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Demonstrating Ignition Hydrodynamic Equivalence in Cryogenic DT Implosions on OMEGA

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Demonstrating ignition hydrodynamic equivalence is one of the primary goals of direct-drive cryogenic implosions on OMEGA. It requires the shell reaching implosion velocities $> 3.5 \times 10^7$ cm/s while maintaining the fuel adiabat below 3 and keeping the shell from breaking up as a result of the Rayleigh–Taylor instability. The cryogenic targets used for implosions on OMEGA are 860-μm-outer-diam CD shells filled with DT fuel. The shell thickness varies between 5 and 12 μm, and DT ice thickness between 40 and 65 μm. Experimental results demonstrate, however, that neutron-averaged areal density in excess of 80% and yields above 25% of 1-D predicted values are obtained if the fuel adiabat > 3.5 and shell in-flight aspect ratio (IFAR) is below 22. As the IFAR exceeds this value, the shell breaks up and the areal density and yield are reduced. Identifying the main source of shell nonuniformities that lead to performance degradation in low-adiabat designs is one of the main efforts of OMEGA cryogenic campaign. This talk will summarize progress in cryogenic target implosions over the last year and review the effect of target debris, early-time laser shinethrough, and fuel-pusher roughness on target performance. In addition, the effect of cross-beam energy transfer (a major source of hydroefficiency degradation in a direct-drive implosions) and its mitigation strategies (including high-Z ablator layers, beam zooming, and laser wavelength shifts) will be discussed.
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