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PhD Thesis Abstract

Ultrashort optical parametric oscillator up to the mid-infrared pumped by a femtosecond Ytterbium laser

Coherent light sources in spectral regions which are inaccessible to lasers has been an important issue for more than five decades. Despite tremendous progress in laser technology over the last five decades, substantial portions of the optical spectrum from the ultraviolet (UV) to the infrared (IR) still remain inaccessible to conventional laser sources, at time scales ranging from continuous to almost single cycle pulses. This limitation arises from the limited gain bandwidth of the active medium, which defined the operating spectral region of the laser. This directly limits the application of such devices, while also placing a boundary on ultrashort pulse generation, which requires very broad bandwidths.

In this context, coherent optical sources based on nonlinear conversion, with femtosecond pulse duration and wide tunability, are rapidly emerging. They are extremely versatile and of considerable interest for a wide range of scientific and technological applications in different areas.

Our goal is to investigate the generation of ultrashort laser pulses in the near infrared region between 900 and 1000 nm, which is of interest for current large scale laser projects based on optical parametric amplification. For this, we will design and develop two innovative sub-20 fs tunable optical parametric oscillators (OPO) optimized at a chosen central wavelength.

The OPO systems will be implemented at two existing laser systems: the Laboratory for Intense Lasers (IST), with the goal of generating a seed pulse for a new ultrashort amplifier; and the Vulcan laser system (CLF, RAL), with the goal of generating an off-harmonic femtosecond probe line to upgrade the system and to set up an OPO for the 20 PW project. Their requirements are similar ensuring that the same technology can be applied, with suitable modification to the spectral parameters.