# PhD Thesis DANIEL SANCHEZ PEACHAM 'Development of a High Intensity Mid-Ir OPCPA Pumped by a HO:YLF Amplifier'

DANIEL SANCHEZ PEACHAM

January 27, 2020

11:00

ICFO Auditorium

Monday, January 27, 11:00. ICFO Auditorium

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Attoscience and Ultrafast Optics

ICFO-The Institute of Photonic Sciences

The continuous development of laser sources delivering ultra-short light pulses underpins much of the current progress in experimental science, particularly in the domain of physics concerned with strong-field phenomena. Laser systems that allow scaling of strong-field experiments to unexplored regions of the electromagnetic spectrum, specially the mid-IR

range (2  m

This thesis describes a new laser source of high-intensity, mid-IR light. A long-wavelength pumped optical parametric chirped pulse amplifier (OPCPA) design is chosen as the architecture for this laser, overcoming many of the drawbacks hindering other approaches. This thesis presents two novel sub-systems required for the successful development of a mid-IR OPCPA. The first is a compact, fibre-driven source of broadband mid-IR pulses relying on difference frequency generation (DFG) in the nonlinear crystal CdSiP2. This laser is the seed source in the OPCPA and supports transform-limited pulses corresponding to less than 3 optical cycles at the operating wavelength of 7  m. The second sub-system is a pum source based on a Ho:YLF chirped pulse amplifier (CPA) pumped by commercial Tm-fibr laser. The pump system delivers over 0.25 J of pulse energy at a wavelength of 2052 nm.

The laser system described in this thesis is a developmental milestone towards the realisation of a multi-mJ source of few-cycle duration, carrier-to-envelope phase (CEP) stable mid-IR pulses. The system is designed to operate at a centre wavelength of 7  m, deliverin pulses with an energy of 0.2 mJ and a temporal duration of 180 fs at 100 Hz repetition rate The output parameters of the laser presented in this work lead to a peak power of 1.1 GW an potentially a peak intensity of 7·1014 W/cm2. These values are already compatible wi h strong-field experiments and enable a ponderomotive force 77 times larger than a standa d Ti:Sapphire laser.

**Monday, January 27, 11:00. ICFO's Blue Lecture Room**

**Thesis Advisor: Prof Dr Jens Biegert**

Daniel Sanchez Peacham's Thesi Cover