ENERGY LOSS OF LIGHT IONS AT THE MAXIMUM OF THE STOPPING POWER IN LASER-GENERATED PLASMA

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The energy loss of light ions was measured in a laser-induced plasma at a low projectile energy corresponding to the maximum of the stopping power. A thin graphite foil was irradiated from both sides by high-energy laser beams, creating a 150 eV fully-ionized carbon plasma[1]. The plasma was probed by carbon and nitrogen ion bunches at a projectile energy of 0.5 MeV/u, obtained from a GSI ion source and decelerated through a degrader foil. The ion energy loss in plasma was deduced from time-of-flight measurements at a 0.5 m distance by using a specially developed, well-shielded CVD-diamond detector (Fig.1).

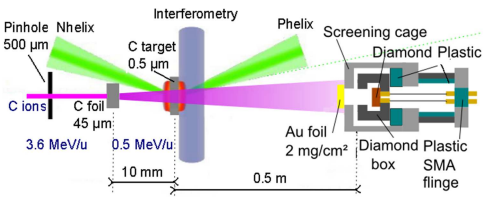

Fig.1: Setup for ion energy-loss measurements at low beam energy in laser-induced plasma.

In the parameter region corresponding to the Bragg peak in the ion-plasma interaction, the known perturbative stopping-power models are expected to be inaccurate due to the strong beam-plasma coupling. Significant discrepancies have been reported between the different theoretical approaches[2], reaching 30% in our configuration. However, no experimental data are available to judge the relevance of these models.
Here, new energy-loss data are presented and compared with various theoretical stopping predictions with the help of plasma simulations[3] and Monte-Carlo calculations of the beam charge-state distribution. This enables a test of the stopping-power theories at low beam energy, which is of high relevance for all ion-plasma interaction processes in ICF and most notably alpha-particle heating in the igniting and burning DT targets.
A preliminary analysis shows energy-loss values significantly smaller than predicted.

[1] A. Frank et al., *Physical Review Letter*, **110**, 115001, 2013
[2] D. Gericke et al., *Physical Review E*, **60**, 01, 1999 and **67**, 037401, 2003
[3] An. Tauschwitz et al., *High Energy Density Physics*, **9**, 158-166, 2013