PhD position
"Femtosecond laser pulses: post-compression and temporal characterization"

3-year funded joint PhD thesis between ICB laboratory (Dijon - France) and the company Femto Easy (Pessac, France).

Research project

The development of femtosecond lasers (10^{-15}s), in the mid-1960s, opened up a wide range of new applications exploiting the short pulse durations, the high peak intensity or the wide spectral bandwidth delivered by these systems. In all these applications, the pulse duration and pulse shape are critical parameters for the outcome so that the use of such pulses requires a comprehensive characterization of the electric field. The emergence of this class of lasers led therefore to a growing interest in reliable and versatile diagnostic tools which represents a difficult task since the pulses are significantly shorter than any photodetector response time. The need of metrology has increased along with the development of new sources at different wavelengths, duration and with their applications. The project covers the two previous major issues: the production of short laser pulses and the metrology of femtosecond pulses. In the first part, different strategies for the nonlinear compression of ultra-short laser pulses will be investigated. The work will focus in particular on techniques implementing multi-pass cell and hollow core fibers. The second part will be dedicated to the development of innovative temporal characterization techniques for non-standard wavelengths or environments. Different architectures based on various measurement methods (FROG, SPIDER or even FROST and SRSI) will be investigated. In particular, the DEER-SPIDER method [1-2] co-developed by the ICB laboratory and Femto Easy will be evaluated in a two-color configuration (X-DERR SPIDER) for the characterization of low-energy UV pulses. Different multi-shot FROG architectures will also be tested in order to assess their potential for a possible commercial characterization device. Finally, a miniaturized characterization prototype allowing the temporal characterization of ultrashort laser pulses in narrow space will be developed.
The work features a substantial experimental content but the student will also be in charge of numerical simulations. The expected results are twofold: publications in peer reviewed journals and filing of patents. In addition to academic opportunities, the thesis will offer a substantial background for possible outlets in industry.

[1] P. Béjot Opt. Lett. **45** 6795 (2020)
[2] E. Szmygel Phys. Rev. A **104** 013514 (2021)

Host Institutions & environment

The candidate will benefit from the established collaboration between the ICB laboratory and Femto Easy. The part of the project related to the nonlinear compression will be carried out at Femto Easy (Pessac) while the development of original temporal characterization techniques will be mainly realized at ICB laboratory (Dijon), both projects being in collaborative environments. Travel and accommodation costs will be covered.

ICB laboratory: the PhD will be hosted in the Photonics Department of ICB lab. All the necessary equipment for the project will be made available to the student such as 2 femtosecond laser systems (100 fs and 35 fs duration) of tunable wavelength and 2 pulse shaper devices enabling a control of the pulse shape. The team also has some experience regarding the development of such projects including the design of device or useful numerical simulations.

Femto Easy:

Femto Easy is a company specialized in ultrafast metrology with a strong expertise in the production and characterization of high energy ultrashort pulses via robust and reliable measurement devices already in use in several state of the art laboratories. Our current product-line includes all the useful instruments to characterize and manage ultrafast lasers: temporal measurement (ROC and FROG), spectral measurement (MISS spectrometer) and spatial measurement (BeamPro).
see : https://www.femtoeasy.eu/

Candidate & required skills

We are seeking for highly motivated candidates with good skills in experimental physics and good adaptability to work in two different environments. An experience in ultrafast optics will be highly beneficial. Fluent English required (French appreciated).

Applications & contacts

The project is funded by Femto Easy and the PhD position is available now.
Please send a CV, cover letter, academic transcripts and contact information of references to
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