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Contents

In Brief

This volume of the LLE Review, covering October–December 2005, features "Measured Dependence of Nuclear Burn Region Size on Implosion Parameters in Inertial Confinement Fusion Experiments" by F. H. Séguin, J. L. DeCiantis, J. A. Frenje, J. R. Rygg, C. D. Chen, and R. D. Petrasso (Plasma Science and Fusion Center at MIT), J. A. Delettrez, S. P. Regan, V. A. Smalyuk, V. Yu. Glebov, J. P. Knauer, F. J. Marshall, D. D. Meyerhofer, S. Roberts, T. C. Sangster, and C. Stoeckl (LLE), and K. Mikaelian, H. S. Park, H. F. Robey, and R. E. Tipton (LLNL). In this article (p. 1), the authors report on radial profiles of nuclear burn in directly driven, inertial confinement fusion implosions that have been systematically studied for the first time using a proton emission imaging system at the OMEGA Laser Facility. The system is sensitive to energetic 14.7-MeV protons from the fusion of deuterium and 3-helium. Clear relationships have been identified between variations in the size of the burn region and variations in such experimental parameters as capsule size, shell composition and thickness, gas-fill pressure, and laser energy. Different laser and capsule parameters resulted in burn radii varying from 20 to 80 μm. Since measured burn region sizes indicate where fusion actually occurs as a consequence of all the complicated processes that affect capsule implosion dynamics, they provide exacting tests of simulations.

Additional highlights of recent research presented in this issue include the following:

- V. A. Smalyuk, R. Betti, V. N. Goncharov, J. A. Delettrez, D. D. Meyerhofer, S. P. Regan, and T. C. Sangster (LLE) with O. Sadot and D. Shvarts (Nuclear Research Center at Negev) present results on Rayleigh–Taylor growth measurements of 3-D modulations in a nonlinear regime (p. 17). The measured modulation Fourier spectra and nonlinear growth velocities are in excellent agreement with those predicted by Haan's model. In real-space analysis, the bubble merger was quantified by a self-similar evolution of bubble size distributions, in agreement with the Alon–Oron–Shvarts theoretical predictions.

- M. D. Wittman and D. R. Harding report the results of studies of isotopic fractionation during the solidification of H_2–HD–D_2 mixtures (p. 26). Understanding this process is important since isotopic fractionation during the cryogenic-target layering process reduces the efficiency of the fusion reaction in future cryogenic D-T targets. It is found that H-D mixtures have to be frozen gradually over an ~1-K temperature range to achieve complete solidification. This is indicative of a completely soluble isomorphic system and that fractionation is incomplete. The maximum measured spatial concentration gradients are of the order of 0.02 to 0.05 molecular fraction per millimeter, which also points to little separation of isotopes.

- P. W. McKenty, M. D. Wittman, and D. R. Harding discuss implications of hydrogen fractionation in ICF ignition target designs (p. 35). Numerical investigation of the effects that fractionation has on hot-spot formation, ignition, and burn in ICF target designs indicates that small levels of fractionation (~10%) are acceptable for ignition performance on the NIF.

- J. A. Marozas, F. J. Marshall, R. S. Craxton, I. V. Igumenshchev, S. Skupsky, M. J. Bonino, T. J. B. Collins, R. Epstein, V. Yu. Glebov, D. Jacobs-Perkins, J. P. Knauer, R. L. McCrory, P. W. McKenty, D. D. Meyerhofer, S. G. Noyes, P. B. Radha, T. C. Sangster, W. Seka, and V. A. Smalyuk present results of polar-direct-drive (PDD) simulations and experiments on the OMEGA Laser System (p. 41).

Forty OMEGA beams arranged in six rings to emulate the NIF x-ray-drive configuration are used to perform direct-drive implosions of CH shells filled with D_2 gas. The results of the two-dimensional PDD simulations performed with *DRACO* code are in good agreement with experimental x-ray radiographs. *DRACO* simulations of NIF-scale PDD designs show ignition with a gain of 20 and the development of a 40-μm-radius, 10-keV region with a neutron-averaged ρr of 1270 mg/cm^2 near stagnation.

- S. N. Shafrir, J. C. Lambropoulos, and S. D. Jacobs report on surface features of tungsten carbide composites processed by bound abrasive deterministic microgrinding and magnetorheological finishing (MRF) (p. 51). White-light interferometry, scanning electron microscopy, and atomic force microscopy were used to characterize the surfaces after various grinding steps, surface etching, and MRF spot taking. It was found that the peak-to-valley microroughness of the surface after microgrinding with rough- or medium-abrasive tools gives a measure of the deformed layer depth. MRF spots revealed the true depth of the grinding-induced deformed surface layer.

Semyon Papernov
Editor