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Low velocity proton stopping power measurements in Warm Dense Matter

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Understanding the physics of ion stopping power in warm dense matter (WDM) at low projectile velocity is of great interest both for fundamental science and inertial confinement fusion. This regime where v_p (ion velocity) ~ v_{th} (electron thermal velocity) is theoretically and experimentally challenging.

We report a first measurement of the energy loss of 500 keV protons in WDM at a low ratio $v_p/ v_{th} \geq 3$. A novel platform for proton stopping power measurements by laser driven ion sources at high repetition rate was developed at the 30 fs 200 TW system CLPU - VEGA II (Spain) [1]. The generated proton beam was used to probe the WDM with electron temperature of $10 - 20$ eV, generated via fs laser heating of a thin carbon foil. The measured proton energy loss in WDM was used to benchmark theoretical stopping power models [2]. Simultaneously, WDM temperature was obtained by XUV spectroscopy and Streaked Optical Pyrometry (SOP). In future planned experiments we aim to extend these measurements to lower ratios $v_p/ v_{th} \geq$ 1-2 approaching the Bragg Peak, and further improve the accuracy of temperature measurements.

References

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