Progress in inertial confinement fusion via lasers: how close to ignition and burn?

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Recent progress in both direct- and indirect-drive ICF (inertial confinement fusion) has considerably improved the prospects for achieving thermonuclear ignition with megajoule-class lasers. Fusion yields from recent indirect-drive HDC (high-density carbon) implosions have exceeded 50 kJ, bringing the fusion core close to burning-plasma conditions. The improvements come from enhanced control of the hohlraum energetics, use of more-efficient HDC ablators, and reduced impact of engineering features. When scaled to NIF laser energies, recent direct-drive implosions on OMEGA are expected to produce close to 300 kJ of fusion yield. Those implosions have benefited from a significant increase in implosion velocity obtained through larger-diameter targets and thinner ice layers. A new statistical approach used in designing OMEGA targets has demonstrated a considerable predictive capability, thereby enabling the design of targets with improved performance. In addition, more advanced fusion schemes like shock ignition are rapidly developing thanks to dedicated experiments designed to validate the physics basis of such new schemes. 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, the New York State Energy Research and Development Authority, and LLNL under Contract DE-AC52-07NA27344. The support of DOE does not constitute an endorsement by DOE of the views expressed in this article.