DPP15-2015-001894

Abstract for an Invited Paper
for the DPP15 Meeting of
the American Physical Society

Performance of Indirectly-Driven Capsule Implosions on NIF Using Adiabat-Shaping[1]

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Indirectly-driven capsule implosions are being conducted on the National Ignition Facility (NIF). Early experiments conducted during the National Ignition Campaign (NIC) were driven by a laser pulse with a relatively low-power initial foot ("low-foot"), which was designed to keep the deuterium-tritium (DT) fuel on a low adiabat to achieve a high fuel areal density (ρR). These implosions were successful in achieving high ρR, but fell significantly short of the predicted neutron yield. A leading candidate to explain this degraded performance was ablation front instability growth, which can lead to the mixing of ablator material with the DT fuel layer and in extreme cases into the central DT hot spot. A subsequent campaign employing a modified laser pulse with increased power in the foot ("high-foot") was designed to reduce the adverse effects of ablation front instability growth. These implosions have been very successful, increasing neutron yields by more than an order of magnitude, but at the expense of reduced fuel compression. To bridge these two regimes, a series of implosions have been designed to simultaneously achieve both high stability and high ρR. These implosions employ adiabat-shaping, where the driving laser pulse is high in the initial picket similar to the high-foot to retain the favorable stability properties at the ablation front. The remainder of the foot is similar to that of the low-foot, driving a lower velocity shock into the DT fuel to keep the adiabat low and compression high. This talk will present results and analysis of these implosions and will discuss implications for improved implosion performance.

[1]This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.