DPP12-2012-000667

Abstract for an Invited Paper
for the DPP12 Meeting of
the American Physical Society

Spectra of laser generated relativistic electrons using cone-wire targets

HIROSHI SAWADA, University of California San Diego

We report on the characterization of the in situ energy spectrum of fast electrons generated by ultra-intense (I$\sim10^{19}$ W cm^{-2}) short pulse (τ ~0.7 and 10 ps) laser-plasma interactions using the TITAN and OMEGA EP lasers. That in situ spectrum is a key component of ignition efficiency for the Fast Ignition (FI) Inertial Confinement Fusion (ICF) concept. It is challenging to model and, until now, has resisted direct experimental characterization; other techniques have very large error bars or measure the modified spectrum of escaped electrons. This technique also gives an indication of the forward coupling efficiency of the laser to fast electrons. This information is derived from the measurement of Cu Kα x-rays emitted from a 1.5 mm long Cu wire attached to the tip of Au or Al cone targets. Fast electrons, generated in the cone, transport through the cone tip with a fraction of coupling to the wire. Electrons in the wire excite fluorescence measured by a monochromatic imager and an absolutely calibrated HOPG spectrometer. An implicit hybrid-PIC code, LSP, is applied to deduce electron parameters from the Kα measurements. Experiments on the TITAN laser with Au cones attached to wires show an increase in pre-pulse energy from 17 to 1000 mJ, decreases the fast electron fraction entering the wire from 8.4% to 2.5%. On OMEGA EP with Al cones attached to wires, total Kα yield, normalized to laser energy, drops ~30% for laser pulse length increasing from 1 to 10 ps, indicative of a saturation mechanism. For Au cones, Kα yields were 50% of that measured for Al cones indicating a strong material dependence. In all cases, the spatial distribution can only be fit with a two-temperature electron energy distribution, the relative fractions depending on prepulse level. These results are being used to develop an optimum cone design for integrated FI experiments. This work was performed under the auspices of the USDOE by LLNL under Contract DE-AC52-07NA27344 and DE-FG-02-05ER54834.