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Achievement of Core Conditions for Alpha Heating in Direct-Drive Inertial Confinement Fusion A. BOSE, K.M. WOO, R. BETTI, D. MANGINO, A.R. CHRISTOPHERSON, W. THEOBALD, Laboratory for Laser Energetics and Fusion Science Center, U. of Rochester, E.M. CAMPBELL, R.L. MCCRORY, S.P. REGAN, V.N. GONCHAROV, T.C. SANGSTER, C.J. FORREST, V.YU. GLEBOV, J.P. KNAUER, F.J. MARSHALL, C. STOECKL, Laboratory for Laser Energetics, U. of Rochester, R. NORA, LLNL, J.A. FRENJE, M. GATU JOHNSON, PSFC, MIT, D. SHVARTS, U. of Michigan — It is shown for the first time that direct-drive implosions on the OMEGA laser have achieved core conditions that would lead to significant alpha heating at incident energies available at the National Ignition Facility (NIF) scale. The extrapolation of the experimental results from OMEGA to NIF energy assumes only that the implosion hydrodynamic efficiency is unchanged at higher energies. This approach is independent of the uncertainties in the physical mechanism that degrade implosions on OMEGA, and relies solely on a volumetric scaling of the experimentally observed core conditions. It is estimated that the current best-performing OMEGA implosion extrapolated to a 1.9-MJ laser driver with the same illumination configuration and laser–target coupling would produce 125 kJ of fusion energy with similar levels of alpha heating observed in current highest performing indirect-drive NIF implosions. This conclusion is reached using an analytic scaling as well as direct numerical simulations of energy-scaled targets. This material is based upon work supported by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0001944.

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