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Direct-Drive Shock-Wave-Timing Experiments in Planar Targets

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Inertial confinement fusion target designs use multiple shock waves to condition the target material for optimal performance. These designs require that the shock waves be accurately timed to coalesce at a particular point in the target. It is essential that the propagation and dynamics of these multiple shocks be understood and correctly modeled. The OMEGA Laser Facility at the University of Rochester is used to perform direct-drive experiments that measure the propagation and coalescence of two laser-driven shock waves propagating in planar targets made of CH or cryogenic D_2. Laser pulses with various temporal shapes generate two primary shocks that propagate in these transparent targets. The velocity and self-emission profiles of these shocks are temporally resolved and clearly show the first shock wave propagating through the material and then being overtaken by the second shock wave. The coalescence of these shocks forms a single, stronger shock that eventually arrives at the rear surface of the target. The measured velocity and emission profiles exhibit distinct features that include the decay rate of unsupported shocks, coalescence and shock breakout times, and curvature of the shock fronts. These results are presented for a number of drive conditions and compared to 1-D and 2-D hydrodynamic codes. The simulated velocity profiles and coalescence times are in good agreement with experimental observations, as are many of the two-dimensional effects. These experiments have also validated the dependence of laser–target coupling on the angle of incidence. The effect of preheat by x rays on these experiments is also discussed. Results of preliminary indirect-drive experiments are also shown. This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-92SF19460. Contributors: E. Vianello, J. E. Miller, R. S. Craxton, V. N. Goncharov, I. V. Igumenshchev, T. J. B. Collins *LLE*; D. G. Hicks, P. M. Celliers, G.W. Collins, *LLNL*; R. E. Olson, *Sandia National Lab*