Improving Direct-Drive Implosion Symmetry Using Three-Dimensional X-Ray Tomography on OMEGA

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Reducing low-mode nonuniformities of imploding targets has been identified as a critical step to demonstrate conditions for laser-direct-drive (LDD) inertial confinement fusion implosions that are hydrodynamically scaled to ignition designs for megajoule laser energy at the National Ignition Facility.[1] A series of well-diagnosed experiments were performed for the 100-Gbar campaign on OMEGA,[2] where the 3-D modes $\lambda = 1$, 2, and 3 of the imploding target were tomographically recorded (within ±0.15%) up to a convergence of 3 using four lines-of-sight x-ray measurements of the ablation front.[3] Measurements of the ablation surface location show that the target modes are the result of two components: a dynamic part that varies linearly with the beam-energy balance, and an approximately constant static part, resulting from physical effects such as beam mispointing, mistiming, and uncertainties in the beam energies.[4] This technique was used to reduce the low-mode nonuniformities of a low-adiabat implosion from 3.5-μm rms to 1-μm rms by adjusting the beam-energy balance to compensate these static modes, which is an important demonstration for LDD. These methods are currently applied to quantify the effect of the target offset on target modes, and will be applied to cryogenic implosions to obtain improved performances. This material is based upon work supported by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0001944, the University of Rochester, and the New York State Energy Research and Development Authority. The support of DOE does not constitute an endorsement by DOE of the views expressed in this article.

References

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