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First liquid-layer implosion experiments at the NIF[1]

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Replacing the standard ice layer in an ignition design with a liquid layer allows fielding the target with a higher central vapor pressure, leading to reduced implosion convergence ratio (CR). At lower CR, the implosions are expected to be more robust to instabilities and asymmetries than standard ice-layer designs, and are also unique in that the hot spot can be primarily formed from material originating in the central fuel vapor. The first liquid-layer implosions on the National Ignition Facility (NIF) have been performed by wicking the liquid fuel into a supporting foam that lines the inside surface of the capsule [T. Braun et al., ACS Appl. Mater. Interfaces 8, 2600 (2016)]. A series of shots has been conducted between CR of 12 and 20 using a HDC ablator driven by a 3-shock pulse in a near-vacuum Au hohlraum [R.E. Olson et al., Phys. Rev. Lett. 117, 245001 (2016)]. At the lowest CR the implosion performance is well predicted by 2-D radiation-hydrodynamics calculations. However, as the CR is increased the nominal simulations do not capture the experimentally observed trends. Data-based models suggest that the hot spot formation is unexpectedly suppressed at higher convergence. The data could be explained by reduced hydrodynamic coupling efficiency, or an anomalously enhanced thermal conductivity in the mixed DT/foam material. We show that the latter hypothesis can explain observed trends in several experimental metrics, including the yield, ion temperature, and burn duration.

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