DEMONSTRATING IGNITION HYDRODYNAMIC EQUIVALENCE IN DIRECT-DRIVE CRYOGENIC IMPLOSIONS ON OMEGA

V.N. Goncharov[1,2], S.P. Regan[1], T. C. Sangster[1], R. Betti[1,2,3], T.R. Boehly[1], M.J. Bonino[1], A. Davis[1,3], D.H.Edgell[1], R. Epstein[1], C.J. Forrest[1], D.H. Froula[1,3], V.Yu. Glebov[1], D.R. Harding[1], S.X. Hu[1], I.V. Igumenshchev[1], R.T. Janezic[1], J.H. Kelly[1], T.J. Kessler[1], T.Z. Kosc[1], S.J. Loucks[1], J.A. Marozas[1], F.J. Marshall[1], R.L. McCrory[1,2,3], D.D. Meyerhofer[1,2,3], D.T. Michel[1], J.F. Myatt[1], P.B. Radha[1], W. Seka[1], W.T. Shmayda[1], A. Shvydky[1], C. Stoeckl[1], B. Yaakobi[1], M. Gatu Johnson[4]

[1]Laboratory for Laser Energetics, University of Rochester, Rochester, NY, USA

[2]Dept. of Mechanical Engineering, University of Rochester, Rochester, NY, USA

[3]Dept. of Physics and Astronomy, University of Rochester, Rochester, NY, USA

[4]Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, MA, USA

vgon@lle.rochester.edu

Achieving ignition in a direct-drive cryogenic implosion at the National Ignition Facility (NIF) requires reaching central stagnation pressures in excess of 100 Gbar. The OMEGA Laser System is used to study the physics of cryogenic implosions that are hydrodynamically equivalent to the spherical ignition designs of the NIF. Based on these experiments, the factors limiting target performance have been identified and models describing their effect on the implosions have been implemented in hydrodynamic codes and benchmarked against the experimental data. In particular, cross-beam energy transfer (CBET) has been identified as the main mechanism reducing laser coupling and hydroefficiency. In addition, a few-micron-scale target debris, which cause shells to break up in low-adiabat implosions, are currently being considered as the main source of short-scale mix. The near-term plan for cryogenic implosions on OMEGA includes CBET mitigation by reducing beam size with respect to the target size. This increases drive pressure, allowing for a thicker, more-stable target to reach ignition-relevant implosion velocities. The longer-term (next five years) plan for reaching hydrodynamic equivalence includes implementing beam-zooming techniques for CBET mitigation, introducing high-*Z* overcoats for imprint reduction, and using multilayer ablator materials to mitigate hot-electron preheat from the two-plasmon–decay instability and to increase implosion hydroefficiency. This talk will summarize the latest results in direct-drive implosions on OMEGA.

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.