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Validating Hydrodynamic Growth in National Ignition Facility Implosions

J. LUC PETERSON, Lawrence Livermore National Laboratory

The hydrodynamic growth of capsule imperfections can threaten the success of inertial confinement fusion implosions. Therefore, it is important to design implosions that are robust to hydrodynamic instabilities. However, the numerical simulation of interacting Rayleigh-Taylor and Richtmyer-Meshkov growth in these implosions is sensitive to modeling uncertainties such as radiation drive and material equations of state, the effects of which are especially apparent at high mode number (small perturbation wavelength) and high convergence ratio (small capsule radius). A series of validation experiments were conducted at the National Ignition Facility to test the ability to model hydrodynamic growth in spherically converging ignition-relevant implosions. These experiments on the Hydro-Growth Radiography platform [1] constituted direct measurements of the growth of pre-imposed imperfections up to Legendre mode 160 and a convergence ratio of greater than four using two different laser drives: a "low-foot" drive used during the National Ignition Campaign [2] and a larger adiabat "high-foot" drive that is modeled to be relatively more robust to ablation front hydrodynamic growth [3]. We will discuss these experiments and how their results compare to numerical simulations and analytic theories of hydrodynamic growth, as well as their implications for the modeling of future designs.

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[2] M. J. Edwards et al., Phys. Plasmas **20**, 070501 (2013)
[3] O. Hurricane et al., Nature **506**, 343 (2014)