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Timing of Multiple Shock Waves in Cryogenic-Deuterium Targets

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Achieving ignition and high performance from inertial confinement fusion targets requires optimization of the implosion dynamics. Critical to this is the timing of a sequence of shock waves that are used to condition the shell and fuel as they are imploded. The National Ignition Campaign (NIC) specifications for ignition designs require that these shock waves coalesce at precise intervals that must be controlled to $\sim$50 ps. The plan for ignition includes optimization experiments that use surrogate targets to measure the timing and strength of shocks, then iterating the drive profile to achieve the required precision. These surrogate targets use an ignition-style capsule fitted with a deuterium-filled re-entrant cone embedded in that shell. The shocks are observed in flight through a transparent window using optical diagnostics. We report on OMEGA experiments that demonstrated this shock-timing technique in liquid deuterium driven by hohlraums that reached radiation temperatures of 165 eV. Multiple spherically converging shocks are also being diagnosed and timed in direct-drive deuterium-filled spheres to optimize cryogenic implosions and validate hydrodynamic simulations. This work was supported by U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-08NA28302. Contributors: V.N. Goncharov, S.X. Hu, M.A. Barrios, D.E. Fratanduono, T.C. Sangster, D.D. Meyerhofer, UR/LLE, P.M. Celliers, D.H. Munro, D.G. Hicks, H.F. Robey, G.W. Collins, O.L. Landen, LLNL, R.E. Olson, SNL.