REVIEW OF THE CAPSULE IGNITION SCIENCE CAMPAIGN ON NIF

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The mission of the capsule Ignition Science Campaign is to develop a greater understanding of capsule physics in ICF implosions, primarily effects of hydrodynamic instabilities on implosion performance, and to develop techniques to mitigate these instabilities. An indirectly driven implosion begins with an acceleration phase when the hohlraum x-rays ablate the shell surface and the capsule starts to converge. At this stage, outer-shell non-uniformities grow due to the acceleration-phase Richtmyer-Meshkov (RM) and Rayleigh–Taylor (RT) instabilities. As the shell accelerates, these front-surface perturbations feed through the shell, seeding perturbations on the ablator-ice and ice-gas interfaces. After the x-ray drive is turned off, the ablation front becomes stable and the shell starts to decelerate while continuing to converge. During the deceleration phase, the inner surface of the shell is subject to RT instability. In addition, modulations grow due to Bell-Plesset (BP) convergent effects throughout the compression.

Several new platforms have been developed to experimentally measure hydrodynamic instabilities in all phases of implosions on NIF. At the ablation front, instability growth of pre-imposed modulations was measured with face-on x-ray radiography using the Hydrodynamic Growth Radiography (HGR) platform. The instability growth factors were investigated in the linear regime in the range of Legendre mode numbers from 30 to 160. In addition, modulation growth of 3-D "native roughness" modulations was measured to investigate hydrodynamic stability in conditions similar to those in layered DT implosions.

A new experimental platform was developed to measure instability growth at the ablator-ice interface. 2-D modulations were laser-imposed at the inner surface of the plastic capsule for implosions with DT layers to probe stability of the ablator-ice interface using x-ray radiography with this new Layered Hydrodynamic Growth Radiography (LHGR) platform.

In the deceleration phase of implosions, an innovative method was developed to use the self-emission from the hot spot to "self-backlight" the shell in-flight. Capsules used argon dopant in the gas to enhance x-ray emission at the beginning of the deceleration phase that serves as a "backlighter" to image growing shell modulations. To stabilize instability growth, new "adiabat-shaping" techniques were developed at the ablation front using the HGR platform and applied in layered DT implosions. Experimental results from all these campaigns will be presented.

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