ICFO


# PhD Thesis Defense JOSEP CANALS 'Picosecond, High-Repetition-Rate, Optical Parametric Sources from the Ultraviolet to the Deep-Infrared'

JOSEP CANALS

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Thursday October 18, 11:00. ICFO Auditorium

**JOSEP CANALS**

Optical Parametric Oscillators

ICFO-The Institute of Photonic Sciences

High-power, high-repetition-rate coherent picosecond sources with high beam quality are of great interest for many scientific and technological applications. For example, coherent sources at the ultraviolet (UV) spectrum are used to image molecules using confocal microscopy. Mid-infrared (mid-IR) sources allow the study of the composition and dynamics of different molecules thanks on the unique and strong mid-IR spectral fingerprints that reveal valuable chemical information in this part of the optical spectrum. Near-infrared (near-IR), sources close to 2 ?m are in the ?eye-safe? region allowing their use in space free applications such as LIDAR or gas sensing. Moreover, they are very useful to pump semiconductor crystals to generate mid-IR sources using frequency down-conversion techniques.

After almost 60 years since laser invention, there are still many regions in the optical spectrum that still remain uncovered by any coherent source due to the lack of suitable laser gain materials. Nonlinear frequency conversion techniques based on new nonlinear crystals and the well stablish fiber-laser technology at 1 ?m provide access to the spectral regions that are unavailable to conventional lasers, giving wavelength tunability across extended spectral regions with a single device. Moreover, they offer practical output power with high efficiency, high spatial quality and can be operated in all temporal regimes, from continuous-wave, quasi-cw, and pulsed nanosecond to ultrafast picosecond and femtosecond time-scales.

In this thesis, we have demonstrated UV, near-, mid- and deep-IR sources, all in ultrafast picosecond temporal regime and high-reptition-rate. First, coherent UV source at 266 nm, based on four harmonic generation from the pump fiber-based laser at 1 ?m is reported together with thermal effects characterization in the BBO crystal. Maximum UV average power of 2.9 W is achieved using a double BBO in a walk-off compensation scheme. Secondly, tunable optical parametric oscillator (OPO) based on CSP crystal and pumped by 1 ?m laser providing deep-IR idler wavelengths from 6.2-6.7 ?m with maximum average power of 95 mW at 6.2 ?m is reported. Thirdly, a tunable mid-IR source from 3-3.1 ?m based on OP-GaP DFG pumped with fiber-laser at 1 ?m and the signal of a tunable OPO providing 57 mW of average power at 3044 nm. Finally, we report a high-power, high-repetition-rate, near-IR picosecond OPO at 2.1 ?m with high power stability, high beam quality and narrow bandwidth (??~2.5 nm).

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