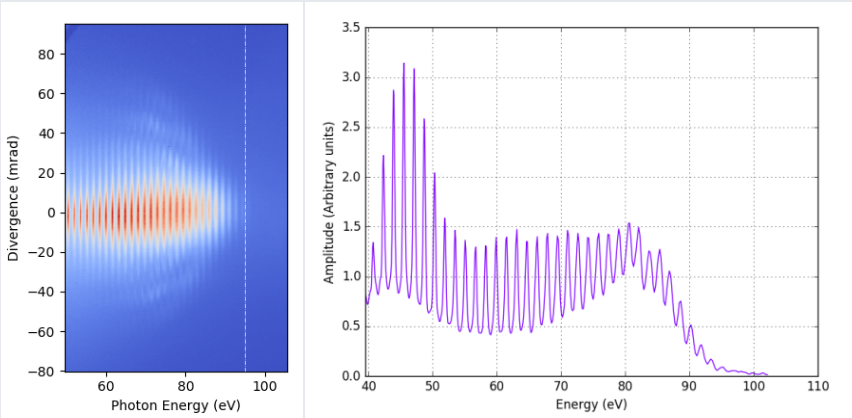
High repetition rate optical parametric chirped pulse amplifier (OPCPA) source for high field physics applications

G. Jargot, A. Van de Walle, P. Rigaud, M. Hanna, P. Georges (LCF, IOGS), D. Franz, Q. Ripault, R. Nicolas, A. Gonzalez, H. Merdji, T. Ruchon (LIDyL, CEA).

The majority of high field physics experiments have been performed so far with Ti:Sa laser systems that are able to deliver short (<30 fs) energetic pulses (few mJ) at repetition rate limited to a few kHz, corresponding to average powers below 10 W. However, there is currently considerable technological and research effort towards emerging laser systems that are scalable to higher average powers, and typically operate at much higher repetition rate (>100 kHz) and lower energy per pulse. The OPCPA architecture allows translating the central wavelength to the SWIR (1 µm - 2.5 µm) and MIR (> 2.5 µm) domains. These high repetition rate systems are of great interest for a number of applications such as high harmonic generation (HHG), coincidence detection of ionization fragments, and photoemission spectroscopy.



We have developed such a source, pumped by an ytterberbium-doped fiber amplifier, and delivering simultaneously 50 fs 20 µJ pulses at 1.55 µm and 70 fs 10 µJ pulses at 3.1 µm at the repetition rate of 125 kHz. This source was used to perform both HHG in solids using the 3.1 µm beam and HHG in gases using the 1.55 µm beam. In the figure, we show the XUV intensity distribution in the spatio-spectral domain and corresponding spectrum obtained in argon. The tight focusing geometry required by the modest pulse energy to perform HHG, together with the long driving wavelength, induce spatio-spectral structures that are currently being investigated.

This work has been performed in collaboration with the companies Fastlite and Amplitude Systemes and co-funded by the FUI STAR program.

A. Van de Walle, M. Hanna, F. Guichard, Y. Zaouter, A. Thai, N. Forget, and P. Georges, *Spectral and spatial full-bandwidth correlation analysis of bulk-generated supercontinuum in the mid-infrared, Opt. Lett.* 40, 673-676 (2015)

P. Rigaud, A. Van de Walle, M. Hanna, N. Forget, F. Guichard, Y. Zaouter, K. Guesmi, F. Druon, and P. Georges, *Supercontinuum-seeded few-cycle mid-infrared OPCPA system*, Opt. Express 24, 26494-26502 (2016)

Résultats obtenus dans le cadre du projet MIROPCPA financé par le thème 3 du LabEx PALM et porté par Patrick Georges (LCF, IOGS) et Thierry Ruchon (LIDYL, CEA).