Laser-driven ion acceleration at the ELIMAIA user beamline: commissioning experiments.

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The ELIMAIA [1] (ELI Multidisciplinary Applications of laser-Ion Acceleration) user beamline aims to provide stable, fully characterized, and tunable ion beams for multidisciplinary applications via laser-driven acceleration. The commissioning of the ELIMAIA Ion Accelerator section has been recently performed [2] using high-repetition-rate (up to 10 Hz), high peak-power (>10J in 30 fs) L3-HAPLS laser system available at the ELI Beamlines user facility, reaching relativistic intensities (above 10^{21} W/cm^2).

Figure 1: Photo of the ELIMAiA beamline, showing an interaction chamber, ion beam transport (blue and red), and different diagnostic stations.

The laser-plasma interaction was optimized in terms of the ion cutoff energy (∼30 MeV) and flux (above 10^{11}/sr) using targets of different composition and thickness. Excellent shot-to-shot stability (1-2% energy spread) and on-shot target positioning was demonstrated for the repetition rate of 0.5 Hz for several hundreds of consecutive shots. Additionally, online data acquisition and analysis systems were successfully tested, including ion detectors operating in TOF (time-of-flight) geometry (Ion Collectors, semiconductor detectors), Thomson Parabola spectrometer, real-time calorimeter for hard X-rays measurements, optical diagnostics, and also laser beam diagnostics. The results demonstrate the robustness of the technology developed at the ELIMAIA beamline, aimed to support its future users in fundamental and applied research (i.e. radiobiological field, cultural heritage, material science, nuclear physics).

References

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