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Laboratory generation and applications of uniform dense plasma

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Laboratory generation of uniform dense plasmas have important applications in a wide range of fields. We created a well-defined, uniform, relatively large-scale ~millimeter plasma sample through heating a Tri-Cellulose Acetate (TCA) foam with the high-power-laser-driven hohlraum radiation (see Fig.1). The temperature of the plasma is about 17eV, and the electron temperature is about $4*10^{20}$ cm^{-3}. Using the plasma sample, 1) we studied the laser-accelerated intense proton beam stopping process. It was demonstrated that owing to a collective effect, the energy loss is enhanced by about one order of magnitude compared to individual ion stopping theory predictions [1]; 2) The temperature and the C/O ratio of the plasma sample are similar to those of White Dwarf (WD) H1504+65's atmosphere. We obtained the well-resolved emission lines of the plasma sample and make detailed comparison with Chandra telescope observations. Our well-resolved results help to distinguish the weak lines and provide reference data to benchmark the related models [2]; 3)We experimentally studied the $p^{11}B$ nuclear reactions in plasma circumstance, and found that the reaction product yield are enhanced in plasmas compared with cold matter and the yield increase with beam intensity non-linearly; 4) We studied the charge transfer process of laser-accelerated carbon ions in the plasma, and found that the target density effect plays important roles in the current case; 5) We propose to the generate high-current relativistic electron beam and brilliant X/γ sources through laser interaction with this near critical density plasma. The temperature of the electron beam is expected to be enhanced by order compared with laser-foil interaction.

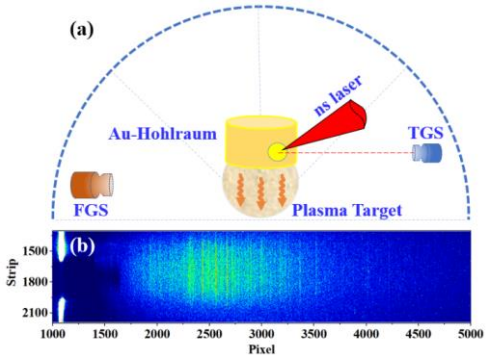

Fig 1. (a) Layout of the experiment; (b) Raw spectra recorded with flat field grating spectrometer.

Reference

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