Plasma Interaction Conditions achievable using Astra

P. S. Foster*, D. Neely, J. Collier, J. Smith, A. Langley, C. Hooker, E. Divall
CCLRC - Rutherford Appleton Laboratory
Chilton, Didcot, Oxon, UK, OX11 0QX

**E-mail:p.foster@rl.ac.uk*

ABSTRACT

Laser produced plasmas are an ideal environment for studying many areas of physics including plasma physics, atomic physics, stellar physics and high-field physics and has opened the way for new methods of producing high energy proton beams, mono-energetic electron beams, x-ray lasers, high harmonics and nuclear interactions amongst others.

We present here the plasma interaction and characterization capabilities of the Astra laser facility. The 800 nm Ti:Sapphire laser system operates at 10Hz and is capable of delivering 500mJ in 40fs. This is deliverable to target with a maximum intensity of mid 10^{19} Wcm^{-2} using F/2.5 illumination optics. The beam can be focused onto a wide range of target types ranging from the solid slab, wire or tape targets to supersonic gas jet systems or static gas fill thus providing a large choice in target densities. A wide range of interaction conditions is obtained by varying the focal spot size, energy, pulse duration and line foci can also be produced if required. Co-linear and transverse probes are routinely used to measure energy deposition and pre-pulse associated density gradients. Diagnostic equipment such as optical, soft X-ray and ~KeV spectrometers and imaging systems are routinely used to characterize plasma conditions. Large aperture non-linear crystals are available to frequency double the Astra beam to provide up to 100mJ at 400nm and this has been used to reduce pre-pulse effects and the hot electron temperature generated in the plasma.

We also present our current developmental program which includes an in chamber adaptive optic, which along with a wave front sensor and short focal length parabola will allow us to increase our maximum deliverable intensity by an order of magnitude to $>10^{20}$ Wcm^{-2} opening up new interaction regimes for experimental investigation.