HYDRODYNAMIC INSTABILITY GROWTH IN POLAR-DIRECT-DRIVE IMPLOSIONS AT THE NATIONAL IGNITION FACILITY

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Polar direct drive (PDD) [1] is being developed at the National Ignition Facility (NIF) as an alternative, laser-driven inertial confinement fusion (ICF) platform to achieve ignition. Shell stability of the ignition target is of key importance for an optimized performance; achieving the irradiation uniformity sufficient for a viable PDD-ignition platform necessitates single-beam smoothing in excess of what is required for the indirect-drive approach to ICF.

Initial results from backlit PDD implosion experiments on the NIF [2] indicate that the shell trajectories are in good agreement with simulations using the 2-D hydrocode *DRACO*, but the ablation-surface trajectory, inferred via gated, x-ray self-emission images of the implosion exhibit slower implosion velocities than predicted. This implies a decompression of the shell compared to simulations. A potential source for this discrepancy is hydrodynamic instabilities seeded by target-surface roughness and nonuniformities of the incident laser intensity ("imprint"). Laser imprinting occurs because spatial variations in the laser intensity drive nonuniform shocks into the target that can be amplified via Rayleigh–Taylor (RT) growth to high-amplitude modulations of the ablation surface [3].

We have developed a new experimental platform on the NIF to measure RT growth and laser imprint in spherical PDD implosions. Plastic, cone-in-shell targets with an outer diameter of ~2.2 mm were imploded, and the RT-amplified shell mass modulations were tracked via measurements of the 2-D optical depth variations using soft x-ray radiography. The RT growth of discrete modes was investigated by machining single-mode, sinusoidal corrugations onto the target surface, which acted as well-characterized seeds. We will present platform characterization data and first experimental results of instability growth in spherical PDD experiments on the NIF. The experimental data will be compared to 2-D *DRACO* simulations and strategies for measuring high ℓ-mode perturbations >300 and for mitigating imprint in future PDD experiments will be discussed.

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[1] Skupsky S. *et al.* 2004 *Phys. Plasmas* **11** 2763

[2] Hohenberger M. *et al. Polar-Direct-Drive Experiments on the National Ignition Facility* to be published in Physics of Plasmas

[3] Smalyuk V.A. *et al.* 1998 *Phys. Rev. Lett.* **81** 5342