

Thesis framework: Study of laser-plasma interaction in a high repetition rate régime, Project 1

Supervisor: Ing. Alexandr Jančárek, CSc., Czech Technical University in Prague, FNSPE

Co-supervisor: Jonathan Tyler Green, PhD, Alexander Molodozhentsev, PhD, ELI ERIC, ELI Beamlines

Abstract:

The aim of the Project 1 is to gain an understanding the laser-plasma interaction in a high repetition rate regime to get, as the result, a laser-plasma accelerated (LPA, LWFA) high-quality electron beam suitable for further usage, for instance, to generate a coherent photon radiation. This work is a key part of the LUIS project development at ELI-Beamlines.

Objectives of the Project 1 are the following: (1) develop the laser beam diagnostics at the low and high power regime in the laser focus to be able to control it before the laser-plasma interaction; (2) prototype the complete setup to create the controllable and repeatable plasma channel in the high-repetition rate regime.

The PhD student will study laser-plasma interaction to get, as the result, a high-quality electron beam suitable for generation of the coherent photon radiation in an undulator. To be able to do this student will take part in preparation of the L2 (DUHA) novel laser system at ELI-Beamlines in tight collaboration with the laser-team to finalize the system, which should produce a compressed high-power laser pulse with the pulse duration 25-30 fsec with unprecedented repetition rate up to 50 Hz with the pulse energy up to 5 Joules. The laser beam diagnostics in the LUIS target area (in the E5 experimental hall of ELI-Beamlines) will be implemented into the LUIS experimental setup to characterize the laser parameters before and after the laser-plasma interaction aiming the quality control of the LPA electron beam. Using the preformed plasma channel the length of the laser-plasma interaction will be much more than the diffraction limit, which will allow to get the high-energy electron beam utilizing less power of the laser pulse. Active cooperation with the PhD student, who should join the EuPRAXIA DN-Project-2 at ELI-Beamlines, will open the way to get GeV-level electron beam with high bunch charge using the moderate pulse power of the high-repetition rate laser. The work is assigned for selected EuPRAXIA-DN candidate.