Short Course: Optical Parametric Oscillators

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Course Description:

This course provides an overview of optical parametric oscillators (OPOs), from basic operation principles to advanced devices. The course will begin with a description of the fundamental concepts in nonlinear optics and frequency conversion, followed by a discussion of OPO devices, an overview of the latest advances in OPO technology, and applications. The discussion will cover OPOs operating in all temporal regimes, from the continuous-wave (cw) to the ultrafast femtosecond time-scales.

Specifically, the course participants will gain knowledge of the basic principles of nonlinear frequency conversion and optical parametric generation; phase-matching, amplification and tuning; OPO design issues, including nonlinear material and pump laser selection criteria; OPO operation in different time-scales, generic device architectures, pumping and resonance configurations; cw OPOs: singly-resonant, pump-enhanced, doubly- and triply-resonant oscillators, pump power threshold and frequency behavior, frequency tuning and control, solid-state, fiber, and semicondcutor disk laser pumping, visible to mid-IR generation, novel device architectures; pulsed OPOs: operating principle, threshold condition, compact all-solid-state oscillators, high-energy and low-energy devices, single-mode operation, UV to mid-IR and THz generation; synchronously-pumped OPOs: picosecond OPOs: high-repetition-rate cw and pulsed oscillators, solid-state, Ti:sapphire and fiber laser pumping, birefringent and quasi-phase-matched devices, UV to mid-IR generation; femtosecond OPOs: Ti:sapphire, solid-state, and fiber-pumped devices, collinear and noncollinear pumping, birefringent and quasi-phase-matched oscillators, spectral and temporal control, UV to mid-IR generation; applications of OPO devices in spectroscopy, trace gas sensing, imaging, frequency synthesis and comb generation; commercial developments in OPO technology.