PhD Thesis Defense SHAHRZAD PARSA 'High-power fiber-laser-pumped picosecond nonlinear optical sources from the near- to mid-infrared'

SHAHRZAD PARSA

July 24, 2018

Tuesday July 24, 11:00 h. ICFO Auditorium

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Optical Parametric Oscillators

ICFO-The Institute of Photonic Sciences

Ultrafast picosecond coherent sources in the near-to-mid-infrared (IR) spectral range are of great interest for a variety of applications such as pump-probe spectroscopy, remote sensing, photobiology and novel upconversion imaging techniques. Nonlinear optics, and in

particular nonlinear frequency conversion techniques, offer an efficient and effective approach towards the realization of sources emitting such radiation, as nowadays, nonlinear frequency conversion technologies are recognised to be viable and reliable sources of laser radiation with broad wavelength tunability and power scalability, without the need of cryogenic cooling.

In this thesis, we have demonstrated high-power, high-repetition-rate picosecond sources based on nonlinear frequency conversion processes through optical parametric oscillators (OPOs) and difference-frequency-generation (DFG), in order to cover the near- to mid-IR wavelength region.

We have developed a stable, high-repetition-rate picosecond rapidly tunable OPO based on fan-out designed grating periods in PPKTP nonlinear crystal. The OPO is synchronously pumped by a mode-locked frequency-doubled Yb-fiber laser in the green at 532 nm, and can provide stable and high-power radiation which is rapidly tunable from 749-962 nm in the signal and from 1189-1838 nm in the idler, at room temperature.

Further, we have demonstrated what we believe to be the first tunable high-repetition-rate picosecond source based on OP-GaP crystal in the mid-IR. Using a single-pass DFG between a mode-locked Yb-fiber laser at 1064 nm and the tunable output from a picosecond MgO:sPPLT OPO synchronously pumped by the same laser, the source generated continuous tunable radiation across 3040-3132 nm in the mid-IR at the repetition rate of ~80 MHz, in good beam quality.

Additionally, we have also presented the first high-power, high-beam-quality, idler-resonant picosecond OPO based on a multi-grating MgO:PPLN crystal tunable across 2100-4000 nm in the mid-IR. The OPO provided as much as 3.5 W of mid-IR radiation with M2 values to be better than 1.8 in both horizontal and vertical directions

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