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Laser-proton acceleration from a cryogenic hydrogen jet

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Demanding applications like radiation therapy of cancer have pushed the development of laser proton accelerators and defined necessary proton beam properties as well as levels of control and stability.
The presentation will give an overview of the recent experiments for laser driven proton acceleration employing a cryogenic target system which is capable of producing a renewable and debris free jet target. The micrometer sized pure hydrogen jet is characterized by a low plasma density of 30 times the critical density at 800 nm and was irradiated at the Petawatt (PW) amplifier stage of the high power laser source DRACO at the HZDR. The Ti:sapphire system delivers laser pulses with energies of up to 23 J and pulse durations of 30 fs on target.
In this talk we present substantially improvements of the target system leading to an increase in stability of the accelerated protons as well as the long-term operations. Evaluation of different target geometries e.g. cylindrical with a diameter of 5µm and planar with up to 4x20 µm² demonstrating the capabilities in terms of size and shape of available hydrogen jets.
We report on the laser contrast dependencies of the proton beam properties by introducing artificial prepulses and describe their influence on the target shape at the interaction time by using a synchronized optical probe beam.
Furthermore different ion diagnostics reveal mono-species proton acceleration in the laser incidence plane from the jet target, reaching foil-like proton cut-off energies in target normal direction.

Working group

Laser-driven ion acceleration

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