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Three-dimensional simulations of NIF implosions: insight into experimental observations[1]

BRIAN SPEARS, Lawrence Livermore National Lab

We have developed new three-dimensional (3D) radiation hydrodynamics simulation capabilities for NIF implosions to help explain trends in experimental observations. Simulation advances include full Monte Carlo particle transport for nuclear burn and diagnostics processes, resolution of lower-energy DD neutrons, and updated mesh management to allow large, low-mode spherical harmonic perturbations. We have also further advanced our 3D post-processing to generate simulated diagnostics, including time-integrated neutron images, detailed neutron spectra from instrument lines of sight, low-resolution neutron spectra covering the full sphere, and time-resolved x-ray imaging with enhanced spectral resolution. The advanced simulations and the resultant simulated diagnostics reproduce many surprising aspects of the NIF experimental trends. Puzzles that may be explained include longer burn durations, large and strongly direction-dependent ion temperatures as inferred from neutron spectra, large neutron-weighted bulk velocities, and large differences between DD- and DT-inferred temperatures. The improved simulations have allowed the development of controlled NIF experiments designed to test our capabilities to accurately model the impact of 3D shape perturbations on cryogenic layered implosions and surrogate gas-filled symcaps. LLNL-ABS-654616.

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