Development of Gas Targets for Stable Laser Wakefield Electron Acceleration at ELI-Beamlines

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The output of a laser wakefield electron accelerator (LWFA) strongly depends on the choice of optimal density profile formed in a gas target. Here we present development of gas targets for electron acceleration driven by PW-class 10 Hz laser system and compact scheme of electron acceleration with TW-class laser at 1kHz repetition rate [1].

For designing the targets we use hydrodynamic simulations of the neutral gas flow [2]. Then the target characterisation is performed by interferometric measurement [3] and tomographic reconstruction of the density profile. The data obtained from in-situ testing of the targets in accelerator are then benchmarked with PIC plasma simulations.

In order to improve stability of the accelerated electron beam, the targets are designed to work in continuous flow operation regime. In particular, we investigate the conical and slit supersonic nozzles. These nozzles are tested with differential pumping system. Then, the novel dual-stage target with low gas load for PW-class lasers is made. We also present our progress in conceptual study of a target implementing nanoparticle injector.

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