nano-structured 3D templates fabricated by direct laser writing. Polarisation microscopy results illustrate the stability and future display applications.

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Large-parameter space optimization of photonic crystal slab cavities

- J.P. Vasco and V. Savona; Institute of Physics, École Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland

We optimize the L3 cavity in a large parameter space by means of a hybrid stochastic-global optimization approach and obtain quality factors in the 80 and 10 million range for the silicon-on-air and Si/SiO\(_2\) cavities, respectively.

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Structural Design for Broadband Light Management In a Biological Example

- B. Schwind\(^1\), H.-O. Fabritius\(^2\), and X. Wu\(^1\);
  \(^1\)Paderborn University, Paderborn, Germany; \(^2\)Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf, Germany

We reveal that the structure of the setae of the Saharan silver ant is adapted to its optical functions for broadband light management, which is inspiring for the design of artificial structures facing similar problems.

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Investigation of low-index waveguiding in inverse rod-connected diamond photonic crystals

- M.P.C. Taverne, Y.-L. Ho, C.-H. Fang, X. Zheng, L. Chen, and J.G. Rarity; Department of Electrical and Electronic Engineering, University of Bristol, Bristol, United Kingdom

We investigate low-index waveguides in 3D direct rod-connected diamond photonic crystals, exploiting the hexagonal symmetry of their F – 4 planes to transfer existing waveguide designs from 2D to 3D.

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Spatialtemporal stabilization of PT-symmetric BAS Lasers

- J. Medina Pardell\(^1\), T. Jeong, H. Kim, and J.G. Rarity;
  \(^1\)Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom

We theoretically studied temporal dynamics of the cross correlation function of two photons generated by electron–hole pair generation in a quantum dot system, exploiting the Heisenberg uncertainty principle so that the degrees of freedom are effectively independent.

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Highly correlated photon-pair generation from a silicon waveguide integrated with on-chip pump-rejection filters

- J.M. Lee, W.-J. Lee, M.-S. Kim, and J.J. Lee; Electronics & Telecommunications Research Institute, DAEJEON, South Korea

We demonstrate the photon-pair generation through a silicon waveguide spiral followed by on-chip cascaded Mach–Zehnder interferometers for a pump-rejection on a single chip. The coincidence-to-accidental ratio of the photon pairs is enhanced up to 700.

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Time-Energy Entangled Photon Pairs from Doppler-Broadened Atomic Ensemble via Collective Two-Photon Coherence

- J. Park, T. Jeong, H. Kim, and H.S. Moon; Department of Physics, Pusan National University, Busan, South Korea

We experimentally demonstrate two-photon interference of a time-energy entangled photon pair generated via collective two-photon coherence in Doppler-broadened cascade-type 87Rb atoms. The two photons originally proposed by J. D. Franson are realized as a photon pair due to collective effect.
tornic transitions in a ladder-type atomic three-level system, depending on the degree of spectral entanglement of two photons.

**EA-P.9 WED**
Coupling distant quantum dots using a photonic crystal Fano structure

• Y. Yu, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; Technical University of Denmark, Kgs. Lyngby, Denmark
A photonic crystal cavity-waveguide structure is proposed where two well-separated nanocavities are efficiently coupled through Fano interference effects, leading to an optical mode that facilitates distant coupling between two quantum dots in the cavities.

**EA-P.10 WED**
Enhanced Light-Matter Interactions in Ordered Arrays of Diamond Nitrogen-Vacancy Centres

• M. Nicoll1,2, J.N. Becker1, P.M. Ledinh1, J. Nunn3, and I.A. Walsmey1; 1University of Oxford, Oxford, United Kingdom; 2University of Bristol, Bristol, United Kingdom; 3University of Bath, Bath, United Kingdom
We here theoretically investigate an enhanced light-matter interface based on collective effects in an ordered array of diamond nitrogen-vacancy centres coupled to a photonic waveguide, and discuss potential applications to magnetic field sensing.

**EA-P.11 WED**
3D Laser Writing around Lifetime-Limited Quantum Emitters

• M. Cola1,2, P. Lombardi1, S. Pazzagli1,3, D. Wiersma1,2,4, S. Pazzagli1,3, J.N. Becker1, P. Lombardi1, S. Pazzagli1,3, J.Nunn1, and M. Colautti1,3; 1Department of Physics, Engineering Physics and Astronomy, Queen’s University, Kingston, Canada; 2Department of Physics and Institute for Optical Sciences, University of Toronto, Toronto, Canada
We present an integrated source of counterpropagating entangled state based on vertically-pumped coupled resonator optical waveguides and investigate theoretically the generation and propagation of continuous variable entangled states in such a system.

**EA-P.13 WED**
Photon correlations in PT-symmetric waveguide systems

• F. Klauck1, L. Teuber1, M. Oringgotti1, M. Heinrich1, S. Scheel1, and A. Szameit; 1University of Rostock, Institute of physics, Rostock, Germany
We investigate quantum interference in a PT-symmetric system by measuring a Hong-Ou-Mandel-Dip in waveguide couplers. The nontrivial loss distribution giving rise to PT-symmetry systematically displaces photon bunching with respect to the Hermitian case.

**EA-P.14 WED**
Spatially separated generalized two-mode squeezed vacuum states in lossy coupled resonator optical waveguides

• H. Seifour1,2, L.G. Helt1, J.E. Sipe1, and M.M. Dignam1; 1Department of Physics, Engineering Physics and Astronomy, Queen’s University, Kingston, Canada; 2Department of Physics and Institute for Optical Sciences, University of Toronto, Toronto, Canada
We present an integrated source of counterpropagating entangled state based on vertically-pumped coupled resonator optical waveguides and investigate theoretically the generation and propagation of continuous variable entangled states in such a system.

**EA-P.15 WED**
Ge-on-Si High Efficiency SPADs at 1310 nm

• D.C.S. Damos1, J. Kordoda1, P. Vines1, K. Kazemoko1, R.W. Millar1, G.S. Buller1, and D.J. Paul1; 1University of Glasgow, Glasgow, UK; 2Heriot-Watt, Edinburgh, UK
High efficiency Ge-on-Si single photon detectors have been fabricated which demonstrate a detection efficiency of 38% ± 1310 nm. Devices show operation at up to 175 K and detection wavelengths up to 1550 nm.

**EA-P.16 WED**
 Optical Quantum Technologies based on Quantum Zeno dynamics

• H.V. Do and F.S. Cataliotti; LENS, Università di Firenze, Sesto Fiorentino (FI), Italy
Quantum phase gate, noise sensor, and Berry phase demonstration based on the realization of the Quantum Zeno regime on a Bose-Einstein condensate using either a strong Raman laser coupling or a laser-induced fluorescence.

**EA-P.17 WED**
Experimental observation of a quantum Cheshire cat using a weak measuring device

• Y. Kim1,2, D.-G. Im1, Y.-S. Kim2, S.-Y. Lee3, S.-W. Han1, S. Moon1, Y.-H. Kim1, and Y.-W. Cho2; 1Department of Physics, Pohang University of Science and Technology (POSTECH), Pohang, South Korea; 2Center for Quantum Information, Korea Institute of Science and Technology (KIST), Seoul, South Korea
We experimentally observe a disembodied polarization from a single photon, known as the quantum Cheshire cat effect. We locate the probe of the photon and its polarization simultaneously using a weak measuring device.

**EA-P.18 WED**
The Role of Detector Position in Quantum Ghost Diffraction

• A. Vega1, E. Santos1, S. Saravi2, T. Pertsch1, and E. Setzpfand3; 1Institute of Applied Physics, Abbe Center of Photonics, Jena, Germany; 2Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
Quantum Ghost Diffraction is studied theoretically. We show, that the position of the single detector measuring the transmitted photons has a profound effect on which object features can be identified in its measured diffraction pattern.

**EA-P.19 WED**
The contribution has been withdrawn.

**EA-P.20 WED**
Nonlinear Quantum Spectroscopy Enhanced by Parity-Time Symmetry

• P. Kumar1,2, S. Saravi3, T. Pertsch1, and E. Setzpfand3; 1Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany; 2Nonlinear Physics Centre, Research School of Physics and Engineering, Australian National University, Canberra, Australia
We reveal strongly enhanced detection of absorption by samples placed at one arm of parity-time symmetric waveguide coupler, by incorporating in a nonlinear photon-pair interferometer for broadband quantum spectroscopy through simple one-color photon counting.

**EA-P.21 WED**
Tuning the temporal coherence of polariton condensates

• A. Askarpooul1, L. Pickup2, S. Alyatkin1, A. Zasedatelev1, W. Langbein1, and P. Lagoudakis1; 1Skolkovo Institute of Science and Technology, Moscow, Russia; 2Southampton University, Southampton, United Kingdom; 3University of Cardiff, Cardiff, United Kingdom
The temporal coherence and number fluctuations of polariton condensates are investigated, revealing a regime where the coherence time of the system is increased 40-fold. We use existing quantum matter-wave laser models to interpret our results.

**EA-P.22 WED**
Optomechanical self-structuring of cold atoms with structured light

• G. Baiou, G. Robb, A. Yao, and G.-L. Oppo; University of Strathclyde, Glasgow, United Kingdom
We study density self-organization of cold atoms in a ring cavity in the presence of structured phase. We observe dynamical behaviour resulting in coupled light intensity and atomic density transverse patterns carrying orbital angular momentum.

**EA-P.23 WED**
An Archimedes’ spiral for cold atoms

• V.E. Lembessis1, A. Al Rihed2, A. Lyra3, and O.M. Aldosary1,2; 1Quantum Technology Group, Department of Physics and Astronomy, College of Science, King Saud University, P.O. Box 2455, Riyadh 11451, Kingdom of Saudi Arabia; 2The National Center for Applied Physics, KACST, P.O. Box 6086, Riyadh 11442, Kingdom of Saudi Arabia
We show how a configuration of two counterpropagating optical vortex beams with opposite windings can be used for the creation of an Archimedes’ spiral for cold atoms.

**EA-P.24 WED**
Towards Quantum Many-Body Physics with Strontium in Optical Lattices

• A. Heinze1, A. Park2, J. Trautmann1, R. Haindl2, E. Staub2, N. Santic1, J. Dalibard1, J. Bloch1, and S. Blatt1; 1Max-Planck Institute for Quantum Optics, Garching, Germany; 2Laboratoire Kastler Brossel, Collège de France, ENS-PSL Research University, CNRS, UPMC-Sorbonne Universités, Paris, France
We present progress towards a Sr quantum gas microscope using large, homogeneous, state-dependent optical lattices based on red light. To reach the required laser intensity, we developed a stable in-vacuum buildup cavities.

**EA-P.25 WED**
Deep laser cooling of atoms on narrow-line optical transitions in polarized fields: scaling law

• R. Ilkenkov1,2, O. Pudnikov1,2, A. Tsitschenkov1,2, and V. Yudin1,2,3; 1Institute of Laser Physics SB RAS, Novosibirsk, Russia; 2Novosibirsk State University, Novosibirsk, Russia; 3Novosibirsk Technical State University, Novosibirsk, Russia
The work is devoted to the study of laser cooling of atoms at narrow optical transitions. The existence of the scaling law is shown, the optimal configurations of laser cooling of atoms are determined.
Field-compatible, compact atomic quantum sensors require miniaturized optical systems, which are integrated close to the atomic source. We present the current status of our 1064nm in-vacuum optical dipole trap and our versatile UVH qualification apparatus.

Proposed scheme achieves the spectral flatness within 1 dB for 38 taps using an intensity and two phase modulators. 

Telecom lasers are interesting for cold atoms applications due to the possibility to reach targeted wavelengths by frequency doubling. Locking systems in the infra-red are needed, we propose to use a vibrational transition of acetylene.

Field-of-view and the application of miniaturized, UVH-compatible optical systems for for atomic quantum sensors

- M. Christ1,2, A. Wicht, and M. Krutzik1,2; 1 Humboldt-Universität, Berlin, Germany; 2 Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Berlin, Germany

ED-P.27 WED
Telecom Laser Lock On Acetylene Line For Applications In Cold Atoms Experiments
A. Hilico1, V. Mancofs1, R. Veyron1, F. Benahid2, P. Boyer1, and S. Bernard1; 1 Laboratoire Photonique, Numérique et Nanosciences, CNRS, Université de Bordeaux, Institut d’Optique, Talence, France; 2 GPPMM Group, XLI Research Institute, CNRS UMR 7252, University of Limoges, Limoges, France

Telecom lasers are interesting for cold atoms applications due to the possibility to reach targeted wavelengths by frequency doubling. Locking systems in the infra-red are needed, we propose to use a vibrational transition of acetylene.
We have developed an iodine-stabilized laser at 1542 nm by using a dual-pitch PPLN waveguide for third-harmonic generation. Frequency stabilization is based on saturation spectroscopy of the R(73)46-0 transition of molecular iodine.

**ED-P.25 WED**

**Scrutinizing the equidistance of frequency comb sources**

E. Escoto and G. Steinmeyer; Max-Born-Institut, Berlin, Germany

We propose and demonstrate a novel experimental test for the equidistance and coherence of frequency combs. This test is based on Fourier spectroscopy and can also disambiguate coherent artifacts in the characterization of mode-locked lasers.

**ED-P.26 WED**

**Characterization of a robust Er:ﬁber-based Difference Frequency Comb at 200 MHz repetition rate**

J. A. Seer, C. Tresp, R. Herda, T. Puppe, P. Thouamou, S. Müller, F. Rohde, and R. Wilt; TOPTICA Photonics AG, Garching/Munich, Germany

We report on a robust, inherently ICEO phase-stable difference frequency generation comb at a repetition rate of 200 MHz. Its performance under optical-lock conditions is characterized by means of a comb-comb comparison.

**ED-P.27 WED**

**Scanning of a dissipative Kerr-microresonator soliton comb for direct optical frequency comb spectroscopy**

N. Kuse1, T. Tetsumo1, and M. Ferrmann1; IMRA America Inc., Boulder Research Labs, Longmont, USA; IMRA America Inc, Ann Arbor, USA

We propose and demonstrate a novel technique for continuous and autonomous scanning of a dissipative Kerr-microresonator soliton comb facilitated by Pound-Drever-Hall locking.

**ED-P.28 WED**

**Robust offset locking of laser frequency with electronically tunable LC circuits for sub-millihertz uncertainty**

T. Hasegawa and Y. Seishu; Keio University, Yokohama, Japan

Laser frequency offset locking introduced in Opt. Express, 25, 2752 (2017) has been improved. By employing this scheme with optical phase lock loop, robust and precise laser frequency stabilization is achieved even in noisy circumstances.
EF-P.4 WED

Exfoliation of Centimetre-sized Transition Metal Dichalcogenide Monolayers
M. Velicky, G. Donnelly, W. Hendren, D. Scullion, E. Santos, R. Bowman, and F. Huang; Queen’s University Belfast, Belfast, United Kingdom

Mediated by the strong physiosorption of smooth and clean Au surfaces, extraordinarily large-size transition metal dichalcogenide monolayers up to centimetre scale are exfoliated using scotch tape method, including MoS2, WS2, MoSe2, WSe2, MoTe2 and WTe2.

EF-P.5 WED

Control of Nonlinear Optical Properties of the Carbon Nanotubes Saturable Absorber with Electrochemical Gating
• Y. Gladish1, A. Mkrtchyan2, D. Kopylova1, A. Ivanenko1, B. Nyushkov2, S. Kobets2, A. Khegai1, M. Melkumov1, M. Burdanova1, M. Stanforlī1, J. Lloyd-Hughes3, and A. Nasabali1,2

1Skolkovo Institute of Science and Technology, Moscow, Russia; 2Novosibirsk State University, Novosibirsk, Russia; 3Fiber Optic Research Center, Moscow, Russia; 4University of Warwick, Coventry, United Kingdom; 5Aalto University, Espoo, Finland.

We demonstrate the ability to control the nonlinear optical properties of carbon nanotube saturable absorber by electrochemical gating. The tuning capability of the gated absorber was explored by pump-probe spectroscopy and tested in lasers.

EF-P.6 WED

Wave Mixing in Graphene Nonlinear Resonators Utilizing Coupled-Mode Theory
• T. Christopoulos1, O. Tsilipakos1, G. Sinatkas1, and E.E. Kriezis1

1School of Electrical and Computer Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece; 2Institute of Electronic Structure and Laser, Foundation for Research and Technology Hellas, Heraklion, Crete, Greece

A strict mathematical framework for analyzing wave mixing in nonlinear resonators comprising graphene is presented. The proposed framework is used to model four-wave mixing in THz graphene nanoribbon resonators supporting surface plasmon polariton waves.

EF-P.7 WED

Wideband Graphene Electro-optic Modulator on 1D Photonic Crystalline Cavity
• T. Wood, J. Lhuillier, P. Demongodin, M. Kemiche, B. Vilquin, P. Rojo Romeo, A. Belarouci, S. Callard, and C. Monat; Université de Lyon, Institut des Nanotechnologies de Lyon (INL), CNRS, UMR 5270, École Centrale de Lyon, Écully, France

A wideband electro-optic modulator is demonstrated, featuring relative modulation depths of 20% or more over a 400nm wavelength range in the near-infrared spectral region. Design, fabrication, electro-optical characterisation and multi-physics modelling of behaviour are described.

EF-P.8 WED

Graphene Nanoribbons: From photophysical properties towards devices
• S.K. Alavi1,2,3, A.V. Senkovskiy1, M. Pfeiffer1, D. Haberer1, F.R. Fischer1,2, K. Meerholz3, Y. Ando1,4, A. Grünitz1,3, and K. Liedorf1,4

1Department for Chemistry, Universität zu Köln, 50935, Köln, Germany; 2Institut für Angewandte Physik der Universität Bonn, Wegeler Straße 8, 53115, Bonn, Germany; 3Physikalisches Institut, Universität zu Köln, Zuelpicher Straße 77, 50937, Köln, Germany; 4Department of Chemistry, Universität California at Berkeley, Tan Hall, CA 94720, Berkeley, USA; 5Materials Sciences Division, Lawrence Berkeley National Laboratory, CA 94720, Berkeley, USA; 6Kavli Energy NanoSciences Institute at the University of California Berkeley and the Lawrence Berkeley National Laboratory, CA94720, Berkeley, USA.

Armchair graphene nanoribbons (AGNRs) are novel material for optoelectronics. We investigate the process of fluorescence brightening due to defect formation in AGNRs. We also demonstrate a nanoscale photodetector based on nanoribbons.

EF-P.9 WED

Ultrafast charge transfer and valley dynamics in WSe2/MoSe2 heterostructure
• S. Dal Conte1,2, Z. Wang1, P. Altmann1, W. Li2, L. Ghirardini1, M. Celebra3, S. De Silvestri1,2, D. Akinwande1, and G. Cerullo1,2,3

1Politecnico di Milano, Milan, Italy; 2Microelectronics Research Centre, The University of Texas at Austin, Austin, USA; 3IFN-CNR, Milan, Italy

We use two-color pump-probe spectroscopy to study the charge transfer dynamics in type II WSe2/MoSe2 heterostructure. We find that photoexcited holes selectively injected in MoSe2 quickly scatter into the WSe2 layer on a sub-ps timescale.

EI-P.10 WED

• R.T.K. Schock1, A. George2, C. Neumann1,2, B. Doherty3, S. Warren-Smith1, A. Turchanin2, H. Eberdorff-Heidemüller2, M.A. Schmidt2, and F. Eidenberger3,4

1Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University, Jena, Germany; 2Institute of Physical Chemistry, Abbe Center of Photonics, Friedrich Schiller University, Jena, Germany; 3Leibniz Institute for Photonics Technologies, Jena, Germany; 4ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP), Institute for Photonics and Advanced Sensing, School of Physical Sciences, University of Adelaide, Adelaide, Australia; 5Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena, Germany; 6Max Planck School of Photonics, Jena, Germany

We show that 2D-Transition-Metal-Dichalcogenides such as MoS2 can be grown directly on exposed core optical fibers and present results of photoluminescence and nonlinear effects in this fibers.
**EI-P.13 WED**

**Strong Exciton-Coherent Phonon Coupling In Single-Layer MoS2**

- University catholique de Louvain, Louvain, Belgium
- University of Valencia, Valencia, Spain
- University of Cambridge, Cambridge, United Kingdom
- CNR-ISM, Rome, Italy
- Université du Luxembourg, Luxembourg, Luxembourg
- IFN-CNR, Milan, Italy

We use broadband pump-probe spectroscopy to study coherent optical phonons in 1L–MoS2. We detect a strong coupling with the A1 mode, which is enhanced around the C-exciton peak. Ab-initio calculations of the phonon-induced band structure variation fully confirm this result.

**EI-P.14 WED**

**Vector helical Bloch modes in N-fold rotationally symmetric waveguiding structures: spin and azimuthal order**

- P. Russell, Y. Chen, P. Roth, and G. Wong; MPI Science of Light, Erlangen, Germany
- Department of Physics, University of Erlangen-Nuremberg, Erlangen, Germany

Vecotorial coupled mode theory is used to analyse helical Bloch modes (hBMs) in N-fold rotationally symmetric waveguide arrays. The hBMs carry azimuthal momentum and are circularly polarized, except near the Brillouin zone centre and edges.

**EI-P.15 WED**

**Dynamical mean field theory study of the metal-insulator transition in piezoelectric thin film rare-earth compounds in contact with metal electrodes**

- National Physical Laboratory, London, United Kingdom
- University of the Basque Country, San Sebastian, Spain
- IBM Thomas J Watson Research Center, Yorktown Heights, USA
- Royal Holloway, Egham, United Kingdom

By using DFT+DMFT, we analyze bulk and quantum transport calculations of SmX, (X=S,Se,Te). These materials are key for piezoelectric transistors, acting as switches and memories. Our results are in good agreement with experiment.

**EI-P.16 WED**

**Continuous Wave Amplified Spontaneous Emission in Phase-Stable Triple Cation Lead Halide Perovskite Thin Films**

**IJ-P.4 WED**

**Constant intensity waves in disordered media**

- I. Krasnikov, A. Brandstötter, K. Makris, and S. Rotter; Institute of Theoretical Physics, Vienna, Austria
- Institute of Physics, Zagreb, Croatia
- Department of Physics, Heraklion, Greece

We study a class of waves with constant intensity inside and perfect transmission through a disordered scattering potential. A proposal for experimental observation of these waves in optical fibers is given.

**EI-P.5 WED**

**Control of space-time trajectories of noise-driven optical extreme events in metamaterial waveguides**

- G. Xu, J. McNiff, A. Boardman, and B. Kibler; Laboratoire Interdisciplinaire Carnot de Bourgogne, Dijon, France
- Original Perspectives Ltd, Tewkesbury, United Kingdom
- University of Salford, Manchester, UK

We report theoretical and numerical studies on the spontaneous generation of noise-driven optical extreme events in metamaterial waveguides. We also demonstrate the control of space-time trajectories of localized waves by means of the magnetooptic effect.

**EI-P.6 WED**

**Conical Refraction with Laguerre-Gaussian beams: from Raman spot to anti-Raman doughnut distribution**

- V. Mylnikov, E. Rafailov, and G. Sokolovskii; Institute of Physics, Saint-Petersburg, Russia
- Peter the Great St. Petersburg Polytechnic University, Saint-Petersburg, Russia
- School of Engineering and Applied Science, Aston University, AIP; Aston Triangle, Birmingham, United Kingdom

We discuss conical refraction of the Laguerre-Gaussian beams within the dual-cone model. Application of this formalism enables visualization of the Raman spot transformation into the ‘anti-Raman’ doughnut distribution for the non-zeroth order Laguerre-Gaussian input beams.

**EI-P.7 WED**

**Genetically optimized photonic crystal for spatial filtering of reinjection into broad-area diode lasers**

EJ-P.8 WED
Laser-induced breakdown in dielectrics: Strong electron superheating
O.A. Louchev and S. Wada; RIKEN, Wako, Japan
We report computational results of laser-induced breakdown in dielectrics with dynamics of strong electron superheating above the critical ionization energy fed during additional kinetic time that the free electrons have before producing the ionizing impacts.

EJ-P.9 WED
Homogenization of Layered Media: The Role of Magnetoelastic Coupling
A.N.M.S. Hossain1, I. Tsukerman1, and Y.D. Chong2; 1The University of Akron, Akron, Ohio, USA; 2Nanyang Technological University, Singapore, Singapore
Our homogenization procedure yields an effective tensor with magnetoelastic coupling, which produces correct symmetry breaking for periodic structures. Reflection coefficients for illumination from two opposite sides differ but are approximated accurately via the same effective tensor.

EJ-P.10 WED
Inverse Design of Orbital Angular Momentum Mode Demultiplexer by Combining Wavefront Matching Method and Gradient Descent Algorithm
Z. Lin1, Y. Wen1, Y. Chen1, Y. Zhang1, and S. Yu1,2; 1Sun Yat-sen University, Guangzhou, China; 2University of Bristol, Bristol, United Kingdom
We design an OAM demultiplexer inversely by combining the wavefront matching method and the gradient descent algorithm. The crosstalk of the device is -21.1 dB, with a 5.6 dB improvement resulting from the gradient descent optimization.

EJ-P.11 WED
Structured Auxiliary Mesh (SAM) algorithm for opto-thermal simulation of laser-based lighting systems
E. Chatzizyrli1, A. Wienke1, R. Lachmayer1,2, J. Neumann1, and D. Kracht3; 1Laser Zentrum Hannover e.V., Hannover, Germany; 2Institut für Gerätebau und Produktentwicklung (IpeG), Hannover, Germany
The optical properties of materials, here phosphors, heavily depend on temperature, which requires opto-thermal analysis. The proposed SAM algorithm enables this coupling by using the optical mesh for point location in the unstructured FEM mesh.

EJ-P.12 WED
Electromagnetic Approach in Design of the Fiber-Based Evanescent Wave Sensors for the Mid-Infrared Spectroscopy
S. Korsakova, E. Vinogradova, E. Romanova, and A. Rozhnov; Saratov State University, Saratov, Russia
A novel theoretical approach based on electromagnetic theory of optical fibers has been developed for analysis, design and optimisation of chalcogenide sensing elements of the fiber-based evanescent wave sensors for the mid-IR spectroscopy.

EJ-P.13 WED
Design of nonparaxial accelerating beams based on Wigner distribution function
Z. Liu1, S. Li1, Y. Wen1, Y. Chen1, Y. Zhang1, and S. Yu1,2; 1Sun Yat-sen University, Guangzhou, China; 2University of Bristol, Bristol, United Kingdom
We generalize the design of accelerating beams to the nonparaxial situation (for example, parabola beam and circle beam) by a new form of constructed Wigner distribution function.

EJ-P.14 WED
Scattering of Electromagnetic Waves by Cantor Screens: Rayleigh-Sommerfeld Integrals on Complex Domains
S. Christian and H. Middleton-Spencer; University of Salford, Greater Manchester, United Kingdom
We consider the problem of electromagnetic scattering by fractal iterations of a Cantor screen. The formulation for calculating electric and magnetic field components is based on Rayleigh-Sommerfeld integrals, going beyond (scalar) Fresnel and Fraunhofer approximations.

EJ-P.15 WED
Stability Condition Prediction of Integrated Opto-Mechanical Phaseshifters Using Finite Element Analysis
M. Ashour1, E.M. Weig2, and J.N. Caspers1; 1Robert Bosch GmbH, Renningen, Germany; 2University of Konstanz, Konstanz, Germany
We present an FEM analysis of an opto-mechanical optical phasemixer stability. Our method provides a more realistic prediction of such a device by accounting for internal restoration forces of suspended waveguides and avoiding opto-mechanical force linearization.

EJ-P.16 WED
Dynamics of temperature field of ultrashort laser pulse with gaussian and tubular form in metal
A. Fedotov, Y. Okrut, and Y. Tisivadets; Belarusian State University, Minsk, Belarus
Propagation of laser heat field in gold film caused by pulses with different spatial shapes- gaussian and tubular is numerically studied with FD and FE methods.

EJ-P.17 WED
Propagation of laser beams by decomposition into Gaussian beamlets
A.M. Talpos1,2 and D. Ursescu1,2; 1Horia Hulubei National Institute for Physics and Nuclear Engineering, Extreme Light Infrastructure - Nuclear Physics (ELI-NP), Magurele, Romania; 2University of Bucharest, Physics Department, Magurele, Romania
We propose and benchmark a beam propagation method based on decomposing the initial field into a sum of Gaussians beamlets. The total field after an optical system is determined by all Gaussian beamlets contributions.

EJ-P.18 WED
Optimization of subband electron temperature effect on a quantum cascade laser characteristics
C. Peng1, Y. Sun1,2, T. Chen1, and Z. Li3; 1Institute of Fluid Physics, China Academy of Engineering Physics, Mianyang, China; 2Chongqing University, Chongqing, China
The electron temperature of each subband is the key to understanding the QCL characteristics. We show herein a method based on the particle swarm optimization algorithm to obtain the electron temperature of QCLs.

EJ-P.19 WED
Tailoring elegant Gaussian modes for generating high-gain confocal resonators eigenmodes
A. Jaimes-Najera1, J. Gomez-Correa2, S. Luo3, J. Pu4, and S. Chavez-Cerda5; 1INADE, Puebla, Mexico; 2CONACyT-CICESE, Monterrey, Mexico; 3Huaqiao University, Xiamen, China
In this work we present a new family of confocal resonator modes. We demonstrate that a suitable finite superposition of elegant Laguerre-Gaussian beams can create high gain elegant eigenmodes of confocal resonators.

EJ-P.20 WED
Electromagnetic Diffraction by Fractal Dusts, Triangles and Carpets: A Kirchhoff Approach to Circulation
J. Christian and H. Middleton-Spencer; University of Salford, Greater Manchester, United Kingdom
We present an analysis of plane waves diffracted by three families of fractal screens based on structures with zero measure. The scattered field is represented by a Kirchhoff circulation integral around the constituent domain boundaries.

EJ-P.21 WED
Contrast of visibility in water and air
Z. Lee1 and S. Shang2; 1School for the Environment, University of Massachusetts Boston, Boston, Massachusetts, USA; 2State Key Laboratory of Marine Environmental Science, Xiamen University, Xiamen, China
Here we present a general relationship for the Law of Contrast Reduction based on radiative transfer, which is the key to deduce visibility in both air and water.
All-fiber all-normal-dispersion Femtosecond Laser with Non-linear Multimodal Interference-based Saturable Absorber

Delivering Transverse-mode Switching based on All-fiber Femtosecond Laser

A Random Anti-Laser Implemented by Coherent Perfect Absorption in a Disordered Medium

Glass Integrated Optics: 50 Years and Still Growing Strong

Pulse Shaping in Multi-Section Tapered Semiconductor Quantum-Dot Passively Mode-Locked Lasers

Topological Photonics

The fundamentals of the new area called Topological Photonics will be reviewed, along with exciting applications such as topological insulator lasers, new ideas related to topology in synthetic dimensions, current challenges and open questions.
Room 14b ICM
8:30 – 10:00
CH-10: Microscopy II
Chair: Cristian Manzoni, IFN-CNR Politecnico di Milano, Milano, Italy

CD-9: Spectral broadening
Chair: Concetta Sibilia, Sapienza Università di Roma, Roma, Italy

Room Osterolner CIC
8:30 – 10:00

Room 1 Hall A1
8:30 – 10:00
CF-9: Generation of few-cycle pulses
Chair: Ming-Chang Chen, National Tsing Hua University, Taiwan

Room 2 Hall A1
8:30 – 10:00
CE-11.2 THU: Fabrication and Characterization of High-Quality Factor Silicon WGM Microresonators
Chair: Peter Horak, ORC University of Southampton, Southampton, United Kingdom

Room 3 Hall A1
8:30 – 10:00

EG-3-1 THU (Invited) 8:30
The contribution has been withdrawn.

Room 14a ICM
8:30 – 10:00
EG-3: Nanoscale imaging and spectroscopy
Chair: Michele Celebrano, Politecnico di Milano, Milan, Italy

CH-10.1 THU 8:30
High-resolution, three-dimensional investigation of protein diffusion and trafficking in the live HeLa cell via interferometric scattering microscopy (ISCAT)

CD-9.1 THU 8:30
Sign-Alternating Dispersion Patterning for Supercontinuum Generation

CD-9.2 THU 8:45
Multipass spectral broadening with tens of millijoule pulse energy

CD-5.1 THU (Keynote) 8:30
Wireless Terahertz Communications

CF-9.1 THU 8:30
10 W CEP-stable few-cycle source at 2 μm with 100 kHz repetition rate

CF-9.2 THU 8:45
High-Power Single-Cycle Mid-Infrared Transients Generated via Intra-Pulse Difference-Frequency Mixing at 2 μm

CE-11.2 THU 8:45
Analysis of various approaches for the fabrication of Diffraction Optical Elements

Thursday – Orals
Spatiotemporal Mode-Locking in Multimode Fiber Lasers

**F. Wise; Cornell University, Ithaca, NY, USA**

Initial demonstrations of spatiotemporal mode-locking in fiber lasers will be summarized. Current and future research directions will be described.

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**JSII-1.3 THU (Invited) 9:00**

**Spatiotemporal Mode-Locking in Multimode Fiber Lasers**

*S. Pal and R. Säive; University of Twente, Enschede, Netherlands*

We developed an efficient and convenient experimental set-up and procedure to measure spectral and angular solar irradiance, which allows for 360° light capture, to accurately predict and optimize bifacial solar power plant performance and simulations.

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**EF-7.3 THU 9:00**

**Rapid hot carrier relaxation and mobility increase in Sn- and Pb-containing halide perovskite semiconductors**

*M. Moon1, J. Woolley2, E. Butler-Caddle2, M. Stanford1,2, A. Wijesekara2, C. Bandara1, J. Jayawardena1, R. Silva3, R. Hutton4, and J. Lloyd-Hughes4; 1University of Warwick, Department of Chemistry, Coventry, United Kingdom; 2Advanced Technology Institute, University of Surrey, Guildford, United Kingdom*  

Hot carrier energy relaxation times were assessed in tin- and lead-containing halide perovskite semiconductors via ultrafast THz spectroscopy and visible pump-probe methods. The faster energy relaxation in Pb-containing perovskites was attributed to enhanced electron-phonon coupling.

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**ED-7.4 THU 9:15**

**Optical control of coupling in phase-locked polariton dyads**

*S. Alyatkin1, J. Topfer2, A. Askitopoulos1,2, W. Langbein2, and P. Lagoudakis1; 1Skolkovo Institute of Science and Technology, Moscow, Russia; 2University of Southampton, Southampton, United Kingdom; 3Cardiff University, Cardiff, United Kingdom*  

We demonstrate optical control of the coupling strength between polariton condensates in dyad by an effective barrier. Tuning the barrier height allows for switching the phase configuration of the system.

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**JSVI-2.2 THU (Invited) 9:00**

**Numerical Techniques for Modelling Integrated Optical Circuits**

*F. Prudenzano; Department of Electrical and Information Engineering, Politecnico University of Bari, BARI, Italy*  

A few simulations of integrated optical devices as an optical thermometer, non-linear devices based on cascade of second order nonlinearity, rare earth doped amplifiers and lasers, are described.

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**EB-8.4 THU 9:15**

**A micro-integrated mode-locked extended-cavity diode laser emitting in the wavelength range around 780 nm**

*H. Christopher1, A. Wicht1, A. Peters2, and G. Tränkle1; 1Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Berlin, Germany; 2Institut für Physik, Humboldt-Universität zu Berlin, Berlin, Germany*  

We present a micro-integrated passively mode-locked ECDL module featuring a spectral bandwidth exceeding 15 nm (20 dBc) at around 780 nm and a free-running RF linewidth of less than 10 kHz (FWHM) at 3.4 GHz.

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**EC-1.2 THU 9:15**

**Realization of a Photonic Topological Z2-Insulator**

*L. Maczewsky1, B. Höckendorf2, M. Kremer1, T. Biesenthal2, M. Heinrich1, A. Alvermann1, H. Felmke2, and A. Szameit2; 1Universität Rostock, Institute of Physics, Rostock, Germany; 2Universität Greifswald, Institute of Physics, Greifswald, Germany*  

We introduce a photonic topological Floquet Z2-insulator with fermionic time reversal symmetry (TRS). Our experiments demonstrate the characteristic protected counter-propagating edge modes and unequivocally prove the presence of fermionic TRS in this bosonic system.
Hyogo, Japan; 1The University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, Tokyo, Japan; 2Utsunomiya University, 7-1-2 Yoto, Utsunomiya, Tochigi, Japan

We developed laser scanning optical-frequency-comb spectroscopy. It can acquire spectroscopic informations of light amplitude and phase simultaneously with high sensitivity measurement by focusing a laser beam.

CD-10.3 THU 9:00
Quantitative Phase Imaging using a Frequency Comb for Speckle-less Cellular Motion Measurement
J. Boomgaardan1, H. Farrokhan1, S. Kwo2, T. Carney2, and Y.-J. Kim1
1School of Mechanical and Aerospace Engineering, Nanyang technological university, Singapore, Singapore; 2Lee Kong Chian, School of Medicine, Nanyang technological University, Singapore, Singapore

A frequency comb was employed as a light source in quantitative phase microscopy. This technique provided speckle-less phase images of cellular motions in a live zebrafish by spatio-temporal coherence control.

CH-10.4 THU 9:15
The contribution has been withdrawn.

CD-9.4 THU 9:15
Tailable supercontinuum generation in nanoparticle-composite core fibers
M. Chemnitz1,2, N. Wältler1, R. Scheibinger1, K. Scharaenschmidt1, and M.A. Schmidt1,2,3
1Leibniz Institute of Photonic Technology, Jena, Germany; 2Abbe Center of Photonics, Friedrich-Schiller-Universität, Jena, Germany; 3Otto Schott Institute of Material Research, Friedrich-Schiller-Universität, Jena, Germany

We accurately determine dispersion control in easy-to-fabricate liquid/silica step-index fibers via the liquid core composition, finally opening the cost-effective and technology-rich telecom window for tailorable soliton-mediated supercontinuum generation.

CC-5.2 THU 9:15
Investigation of Nanoparticle-assisted Laser Tissue Soldering by Terahertz Radiation
J. Dong1,2, H. Breitenborn1,2, R. Curri1,2, A.O. Govorov3, L. Zaccari1, R. Naccache3,4, F. Vertone4, and R. Morandotti3,4
1InRS-EMT, Varennes, Canada; 2University of Electronics Science and Technology of China, Chengdu, China; 3Concordia University, Montreal, Canada; 4TTU University, St Petersburg, Russia

Terahertz reflective imaging was applied to characterize the process of laser tissue soldering using photothermal nanoparticles. Our results demonstrate the capability of terahertz imaging for investigating the thermal-induced tissue damage in three dimensions.
We propose a quasi one-dimensional theoretical model for selective unidirectional propagation around sharp corners and junctions.
Nanoscale mid-infrared near-field tomography of topological insulator surfaces
F. Mooshammer1, F. Sandner1, M.A. Huber1, M. Zießlerger2, H. Weigand1, M. Blank1, C. Weyrich2, M. Lanz4, J. Kampmeier2, G. Musser3, D. Gritzmacher1, J.L. Bolland1, T.L. Cocker2, and R. Huber1; 1 University of Regensburg, Regensburg, Germany, 2 Forschungszentrum Jülich, Jülich, Germany, 3 Department of Applied Physics, Aalto University, Espoo, Finland, 4 Michigan State University, Michigan, USA

Employing mid-infrared near-field tomography on a three-dimensional topological insulator, we retrieve the local dielectric function of a few-nm thick surface layer, suggesting the coexistence of a massive electron gas and the topologically protected surface states.

In flow manipulation and characterization of cancer cells by coherent computational microscopy
L. Misico1, V. Bianco1, P. Memmolo1, F. Merola1, M. Magnano1, M. Villone2, P.L. Maffettone2, and P. Ferraro3; 1 Institute of Applied Sciences and Intelligent Systems (ISASI-CNRS), Pozzuoli, Italy, 2 Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, University of Naples “Federico II”, Napoli, Italy

We show the recent advances of in-flow holographic tomography, which exploits an induced rotation of the sample to probe it from different view angles. Its application to the characterization of cancer cells will be reported.

Higher-Order Mode Temperature-Tunable Supercontinuum Generation in Liquid-Core Optical Fibers
R. Scheibinger1,2, M. Chemnitz1,2, K. Schaarschmidt1,2, and M.A. Schmidt1,2; 1 Leibniz Institute of Photonic Technology, Jena, Germany, 2 Abbe School of Photonics and Faculty of Physics, Friedrich-Schiller University Jena, Jena, Germany

We demonstrate OCT signal enhancement through manipulation of the optical wavefront incident to the sample. The technique is based on the acquisition of the sample’s complex-valued reflection matrix and subsequent optical phase conjugation.

Two-colour Surface Optical Rectification: Route to All-optical Control of Terahertz Emission from Quasi-2D structures
J.S. Totero Gongora1, L. Peters1, J. Tunes2, M. Clerici2, A. Pasquazi3, and M. Peccianti1; 1 Abbe School of Photonics and Faculty of Physics, Friedrich-Schiller University Jena, Jena, Germany, 2 Otto-Schott Institute of Material Research, Friedrich-Schiller University Jena, Jena, Germany

We experimentally demonstrate temperature-tuning of the supercontinuum generation within a TM01 mode in a liquid CS2-core step-index fiber. Our optimized dispersion design enables generating two temperature-tunable dispersive waves in the near and short-wave infrared.

We present large-FSR dual-microring bandpass filters
B. De Vries1, M. Guilez2, P.L. Maffettone2, and H.K. Tria2; 1 Institute of Micro System Technology, Hamburg University of Technology, Hamburg, Germany, 2 Department of Nanoscience, Eindhoven University of Technology, Eindhoven, The Netherlands

We present a new experimental scheme to set the filters to achieve over-an octave bandwidth spectrum for the amplification of monocycle shortwave infrared pulses.

Few-cycle Midwave-IR OPCPA with 32 GW Peak Power at a 1 kHz Repetition Rate
L. van Grafenstein, M. Bock, U. Besnard1, and J. Gomez-Rivas1; 1 Eindhoven University of Technology, Eindhoven, Netherlands, 2 Dutch Institute For Fundamental Energy Research, Eindhoven, Netherlands

We report a new experimental scheme to control the dispersion of an over-an octave bandwidth spectrum for the amplification of monocycle shortwave infrared pulses.

Permanent Optimization of Large-FSR Dual-Microring Bandpass Filters
J. Lipka1, I. Gomberg, and H.K. Tria2; 1 Institute of Micro System Technology, Hamburg University of Technology, Hamburg, Germany

We present large-FSR dual-microring bandpass filters manufactured with multilayer compatible deposited silicon. Fabrication tolerances are compensated by a permanent post-fabrication correction method and the possibility to set the filters to prespecified wavelength channels is demonstrated.
Single-Frequency Sub-kW-Peak-Power Combined Er/Er-Yb-Fibers Amplifier with a High-Pump-to-Signal Conversion Efficiency

*M.M. Korotchenko,1,2, D.S. Lipatov3, A.N. Gur’yanov,4 M.M. Budnov,3 and M.E. Likhachev3

1 Russian Academy of Sciences, Institute of Physics and Technology, NizhniNovgorod, Russia
2 Russian Academy of Sciences, NizhniNovgorod, Russia
3 Fiber Optics Research Center of the Russian Academy of Sciences, Moscow, Russia
4 Institute of Chemistry of High-Purity Substances of the Russian Academy of Sciences, Nizhni Novgorod, Russia

Fiber amplifier for 1.55 um spectral range based on simultaneous utilization of Er-doped (Yb-free) and Er-Yb-doped fibers was developed to achieve sub-kW peak power in single-frequency pulses and a high pump-to-signal conversion efficiency.

Control of Thermal-Photon Energy Flows with Nano-Structured and 2D Materials

O. Ilie,1 C. Schelter,2,3 Padadona, USA

We discuss how nano-structured materials can manipulate thermal electromagnetic fields in unprecedented ways, including engineered thermal emitters for heat-to-electricity energy conversion, active modulation of thermal radiation with gate-tunable graphene plasmons, and strategies for efficient solar spectrum splitting.

EF-8: Solitons in microcavities

Chair: Thorsten Ackemann, University of Strathclyde, Glasgow, United Kingdom

EF-8.1 THU 10:30

Dynamics of Optically Injected Kerr Gires-Tournois Interferometers

J. Jalaviales1, C. Schelter2, and S. Gurevich1

1 Nonlinear Wave Group, Université de les Illes Balears, Palma de Mallorca, Spain; 2 Institute for Theoretical Physics, University of Münster, Münster, Germany

We demonstrate theoretically that a high finesse Fabry-Perot microcavity containing a Kerr medium, coupled to a external cavity and in presence of Optical injection can give rise to phase-locked, dispersive, temporal Localized Structures (L.S.).
CH-1: Infrared gas sensing
Chair: Alexander Gomes, Federal University of Pernambuco, Recife, Brazil

CH-11.1 THU 10:30
Broadband Multi-species Trace Gas Detection by Up-Converting Mid-Infrared Supercontinuum Light into the Near-Infrared

• K. Edlund Johrini, Q. Fan, A. Khodabakhsh, and E. Harrer, Trice gas research group, Department of Molecular and Laser Physics, Royal Institute of Technology, Stockholm, Sweden

We report a mid-infrared supercontinuum-based multi-species trace gas sensor (coverage > 600 cm⁻¹) in combination with sum-frequency up-conversion allowing sub-ppm detection, with a 5 cm⁻¹ spectral resolution.

CD-10.1 THU 10:30
Mid-Infrared Photon Counting by Intra-Cavity Up-Conversion for LIDAR

• M. Widarsson, M. Henrikssoon, P. Matther, C. Canalias, V. Pastukhivcica, and F. Laurell

High frequency comb based on this approach.

CC-6.1 THU 10:30
Demonstration of a Tilted-Pulse-Front Pumped Plane-Parallel Slab Terahertz Source

• S. Nagyváry1,2, G. Krizsán1, C. Lombok1, L. Pálfi1, G. Tóth1, G. Almási1, J. A. Fülöp1,2, and J. Hebling1,2,3

A new type of tilted-pulse-front pumped terahertz source has been demonstrated, which utilizes a plane-parallel LN slab with an echelon structure, single-cycle pulses of 1 μJ energy and 0.30 THz central frequency with 5.1×10⁻⁴ efficiency have been generated.

CD-10.2 THU 10:45
Type 1 Quasi-Phase Matching in a Periodically Poled Rib-doped KTiOPO₄, Ridge Waveguide

• C. Korev, P. Mutter, H. Ksanraad, C. Canalias, and F. Laurell

Ridge waveguides were fabricated by diamond dicing of a Rb-ion exchanged periodically poled Rubidium-doped KTP sample. Blue light at 468.8 nm was generated through first order Type I quasi-phase matched second-harmonic generation.

CC-6.2 THU 10:45
THz Pulse Generation Emitted From Slant-Stripe-Type PPLN Via Optical Rectification Effect

• I. Hamazaki, Y. Ogawa, N. Šekine, A. Kasamatsu, and J. Hosakou

To obtain multi-cycled THz pulse emission by preventing material absorption of the generated THz wave, slant-stripe-type PPLN crystal is fabricated. THz wave generation from side surface of slanted PPLN pumped by femto-second pulse is demonstrated.

CF-10.2 THU 10:45
Sub-20 fs - 10.5 W visible pulse generation from Yb-doped fiber laser

• D. Descamps1, F. Guichard2, S. Petit3, A. Combry1, L. Lavenu2, and Y. Zouaer2,3

We report on the generation of 10.5 W sub-20 fs visible pulses based on the post-compression in a krypton-filled capillary of high power second harmonic Yb:fiber laser.
Graphene metamaterial for high absorption of unpolarized light over more than three octaves of bandwidth

H. Lin1, B. Sturmburg2, K.-T. Lin3, W. Nguen1, X. Zhong1, F. Chuang4, M. de Sterke4, and B. Jia5

Swinburne University of Technology, Melbourne, Australia; 2University of Sydney, Sydney, Australia; 3Australian National University, Canberra, Australia.

We report a 90 nm thick graphene-based metamaterial with 12.5 cm2 area, that strongly absorbs (>80%) unpolarised 300-2500 nm light. The metamaterial was fabricated by wet self-assembly, that can scale to 1 m2 areas.

Graphene metamaterial for high absorption of unpolarized light over more than three octaves of bandwidth

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Low-loss RF cavity for Quantum Cascade Laser frequency combs

• E. Kapsalis, M. Singleton, M. Beck, and J. Faist; Institute of Quantum Electronics, ETH Zurich, Zurich, Switzerland

A QCL structure is grown on a high-doped substrate, and by restricting the area of the top contact, the parasitic capacitance is reduced, improve the RF-frequency response and enhancing the coupling between the comb formation and the transport.

Low RF-power injection-locking and beatnote control of terahertz quantum cascade laser combs

• P. Taeschler, A. Forrer, D. Stark, T. Olariu, M. Beck, J. Faist, and G. Scalari; Institute of Quantum Electronics ETH Zurich, Zurich, Switzerland

We demonstrate that the round-trip frequency of terahertz quantum cascade laser frequency combs can be injection-locked by direct RF-modulation of the bias current. Furthermore, we show beatnote control by means of an external cavity.
Symmetry-Forbidden Second-Harmonic Generation In A Fully-Symmetric Plasmonic Nano-Center T.-Y. Chen1, J. Obermeier2, T. Schumacher3, F. C. List1, J.-S. Huang4,5, M. Lippitz8, and C.-H. Huang1,2,6,1; 1Institute of Photonics Technologies, National Tsing Hua University, Hsinchu, Taiwan, 2Department of Physics, University of Bayreuth, Bayreuth, Germany, 3Department of Chemistry, National Tsing Hua University, Hsinchu, Taiwan, 4Leibniz Institute of Photonic Technology, 07745 Jena, Germany, 5Department of Electrophysics, National Chiao Tung University, Hsinchu 30011, Taiwan, 6Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan

Although both the material as well as the structure are fully symmetric, the optical modes in a plasmonic two-wire transmission line lead to allowed second-harmonic generation at the metal surface.

Tailoring second-harmonic generation in plasmonic radial trimers using cylindrical vector beams G. Baustaiti1, C. Dreise1, X. Zhang1, D.P. Kern1, M. Kauranen1, and M. Fleischer2,1; 1Photons Laboratory, Tampere University, Tampere, Finland, 2Institute for Applied Physics, University of Tübingen, Tübingen, Germany, 3Center for Light-Matter Interaction, Sensors and Analytics LISA+, University of Tübingen, Tübingen, Germany

We investigate second-harmonic generation in a single plasmonic radial trimer using cylindrical vector beams. The second-harmonic generation from the trimer was found to depend strongly on the input vector beam structure and trimer gap size.

Nonlinear Generation of Ultrashort, Higher Order Vector Vortex Beams R.K. Saripalli1, A. Ghosh1, A.C. Neillikka1, and G.K. Samanta1; 1Physical Research Laboratory, Ahmedabad, India, 2Tecnológico de Monterrey, Monterrey, Mexico

We report on a novel experimental scheme based on single-pass, second harmonic generation producing ultrashort vector vortex beams of order as high as 24 and output power as high as 20.5 mW at 405 nm.

Tailoring second-harmonic generation in the headspace of Champagne and sparkling wines glasses B. Parvitte, A.-L. Moriaux, R. Vallon, C. Cilindre, G. Ligier-Belair, and V. Zenini; Groupe de Spectrométrie Moléculaire et Atmosphérique, Reims, France

We report the latest developments and the application of an infrared diode laser spectrometer devoted to the monitoring and mapping of gas-phase carbon dioxide in the headspace of Champagne and sparkling wines glasses.

Dispersive Fourier transform based single-shot CEP drift measurement at arbitrary repetition rate M. Karnucz1, S. Töth1, R. Flender1, L. Haxier1, B. Kiss1, B. Perselli3, and E. Cormier2; 1ELI-ALPS, Szeged, Hungary, 2CELIAS, Université de Bourdeaux, Talence, France

A single-shot dispersive Fourier transform based CEP drift measurement technique with arbitrary repetition rate capabilities is presented. We validated the concept by comparing to a well-established measurement device using high-repetition rate mid-IR laser source.

Multi-Species Environmental Gas Sensing Using Drone-Based Fourier-Transform Infrared Spectroscopy M. Rutkauskas1,2,3, M. Asenov1,2,3,4,5,6, M. Buozius1,2,3,4,5,6, A.C. Bell1,2,3,4,5,6, and D. Reid1,2,3,4,5,6, 1Heriot-Watt University, Edinburgh, United Kingdom, 2University of Edinburgh, Edinburgh, United Kingdom

We report a broadband FTIR spectrometer integrated with an autonomous UAV enabling quantitative aerial surveys of multiple gas species simultaneously with an estimated noise-limited performance of 18 ppm and sub-metre accuracy for a source localization.

Terahertz wave generation in air by femtosecond optical vortex pulses M. Ivanov1, I. Thiele1, S. Skupin1, D. Bozou1, and V. Vaisäär1; 1Laser Research Center, Vilnius University, Vilnius, Lithuania; 2Chalmers University of Technology, Gothenburg, Sweden, 3Institut Lumière Matière, UMR 5306 Université Lyon 1 - CNRS, Université de Lyon, Villeurbanne, France

We propose a generation scheme for broadband THz pulses with a phase singularity from two-color femtosecond laser-induced gas-plasmas. The predictions are confirmed by means of THz intensity and phase measurements for Vortex driving pulses.
Spectral response of distributed-feedback resonators with a continuously distributed phase shift

**C.C. Kores**, N. Imamii, E. Bernhardt, F. Laurell, and M. Pollnau
1 Department of Applied Physics, Royal Institute of Technology, Stockholm, Sweden; 2 Department of Materials and Nano Physics, Royal Institute of Technology, Kista, Sweden; 3 Visiting Scientist, Department of Materials and Nano Physics, Royal Institute of Technology, Kista, Sweden; 4 Advanced Technology Institute, University of Surrey, Guildford, United Kingdom

In distributed-feedback laser resonators with a distributed phase shift, the resonance wavelength deviates from design. Calculations and experiments hold an incomplete accumulation of distributed phase shift due to light intensity decaying into the grating responsible.

### ROOM 13a ICM

**EB-6.5 THU 11:30**

**Interband Cascade Lasers for Monolithic and Battery Driven Dual-Comb Spectrometers**

**B. Schwarz**, J. Hillbrand, M. Beiser, A.M. Andrews, G. Strasser, H. Delé, A. Schada, R. Welt, and S. Höfling
1 Institute of Solid State Electronics, TU Wien, Vienna, Austria; 2 Center for Micro- and Nanostructures, TU Wien, Gerbrunn, Austria; 3 Central European Institute of Technology, Brno University of Technology, Brno, Czech Republic; 4 Technische Universität München, Institute of Photonic Technologies, Munich, Germany; 5 Nanoplus Nanosystems and Technologies GmbH, Am hambach, Germany; 6 SUPA, School of Physics and Astronomy, University of St Andrews, St. Andrews, United Kingdom

We present a dual-comb platform combining interband cascade laser frequency combs and sensitive on-chip heterodyne detection functions to demonstrate over an octave of order dispersion. Experimentally achieved in Kerr microresonators, resulting in a train of pulses 12 ps FWHM and peak-to-average ratio exceeding 40.

**CB-9.5 THU 11:30**

**Compressed Pulses from a Mid-Infrared Quantum Cascade Frequency Comb**

**M. Singleton, M. Beck, and J. Faist**

ETH Zürich, Zuerich, Switzerland

A Martinis-style grating compressor is used to compress the inter-modal phase differences of a mid-IR QCL comb, resulting in a train of pulses 12 ps FWHM and peak-to-average ratio exceeding 40.

### ROOM 13b ICM

**EC-2.4 THU 11:30**

**Inducing topological effects in locally resonant metamaterials**

S. Yesé, G. Lerosey, and F. Lemosi
1 Institut Langevin, ESPCI Paris, PSL University, CNRS UMR 7587, Paris, France; 2 Greenwave, Paris, France

The concept of topological insulators is investigated macroscopically for the propagation of electromagnetic waves within a metamaterial. We explain how structural deformations, although sub-wavelength scaled, induce topological phase transition and experimentally map some topological invariants.
Mid-infrared multi-species trace gas sensing using a supercontinuum light source

- Q. Pan, K. Eslami Jabromi, R. Khodabakhsh, and F. Harren; Radboud University, Nijmegen, Netherlands

We report upon an integrated and transportable multi-species trace gas sensor by combining a bright mid-infrared supercontinuum light source with a fast-scanning spectrometer employing a balanced detection scheme.

Optically Probed Time Dynamics of (χ(2) Grating Inscription in SiN Waveguides)

- E. Nittis1, T. Liu1, T.J. Kippenberg2, D. Grassani3, and C.-S. Bré4; 1Ecole Polytechnique Fédérale de Lausanne (EPFL), Photonic Systems Laboratory, Lausanne, Switzerland; 2Ecole Polytechnique Fédérale de Lausanne (EPFL), Laboratory of Photonics and Quantum Measurements, Lausanne, Switzerland

We probe the (χ(2) grating in all-optically poled SiN4 waveguides. We show that poling ratio, efficiency and number of the inscribed gratings can be dynamically altered by changing pump laser wavelength and power.

Optically rectified conversion of 100-W average power modelocked oscillator in cryogenically-cooled GaP

- N. Hekmat, F. Meyer, S. Mankoszadz1, E. Azlani, E. Fobbe, M. Hoffmann, Y. Wang, and C.J. Saraceno; Center for Ultraviolet Research, Bochum, Faculty of Electrical Engineering and Information Technology, Photonics and Ultrafast Laser Science, Bochum, Germany

We investigate optical rectification of a 100W average power thin-disk laser in GaP crystals cooled to cryogenic temperatures. We show that a balance between cooling and velocity-matching is required for efficient conversion at high power.

Active f-to-2f interferometer for carrier-envelope phase locking

- G. Steinmeyer1, R. Liu2, Y. Song2, and M. Hsu3; 1Max-Born-Institut, Berlin, Germany; 2Tianjin University, Tianjin, China

We report that introduction of optical gain into an f-2f interferometer can boost signal-to-noise ratios in CEP stabilization by up to 20dB. This finding opens an avenue for previously unattainable modulated lasers, including thin-disk lasers and high-repetition rate sources.

Compact, UAV compatible 2D Spectrometer for multi-species atmospheric gas analysis

- J. Gouman1, P. Renevey1,2, F. Karouta3, C.Jagadish3, and T.H. Dinh; 1University of New South Wales, Canberra, Australia; 2Australian National University, Canberra, Australia; 3Photonics Laboratory, Physics Unit, Ecole Polytechnique Fédérale de Lausanne, Switzerland

We present 0.7 mJ, femtosecond Yb:YLF CPAs delivering 260 mJ at 1050 nm to 2400 nm. HHG in ZnSe expanding from 530 nm to 2000 nm.

We report on a delay scan we observe both parametric waveformsynthesizer and power tracking. We measure the absolute phase difference of the harmonic emission of Ar, Ne and He atoms using XUV interferometry, providing a direct insight into electron scattering, structural phase jumps and multi-electron resonances of atomic systems.
Diode-pumped multimode Raman fiber lasers

S.A. Babin; Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; Novosibirsk State University, Novosibirsk, Russia

We review the results on all-fiber diode-pumped Raman lasers based on graded-index fibers enabling beam quality improvement via specific transverse structure of Raman gain, fs-inscribed fiber Bragg gratings and Rayleigh backscattering employed for cavity feedback.

Ultra-Fast Laser Printing of IR-resonant Plasmonic Metasurfaces

M. Lapine1, D. Pavlov2, A. Porfirov1, and A. Kuchmizhak1; 1University of Technology Sydney, Sydney, Australia; 2Far Eastern Federal University, Vladivostok, Russia; 3Samara National Research University, Samara, Russia

We report on ultra-fast fabrication of patterned plasmonic meta-surface, suitable for production of controllable resonances in the infra-red range, and explain the observed resonances by analysing plasmonic features of these structures.
We discuss how recent advances made in a chalcogenide-based semiconductor laser emitting at 785 nm together with a fiber coupled ion-implanted gallium arsenide (GaAs) photodetector are used as a coherent CW THz source.

We present the first experimental observation of plasmon-soliton waves. The demonstration, backed by numerical simulations, is performed in a chalcogenide-based multilayered waveguide, with gold structures, designed to limit propagation losses while exhibiting efficient Kerr self-focusing at moderate power.

We report on results of experimental investigation on high order harmonic generation in semiconductor quantum dots, resembling an intermediate system between gaseous and condensed matter.

Comprehensive study of high order harmonic generation in monolayer-thick semiconductors

Chair: Matteo Lucchini, Politecnico di Milano, Milano, Italy
Raman-free switching between dissipative soliton resonances in fiber figure of eight laser

- Novosibirsk State University, Novosibirsk, Russia
- 1 Aston Institute of Photonic Technologies, Birmingham, United Kingdom

We demonstrate a switching between different dissipative soliton resonances (DSR) inside figure of eight laser with two independently pumped amplifying fibers. Laser provides four Raman-free DSR with peak power range from 50 to 300 W.

CJ-13.2 THU 14:30

Achieving high-power, ultra-high spectral purity cascaded Raman fiber lasers through low intensity-noise pump sources

- V. Balaswamy, B.S. Vikram, P. Rai, H. M. R. D. Nair, and V.R. Supradeepa; Center for Nano Science and Engineering, Indian Institute of Science, Bengaluru, India

We investigate recently proposed role of pump intensity noise on output spectral purity of cascaded Raman fiber lasers. We demonstrate >97% in-band power ratio from 1.1 to 1.5 μm based on high-power phase-modulated narrow-linewidth pump laser.

CJ-13.3 THU 14:45

Third-harmonic imaging with all-dielectric nonlinear metalenses

- C. Schlückerde, S. Krik, L. Wang, B. Sain, Y. Kevihar, and T. Zentgraf; 1 Paderborn University, Paderborn, Germany; 2 Nonlinear Physics Centre, Canberra, Australia

Image formation with highly efficient all-dielectric metalenses for THG is investigated experimentally and described analytically with a generalized lens equation. Thereby, we study spatial information crosstalk originating from the nonlinear nature of the effect.

CJ-13.4 THU 14:55

Reservoir computing using VCSL polarization dynamics

- J. Vatin; 1,2, D. Danti; 1,2, and M. Sciamanna; 1,2

We design a reservoir computer made of a VCSL with time-delayed feedback and optical injection. Experiments confirm that the VCSL polarization dynamics enhances the computational performance on chaos prediction and channel equalization.

CD-11.2 THU 14:30

Efficient 2-W Average Power 206 nm Deep-UV Generation from 100-kHz Picosecond Pulses

- B. Willenberg, F. Brunner, C.R. Phillips, and U. Keller; Departement of Physics, ETH Zurich, Switzerland

We present a 100-kHz all-solid-state deep-uv-ultraviolet source delivering 206 nm few-picosecond pulses with 2-W average power based on non-collinear sum frequency generation, which features high conversion efficiency by pulse front tilt matching and beam flattening.
Room 14a ICM

EG-5.3 THU 14:30
Scanning Resonant Nano-antenna High Resolution Imaging and Emission Control of IBN Defect Photon Emission
• N. Palombo Blasetta, ICFO, Castelldefels, Spain
First systematic coupling and imaging of IBN defects with resonant optical antennas, nanometer control and optical resolution of 45 nm. Nano-antennas manipulation of IBN defects by emission depletion of 30-70% and maximum lifetime reduction of 2x.

Room 14b ICM

CH-12.3 THU 14:30
Probing Molecules next to Surfaces
J. Lukas Malu1, T. Mashimo1,2, I. Maurin1, D. Bloch2, B. Darquie1, and A. Lalot3; 1Laboratoire de Physique des Lasers, UMR7538 CNRS, Université Paris13, Sorbonne Paris–Cité, Villeurbanne, France; 2Department of Physics, Chuo University, Tokyo, Japan
We present high-resolution reflection spectroscopy of a micrometric molecular gas layer next to a surface. Our measurements offer spectroscopic information on SF6 vibrational transitions and allow compact molecular spectroscopy and measurements of the molecule-surface interaction.

Room Osterseen ICM

CC-7.3 THU 14:30
Self-written Y-junctions using spatial solitons
• A. Alberucci1, C.P. Ishii1, J. Beeckman2, R. Van Acker2, K. Neys1, and S. Nolte3; 1Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany; 2Ghent University, Gent, Belgium; 3Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
We experimentally observed the spontaneous formation of soliton-based Y-junctions in nematic liquid crystals excited by a bell-shaped beam. A theoretical explanation based upon the interplay between a focusing and a defocusing nonlinearity is provided.

Room 1 Hall A1

CC-11.2 THU 14:30
A compact tunable narrow-bandwidth and high-photon-flux turn-key XVU source for experiments with highly charged ions at storage rings
• V. Hilbert1, M. Tschernajew2, R. Klau1, J. Limpert1,2, and I. Rothhardt1,2; 1Institute of Applied Physics, Jena, Germany; 2Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
In our experiment HHG-radiation is created in Argon and subsequently analyzed. At 26.5 eV an energy bandwidth of ΔE/E=7.5-10^-4 is achieved. Merging of the XVU source with a heavy ion storage ring is presented in detail.

Room 2 Hall A1

CC-7.3 THU 14:30
Room-temperature CW widely-tunable THz-generating laser
• K.A. Fedorova, H. Guoyu, C. Kriss, F. Zhang, W. Stolz, and A. Rahimi-Iman; Philips-Universität Marburg, Marburg, Germany
We demonstrate a room-temperature, CW, tunable THz-generating laser in the 0.8-1.1THz spectral region. The laser source is based on intracavity frequency conversion in an aperiodically-poled lithium niobate crystal within a dual-wavelength semiconductor disk laser.

Room 3 Hall A1

CG-8.3 THU 14:30
Attosecond Soft-X-Ray Spectroscopy in a transition metal dichalcogenide
• B. Baude1, J. Leon1, N. Di Palo2, D.E. Rivas1,2, T.P.H. Sididropoulos3, S. Severino4, M. Reduzzi1, S.L. Cousin1, M. Henrard1, C. Caroli1, E. Pellegrin1, J. Herrero Martin5, S. Matús-Valero6, E. Coronado7, D. Tanzi7, C. Draz7, M. Uemoto8, K. Yabuna8, M. Schulze8, S. Wall9, A. Picon10, and J. Biegert10,1; 1IPCL-Inst. Ciencies Fotòniques, The Barcelona Inst. of Science and Technology, Castelldefels, Spain; 2European XFEL GmbH, Schenefeld, Germany; 3Inst. für Physik and IRIS Adlershof, Berlin, Germany; 4ALBA Synchrotron Light Source, Cerdanyola del Vallés, Spain; 5Inst. de Ciencia Molecular (ICMol), Paterna, Spain; 64th Physical Inst. - Solids and Nanostructures, Göttingen, Germany; 7Center for Computational Sciences, Tsukuba, Japan; 8Fakultät für Physik, LMU, Garching, Germany; 9Depart. de Quimica, Univ. Autónoma, Madrid, Spain; 10ICREA, Barcelona, Spain
We exploit temporal resolution and spectral sensitivity of attosecond soft X-ray spectroscopy to follow peta-hertz carrier motion in semi-metallic TIS2. The results demonstrate the high mobility and significant carrier acceleration in the material.

CG-8.4 THU 14:30
Breakdown of the quasi-1D nature of Black phosphorus in Non-perturbative Higher harmonic generation
• K. Uchida1, V. Parrek2, K. Nagai3, K. Dan1, and K. Tanaka4; 1Dep. of Physics, Kyoto Univ., Kyoto, Japan; 2Femtosecond Spectroscopy Unit, Okinawa Inst. of Science & Tech. Graduate Univ, Okinawa, Japan
We observed higher harmonic generation from thin-layer black phosphorus, which shows quasi-one dimensional nature in transport and linear optical properties. The crystal orientation dependence shows large deviation from that is expected in quasi-one dimensional system.

Thursday – Orals

Thursday 27 June 2019
PhD synchronization of the beat-note of monolithic DFB lasers on a microwave reference using an optical loop is investigated, both numerically and experimentally. The influence of feedback phases and delay on the dynamics is studied.

Ultra-compact Low-noise Broad-band Upconversion Detector at 6 µm

A. Barh, P. Tidemand-Lichtenberg, and C. Pedersen; DTU Fotonik, Technical University of Denmark, Roskilde, Denmark

We present an ultra-compact low-noise mid-infrared (MIR: 6 - 6.8 µm) upconversion detector using an AgGaS2 crystal, placing inside a long-wavelength (than upconverted wavelength) diode pumped solid-state LASER cavity (1.03 µm) for broadband MIR spectroscopy.

High-order harmonic analysis of anisotropic petahertz photonic currents in solids

A.A. Lamin1,2,3, A.V. Mitrofanov1,2,3, D.A. Sidorov-Bryukov1,2,3,4, A.B. Fedotov1,2,3,4, and A.M. Zheltikov5,2,3,4,5; 1Physic Department, International Laser Center, M. V. Lomonosov Moscow State University, Moscow, Russia; 2Department of Physics and Astronomy, Texas A&M University, College Station TX, USA; 3Russian Quantum Center, Moscow, Russia; 4Kazan Quantum Center, A.N. Tupolev Kazan National Research Technical University, Kazan, Russia; 5Kurchatov Institute National Research Center, Moscow, Russia; 6Institute of Laser and Information Technologies, Russian Academy of Sciences, Shaturna, Moscow Region, Russia

We have shown that polarization maps of high-order harmonics from a zinblende-ZnSe crystal can serve to characterize vectorial properties of petahertz electron currents generated in the crystalline solid by an ultrashort optical driver.
Plasmon Based Suppression of Surface Trap States and Enhanced Band-edge Emission Rate in a Single CdTe Quantum Dot

A.M. Flatae1, F. Tantussi2, G.C. Messina1, F. De Angelis3, and M. Agio1,3,1 Laboratory of Nano-Optics and Cu, University of Siegen, Siegen, Germany; 2 Institute Italiano di Tecnologia, Genova, Italy; 3 National Institute of Optics (INO), National Research Council (CNR), Florence, Italy

A hybrid-quantum system of a quantum dot coupled to plamonic-nanocore provides enhanced band-edge nanocavities and selective suppression of surface-states. The spontaneous emission rate is enhanced by more than two orders of magnitude by Purcell effect.

Broadband dual-comb spectroscopy of methane with a free-running erbium chip laser

P. Guay1, N. Bourbeau Hébert1, V. Michaud-Bellu2a, D. Lancaster1, and J. Genest1, 1Centre d’optique, photonique et laser, Université Laval, Québec, Québec, G1V 0A6, Canada; 2Laser Physics and Photonics Devices Laboratory, Future Industries Institute, and School of Engineering, University of South Australia, Mawson Lakes, SA 5095, Australia

Absorption lines in the R and Q branches of methane’s overtone 2ν3 were measured simultaneously with a broadband, simple, and compact spectrometer. The free-running mode-locked dual-comb laser is based on a single erbium-doped glass chip.

The contribution has been withdrawn.

Optical self-localization based upon the Pancharatnam-Berry phase

C.P. Jisha1, A. Alberucci1, J. Beekenkorn2, and S. Nolte3, 1Friedrich-Schiller-Universität Jena, Jena, Germany; 2Ghent University, Gent, Belgium; 3Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We discuss light self-focusing and self-trapping based upon the Pancharatnam-Berry phase controlling the Kerr effect, the nonlinear tailoring of the wavefront is achieved by an intensity-driven manipulation of the polarization variations.

C.C. 7.5 THU (Invited) 15:00

Optical Temperature 1 to 7.5 THz Metrological Grade Spectrometer

M. De Reggi1, L. Consolino1,2, S. Bartalim1,2, and R. De Natale1,2, 1INO, Istituto Nazionale di Ottica-CNR, Largo E. Fermi 6, Florence, I-50125, Italy; 2LENS, European Laboratory for Nonlinear Spectroscopy, Via N. Carrara 1, Sesto Fiorentino (FI), I-50019, Italy

A continuous-wave terahertz (THz) spectrometer, referenced to the primary frequency standard and tunable from 1 to 7.5 THz is presented. Room-temperature detection and high-accuracy spectroscopy is demonstrated with a state-of-the-art accuracy of 10⁻⁹.

CF-11.4 THU 15:00

A spectrally resolved single-shot wavefront sensor for broadband high-harmonic generation sources

X. Liu1,2, M. Jansen3,4, A. de Beurs1, K. Eikema1,2, and S. Witte1,2, 1Advanced Research Center for Nanophotography, Amsterdam, Netherlands; 2Vrije Universiteit, Amsterdam, Netherlands

We present a wavefront sensor that can characterise wavefronts of multiple extreme-ultraviolet high harmonics in a single exposure. We demonstrate its capabilities by measuring wavefronts of nine harmonics between 25 and 49 nm simultaneously.

CG-8.5 THU 15:00

1.9 fs deep-UV pulses from Third-harmonic Generation in Argon

V. Wanie1,2,3, M. Gali1,3,4, D.P. Lopes5, E.P. Månson1, A. Trabattoni1, L. Colatelli1, K. Saraswathula1, A. Cartella1,5,6, F. Frassetto1, L. Pollet10, F. Legard2, S. Stagia3,4, M. Nisoli3,4, R.M. Vazquez7, R. Oseleic1, and F. Calegari1,3,5,7, 1DESY, Hamburg, Germany; 2Inst. National de la Recherche Scientifique, Varennes, Canada; 3Inst. for Photonics and Nanotechnologies CNR-IFN, Milan, Italy; 4Dept. of Physics, Politecnico di Milano, Milan, Italy; 5Hamburg Centre for Ultrafast Imaging, Univ. Hamburg, Hamburg, Germany

We report 1.9 fs deep-UV pulses from frequency up-conversion of 800 nm (5 fs) pulses in argon using a laser micromachined gas cell. A cross-correlation with the near-infrared field was performed in xenon for characterization.

CG-8.6 THU 15:15

Cavity-Enhanced Noncollinear High-Harmonic Generation

M. Högner1,2, T. Saule1,2, S. Heinrich1,2, N. Lilienfen4,5, D. Esser1, M. Trubetskov1, V. Pervak1, and I. Papez1,4, 1Max-Planck-Institut für Quantenoptik, Garching, Germany; 2Ludwig-Maximilians-Universität München, Garching, Germany; 3Fraunhofer-Institut für Laserotechnik, Aachen, Germany

We demonstrate the first cavity-enhanced noncollinear high-harmonic generation, offering the prospects of gating isolated attosecond pulses at multi-10 MHz repetition rates and a highly efficient, photon-energy- and power-scalable output coupling mechanism.

CG-8.7 THU 15:15

13.5 nm High Harmonic Source Driven by a Few Cycle Fiber Laser

R. Klas1,2, W. Eschen1, A. Kirsche1,2, J. Rothhardt1,2, and J. Limpert1,2, 1Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Albert-Einstein-Str. 6, 07745 Jena, Germany; 2Helmholtz-Institut Jena, Föhrbelstr 3, 07745 Jena, Germany; 3Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Str. 7, 07745 Jena, Germany

We report 1.9 fs deep-UV pulses from frequency up-conversion of 800 nm (5 fs) pulses in argon using a laser micromachined gas cell. A cross-correlation with the near-infrared field was performed in xenon for characterization.
CJ-14: Coherent beam combining and multi-core fibers
Chair: Siddharth Ramachandran, Boston University, Boston, United States

CJ-14.1 THU 16:00

3.5 kW four-channel coherently combined ultrafast fiber laser
- M. Müller1, A. Klénke2, M. Müller1, H. Stark1, A. Tünnemann1,2,3, and J. Limpert1,2,3
- 1Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller University Jena, Jena, Germany; 2Helmholtz-Institute Jena, Jena, Germany; 3Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We present a 3.5 kW average power four-channel ultrafast fiber laser emitting 430 fs pulses at 80 MHz repetition rate with close to diffraction limited beam quality. Further power scaling is discussed.

Thursday – Orals

ROOM 1 ICM

16:00 – 17:30

CJ-14: Coherent beam combining and multi-core fibers
Chair: Siddharth Ramachandran, Boston University, Boston, United States

CJ-14.2 THU 16:15

170 W Multicore Fiber based Femtosecond CPA System
- A. Klénke1,2, M. Müller1, H. Stark1, A. Tünnemann1,2,3, and J. Limpert1,2,3
- 1Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller University Jena, Jena, Germany; 2Helmholtz-Institute Jena, Jena, Germany; 3Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We present a femtosecond fiber CPA system emitting up to 172 W average power. The main amplifier comprises a multicore fiber with 16 amplification channels that are coherently combined in a compact system.

ROOM 4a ICM

16:00 – 17:30

EH-6: Plasmonic enhancement of light-matter interactions
Chair: Vinod Menon, City College and Graduate of CUNY, New York, USA

EH-6.1 THU 16:00

Quantum Nano-Jewelry: Plasmonic Addressing of Single-Photon Emitters in High-quality Diamond Nanostructures
- T. Jaffe1, N. Felgen1, L. Gal1, C. Pogany1, J.P. Reithmaier1, and M. Orenstein1
- 1Andrew & Erna Viterbi Department of Electrical Engineering, Technion - Israel Institute of Technology, Haifa, Israel; 2Institute of Nanotechnology and Analytics, University of Kassel, Kassel, Germany

We designed, fabricated and validated by calculations bright sources consisting of plasmonic structures centered about diamond nanodisk-pillar hosting silicon-vacancy centers enabling the simultaneous focusing of the excitation (532nm) and enhanced extraction of their emission (738nm).

ROOM 4b ICM

16:00 – 17:30

EC-4: Nonlinear and quantum aspects in topological photonics
Chair: Hannah Price, University of Birmingham, Birmingham, UK

EC-4.1 THU 16:00

Topological interface states in a polarization SSH lattice: linear and nonlinear regimes
- P. St Jean1, N. Pernet2, A. Lemaître3, A. Harari4, I. Sagnes5, S. Ravets6, A. Amo7, and I. Bloch8
- 1CRNS - Université Paris-Sud, Paris, France; 2CRNS - Université de Lille, Lille, France

Polaritons, half-light and half-matter quasiparticles, appear as an ideal candidate for exploring nonlinear topological photonics. Here, using an array of coupled micropillars, we show how the robustness and spatial distribution of topological states are not affected by strong nonlinearities.

EC-4.2 THU 16:15

Wavefront Dislocation as Real-Space Measurement of the Zak Phase in 1D Photonic Topological Insulators
- C. Dateix1, P. Delplace2, P. Belle3, F. Mortessagne2,1
- 1Laboratoire Ondes et Matière Aquatiques, Université de Bordeaux and CNRS, Talence, France; 2Université Lyon, ENS de Lyon, Univ Claude Bernard, CNRS, Laboratoire de Physique, Lyon, France; 3Institut dePhotonique, Université Côte d'Azur and CNRS, Nice, France

Two-photon interference at 1550 nm after quantum frequency conversion of remote quantum emitters
- S.L. Portalupi1, J.H. Weber1, B. Kamps1, J. Kettrt2, S. Kern1, J. Mäsch1, H. Vuray1, M. Jetzer3, C. Becker1, and P. Michler1
- 1Institut für Halbleiteroptik und Funktionele Grenzflächen, Center for Integrated Quantum Science and Technology (IQST) and StCoE, University of Stuttgart, Stuttgart, Germany; 2Fachrichtung Physik, Universität des Saarlandes, Saarbrücken, Germany

We investigate the Friedel oscillations in a 1D photonic topological insulator and experimentally report the existence of wavefront dislocations in the interference patterns, a direct real-space measurement of the Zak phase.

CB-11: Vertical cavity semiconductor lasers
Chair: Michael Jetter, University of Stuttgart, Stuttgart, Germany

CB-11.1 THU 16:00

Pulse dynamics in SESAM-free electrically-pumpedVECSELs
- N. Chichkov1, A. Yadav2, T. Munsbi, K. Fedorova, A. Kovalev3, E. Viktorov2, and E.U. Rajafair1
- 1Aston Institute of Photonic Technologies, Aston University, Birmingham, United Kingdom; 2Faculty of Physics and Materials Science Center, Philipps-University Marburg, Marburg, Germany; 3TIMO University, Saint Petersburg, Russia

We analyze the pulse dynamics in a mode-locked, SESAM-free EP-VECSEL. The laser generates a continuum pulse train with average pulse energies of 3.6 pJ. The observed pulse-to-pulse fluctuations are explained with the delay-differential-equation modelling approach.

CB-11.2 THU 16:15

Nonlinear lensing phenomena in semiconductor disk lasers
- C. Kriso1, S. Kreut1, T. Munsbi1, M. Grossmann, R. Bek2, M. Jetter3, P. Michler2, W. Stolz1, M. Koch1, and A. Rahimi-Iman4
- 1Faculty of Physics and Materials Science Center, Philipps-University Marburg, Marburg, Germany; 2Institut für Halbleiteroptik und Funktionelle Grenzflächen, Universität Stuttgart, Stuttgart, Germany; 3Institut für Halbleiteroptik und Funktionelle Grenzflächen, Universität Stuttgart, Stuttgart, Germany

We present a model for self-focusing of vertically-pumped semiconductor lasers. Two remote quantum dots emitting at >900 nm are converted to >1550 nm via two independent quantum frequency converters, maintaining single-photon purity and indistin-
Quantum-correlated photons from semiconductor fiber-cavity polaritons

G. Munoz-Matutano¹, A. Wood¹, M. Johnson², X. Vidal³, B.Q. Baragiola⁴, A. Reinhardt⁴, A. LeMaître⁴, J. Bloch⁵, A. Amo⁶, G. Nogues⁵, B. Bigot⁵, M. Richard⁵, and T. Vold⁵. ¹ARC CoE EQUS, Macquarie University, Sydney, Australia; ²Institut Néel, Université Grenoble Alpes, Grenoble, France; ³CNRS, Univ. Paris-Sud, Université Paris-Saclay, Marcoussis, France

We report the observation of quantum-correlated photons from strongly confined quantum-well microcavity with micrometer-scale lateral confinement. Different ensembles of coupled defects give rise to discrete cavity with cavity polaritons. From the disperse variation of the photon autocorrelation function, we are able to extract a value for the non-linear polarization-polariton interaction constant.

Cavity Exciton-Polariton Condensates in Engineered Potential Landscapes at Room Temperature

F. Scabrino, D. Urbons, T. Stöferle, and R.E. Mahrt. IBM Research-Zurich, Zurich, Switzerland

We generate condensates of exciton-polaritons in polymer-filler optical microcavities with micrometer-scale lateral confinement. Different engineered potential landscapes are studied, ranging from 0D Gaussian-shaped defect microcavity to 2D arrays of coupled defects.

CF-6.2 THU 16:00

Epsilon-Near-Zerosurfaces

V. Shalaev, V.M. Shalaev, A. Pugzlys, 1,2, G. Pusztai, 1,2, G. Kuzmich, 1,2, A. Baltuska, 1,2, and S. Tzortzakis, 1,2, 1 Institute of Electronic Structure and Laser, FORTH, Heraklion, Greece; 2 Science Program, Texas A&M University at Qatar, Doha, Qatar; 3 Photonics Institute, TU Wien, Vienna, Austria; 4 Heidelberg Physical Institute of the Russian Academy of Sciences, Moscow, Russia; 5 Center for Physical Sciences & Technology, Vilnius, Lithuania; 6 Department of Physics, University of Crete, Heraklion, Greece

We demonstrate, intense broadband THz emission with extreme efficiency from two-color mid-infrared (3.9 μm) femtosecond laser filament. The THz conversion efficiency of 2.36 % exceeds by far any previous values reported for plasma-based THz sources.

CC-8.2 THU 16:15

Phase-Locked Programmable Femtosecond Pulse Bursts from a Regenerative Amplifier

J. Astrauskas, G. Archipovaite, V. Shukamova, G. Fan, 1, T. Lihas,1,2 E. Kukulis, 1,2, E. Cermiri, 1,2 T. Ballintink, 1, A. Pugzlys, 1,2, and A. Baltuska, 1,2, 1 Photonics Institute, TU Wien, Vienna, Austria; 2 CELIA, Université de Bordeaux-CNRS-CEA, Talence, France; 3 DSO National Laboratories, Singapore, Singapore; 4 Center for Physical Sciences & Technology, Vilnius, Lithuania; 5 Institute of Physics, University of Pécs, Pécs, Hungary; 6 EIL-ALPS, EIL-HU, Szeged, Hungary

Gigawatt Peak Power Pulses in the 5-9 μm Window Driven by an Yb Amplifier

J. Aastrauskas, G. Archipovaite, V. Shukamova, G. Fan, T. Lihas, E. Kukulis, E. Cermiri, T. Ballintink, A. Pugzlys, and A. Baltuska. 1 Photonics Institute, TU Wien, Vienna, Austria; 2 CELIA, Université de Bordeaux-CNRS-CEA, Talence, France; 3 DSO National Laboratories, Singapore, Singapore; 4 Center for Physical Sciences & Technology, Vilnius, Lithuania

A difference frequency between the signal and idler pulses of Yb:CaF₂ laser driven OPA, sub-mJ, mid-IR pulses tunable in the 5-9 μm spectral range, having peak powers above 1GW are generated and characterized.
High-Power Electro-Optically Controlled Divided-Pulse Amplification

H. Stark, J. Baldt, M. Müller, A. Klenke, H. Tönnermann, and J. Limper
d1,1,2
1 Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
2 University of Jena, Jena, Germany

Bursts of 8 pulses are amplified in 15 parallel fiber amplifiers. All signals are combined to a single pulse with 700 W average power and 16 m pulse energy, compressible to 260 fs pulse duration.

Strong plasmon-exciton interactions at a single nanoantenna level

T. Shegai, Chalmers University of Technology, Gothenburg, Sweden

In this talk, I will show that plasmon-exciton interactions between mono- and multilayer transition metal dichalcogenide and individual plasmonic nanoantennas can reach the level of strong plasmon-exciton coupling.

Realization of Aharonov-Bohm Cages in Photonic Lattices

S. Mukherjee, M. Di Liberto, P. Öhberg, R. R. Thomson, and N. Goldman
1 The Pennsylvania State University, State College, USA
2 Université Libre de Bruxelles, Bruxelles, Belgium
3 Heriot-Watt University, Edinburgh, United Kingdom

We experimentally demonstrate how the interplay between lattice connectivity and synthetic magnetic flux yields full localization of light in a rhombic array of optical waveguides, a phenomenon known as Aharonov-Bohm cages.

Network integration and coherent operation of telecom entangled light sources based on semiconductor quantum dots

1 Toshiba Research Europe Ltd., Cambridge, United Kingdom
2 Cavendish Laboratory, University of Cambridge, Cambridge, United Kingdom
3 Department of Electronic & Electrical Engineering, University of Sheffield, Sheffield, United Kingdom
4 EPSRC National EpiRay Facility, University of Sheffield, Sheffield, United Kingdom

We operate quantum-dot entangled photon-pair sources emitting in the telecom O- and C-band. Stable transmission of entanglement over installed networks and generation of highly coherent states for teleportation prove their suitability for future network integration.

An Entanglement-based wavelength multiplexed quantum communication network

S. Wengrowsky, S. K. Joshi, F. Steinlechner, and H. Häbel
1 Institute for Quantum Optics and Quantum Information - Vienna (IQUOi), Vienna, Austria
2 Quantum Engineering Technology Labs, H. H. Wills Physics Laboratory & Department of Electrical and Electronic Engineering, University of Bristol, Bristol, UK, Bristol, United Kingdom
3 Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
4 Austrian Institute of Technology, Vienna, Austria

An analytical model of the thermal phase noise of an optically pumped Vertical-External-Cavity Surface-Emitting Laser is established starting from a heat equation resolution and propagating both pump-induced and fundamental temperature fluctuations within the laser mode.

Third Harmonic Generation with Double-side Pumped MEMS

C. Schrauder, A. Klenke, M. Cernowitz, R. Schiebinger, and M. A. Schmidt
1 Leibniz-Institute of Photonic Technology, Jena, Germany
2 Abbe School of Photonics and Faculty of Physics, Friedrich Schiller University, Jena, Germany
3 Otto-Schott-Institute of Material Research, Friedrich-Schiller University Jena, Germany

Ultrafast third harmonic generation in a liquid core fiber filled with a C2Cl4 is demonstrated experimentally for different pump pulse durations (30fs...
Modifying the Optical Phonon Response of Nanocrystals inside Terahertz Plasmonic Nanocavities

A. Saetchnikov, 1, 2 E. Tcherniavskaya, 1, V. Saetchnikov, 1 and A. Osthoff 1

Inhomogeneous broadening of a polaritonic mode in the ultrastrong coupling regime

S. Rajahult, C. Scalari, J. Keller, M. Beck, and J. Faist; ETH Zurich, Institute of Quantum Electronics, Auguste-Piccard-Hof 1, Zurich, Switzerland

We investigate the influence of the capacitive gap width of complementary split ring resonators on their coupling to Landau level transitions. Below a threshold width, the upper polarization of the coupled system broadens inhomogeneously.

Biochemical kinetic parameters evaluation by resonator-based multiplexed sensor

A. Saetchnikov, 1, 2 E. Tcherniavskaya, 1, V. Saetchnikov, 1 and A. Osthoff 1

Locking of domain walls and quadratic frequency combs in doubly resonant optical parametric oscillators

P. Barra-Rivas, 1, L. Gelens, 2 T. Hanson, 3 W. Balibar, 4 and F. Leo 4

Inhomogeneous broadening of a transition values is less than 5% for different analyte concentrations.

Soliton Enhancement Cavities

N. Lilenfen 1, 2 M. Högener 1, 3, C. Hofer 1, 2, 3, L. Razzari 1, and F. Palazon 3

We report generation of >50 kW narrow-line radiation at 5.7 THz from a pulsed KTP off-axis THz parametric oscillator seeded by a synchronously pumped KTP THz parametric generator.

Ultrafast single-shot burst imaging in a few-nanosecond window using a spectrally tagging laser

H. Nomo, T. Suzuki, K. Matsushita, K. Takasawa, and F. Kansai; Keio University, Yokohama, Japan

Adopting spectrally sweeping laser pulses and a 1-kps fast camera to sequentially timed all-optical mapping photography utilizing spectral filtering (SF-STAMP), we realize single-shot 2-D burst imaging with a nanosecond time window at every 1 ms.

Metasurface-enabled Fourier-transform optical pulse shaper

S. Divitt, 1, 2 W. Zhu, 1, 2 C. Zhang, 1, 2 L. Chen, 1, 2, H. Lezec, 1, 2, and A. Agrawal 1, 2

Physical Institute – Solids and Nanostuctures, University of Göttingen, Göttingen, Germany; 2 Institute of Physics, University of Augsburg, Augsburg, Germany; 1 International Center for Advanced Studies of Energy Conversion (ICASEC), University of Göttingen, Göttingen, Germany

We demonstrate the first femtosecond microscopy using high-harmonic radiation. The ultrafast demagnetization dynamics in the network of nanoscale magnetic domains are quantitatively mapped with 30 nm spatial, and 50 fs temporal resolution.

Ultrafast Spin Dynamics Resolved with High-Harmonic Generation Microscopy

S. Zayko, 1 O. Khr, 1 M. Heigl, 2 M. Lohmann, 1 M. Soris, 1 M. Albrecht, 2 and C. Ropers, 1, 2

We investigate the formation, through the locking of domain walls of localized dissipative structures, and their corresponding frequency combs, in doubly resonant dispersive optical parametric oscillators.

In the work we report on quantification of the kinetic parameters of protein adsorption via resonator-based multiplexed sensor.

Below a threshold width, the up-converted values is less than 5% for different analyte concentrations.

Locking of domain walls and quadratic frequency combs in doubly resonant optical parametric oscillators

P. Barra-Rivas, 1 L. Gelens, 2 T. Hanson, 3 W. Balibar, 4 and F. Leo 4

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Inhomogeneous broadening of a polaritonic mode in the ultrastrong coupling regime

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We report generation of >50 kW narrow-line radiation at 5.7 THz from a pulsed KTP off-axis THz parametric oscillator seeded by a synchronously pumped KTP THz parametric generator.
Modal properties of Yb-doped 4-core fibers under heat load
F. Poli1, J. Legggaard2,3, A. Cacinotti3, and S. Selleri1
1Department of Engineering and Architecture, University of Parma, Parma, Italy; 2DTU Fotonik, Department of Photonics Engineering, Technical University of Denmark, Kongens Lyngby, Denmark
The influence of thermo-optic refractive-index changes on supermode guiding properties of 4-core fiber amplifiers is numerically studied for the first time. Besides effective area shrinking, the higher-order supermode guidance is demonstrated at high heat load.

Towards near-field coupling of surface plasmon polaritons across few-micrometer gaps between two laterally tapered gold waveguides
V. Smirnov1, S. Stephan1, M. Westphal2, H. Kollmann1, D. Emmrich1, A. Beyer1, A. Gößhäuser2, C. Lienau1, and M. Siles1
1Institute of Physics and Center of Interface Science, Carl von Ossietzky University Oldenburg, Oldenburg, Germany; 2Faculty of Physics, University Bielefeld, Bielefeld, Germany
Optical spectro-microscopy is used to study the coupling of two sized, tapered plasmonic waveguides fabricated using GaAs-based FIB via SPP waves. For gap sizes below 20nm between the waveguides near-field coupling is observed.

Plasmon-plasmon Coupling Probed by Ultrafast, Strong Photoemission with <7 Å Sensitivity
Z. Pápa1,2,3, J. Budai1,3, I. Mártón1, P. Wrobel1, T. Stefaniuk1, and S. H. O. Wegener1
1Faculty of Physics, University of Warsaw, Warsaw, Poland; 2Institute of Photonics and Quantum Sciences, Heriot-Watt University, Edinburgh, UK; 3Department of Physics, University of Bath, Bath, UK
Mode-selective multicores fibre photonic lanterns are used to create a 6-mode multimode optical fibre link that is considerably more resistant to focal ratio degradation (FRD) than a 6-mode step-index optical fibre.

Towards topological quantum states of light and sound in 2D arrays with solid state emitters: A novel quantum hybrid platform
M. A. Lemonde1, V. Peano2, P. Rabl3, and D. D. Angelakis2
1Centre for Quantum Technologies, Singapore, Singapore; 2Institute for Theoretical Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany; 3Vienna Center for Quantum Science and Technology, Vienna, Austria
We fabricate an integrated beam splitter for topologically protected photonic states in a linear array of evanescently coupled waveguides. We use this device for successfully observing high visibility 2-photon quantum interference between topological modes.

Remote State Preparation and Quantum Steering based on Hybrid Entanglement of Light
T. Darras1, A. Cavalière2, H. Le Jeannic1, J. Raskop1, K. Huang1, G. Guccione1, and J. Laurat1
1Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-PSL, Université, Collège de France, Place Jussieu, 75005, Paris, France; 2Niels Bohr Institute, University of Copenhagen, Blegdamsvej 17, DK-2100, Copenhagen, Denmark
We experimentally demonstrate non-Abelian geometric phases by measuring Wilson loops in femtosecond laser written waveguide arrays. To ensure the adiabaticity of the process, we harness the novel concept of quantum metrics for optimization.

Entanglement between a photonic time-bin qubit and a collective atomic spin in an ion trap
P. Ferrars3, G. Heinze1, and H. de Riedmatten1,2
1ICFO - The Institute of Photonic Sciences, Barcelona, Spain; 2CREA - Institutio Catalana de Recerca e Estudis Avançats, Barcelona, Spain
Light-matter entanglement combines long-distance transmission advantage of photonic qubits with storage and processing capabilities of atomic qubits. In this work we used a laser-cooled atomic cloud to generate entanglement between photonic time-bin qubits and atomic spin-waves.

Optical Quantum Hybrid Steering of Four Non-Abelian Geometric Phases based on Quantum Metric
M. Kremer, L. Teuber, A. Szameit, and S. Scheel1,2,3
1Institut für Physik, Universität Rostock, Rostock, Germany
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Remote State Preparation and Quantum Steering based on Hybrid Entanglement of Light
T. Darras1, A. Cavalière2, H. Le Jeannic1, J. Raskop1, K. Huang1, G. Guccione1, and J. Laurat1
1Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-PSL, Université, Collège de France, Place Jussieu, 75005, Paris, France; 2Niels Bohr Institute, University of Copenhagen, Blegdamsvej 17, DK-2100, Copenhagen, Denmark
We fabricate an integrated beam splitter for topologically protected photonic states in a linear array of evanescently coupled waveguides. We use this device for successfully observing high visibility 2-photon quantum interference between topological modes.

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Technical University of Denmark,
Parma, Italy
1
2
3

Department of Photonics Engineering,
Technical University of Denmark,
Kongens Lyngby, Denmark

Room 14-5 ICM
17:00

Modal properties of Yb-doped 4-core fibers under heat load
F. Poli1, J. Legggaard2,3, A. Cacinotti3, and S. Selleri1
1Department of Engineering and Architecture, University of Parma, Parma, Italy; 2DTU Fotonik, Department of Photonics Engineering, Technical University of Denmark, Kongens Lyngby, Denmark
The influence of thermo-optic refractive-index changes on supermode guiding properties of 4-core fiber amplifiers is numerically studied for the first time. Besides effective area shrinking, the higher-order supermode guidance is demonstrated at high heat load.

Plasmon-plasmon Coupling Probed by Ultrafast, Strong Photoemission with <7 Å Sensitivity
Z. Pápa1,2,3, J. Budai1,2,3, I. Mártón1, P. Wrobel1, T. Stefaniuk1, and S. H. O. Wegener1
1Faculty of Physics, University of Warsaw, Warsaw, Poland; 2Institute of Photonics and Quantum Sciences, Heriot-Watt University, Edinburgh, UK; 3Department of Physics, University of Bath, Bath, UK
Mode-selective multicores fibre photonic lanterns are used to create a 6-mode multimode optical fibre link that is considerably more resistant to focal ratio degradation (FRD) than a 6-mode step-index optical fibre.

Remote State Preparation and Quantum Steering based on Hybrid Entanglement of Light
T. Darras1, A. Cavalière2, H. Le Jeannic1, J. Raskop1, K. Huang1, G. Guccione1, and J. Laurat1
1Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-PSL, Université, Collège de France, Place Jussieu, 75005, Paris, France; 2Niels Bohr Institute, University of Copenhagen, Blegdamsvej 17, DK-2100, Copenhagen, Denmark
We fabricate an integrated beam splitter for topologically protected photonic states in a linear array of evanescently coupled waveguides. We use this device for successfully observing high visibility 2-photon quantum interference between topological modes.

Technical University of Denmark,
Parma, Italy

Room 14-6 ICM
17:15

A focal ratio-degradation (FRD) resistive multimode fibre link using mode-selective photonic lanterns
A. Benoît1, Y. Yerolatsitis1, K. Harrington1, T.A. Birks2, and R.R. Thomson3
1Institute of Photonics and Quantum Sciences, Heriot-Watt University, Edinburgh, UK; 2Department of Physics, University of Bath, Bath, UK
Mode-selective multicore fibre photonic lanterns are used to create a 6-mode multimode optical fibre link that is considerably more resistant to focal ratio degradation (FRD) than a 6-mode step-index optical fibre.

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We fabricate an integrated beam splitter for topologically protected photonic states in a linear array of evanescently coupled waveguides. We use this device for successfully observing high visibility 2-photon quantum interference between topological modes.
Coherent coupling of single molecules to microresonators

J. Sikaria1, D. Rattenbacher1, J. Renger3, T. Utkul2, S. Goetzinger2,1, and V. Sandoghdar2,1,2,3
Max Planck Institute for the Science of Light, Erlangen, Germany;
1Department of Physics, Friedrich Alexander University Erlangen-Nuremberg, Erlangen, Germany

We report on fabrication and use of chip-based micro-resonators to efficiently couple light to single dye molecules. We observe enhancement of light-matter coupling by a factor of 3.5 compared to a simple waveguide.

Non-radiative near-field interactions with molecules. We observe enhancement of light-matter coupling by a factor of 3.5 compared to a simple waveguide.

EG-6.5 THU 17:00

Graphene Near-field Interactions for the Observation of DNA Hybridization in Aqueous Environment with Nanoscope Resolution

R.M.R. Adão1, R. Campos3, E. Figueiras2, P. Alpuim2, and J.B. Nieder2,1,2,3
1,2Dept. of Nanophotonics, INL - International Iberian Nanotechnology Laboratory, Braga, Portugal;
3Dept. of Physics, University of Minho, Braga, Portugal

Non-radiative near-field interaction with molecules.

EG-6.6 THU 17:15
13:00 – 14:00
CD-P: CD Poster session

CD-P.1 THU
Retaining 3D laser pulse shape at sum frequency generation processes
Possibility of effective second, fourth and third harmonics generation with retaining of a shape of linearly chirped ellipsoidal IR laser pulses with triangular temporal intensity profile has been demonstrated numerically.

CD-P.2 THU
Effect of annealing on nonlinear optical properties of 70% deuterated DKDP crystal at 355 nm
D. Cai, X. Pan, X. Xu, Z. Wang, and X. Sun; State Key Laboratory of Crystal Materials, Shandong University, Jinan, China
Thermal annealing decreased the nonlinear absorption and refraction of DKDP crystal, which could lead an improvement of the laser-induced damage threshold. This indicated nonlinear properties may play important role in the damage process.

CD-P.3 THU
Nonlinear optical label-free multimodal imaging of neurons, astrocytes and glial interfaces
M.S. Pochechuev1,2, M.V. Lomonosov Moscow State University, Moscow, Russia; 2Russian Quantum Center, Moscow, Russia; 3Kazan Quantum Center, A.N. Tupolev Kazan National Research Technical University, Kazan, Russia; 4Kurchatov Institute National Research Center, Moscow, Russia; 5M.M. Shemyakin and Yu.A. Ovchinnikov Institute of Bioorganic Chemistry, Moscow, Russia
Combination of harmonics generation and multiphoton microscopy of endogenous chromophores is shown to enable imaging of neurons, astrocytes and glialvascular interfaces in rat brain without exogenous labels.

CD-P.4 THU
Thermal effects in a single-frequency optical parametric oscillator pumped by a master oscillator fiber amplifier laser
T. Hamoudi1,2, J.-B. Dherbecourt1, X. Dèler2, A. Godard2, P. Georges2, M.-M. Melkonian1, and M. Raybaud1; 1DPHY, ONERA, Université Paris Saclay, Palaiseau, France; 2Laboratoire Charles Fabry, Institut d’Optique Graduate School, CNRS, Université Paris-Saclay, Palaiseau, France
We investigate thermal effects in a nested-cavity doubly resonant optical parametric oscillator (NesCOPO), pumped by a high repetition rate laser, and the consequences on its spectral characteristics.

CD-P.5 THU
Adaptive spectral phase optimization of high repetition rate fiber-optic frequency combs for enhanced nonlinear spectral broadening
B.S. Vikram, R. Prakash, S.K. Selvaraja, and V.R. Supradeepa; Indian Institute of Science, Bangalore, India
We demonstrate enhanced spectral broadening of a 9 line, 25GHz C-band electro-optic frequency comb in highly nonlinear fiber through adaptive optimization of spectral phase, increasing the bandwidth by over 13 times to 121 lines.

CD-P.6 THU
Lithium-niobate-based Cavity Resonator-Integrated Guided-mode Resonance Filters
S. Calvez, A. Mommayrani, and O. Gauthier-Lafaye; LAAS-CNRS, Université de Toulouse, CNRS, Toulouse, France
We report the fabrication and characterization of the first Cavity Resonator-Integrated Guided-mode Resonance Filters made using lithium niobate on insulator (LNOI) technology for nonlinear optics applications. The measured resonant characteristic shows a Q-factor of ~1620.

CD-P.7 THU
Ge/SiGe Asymmetric Quantum Wells for Second Harmonic Generation in the Mid-Infrared
J. Frerigeri1,2, A. Ballabio1, C. Ciano1, A. Mancini2, L. Baldaasare2, J.-M. Melkonian1, and M. Raybaud1; 1DPHY, ONERA, Université Paris Saclay, Palaiseau, France; 2Laboratoire Charles Fabry, Institut d’Optique Graduate School, CNRS, Université Paris-Saclay, Palaiseau, France
We present the theoretical investigation and the experimental demonstration of second harmonic generation in the mid-infrared by hole-doped Ge/SiGe asymmetric quantum wells. Possible applications in non-linear molecular sensing are discussed.

CD-P.8 THU
Tailored spontaneous four-wave mixing in sinusoidally-tapered fibres
M. Saleh; Heriot-Watt University, Edinburgh, United Kingdom
A rigorous quantum model is developed to investigate spontaneous four-wave mixing in periodically-tapered waveguides. Using sinusoidally-modulated fibres with only 50 periods can enhance photon-pairs generation at on-demand frequencies and with high spectral-purity by 35 dB.

CD-P.9 THU
Parametric Mechanism of the Self-Mode-Locking in a CW Non-Stationary Superradiant Laser with a Combined DBR Fabry-Perot Low-Q Cavity
V. Kocharyov1, A. Mishin1, V. Kocharyov1,2, E. Kocharyovskay1,2, and V. Kukashkin1,2; 1Institute of Applied Physics, Russian Academy of Science, Nizhny Novgorod, Russia; 2Department of Physics and Astronomy, Texas A&M University, College Station, USA
We find a new parametric mechanism of self-mode-locking which operates via beating of two su-perradiant lasing modes with a period two times less that a roundtrip period and doesn’t require implementation of any standard mode-locking technique.

CD-P.10 THU
Nonlinear frequency conversion of broadband mid-IR laser radiation
A. Ilov, I. Krynąrsy, V. Klimachev, A. Kotkov, A. Kozlov, D. Sinitsyn, and L. Seleznay; P.N.Lebedev Physical Institute of Russian Academy of Sciences, Moscow, Russia
Nonlinear frequency conversion of broadband mid-IR radiation of different molecular gas lasers by various nonlinear crystals converting their multi-line emission into broadband radiation on sum and difference frequencies within 1.7 – 17 µm is discussed.
tions that modify the fluorescence lifetime of fluorophores in the vicinity of graphene are used to develop a DNA biosensor. The developed biosensor allows observation of the DNA hybridisation process with nanometer resolution.

Here we present nonlinear measurements obtained on GaAs nanowires partially coated by gold in an asymmetric way.

CD-P.11 THU

Peak Power Enhancement of Yb:YAG Laser Pulses by Second Harmonic Generation with Time Preadelay in Borate Crystals
• M. Dudea1,2, O. Novák1, H. Turtičová2, M. Chyła1, V. Kubec2, M. Smrž1, and T. Macek1; 1HiLESE Centre, Institute of Physics CAS, Dolní Břežany, Czech Republic; 2Faculty of Nuclear Sciences and Physical Engineering, CTU in Prague, Prague, Czech Republic

CD-P.12 THU

Optimization of the Efficient Single Pass Two-Stage DFG of Er and Yb Fiber Lasers Radiation into Mid-Infrared Region.
• A. Gulyaško1, I. Larionov1,2, and V. Tyrtshynny1; 1NTO IRÈ-Polus, Fryazino, Russia; 2Moscow Institute of Physics and Technology, Dolgoprudny, Russia

We investigate the difference frequency generation to the mid-infrared region with 20 W average power in tandems of PPLN or PPLT crystals. The theoretical model allowed optimizing conversion setup by tuning seed wavelength.

CD-P.13 THU

Nonlinear chiroptical response of GaAs nanowires partially covered by Au
• A. Belardini1, J. Collins2, D. Hooper2, E. Petronijevic, T. Hakkarainen1, E. Koivusalo1, R. Novák1,2, J. Collins3, S. Soumalainen1, M. Guina1, V. Válek1, and C. Sibilia1; 1Sapienza Università di Roma, Roma, Italy; 2University of Bath, Bath, United Kingdom; 3Tampere University of Technology, Tampere, Finland

Extrinsic chirality can be dramatically evidenced by using circular polarised light in the second harmonic field.

Guide showing ultra-low modal THz losses, improving significantly previous demonstrations. High-Q THz cavities by etching circular holes in the waveguide membrane are also demonstrated.

CaF2 enabling spectral coverage of the whole 1-6 µm region is also presented.

CD-P.16 THU

Experimental investigation of ultrafast solitonic all-optical switching in a high index contrast dual-core optical fiber
• M. Longobucco1, A. A. Guiffrida1,2, I. Astrauska2, A. Pugzlys2, D. Pyys1, M. Urtjasouza1, A. Baitiska1, R. Buczynski1,2, and I. Bugár1; 1Institute of Electronic Materials Technology, Wólczyńska 133, 01-919 Warsaw, Poland; 2Department of Geophysics, Faculty of Physics, University of Warsaw, Pasteura 5, 02-093 Warsaw, Poland; 3Photonics Institute, Vienna University of Technology, Gusshausstrasse 27-37, 1040 Vienna, Austria; 4International Laser Centre, Ikorňova 3, 841 04 Bratislava, Slovakia, Slovakia

Experimental study of novel all-optical switching concept based on self-trapping of ultrafast sub-nJ solitons in high-index contrast dual-core fiber. Nonlinear switching and moderate spectral broadening were observed through single-core output camera pictures and spectral registrations.

CD-P.17 THU

Polarization modulation instability in all-normal dispersion microstructured optical fibers with quasi-continuous 1064 nm pump
• A. Loredo-Trejo1, Y. López-Díezgués1,2, L. Velázquez-Ibarra1,3, A. Díez1, E. Silvestre2, and M. Andrés2; 1Instituto de Optica - ICMM, Universidad de Valencia, Burjassot, Spain; 2Departamento de Física Aplicada - ICMM, Universidad de Valencia, Burjassot, Spain; 3División de Ingeniería Campus Urrutiko-Salamanca, Universidad de Guanajuato, Salamanca, Mexico; 4Departamento de Física, Universidad de Guanajuato, León, Mexico; 5Departamento de Óptica - ICMM, Universidad de Valencia, Burjassot, Spain

Experimental observation of polarization modulation instability (PMI) in all-normal dispersion microstructured optical fibers pumped in the picosecond regime is reported. Only one PML process was observed. Residual fiber birefringence is enough to produce widely spaced sidebands.

CD-P.18 THU

Quadratic solitons and their interaction with dispersive waves in Lithium Niobate nano-waves.
• W. Rowe, A. V. Gorbach, and D. V. Skryabin; Centre for Photonics and Photonic Materials, Department of Physics, University of Bath, Bath, United Kingdom

We investigate the frequency conversion due to the mixing of the dispersive waves and quadratic solitons in Lithium Niobate nano-waves. Analytical predictions for frequencies of the dispersive waves are backed up by simulation.

CD-P.19 THU

Tunable Near 3-µm Difference Frequency Generation Using Ytterbium and Broadband Seed Erbium Fiber Lasers
• I. Larionov1,2, A. Gulyaško2, and V. Tyrtshynny2; 1Moscow Institute of Physics and Technology, Dolgoprudny, Russia; 2IRE-Polus, Fryazino, Russia

Wavelength tunable parametric generation of mid-infrared radiation in the periodically poled lithium niobate crystals was investigated. Up to 8 W of output radiation power with 15% conversion efficiency was obtained in 2.9–3.1 µm tuning range.

CD-P.20 THU

Photonic crystal fiber infiltrated with carbon tetrachloride for supercontinuum generation
• V.T. Hoang1,2, R. Kasztelan1,2, A. Filipkowski1,2, M. Klomczak1,2, D. Pyys1, G. Stepniewski1,2, K. Dinh Xuan1, and R. Buczynski1,2; 1Institute of Electronic Materials Technology, Warsaw, Poland; 2Faculty of Physics, University of Warsaw, Warsaw, Poland; 3Department of Physics, Víň University, Víň, Vietnam
We report all-normal dispersion supercontinuum generation in photonic crystal fiber with carbon tetrachloride liquid core. The supercontinuum in the range 850-1250 nm is achieved with 400 fs pulses with 62.5 kW of peak power.

**CD-P.21 THU**

**Temperature Noncritical Phase Matching For Borate Crystals**

S. Gagarsky, S. Grechin, P. Drachnin, K. Kato, D. Kochier, and N. Umemura

**CD-P.22 THU**

**4π-periodicity of Stokes Vector in Second Harmonic Generation from Bacteriorhodopsin protein**

A. Di Vita and F.A. Bovino

**CD-P.23 THU**

**Achromatic Electro-Optic Modulation using Cascaded Lithium Niobate Tidiffused Waveguides**

M. Foin, G. Martin, S. Lacour, G. Ulliac, and N. Courjal

**CD-P.24 THU**

**Impact of the electrical configuration on the thermal poling of optical fibres with embedded electrodes: theory and experiments**

F. De Lucía, R. Bannerman, J. Gaito, M.A. Nizey Velasquez, J. Sahú, N. Englebert, F. Leo, S.-P. Gorza, and P. Sazio

**CD-P.25 THU**

**Tunable mid-infrared continuous-wave optical parametric oscillator based on fan-out grating PPLN pumped at 1064 nm**

J.-K. Yoo, I.-h. Bae, S. Lim, S.K. Kim, D. H. Lee, D. Kroemer, P. Sazio; 1: division of physical metrology, Korea research institute of standards and science, daejeon, South Korea; 2: quantum technology institute, Korea research institute of standards and science, daejeon, South Korea. We developed a continuous-wave optical parametric oscillator that can be tuned from 2.5 μm to 5 μm based on fan-out grating PPLN pumped at 1064 nm.

**CD-P.26 THU**

**Development of Periodically Poled Lithium Niobate Zinc-Indiffused Ridge Waveguides at Blue Wavelengths**

A.C. Gray, L.G. Carpenter, S.A. Berry, J.C. Gaito, C. Holmes, P.G. Smith, and C.R.E. Gwathm

**CD-P.27 THU**

**Single-Pass Generation of Spatial-Temporal Coupled States from Multimode and Vacuum**

T. Koudou, L. La Volpe, S. De, C. Fabre, V. Parigi, and N. Treps; Laboratoire Kastler Brossel, Paris, France

We show the single-pass generation of entangled states featuring spatial-spectral quantum correlations via SPDC. They constitute multimode building blocks of dual-rail cluster states, which can be achieved via multiplexing in the time (pulsed) domain.

**CD-P.28 THU**

**Green-pumped optical parametric oscillator based on fan-out-grating periodically-poled Mg-doped congruence LTAO**

Sukkert, C.K. Suddapaith, and M. Ebihara

**CD-P.29 THU**

**Dynamics of coupled degenerate parametric oscillators beyond coupled Ising spins**

L. Bello, M.C. Strinati, E.G. Dalla Torre, and A. Peir

**CD-P.30 THU**

**A tellurite all-solid hybrid microstructured fiber with ultra-small chromatic dispersion fluctuation**

H.P.T. Nguyen, H.T. Tong, T.S. Saini, X. Luo, T. Suzuki, and Y. Oishi; Toyota Technological Institute, Nagoya, Japan

We report a tellurite all-solid hybrid microstructured fiber with ultra-small chromatic dispersion fluctuation which has the potential as mid-infrared fiber optical parametric amplifier medium.

**CD-P.31 THU**

**Optical Computing of Mathematical Derivatives using Dispersion and Coherent Detection**

M. Suthar and B. Jalaludin

**CD-P.32 THU**

**Coherent Mid-IR Supercontinuum Generation using Tapered Chalcogenide Step-Index Fiber**

T.S. Saini, H.P.T. Nguyen, X. Luo, T.H. Tong, T. Suzuki, and Y. Oishi; Research Center for Advanced Photon Technology, Toyota Technological Institute, Nagoya, Japan

We demonstrate coherent mid-IR supercontinuum extending from 1.6 μm to 3.7 μm using a 3 cm long tapered chalcogenide fiber pumped with femtosecond laser pulses of the peak power of 18.4 kW at 2.5 μm.

**CD-P.33 THU**

**Picoscope Deep Ultraviolet Pulses Generated in Excess of the 1030 nm Fundamental Beam**


**CD-P.34 THU**

**Piezoelectric Resonance Laser Calorimetry of LBO Crystals at Low Air Pressures**

I. Shebashkina, A. Koshevnkov, A. Koryolkov, A. Konyashkin, and O. Ryabushkin

**CD-P.35 THU**

**Generation of synchronized, narrow bandwidth picosecond pulses in the visible spectral region based on an Yb pump laser**

E. Elmer and A. Ziemunsch

We present a novel, simple source of synchronized, narrow bandwidth ps pulses in the visible based on an Yb pump laser suitable especially for CARS and SRS microscopy under electronic pre-resonance conditions.
Magic crossing points of temperature dependent cascaded frequency conversions in nonlinear photonic crystals

• S. Mohand Ousaid; Laboratoire de Physique de Lasers CNRS UMR 7538, Université Paris 13, Sorbonne Paris Cité, Villetaneuse, France

We report the study of crossing points when mapping the nonlinear interactions vs temperature in PPLT-2D. Results suggest a novel approach to generate entangled photons with controlled spectral features by parametric down conversion interactions.

Towards optimized photon-pair sources for two-photon transitions

• A. Krstić, J. Pierangeli, Y. Ran, L. Z. Rajaofara, S. Nolte, G. Millot, P. Leproux, J. Lægsgaard, H. Kano, A. Picozzi, F. Setzpfandt; 1 Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-University Jena, Jena, Germany; 2Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena, Germany

We investigate the spectral properties of two-photon absorption of photon pairs and identify regimes of photon-pair spectra that induce these transitions optimally, characterized as a non-linear polarization function hidden in the middle point of a single higher-order mode of a photonic crystal fiber are numerically investigated using a novel simulation technique relying on a real-space representation of the non-linear polarization.

In Situ Fabrication of Far-Detuned Mid-Infrared Optical Fiber Waveguide Converters

• I. Alamgriz, N. Ablakerim, and M. Rochette; McGill University, Montreal, Canada

We demonstrate the fabrication of far-detuned waveguides from As2S3 microwires. The in situ technique is the most advantageous approach for the fabrication of waveguide converters with predetermined far-detuned wavelength offset.

Comparison of seedsources for a high-power, pico-second mid-IR optical parametric amplifier: Optical parametric generation versus supercontinuum

• R. Gainaud1,2, L. Reckoi1, O. Novák1, I. Matik1,3, H. Jelinková2, M. Smrt3, and T. Macák1; 1HLLACE Centre, Institute of Physics AS CR, Dohi Břevnov, Czech Republic; 2Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Prague, Czech Republic

We are developing a picosecond, high-power, parametric, mid-IR source broadly tunable in wavelength between 1.45 and 3.5 μm. We compare two different seed sources of the mid-IR system – an optical parametric generator and a supercontinuum

Femtosecond Coherent Anti-Stokes Raman Scattering Measurement of Gas Temperature Simultaneously from H2, N2 and CO2

• Y. Ran1, S. Notle1,2, A. Tümennörm1,2, and R. Ackermann1; 1Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-University Jena, Jena, Germany; 2Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

A two-beam femtosecond coherent anti-Stokes Raman scattering (fs-CARS) system is presented to provide accurate, high-repetition-rate thermometric measurements simultaneously and independently from H2, N2 and CO2 fs-CARS signals.

Continuum generation in higher-order modes of photonic crystal fibers

• J. Lægsgaard; DTU Fotonik, Technical University of Denmark, Ørsted Plads 343, Kongens Lyngby, Denmark

The perspectives for generating supercontinuum in a single higher-order mode of a photonic crystal fiber are numerically investigated using a novel simulation technique relying on a real-space representation of the non-linear polarization.

All-optical sampling of a 40 GHz signal based on four wave-mixing through a nonlinear InGaP on Silicon platform

• L. Constans; Center of Nanosciences and Nanotechnologies, Palaiseau, France

All-optical sampling of a 40 GHz signal is demonstrated using four-wave-mixing implemented in a low loss InGaP on Silicon waveguide. The sampled signal is reconstructed up to 40 GHz at a sampling rate of 2 GHz.

Femtosecond Laser-Written Waveguides In Periodically Poled MgO-Doped Stoichiometric Lithium Tantalate For Frequency Conversion

• S. Watanaabe, J. Hirohashi, K. Inami, M. Hoshi, and S. Makio; OiDXE Corporation, Yamanashi, Japan

We developed optical waveguides inside periodically poled MgO-doped stoichiometric LiTaO3 frequency conversion device by direct femtosecond laser writing. The waveguiding and SHG properties were characterized with a CW 1064 nm laser.

Comparison of seedsources for a high-power, pico-second mid-IR optical parametric amplifier: Optical parametric generation versus supercontinuum

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We developed optical waveguides inside periodically poled MgO-doped stoichiometric LiTaO3 frequency conversion device by direct femtosecond laser writing. The waveguiding and SHG properties were characterized with a CW 1064 nm laser.

Quasi-Phase-Matched Third Harmonic Generation in Periodic Stacks of Polymer Bilayers

• M. Cha1, J. Kim1, P. Kumar2, H. Cho3, K.-J. Kim2, and N. Peyghambarian1; 1Department of Physics, Pusan National University, Busan, South Korea; 2College of Optical Sciences, University of Arizona, Tucson, USA

Enhanced third harmonic generation (THG) was obtained from periodic stacks of polymer bilayers; polymer containing ethyl-violet molecules and passive resin. The quasi-phase-matching characteristics were verified by performing THG experiments with tunable fundamental wavelength.

ZnMgO:PPLN Waveguides for Rb cold Atom Trap based Quantum Gravitometry in a CubeSat

• C. Carpenter1,2, J. Berry1, T.H. Legg2, M.C. Farries2, C.I. Watson3, R.H.S. Bunneman1, A.C. Gray3, C. Holmes1, J.C. Gates1, P.R. Smith1,3, and C.B.E. Gwathm1,2; 1University of Southampton, Southampton, United Kingdom; 2Gooch and Hougso, Torquay, United Kingdom; 3Covenson Ltd, Romsey, United Kingdom

We will present our latest work on ZnMgO:PPLN ridge waveguides for magneto-optical cooling of Rb within a CubeSat. We will report on fabrication, secondary harmonic generation spectra/efficiency, loss, vibration and radiation testing.

Characterization of broadband spontaneous parametric down-conversion in periodically poled materials

• C. Lindner, S. Wolf, J. Kiefling, and F. Kämmnern; Fraunhofer Institute for Physical Measurement Techniques IPM, Freiburg, Germany

We develop an application-oriented model for the signal power density of broadband SPDC with near- to mid-infrared idler wavelengths. The model is verified by characterizing SPDC in periodically poled lithium niobate pumped at 532 nm.
Validation of échelle-based quantum-classical discriminator with novelty SPAD array sensor


*CEM, Neuchâtel, Switzerland; Fondazione Bruno Kessler, Trento, Italy; Universität Bonn, Bern, Switzerland; Institute of Physics, National Academy of Sciences of Belarus (IPNASB), Minsk, Belarus*

The separation of entangled and classical photons of the same optical wavelength is demonstrated with échelle grating and observed by novelty SPAD imager. Separation is possible due to de Broglie wavelength of entangled photon pair.

Entanglement Witness for Hybrid Bipartite States Based on the Negativity Volume of the Wigner Function

**J. Svozílík**

*Institute of Physics, University of Technology Sydney, Ultimo, Australia*

We report the experimental implementation of an indistinguishability witness for three photons. Such approach can be extended with limited interferometric complexity to n particles, and is able to testify and bound genuine multiphoton indistinguishability.

All-fibre postselection-loophole-free generation of a one-photon-time-bin qubit characterised by energy-time tomography

**J. M. Jacquet**, S. Zeppetzauer, L. Rozema, and P. Walther

*Vienna Center for Quantum Science and Technology (VCQ), Faculty of Physics, University of Vienna, Vienna, Austria*

We generate a one-photon-time-bin qubit without the postselection loophole characteristic of Franson experiments. The state is characterised by Quantum State Tomography in the Energy-Time basis. This is directly applicable to communication and computing tasks.

Tomography of Quantum Dots in a Non-Hermitian Photonic Chip

**S. H. White**, K. Wang, T. T. Tran, M. Kianinia, J. Titchener, M. Gräfe, S. Fischbach, J. D. Song, S. Zelitenstein, I. A. Aharonovich, A. Sukhorukov, A. Szameit, and A. S. Solntsev

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We present a novel single-photon chip capable of manipulating a quantum state, and allow for the reconstruction of the state, and the ability to perform arbitrary optical operations on the state.

Frequency-multiplexed single-resonant photon pairs from a quadratic nonlinear wavelength resonator


*Graduate School of Engineering Science, Osaka University, Toyonaka, Japan; Quantum Information and Quantum Biology Division, Institute for Open and Transdisciplinary Research Initiatives, Osaka University, Toyonaka, Japan; Advanced ICT Research Institute, National Institute of Information and Communications Technology, Kobe, Japan*

We demonstrated a frequency multiplexed photon pair generation by using a quadratic nonlinear optical waveguide monolithically integrated in an optical cavity which confines only one halves of the photon pairs.

Experimental demonstration of Entropic Steering

**S. Wollmann** and A. Costa

*University of Bristol, Bristol, United Kingdom; Federal University of Paraúna, Curitiba, Brazil*

Here we experimentally test a novel quantum steering criterion which is based on entropic uncertainty relations.

Experimental witness of genuine multiphoton indistinguishability

**D. J. Brodf**

*Instituto de Física, Universidade Federal Fluminense, Niterói, Brazil*

We present an integrated optical chip for efficient quantum tomography of photon states generated by quantum dots. The design of the chip is non-Hermitian and allows utilising optical losses for greater tolerance to errors.

Experimental witness of genuine multiphoton indistinguishability

**P. Marcucci**, P. Cala', G. Siggini', W. Man', C. Conti', and Z. Chen1,2

*Sapienza University, Rome, Italy; San Francisco State University, San Francisco, USA; Nankai University, Tianjin, China*

In optics, nonlinear Schroedinger equation rules many phenomena, including dispersive shock waves (DSWs).

Four-Port Interference Device on an Integrated Photonic Platform Based on Tilted Bragg Gratings


*Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom*

A novel interference device is investigated where multiple mode integrated waveguides are coupled via tilted Bragg gratings to a common cladding mode. We show that a competitive and compact 4x4-multiplexer can be achieved in this platform.

Operational Description of Single-Photon Detectors Including Timing-Jitter Effects

**E. Gouzi**, B. Fedrizzi', R. Mondaini, A. Zavattini, S. Tanzilli, and V. D’Auria

*Université Côte d’Azur, Institut de Physique de Nice (IPhYSN), CNRS UMR 7010, Nice, France; Istituto Nazionale di Ottica (INO-CNR), Firenze, Italy; LENS and Department of Physics, University of Firenze, Firenze, Italy*

We model single photon detectors by explicitly taking into account their timing-jitter, finite efficiency and dead-time effects. Our model represents the first operational and full description of temporal limitations of those detectors.

Entanglement Witness for Hybrid Bipartite States Based on the Negativity Volume of the Wigner Function

**I. Svozíl**

*Institute of Physics, University of Zielona Góra, Poland*

We present a new entanglement witness for arbitrary hybrid quantum states based on the generalized Wigner function. It is shown that this witness can be also applied on quantum systems undergoing decoherence effects.

Experimental demonstration of Entropic Steering

**S. Wollmann** and A. Costa

*University of Bristol, Bristol, United Kingdom; Federal University of Paraúna, Curitiba, Brazil*

We present an experimental test a novel quantum steering criterion which is based on entropic uncertainty relations.

Experimental witness of genuine multiphoton indistinguishability

**D. J. Brodf**

*Instituto de Física, Universidade Federal Fluminense, Niterói, Brazil*

We report experimental evidence of optical DSWs with an anisotropic zero-singularity in m-cresol/nylon, and theoretical describe it by time asymmetric quantum mechanics.

Multi-shear reconstruction of the joint spectral phase of two photons

**I. Gianani**

*Dipartimento di Scienze, Università degli studi di Roma Tre, Rome, Italy*

A novel multi-shear technique for the reconstruction of the joint spectral phase of a biphoton state is discussed. We report on simulations for the phase reconstruction and propose an experiment using a Franson-modified interferometer.

Single photon temporal wavepacket control and its application for qudit encoding

**K. Sedziak-Kacprzowicz, M. Lasota, and P. Kolenderski**

*Nicolaus Copernicus University, Torun, Poland*

We present a method of remote temporal wavepacket narrowing by utilizing spectrally entangled photon pairs. The technique can be applied to extend the range of quantum communication protocols and qudit encoding.

Cooperative States of Nd3+ Ion Pairs and Clusters in Nd3+-LaF3 crystal

**Y. Orlovskii**, S. Chekmanov', S. Bozhko', I. Ilitch', V. Tronets', M. Parfenov', and A. Shamrai

*M. Ioffe Institute, St. Petersburg, Russia; Institute of Solid State Physics Russian Academy of Sciences, Chernogolovka, Russia; ITMO University, St. Petersburg, Russia; Peter the Great Saint-Petersburg Polytechnical University, St. Petersburg, Russia*

A waveguide configuration of a single-photon detector on the lithium niobate substrate was demonstrated. Waveguide fabrication technological parameters were optimized for subsequent growth of NbN nanostructures with high superconducting properties (critical current density of 1.2×10^9 A/m^2).

Superconducting Single-Photon Detector for Lithium Niobate Integrated Quantum Photonic at Telecom Wavelengths

**P. Agruzov**, A. Ionov, S. Chekmanov, S. Bozhko, I. Ilitch', V. Tronets', M. Parfenov', and A. Shamrai

*M. Ioffe Institute, St. Petersburg, Russia; Institute of Solid State Physics Russian Academy of Sciences, Chernogolovka, Russia; ITMO University, St. Petersburg, Russia*

A waveguide configuration of a single-photon detector on the lithium niobate substrate was demonstrated. Waveguide fabrication technological parameters were optimized for subsequent growth of NbN nanostructures with high superconducting properties (critical current density of 1.2×10^9 A/m^2).
EB-P.14 THU
Variable Delay based on Electromagnetically Induced Transparency in Cesium at Room Temperature for Photon Storage
*I. Krohi, E. Gomez Lopez, C. Müller, J. Wolters, O. Benson; 1 Humboldt-Universität zu Berlin, Berlin, Germany; 2 Universität Basel, Basel, Switzerland
We present a controlled delay experiment based on electromagnetically induced transparency at the Cesium D1 hyperfine transitions for pair photons from cavity-enhanced SPDC. The results aim towards application as a room-temperature memory in quantum networks.

EB-P.15 THU
Plasmonic Quantum Walk in Gold Strip Parallel Waveguides
*N. Namekata, R. Kobayashi; 1,2 T. Nakai, A. Tada, D. Fukada, S. Iinoue; 1 Institute of Quantum Science, Nihon University, 1-8-14 Kanda-Surugadai, Chiyoda-ku, Tokyo, 101-8308, Japan; 2 R&D Center, Shimadzu Corporation, 2-11-40 Hachinohe, Ikeda, Osaka 563-8570, Japan
Continuous quantum walk was demonstrated using a plasmonic chip composed of 50 long range surface plasmon polariton parallel waveguides. Non-Gaussian intensity distribution different from that of classical random walk was successfully observed.

EB-P.16 THU
Subohmic decoherence of a quantum emitter embedded in a nanomechanical beam
J. Wilson-Rae; 1,2 A. Imamoglu, W. Zwerger; 1 Department of Physics, University of York, York, United Kingdom; 2 Institute of Quantum Electronics, ETH Zurich, Zurich, Switzerland; 3 Physik Department, Technische Universität München, Garching, Germany
We calculate the fluence of a quantum emitter embedded in a nanomechanical beam and find markedly non-Markovian features, including a strong dependence of the coherent fraction on the detuning and that the zero-phonon line collapses.

EB-P.17 THU
Circuit Quantum Electrodynamic Model of a Resonantly Phase-Matched Josephson Traveling Wave Parametric Amplifier
M. Haider, Y. Yuan, J. Abendos Patino, J. Rasser, P. Huster, and C. Irauschenk; Department of Electrical and Computer Engineering, TU Munich, Munich, Germany
A quantum mechanical closed analytic solution for a resonantly phase-matched Josephson traveling wave parametric amplifier, based on a discrete chain Hamiltonian, is derived. Our model is validated against available results from literature, yielding excellent agreement.

EB-P.18 THU
 Toward coupling color centers in single crystal diamond to two-dimensional materials
O. Opalich, R. Néel, M. Châllier, M. Radlke, A. Slablik, Z. Xu, I. Aharonovich, and E. Neu; 1 Faculty of Natural Science and Technology, Exp. Physics, University of Vienna; 2 University of Toronto, 66121 Saarbrücken, Germany; 3 Institute of Biomedical Materials and Devices (IBMD), Faculty of Science, University of Technology Sydney, Ultimo, NSW, 2007, Australia
We present results towards demonstrating the interaction of nitrogen vacancy color centers in single crystal diamond with tungsten-dilisilene WS6, via near-field energy transfer. We envisage using quenching of the NV center as a sensing resource.

EB-P.19 THU
Method for Quantum Key Establishment Through a Multimode Fiber
L. Amitonov; 1,2 T. Tentrup; 1, 2 Velekoop, and P. Pinke; 2 Complex Photonic Systems, University of Twente, Enschede, Netherlands; 2 Biomedical Photonic Imaging, University of Twente, Enschede, Netherlands; 3 Vrije Universiteit Amsterdam, Amsterdam, Netherlands
We present a fundamentally new concept for secure high-dimensional remote key distribution. Our method utilizes a quantum-secure frontwave shaping procedure and transmit information encoded into a few-photon light pulse through a light-scrambling multimode fiber.

EB-P.20 THU
Miniaturized Devices For Free Space Quantum Key Distribution; In Your Pocket And In Space.
D. Lowndes, S. Frick, A. Hart, and J. Rarity; University of Bristol, Bristol, United Kingdom
We discuss our miniaturized quantum key distribution source and novel implementations where it can be applied. Based on these applications we consider the specific requirements imposed on the source and possible improvements necessary.

EB-P.21 THU
A Ghost Communication Scheme based on 2nd Order Polarization Correlations
M. Roskopf, T. Mohr, and W. Elsäßer; Technische Universität Darmstadt, Darmstadt, Germany
We demonstrate a novel ghost communication scheme, camouflaging the information in the polarization state of unpolarized light. The 2nd order intensity correlation is used to retrieve the transmitted polarization state and thus the message.

EB-P.22 THU
The contribution has been withdrawn.

EB-P.23 THU
Nonlocal Dispersion Compensation in Multi-segment Deployed Telecommunications Fiber
J.A. Grieve, Y. Shi, H.S. Poh, C. Kurtisfeier, and A. Ling; 1 Centre for Quantum Technologies, Singapore, Singapore; 2 Department of Physics, National University of Singapore, Singapore, Singapore
Time-energy entangled photons pairs experience non-local dispersion compensation after propagation over multi-segment deployed telecommunications fiber. The preservation of tight timing correlations enables the use of broadband quantum light sources in existing metropolitan fiber networks.

EB-P.24 THU
Simulation of a Telecom-Provider Driven Reference QKD-Network
A. Poppa; 1, M. Gunke; 2, F. Wiese; 2, P. Schlichter; 2, D. Witt; 2, and M. Peetz; 2 Huawei Technologies Duesseldorf GmbH, Munich, Germany; 2 Deutsche Telekom Technik GmbH, Darmstadt, Germany
A reference network from Deutsche Telecom with 39 nodes and connected by 66 eges was used to simulate the deployment of QKD-links. Two existing algorithms optimizing telecom networks compete for uniformly distributed maximal key rates.

EB-P.25 THU
Highly Efficient Ultra-Broadband Entangled Photon-Pair Generation using a Chirped PPSLT Ridge Waveguide
B. Cao; 1, R. Okamoto; 1, M. Hisamitsu; 2, K. Tokuoka; 3, and S. Takeuchi; 1 Department of Electronic Science and Engineering, Kyoto University, Kyoto University, Kyoto, Japan; 3 Shimadzu Corporation, 2385-13, Liyama, Atsugi, Kanagawa 243-0213, Japan
We developed an entangled photon source based on the technology of chip Quasi-Phase Matching together with a ridge waveguide structure for highly efficient frequency entanglement generation with ultra-broadband spectra.

EB-P.26 THU
Entanglement generation by conversion of position correlation into polarization entanglement
A. Lohrmann; 1,2 C. Perumangal; 1, and A. Lohrmann; 1,2 Centre for Quantum Technologies, National University of Singapore, Singapore, Singapore; 3 Department of Physics, National University of Singapore, Singapore, Singapore
We present a compact source of polarization entangled photons from a single periodically poled potassium titanyl phosphate crystal. The source converts the intrinsic position correlation of photon pairs generated to a polarization entangled bi-photon state.

EB-P.27 THU
Polarization Measurement of Time-energy Entanglement
C. Perumangal; 1, A. Lohrmann; 1, and A. Ling; 1,2 Centre for Quantum Technologies, Singapore, Singapore; 3 Physics Department, National University of Singapore, Singapore, Singapore
In this work we convert the quantum correlation of time-energy entangled photons into polarization entanglement using unbalanced polarizing Michelson interferometers.

EB-P.28 THU
The contribution has been withdrawn.

EB-P.29 THU
Biphoton shaping with cascaded entanglement sources
A. Riaz; 1, E.Y. Zhu; 1, C. Chen; 1, A.V. Gladyshev; 2, P.G. Kazansky; 3, J.E. Sipe; 4, and L. Qian; 1 Department of Electrical and Computer Engineering, University of Toronto, Toronto, Canada; 2 Fiber Optics Research Center, Russian Academy of Sciences, Moscow, Russia; 3 Optoelectronics Research Center, University of Southampton, Southampton, United Kingdom; 4 Department of Physics, Toronto, Canada
We experimentally demonstrate the ability to simultaneously tune the spectral and polarization properties of biphotons through cascading two biphoton sources and altering the dispersion and birefringence properties of the medium in between.

EB-P.30 THU
Joint Topological and Polarization Entanglement Enables Noise-Resistant Optical Information Processing
A. Sergienko; 1, D. Simon; 1,2, and S. Osawa; 1,2 Boston University, Boston, USA; 3 Stony Brook College, Easton, USA
Linear-optical photonic quantum walks are used to jointly entangle polarization and topological winding number. This joint entanglement allows polarization entanglement-based quantum information processing tasks to be performed with high degree or error protection.

EB-P.31 THU
Removing phase ambiguity in fiber-based interferometers for coherent time-bin operations
P. Roztoka; 1, M. Islam; 1, C. Reimer; 2, B. Fischer; 2, S. Sciara; 1,2, Y. Zhang; 1, D.J. Moss; 3, M. Kues; 3, and D.J. Moss; 1,2,3 InRS-EMT, Varennes, Canada; 4 HyperLight Corporation, Cambridge, USA; 5 University of Palermo, Palermo, Italy; 6 Swinburne University of Technology, Hawthorn, Australia; 7 University of Glasgow,
A novel phase-recovery scheme for fiber interferometers, exploiting frequency-multiplexing in orthogonal fiber polarization modes, enables unambiguous phase mapping. This allows for computer-controllable arbitrary phase tuning and stabilization, providing a precise tool for time-bin qubit manipulation.

**EB-P.2 THU**

Quantum Transport of Multipartite-Entangled Edge States in Topological Insulators


We present a protocol for direct detection of arbitrary continuous phase errors in transmission of multi-photon spatially entangled quantum states, and present a design and experimental evidence for its realization in an integrated photonic circuit.

**EB-P.3 THU**

Adiabatic Transport of Multi-partite-Entangled Edge States in Topological Insulators

*A. Zavatta*, A. Cataliotti, A. Della Frera, A. Turpin, and L. Vaidman

We propose a scheme for quantum noiseless linear processor which can exhibit amplification or attenuation by tuning one coupling parameter of an optical parametric amplifier. Our approach has a high success probability for amplification gain $G > 2$.

**EB-P.4 THU**

Squeezing-Enhancement of Stimulated and Spontaneous Raman Spectroscopy

*Y. Michael, L. Bello, M. Rosenbluh, and A. Peér*

We present a new scheme for Raman spectroscopy, which significantly enhances the detection sensitivity beyond the shot-noise-limit while suppressing the nonresonant background using two-mode squeezed illumination.

**EB-P.5 THU**

Universality of local weak interactions and its application for interferometric alignment

*I. Dziewior*, L. Knip, D. Farfurnik, K. Senkalla, N. Benshalom, I. Efremov, I. Meinecke, S. Bar-Ad, H. Weinfurter, L. Vaidman, M.-Planck-Institut für Quantenoptik, 85748 Garching, Germany; *Department für Physik, Ludwig-Maximilians-Universität, 80797 München, Germany; *Raymond and Beverly Sackler School of Physics and Astronomy, Tel-Aviv University, Tel-Aviv 69978, Israel*

Based on a novel paradigm for the description of pre- and postselected quantum systems the universality of weak values is derived and tested experimentally, finding the basis of an efficient alignment technique for optical interferometers.

**EC-P.1 THU**

Orbital angular momentum in photonic integrated circuits

*A. Turpin*, G. Pelleg, J. Polo, J. Mompart, and V. Ahufinger

We demonstrate theoretically the existence of orbital angular momentum (OAM) supermodes in a three-evanescently-coupled waveguide system. We use this result to design OAM cloners and OAM inverters by adding dissipation to one of the waveguides.
Generation of Photon Pairs in Waveguide Arrays Supporting Topologically Protected Guided Modes

X. Bergamasco and M. Liscidini, Dipartimento di Fisica, Università degli studi di Pavia, Pavia, Italy

We study the generation of photon pairs by parametric fluorescence in topologically protected and trivial areas of energy backflow.

EC-P-4 THU

EC-P-5 THU

Bulk mode resonances in Floquet topological insulators based on coupled microring resonator lattices

S. Afed and V. Van, University of Alberta, Edmonton, Canada

We report a new optical resonance phenomenon based on light trapping in the bulk modes of Floquet topological microring lattices. These bulk-mode resonances do not require a cavity and exist only in nontrivial topological phases.

EC-P-6 THU

Optical Chiral Edge Modes at Magnetic Domain Boundaries in Continuous Gyrotropic Media

M. Marciani and P. Delplace, Univ Lyon, Ens de Lyon, Univ Claude Bernard, CNRS, Laboratoire de Physique, F-69342, Lyon, France

We show the emergence of interface chiral modes in continuous gyrotropic media and highlight their topological origin that precludes the need for a Brillouin zone.

EC-P-7 THU

Anderson localization in synthetic photonic lattice with static random coupling disorder

A. Pankov1, I. Vatnik2, D. Churkin3, and S. Derevyanko1; 1Novosibirsk State University, Novosibirsk, Russia; 2Ben Gurion University of the Negev, BeerSheba, Israel

We study Anderson localization in the synthetic photonic lattice with static disorder in the coupling ratio between two fiber loops. We obtain new analytical result for the localization length in the case of weak disorder.

EC-P-8 THU

Switching quasi- at modes at the interface between detuned anomalous Floquet topological insulators F. Piccioli,1 L. Mazzoczy, M. Kremer, M. Heinrich, and A. Szameit; Universität Rostock, Institute of Physics, Rostock, Germany

We show that the interface between topologically equivalent photonic Anomalous Floquet Topological Insulators supports trivial modes. A fraction of light flowing in a topological edge mode can be extracted and deposited on the interface mode.

EC-P-9 THU

Simulating artificial graphene with superconducting resonators

A. Morvan, M. Féchant, G. Aiello, J. Gabelli, and J. Es-tève; Laboratoire de Physique des Solides, CNRS, Univ. Paris-Sud, Université Paris-Saclay, Orsay, France

We present the observations of artificial graphenes re-alized with superconducting circuits. In particular, we present experimental observation of topological Se-menoff edge states at the interface between two gapped artificial graphenes.

EC-P-10 THU

Existence loci of bound states in the continuum in the parameter space of anisotropic planar structures

S. Mukherjee1, J. Gomis-Bresco1, P. Pujol-Closa1, D. Artigas1-3, and L. Torner1-3; 1ICFO-Institut de Cien-cies Fotòniques, The Barcelona Institute of Science and Technology, Castelldefels, Spain; 2Department of Signal Theory and Communications, Universitat Politècnica de Catalunya, Barcelona, Spain

We investigate the existence of bound states in the continuum (BICs) under the variation of system parameters in planar structures with uniaxial materials and uncover a topological transition under breaking of the anisotropy-symmetry.

EC-P-11 THU

Dirac and Exceptional Points in uniaxial waveguides J. Gomis-Bresco1, D. Artigas1-3, and L. Torner1-3; 1ICFO- The Institute of Photonic Sciences, The Barcelona Institute of Science and Technology, Castelldefels, Spain; 2Department of Signal Theory and Communications, Universitat Politècnica de Catalunya, Barcelona, Spain

We show the existence of Drac Points in highly struc-tural and anisotropy symmetric planar waveguides, which adiabatically transforms into two exceptional points by adding gain or losses.

EC-P-12 THU

Scattering of light in dimension (2+1): spin Hall effect and non-paraxial diffusion

X. Cherguet; Laboratoire Kastler Brossel, CNRS, Paris, France

I will show that light propagating in materials with spa-tial disorder along two transverse directions but longitu-dinally homogeneous exhibit a spin Hall effect. This is the first manifestation of spin-orbit interactions of light in the presence of disorder.

EC-P-13 THU

Experimental realisation of PT-symmetric flat bands

T. Biesenthal, M. Kremer, M. Heinrich, and A. Szameit; Institut für Physik, Universität Rostock, Rostock, Germany

This work experimentally connects the growing field of non-Hermitian photonics with light localisation in pho-tonic lattices. Here the intrinsic PT-symmetry induces a flat band structure with a compact localised eigenmode at the systems exceptional point.

EC-P-14 THU

Experimental Demonstration of a Non-Quantized Square Root Topological Insulator using Photonic Aharonov-Bohm Cages

M. Kremer1, I. Petrides2, E. Meyer2, M. Heinrich3, O. Zilberberg3, A. Szameit2; 1Institut für Physik, Universität Rostock, Rostock, Germany; 2Institut für Theoretische Physik, ETH Zürich, Zürich, Switzerland

We report a new type of insulator that displays non-quantized topological invariants. Moreover, a quantisa-tion reveals itself upon squaring the Hamiltonian, assur-ing the topological robustness. We experimentally verify these findings by using photonic Aharonov-Bohm cages.

EC-P-15 THU

Experimental Realization of Two-Dimensional PT-Symmetric Graphene: Bulk Properties and Edge States

M. Kremer1, T. Biesenthal1, L. Mazzoczy1, M. Heinrich2, R. Thomale3, and A. Szameit2; 1Institut für Physik, Universität Rostock, Rostock, Germany; 2Department of Physics and Astronomy, Julius-Maximilians-Universität Würzburg, Würzburg, Germany

We report the first implementation of a 2D PT-sym-metric crystalline structure. Using a novel isotropic loss mechanism in a photonic setting, we probe bulk and edge properties and study the interplay between PT-symmetry and topology.

EC-P-16 THU

Theoretical Description of a Non-Quantized Square Root Topological Insulator using Photonic Aharonov-Bohm Cages

M. Kremer1, I. Petrides1, E. Meyer2, M. Heinrich3, O. Zilberberg1, and A. Szameit1; 1Institut für Theoretische Physik, ETH, Zürich, Switzerland; 2Institut für Physik, Universität Rostock, Rostock, Germany

We predict a topological insulator with nonquantized in-dices, but with robust boundary states. We show that this robustness stems from the quantization of the indices in the corresponding system where the squared Hamil-to-nian is taken.
Nanostructured control of interactions of quantum emitters beyond electric dipole approximation
M. Kouk, O. Burylajenko2, and K. Slotw1; 1Institute of Physics, Nicolaus Copernicus University, Torun, Poland; 2Department of Physics and Technology, V.N. Karazin Kharkiv National University, Kharkiv, Ukraine
We investigate interactions and collective emission of multiple quantum emitters sharing the same photonic environment modified by nanostructured materials. Our analytical approach based on Green's tensor formalism allows steps beyond electric dipole approximation.

EG-P.6 THU
Photoelectrochemical water splitting with cobalt oxide coated gold nanorods under visible excitation
We investigated the generation of hydrogen evolution reaction with cobalt oxide coated gold nanorods in dilute sodium sulphate solutions under visible excitation.

EG-P.7 THU
Spectroscopic probing of retardation effects in the Casimir-Polder interaction: a theoretical study
J.C. de Aquino Carvalho, P. Pedri, M. Ducloy, and A. Lalliot; Laboratoire de Physique des Lasers, UMR7538 CNRS, Université Paris13, Sorbonne Paris-Cité, Villetaneuse, France
We analyze the fully retarded Casimir-Polder potential of cesium energy states. We show deviations from the electrostatic approximation even at nanometric distances away from the surface. These effects are measurable by selective reflection spectroscopy.

EG-P.8 THU
Investigation of Electrical Transport in Semiconductor Heterostructure Devices Coupled Strongly to the Light Field
B. Limbach,1,2 M. Kam2,2 S. Schönhauser3,1 M. Wencelawics, C. Deibel2,2 A. Andre2,2 H. Detz1,2 A. Schwaghofer2, B. Lendl1,2 G. Strauss1,2, J. Darmo1,3, and K. Unterrainer1,3; 1Photonics Institute, TU Wien, Vienna, Austria; 2Institute for Solid State Electronics, TU Wien, Vienna, Austria; 3Center for Micro- and Nanosstructures, TU Wien, Vienna, Austria; 4Institute of Chemical Technologies, TU Wien, Vienna, Austria; 5CEITEC, Brno, Czech Republic
We investigate the influence of electrical current on intersubband polarizations and vice-versa in two quantum well structures originally designed for electrical transport.

EG-P.9 THU
Vibrational ladder-climbing and molecular ground-state dissociation driven by mid-infrared chirp-pulsed plasmonic near-fields
I. Morichika, A. Sakurai, and S. Ashihara; Institute of Industrial Science, The University of Tokyo, Tokyo, Japan
We report on successful driving of vibrational ladder-climbing and ground-state dissociation of W(100) in n-hexane solutions by mid-infrared chirp-pulsed plasmonic near-fields. The demonstrated scheme will pave the way to controlled ground-state chemistry in the condensed-phase.

EG-P.10 THU
Nonlinear splitting of optical trap of metallic nanoparticles
A. De and A. Devi; Indian Institute of Science Education and Research (IISER) Mohali, SAS Nagar, India
We investigated splitting of potential well into two for trapping of metallic nanoparticles due to optical nonlinearity under femtosecond pulsed excitation; this can be utilized to simultaneously trap two particles to study long-range inter-particle interactions.

EG-P.11 THU
Terahertz radiation from nanostructures due to tunnel ionization
I. Babuskin1,2,3, L. Shi2,1, A. Demircan1,4, M. Kovacevic1,2, and U. Morger1,2,4; 1Institute of Quantum Optics, Leibniz University, Hannover, Germany; 2Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering – Innovation Across Disciplines), Hannover, Germany; 3Max Born Institute, Berlin, Germany; 4Hannover Centre for Optical Technologies, Hannover, Germany
We show that free electrons created by ionization near asymmetric metallic nanostructure allow to generate terahertz radiation. This mechanism is an analog of so called Brunel harmonics arising in gases, but requires simpler driver waveforms.

EG-P.12 THU
The contribution has been withdrawn.

EG-P.13 THU
Coherent Scattering of Light from Large Ions Strings and their Mirror Images
A. Leisundak1, P. Ohiil2, T. Pham3, M. Citék2, O. Cip2, R. Filip4, and L. Siodlak4; 1Dept. of Optics, Palacky University, Olomouc, Czech Republic; 2Institute of Scientific Instruments of the CAS, Brno, Czech Republic
We present the experimental observation of scalable coherent light scattering from long trapped ion strings and their mirror images.

EG-P.14 THU
A theoretical study of collective Rabi splitting in nano-lasers and -LEDs
E. André, J. Protosenko2, A. Uskon2, J. Mark1, and M. Wubs1; 1Technical University of Denmark, Kgs. Lyngby, Denmark; 2Lebedev Physical Institute of RAS, Moscow, Russia
We analytically derive the emission spectrum for many pumped cavity-coupled emitters, and show that collective Rabi splitting can occur. We find the splitting decreases with increasing pump and derive a connection between splitting and lasing.

EG-P.15 THU
Reversible Spontaneous Emission Dynamics and Quantum Interference of Quantum Emitters near a MoS2 Nanodisk
I. Thanopoulos1, V. Karamkolas2, N. Iliopoulos2, and E. Papakal12; 1Department of Optics and Optometry, T.E.I. of Western Greece, Aigion, Greece; 2Materials Science Department, University of Patras, Patras, Greece
We show that the spontaneous emission dynamics of quantum emitters close to a MoS2 nanodisk exhibits strong non-Markovian effects, including decaying Rabi or complex decaying oscillations and population trapping, combined with strong quantum interference effects.

EG-P.16 THU
Harmonic generation in Mie-resonant GaAs nanowires
D. De Ceglia1,2, A. Deand2, A. L. Chakraborty1, A. Kar1,2,3, A. Andrews1,2,3, and M. Scalora1; 1Institute for Solid State Electronics, TU Wien, Vienna, Austria; 2Department of Materials & Interdisciplinary Interactions – Innovation Across Disciplines, Hannover, Germany; 3Department of Electrical Engineering, Weizmann Institute of Science, Rehovot, Israel
We report a new experimental technique for mapping effective values of local dielectric characteristics of solid films and progress in the theory of fluorescence changing due to the local field the generalized Purcell effect.
Time Resolved Four-Wave Mixing in Nanocomposites

O. Fedotova, O. Khasanov, V. Nikiforov, and V. Samartsev
1 SPMRC NAS Belarus, Minsk, Belarus;
2 BSU, Minsk, Belarus; 3 Kazan E. K. Zavoisky Physical-
Technical Institute (KPhTI) of the KSC of the RAS, Kazan,
Russia

Features of photon echo and time resolved four-wave mixing signals in nanocomposites consisted of semiconductor quantum dots incorporated into nonlinear dielectric matrix are studied.

Development of quantum network with warm atomic vapors operating with 10 MHz spectral bandwidth

We present the realizations of mutually compatible source of nonclassical light and optical quantum memory in warm atomic vapor with spectral bandwidths in the range of tens of MHz.

In-situ photoluminescence kinetics of lead halide perovskites under sunlight excitation

G.E. Arnaoutakis, N.S. Samoylova, M.V. Khenkin, R. Guo, and E.A. Katz
1 Dept. of Solar Energy and Environmental Physics, J. Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev, Midreshet Ben-Gurion, 84990, Israel, Midreshet Ben-Gurion, Israel

We report on the first in-situ PL monitoring of methylammonium lead iodide thin films upon excitation by concentrated sunlight up to 90 suns.

Absorption Enhancement of a Thin Silicon Film using a 3D Photonic band gap crystal back reflector

D. Devashish, R. Saiye, J.W. de Vegt, and W.L. Vos
1 Complex Photonics Systems (COPS), MESA+ Institute for Nanotechnology, University of Twente, Enschede, Netherlands; 2 Mathematics of Computational Science (MACS), University of Twente, Enschede, Netherlands; 3 Thomas J. Watson Laboratories of Applied Physics and Material Science, California Institute of Technology, Pasadena, USA

As a back reflector for thin silicon film solar cells, we study a thin 3D photonic band gap crystal that forbids light within the band gap for all directions and for all polarizations.

Syntheses of conjugated polymers containing 6-(2-thienyl)-4H-thieno[2,3-b]indole (2-TTI) as electron-rich unit for photovoltaics

J. Kim, S. Chae, A.Y. Yi, H.J. Kim, and H. Suh
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We designed and synthesized polymers containing 6-(2-thienyl)-4H-thieno[2,3-b]indole (2-TTI) as electron-rich unit with low band-gap to provide the new conjugated polymers, PDOCF3, PDOBT, PMBI and PDOMBI.

Infrared emission obtained by pumping the 4I9/2 level of Er3+ ions in Gallium and Lanthanum Oxysulfide nanopowders shows inhomogeneous thermal confinement as well as temperature reduction due to upconversion processes.
The index entries consist of the following data:

- **Author's Name**
- **Title**
- **Date of Presentation**
- **Session**
- **Location**
- **Pages**

Presenting authors are marked by a publication mark (**p**).
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