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Exploring New Methods For Increasing Coupling Efficiency in Indirect Drive Ignition Targets for the National Ignition Facility (NIF)[1]

DEBRA CALLAHAN[2], Lawrence Livermore National Laboratory

Coupling efficiency, the ratio of capsule absorbed energy to driver energy, is a key parameter in ignition targets. The hohlraums originally proposed for the NIF coupled ~11% of the absorbed laser energy to the capsule as x-rays. We describe here a second generation of hohlraum targets which has higher coupling efficiency, ~17.5%. Because an ignition capsule's ability to withstand 3D effects increases so rapidly with absorbed energy, the additional coupling can significantly increase the likelihood of ignition. The new targets include laser-entrance-hole (LEH) shields as a principal method for increasing coupling efficiency while controlling symmetry in indirect-drive ICF targets. The LEH shields are high Z disks placed inside the hohlraum to block the capsule's view of the cold LEH's. The LEH shields can reduce the amount of laser energy required to drive a target to a given temperature via two mechanisms: 1) keeping the temperature high near the capsule pole by putting a barrier between the capsule and the hole, 2) because the capsule poles do not have a direct view of the cold LEH's, good symmetry requires a shorter hohlraum with less wall area. Current integrated simulations of this class of target couple ~140 kJ of x-rays to a target from ~800 kJ of absorbed laser light and produce over 10 MJ of thermonuclear yield. In addition to shields, this design utilizes a low density (1mg/cc) aerogel foam to provide symmetry control. This replaces the He-H fill gas in previous targets and provides significant operational advantages. We describe the new targets, provide a quantitative design analysis of the radiation hydrodynamics properties as well as estimates of the laser-plasma interaction environment and properties. We also describe the diagnostic challenges presented by these targets and how we propose to meet those challenges on NIF.

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[2]In collaboration with P. A. Amendt, E. L. Dewald, S. W. Haan, D. E. Hinkel, N. Izumi, O. S. Jones, O. L. Landen, J. D. Lindl, S. M. Pollaine, L. J. Suter, M. Tabak, R. E. Turner