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IFE/1-2: Progress toward Polar-Drive Ignition for the NIF

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The Omega Laser Facility at the Laboratory for Laser Energetics (LLE) is used to study direct-drive inertial confinement fusion (ICF) ignition concepts. The baseline ignition target design for this research, using symmetric irradiation, consists of a 1.5-MJ multiple-picket laser pulse that generates four shock waves [similar to the National Ignition Facility (NIF) baseline indirect-drive design] and produces a 1-D gain of 48. Re optimized for polar-drive (PD) illumination (with beams in the x-ray drive configuration), the predicted 2-D gain for this design is ˜32, including all known sources of nonuniformities. Verification of the physics base of these simulations is a major thrust of implosion experiments on both OMEGA and the NIF. Many physics issues can be examined with symmetric beam irradiation. OMEGA cryogenic-DT target experiments with symmetric irradiation have produced areal densities of ˜0.3 g/cmˆ2. Physics issues unique to PD are being examined on OMEGA by turning off the equatorial beams and closely approximating the polar-illumination geometry on the NIF. Initial PD "exploding-pusher"experiments on the NIF, designed and tested on OMEGA, have produced neutron yields up to 6 x 10ˆ{14} and are a critical facet in the testing of diagnostics required for the ignition campaign on the NIF.
This talk describes progress in direct-drive central hot-spot ICF in both symmetric and PD configurations. The current research program is comprised of three segments: (1) validation of direct-drive, symmetric, cryogenic target performance on the OMEGA Laser System; (2) demonstration of a viable polar-drive–ignition platform using experiments on the OMEGA Laser System; and (3) definition and execution of a polar-drive–ignition campaign on the NIF. Each of these segments has seen significant progress since the 2010 IAEA FEC, enhancing our confidence in achieving polar-drive ignition on the NIF.
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Country or International Organization of Primary Author

USA

Primary author: Mr MCCRORY, Robert L. (USA)

Presenter: Mr MCCRORY, Robert L. (USA)

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