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Fs-Laser driven secondary sources of x-rays and particles within ELI-Beamlines and their applications

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ELI-Beamlines will be the high-energy, repetition-rate laser pillar of the ELI (Extreme Light Infrastructure) project. It will be an international facility for both academic and applied research, slated to provide first user capability since the beginning of 2018. The main objective of the ELI-Beamlines Project is delivery of ultra-short high-energy pulses for the generation and applications of high-brightness X-ray sources and accelerated particles. The laser system will be delivering pulses with length ranging between 15 and 150 fs and will provide high-energy Petawatt and 10-PW peak powers. For high-field physics experiments it will be able to provide focused intensities attaining 1024 Wcm-2, while this value can be increased in a later phase without the need to upgrade the building infrastructure to go to the ultra-relativistic interaction regime in which protons are accelerated to energies comparable to their rest mass energy on the length of one wavelength of the driving laser.

In this talk we will concentrate on the development of short wavelength (20 eV-100 keV) short pulse high intensity laser driven sources of x-rays and particles (few MeV - 200 MeV) and their practical implementation in the ELI-beamline user facility. The short pulse x-ray sources are either based on direct interaction of the laser beam with gaseous or solid targets (High order harmonics or plasma sources) or will first accelerate electrons which then will interact with laser produced wigglers (Betatron radiation) or directly injected into undulators (laser driven LUX or later X-FEL). The direct interaction (collision) of laser accelerated electrons with the laser again will lead to short pulse high energy radiation via Compton or Thomson scattering. The main planned short pulse laser driven x-ray sources and particles their parameters will be presented, together with the date of commissioning.

We discuss new approaches for efficient proton acceleration with higher repetition rate targets based on a solid Hydrogen ribbon for possible medical applications in the energy range above 60 MeV. The ion acceleration beamline ELIMAIA and the ELIMED concepts will be highlighted for their use in different fields including medicine.

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