PhD Thesis DefenseVENKATA RAMAIAH BADARLA 'Ultrafast Optical Parametric Oscillators-Novel Systems, Techniques, and Concepts'

VENKATA RAMAIAH BADARLA

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Friday December 5, 15:00. ICFO Auditorium

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Optical Parametric Oscillators

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In this thesis, we have demonstrated various ultrafast optical parametric oscillators (OPOs) based on different nonlinear media. The thesis focuses on the study of OPO systems, novel techniques, designs, and concepts that have facilitated the wavelength accessibility from 1 m in the near-infrared region to as far as 8 m in the mid-infrared region.

We have developed a fs OPO based on BiB3O6 (BIBO) which directly pumps the Kerr-lens mode-locked (KLM) Ti:sapphire laser. This system could provide broad and rapid tuning from 1420-1560 nm just by changing the cavity length. By exploiting the unique optical properties of BIBO under type I (e¿oo) interaction, we have also demonstrated the first self-phase-locke degenerate fs OPO. Furthermore, we have developed a technique called synchronou retro-reflection for threshold reduction and signal amplification prior to the onset of th oscillation. This technique is generic and is particularly useful while deploying ultrafast OPO with birefringent materials that have relatively low nonlinear gain and when there is limite pump power.

In addition, we have developed a dual-wavelength fs OPO with arbitrary and independent tuning by making use of an anti-resonant-ring (ARR) or Sagnac interferometer. This universal technique of coupling two optical oscillators can be employed in any time regime (cw to ultrafast pico or fs) regardless of the operating wavelengths. This conceptual technique can be used for intracavity terahertz (THz) generation, which exploits the high intensity intracavity oscillating pulses. Moreover, we have developed a dual-crystal, double-pumped OPOs for intracavity signal amplification in fs regime as well as in ps regime, for arbitrary and independent wavelength tuning. In both systems two crystals share the same optical cavity but are pumped independently by a single laser source.

Finally, we have devised and experimentally demonstrated a novel concept of pumping an OPO within another OPO using a composite cascaded cavity design. This all solid-state Ti:sapphire-pumped fs OPO system is potentially capable of providing access to the mid-infrared region beyond 4 m to as far as 18 m by a careful selection of the nonline r mediu

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