Laser-proton acceleration from a condensed hydrogen jet

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The presentation will give an overview of recent experiments for laser driven proton acceleration with high contrast at the high power laser system Draco at HZDR. We present results of an experimental campaign employing a pure condensed hydrogen jet as a renewable and debris free target.

Different ion diagnostics reveal mono-species proton acceleration in the laser incidence plane around the wire-like target, reaching cut-off energies of up to 20 MeV and exceeding 10^9 protons per MeV per steradian. Evaluations of two different target geometries (cylindrical with a diameter of 2µm, 5µm or 10µm and planar with 2x20 µm²) demonstrate more optimized acceleration conditions using the planar hydrogen jet.

We report on modulations of laser accelerated protons by strong filamentary electromagnetic fields. Those modulations are related to the appearance of electron Weibel instability in the preplasma at the rear side of the target and impose important constraints on the preplasma level for high-quality proton acceleration [1].

Furthermore we present the usage of optical probing to study the laser plasma interaction providing plasma density measurements at the time of the interaction and to precisely determine the jet position. Recorded probe images taken up to 100 ps after the laser pulse arrived at the target, indicate plasma density modulations from pinching effects along the jet axis.

References

[1] S. Göde et al., recently accepted by PRL