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## Mitigation of mode-one asymmetry in laser-direct-drive inertial confinement fusion implosions

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Nonuniformities present in the laser illumination and target in laser-direct-drive (LDD) inertial confinement fusion experiments lead to an asymmetric compression of the target, resulting in an inefficient conversion of shell kinetic energy to thermal energy of the hot-spot plasma. These multidimensional effects on hot-spot formation in LDD DT cryogenic implosions were examined using 3-D nuclear and x-ray diagnostics (i.e., having three or more diagnostic lines of sight) on the OMEGA laser. The neutron-averaged hot-spot velocity ($v_{\mathrm{hs}}$) and apparent ion temperature ($T_{\mathrm{i}}$) asymmetry are determined from neutron time-of-flight (nTOF) measurements of the primary D$-$T fusion neutron energy spectrum, while the compressed shell areal density surrounding the hot spot is inferred from measurements of the scattered neutron energy spectrum. The low-mode perturbations of the hot-spot shape were characterized from x-ray self-emission images recorded along three quasi-orthogonal lines of sight. This talk will present the first systematic study of the $v_{\mathrm{hs}}$ in LDD DT cryogenic implosions, including an interpretation of the experimental results using 3-D radiation-hydrodynamics simulations. Implosions with significant mode-1 asymmetries show large hot-spot velocities ($>$100 km/s) in a direction consistent with the hot-spot elongation observed in x-ray images and the measured $T_{\mathrm{i}}$ asymmetry. Mode 1 laser-drive corrections have been applied through shifting the initial target location in order to mitigate the measured asymmetry. With the asymmetry corrected, a more-symmetric hot spot is observed with reduced $v_{\mathrm{hs}}$ and $T_{\mathrm{i}}$ asymmetry and an increase in fusion yield. Plans to improve implosion performance using these measurements will be discussed. This material is based upon work supported by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0003856.