The Megajoule Direct-Drive Campaign at the National Ignition Facility

P. B. RADHA [1], M. J. ROSENBERG [1], A. SHVYDKY [1], J. A. MAROZAS [1], A. A. SOLODOV [1], D. TURNBULL [1], E. M. CAMPBELL [1], D. H. EDGELL [1], R. EPSTEIN [1], D. H. FROULA [1], V. N. GONCHAROV [1], F. J. MARSHALL [1], R. L. MCCRORY [1], P. W. MCKENTY [1], D. T. MICHEL [1], J. F. MYATT [1], S. P. REGAN [1], T. C. SANGSTER [1], W. SEKA [1], M. HOHENBERGER [2], P. MICHEL [2], and M. KARASIK [3]

1) Laboratory for Laser Energetics, University of Rochester, USA

E-mail: rbah@lle.rochester.edu

2) Lawrence Livermore National Laboratory, USA

3) Naval Research Laboratory, USA

Direct-drive experiments at the National Ignition Facility (NIF) are used to study physics relevant to direct-drive implosions. These are the first experiments to study physics determined by larger coronal density scale lengths and higher temperatures than those on the OMEGA laser—conditions closer to ignition scale. The three major focus areas include validating models of laser-energy coupling, shell adiabat, and laser imprint. Implosions, planar foils, and cone-in-shell geometries are used to study the physics. Several new insights into direct-drive physics have been obtained on the NIF. Cross-beam energy transfer, shown to compromise coupling in both OMEGA and NIF implosion experiments, has been mitigated by detuning the resonance using different wavelengths for the overlapping beams. This technique will potentially expand the parameter space for ignition by permitting more stable designs. Shock velocities and catch-up are well modeled, indicating that the adiabat can potentially be modeled well. Finally, preheat from energetic electrons is shown to occur from a different mechanism than that on OMEGA—namely stimulated Raman scattering instead of two-plasmon decay. This talk will motivate the physics of direct-drive and discuss the implications of these results. The path forward for direct-drive on the NIF will also be discussed.

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