DPP11-2011-001646

Abstract for an Invited Paper
for the DPP11 Meeting of
the American Physical Society

Cryogenic thermonuclear fuel implosions on the National Ignition Facility

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The first inertial confinement fusion implosion experiments with cryogenic fuel layers have been fielded in preparation for ignition experiments on the National Ignition Facility. These experiments use mega joule laser energies that compress fusion capsules in indirect dive hohlraums to test initial hot spot formation and thermonuclear fuel assembly. Hydrogen-rich fuel (THD) provides a relatively low yield and diagnostics rich environment that allows us to measure the implosion core, neutron yield, temperatures and fuel areal density from a suite of x-ray and neutron diagnostics. These experiments have successfully demonstrated the control of the implosion shape using ignition grade cryogenic fuel layers, laser pulse shaping, and nonlinear plasma optics. The implosions show scaling of the DT fusion yield with ion temperature over more than one order of magnitude to a yield in excess of 10^{14} neutrons. Recent implosion performance improvements due to shock timing tuning have led to high Lawson confinement parameters. Additional tuning experiments are being performed with the goal to increase hot spot temperatures and to observe alpha particle heating with pure DT fuel. Prepared by LLNL under Contract DE-AC52-07NA27344.