

## Student's work theme (diploma, PhD)

### Post-compression of high power femtosecond laser pulses for high-order harmonic generation

The world of femtosecond laser pulses is fascinating. Especially when the pulses are very short and very energetic, focusing such pulses into a small spot on a matter causes a very rich ensemble of nonlinear processes to appear, including high harmonic generation (HHG).

A post-compression technique is a common way to obtain few-cycle or even shorter pulses. The technique is based on a broadening of the initial pulse spectrum by means of nonlinear interaction of the pulse with medium and subsequent compression of the pulse typically by using chirped mirrors. However, to post-compress pulses of high energy is very challenging.

#### General and specific aims

The aim of the thesis is to identify a suitable scheme of post-compression of a 100 mJ-class 1 kHz laser with femtosecond pulses. The student will get familiar with methods of generation and amplification of femtosecond pulses, as well as with diagnostic tools available for their characterization. He/She will make a review of state-of-the-art post-compression methods and evaluate those to select the most suitable one. He will design the experimental setups for post-compression of laser with various pulse energies: 5 mJ, 10 mJ, 30 mJ, and 100 mJ. He/She will first theoretically predict and then experimentally study the effect of pulse duration on high-order harmonic generation (HHG) in noble gases.

#### Expected results:

Review of post-compression methods from literature, design of the post-compression scheme for 1 kHz laser system scaled from low to high pulse energy (5-100 mJ). Study of HHG in dependence on the pulse duration.

#### Supervisor

Ondřej Hort, Ph.D. [Ondrej.Hort@eli-beams.eu](mailto:Ondrej.Hort@eli-beams.eu)

#### Consultants

Ing. Michal Jelínek, Ph.D. [michal.jelinek@jfifi.cvut.cz](mailto:michal.jelinek@jfifi.cvut.cz)

Ing. Matej Jurkovič [matej.jurkovic@eli-beams.eu](mailto:matej.jurkovic@eli-beams.eu)