DPP16-2016-000804

Abstract for an Invited Paper
for the DPP16 Meeting of
the American Physical Society

Backlighting Direct-Drive Cryogenic DT Implosions on OMEGA

C. STOECKL, Laboratory for Laser Energetics,U. of Rochester

X-ray backlighting has been frequently used to measure the in-flight characteristics of an imploding shell in both direct- and indirect-drive inertial confinement fusion implosions. These measurements provide unique insight into the early time and stagnation stages of an implosion and guide the modeling efforts to improve the target designs. Backlighting a layered DT implosion on OMEGA is a particular challenge because the opacity of the DT shell is low, the shell velocity is high, the size and wall thickness of the shell is small, and the self-emission from the hot core at the onset of burn is exceedingly bright. A framing-camera–based crystal imaging system with a Si He_α backlighter at $\sim 1.865\,\mathrm{keV}$ driven by 10-ps short pulses from OMEGA EP was developed to meet these radiography challenges. A fast target inserter was developed to accurately place the Si backlighter foil at a distance of 5 mm to the implosion target following the removal of the cryogenic shroud and an ultra-stable triggering system was implemented to reliably trigger the framing camera coincident with the arrival of the OMEGA EP pulse. This talk will report on a series of implosions in which the DT shell is imaged for a range of convergence ratios and in-flight aspect ratios. The images acquired have been analyzed for low-mode shape variations, the DT shell thickness, the level of ablator mixing into the DT fuel (even 0.1% of carbon mix can be reliably inferred), the areal density of the DT shell, and the impact of the support stalk. The measured implosion performance will be compared with hydrodynamic simulations that include imprint (up to mode 200), cross-beam energy transfer, nonlocal thermal transport, and initial low-mode perturbations such as power imbalance and target misalignment. This material is based upon work supported by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0001944.