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Ion acceleration and EMP studies using cryogenic and 3D printed targetry

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High Power Lasers capable of achieving relativistic intensities >10^18 Wcm^2 on target are rapidly developing worldwide and are promising drivers for producing bright sources of multi 10's MeV ion beams. Understanding the mechanisms which control the spectral content is essential, as such ion beams will have many applications from probing electrostatic and magnetic fields through to studies of EMP, plasma heating, stopping powers, cellular damage at high flux rates, ion fast ignition and pulsed neutron production etc.

Using a recently developed cryogenic target system, an ultra thin layer of deuterium can be readily deposited as a pure low Z surface layer. To ensure that the layer is contaminant free it is deposited ms before the shot and using a combination of coating parameters it can be adjusted from a few nm' s to microns in thickness. By controlling the thickness of the deuterium layer it can act as a probe of the acceleration sheath dynamics. Also, as deuterium has a lower charge to mass ratio than hydrogen it can be used to modify the spectral content of the accelerated ions, producing peaked spectra. The escaping electron population from a metallic foil targets and the EMP fields generated simultaneously were measured as a function of driving pulse length in the range 1-20 ps. These measurements were carried out using the Vulcan PW laser.

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