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Improving Cryogenic-DT Implosion Performance on OMEGA

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Although cryogenic-DT implosion performance has improved both in absolute terms and relative to hydro simulations, a number of long-standing discrepancies remain unresolved. Absolute yield performance increased with higher-quality capsule and ice surfaces, routine delivery of low-adiabat ($\alpha \sim 2$) laser pulses at specification, and more-accurate target alignment with respect to the beam pointing (typically less than 10-μm rms for all 60 beams). Higher implosion velocities using thinner ice and constant mass ablators have resulted in additional increases in measured yields and ion temperatures. However, ion temperatures remain systematically below the hydro predictions suggesting higher-than-predicted imprint levels (note that $T_i \sim T_e$ for all implosions except for cases where fuel motion artificially enhances T_i). Imprint reduction is being addressed using dopants (small at.% of silicon) in the outer part of the ablator. To preserve the ablator mass, doped shells are necessarily thinner than undoped shells and recent compression results show a clear inverse relation between the inferred areal density and the measured yields. This suggests more radiative preheat with the thinner ablators (the areal densities are about 70% of predictions—below what is expected based on burn truncation). While improved nonlocal thermal transport and cross-beam energy transfer models resolved a persistent discrepancy between predicted and measured bang times, the measured burn width is longer than predicted. Furthermore, core x-ray emission below 2.5 keV is consistently higher than predictions. These discrepancies, combined with improved modeling, implicate shell stability and suggest that thicker ablators and thinner ice (to preserve the overall payload mass) may lead to improved ignition hydro equivalency. This talk will show the latest experimental results using thicker ablators and ablators doped with silicon, and compare these results with the latest hydro simulations.

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