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Contents

In Brief

This volume of the LLE Review, covering October–December 2006, features "Laser Absorption, Mass Ablation Rate, and Shock Heating in Direct-Drive Inertial Confinement Fusion," by S. P. Regan, R. Epstein, V. N. Goncharov, I. V. Igumenshchev, D. Li, P. B. Radha, H. Sawada, W. Seka, T. R. Boehly, J. A. Delettrez, O. V. Gotchev, J. P. Knauer, J. A. Marozas, F. J. Marshall, R. L. McCrory, P. W. McKenty, D. D. Meyerhofer, T. C. Sangster, S. Skupsky, V. A. Smalyuk, and B. Yaakobi (LLE); D. Shvarts, (Negev Research Center, Ben Gurion University, Israel); and R. C. Mancini (University of Nevada). In this article (p. 1), the authors report on direct-drive laser absorption, mass ablation rate, and shock-heating experimental studies on the OMEGA Laser System, which are used to validate hydrodynamic simulations. A comprehensive set of measurements tracking the flow of energy from the laser to the target was conducted. Time-resolved measurements of laser absorption in the corona are performed on spherical implosion experiments. The mass ablation rate is inferred from time-resolved Ti K-shell spectroscopic measurements of nonaccelerating, solid CH spherical targets with a buried tracer layer of Ti. Shock heating is diagnosed in planar-CH-foil targets using noncollective spectrally resolved x-ray scattering and also in targets with a buried tracer layer of Al using time-resolved x-ray absorption spectroscopy. A detailed comparison of the experimental results and the simulations indicates that a time-dependent flux limiter in the thermal transport model is required to simulate the laser-absorption measurements.

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

- J. R. Rygg, J. A. Frenje, C. K. Li, F. H. Séguin, and R. D. Petrasso (Plasma Science and Fusion Center, MIT) along with J. A. Delettrez, V. Yu. Glebov, V. N. Goncharov, D. D. Meyerhofer, P. B. Radha, S. P. Regan, and T. C. Sangster (LLE) present results of nuclear measurements of fuel–shell mix in inertial confinement fusion implosions on OMEGA (p. 14). To probe the extent of mix, nuclear yields were measured from implosions of capsules containing a deuterated plastic (CD) layer and filled with pure ^{3}He. D^{3}He-proton spectral measurements have been used to constrain the amount of mix at shock time, to demonstrate that some of the fuel mixes with the CD layer, and that capsules with a higher initial fill density or thicker shell are less susceptible to the effects of mix.

- C. K. Li, F. H. Séguin, J. A. Frenje, J. R. Rygg, and R. D. Petrasso (Plasma Science and Fusion Center, MIT); R. P. J. Town, P. A. Amendt, S. P. Hatchett, O. L. Landen, A. J. Mackinnon, P. K. Patel, and M. Tabak (LLNL); and J. P. Knauer, T. C. Sangster, and V. A. Smalyuk (LLE) report on magnetic-field evolution and instabilities in laser-produced plasmas (p. 21). Monoenergetic proton radiography was used to make the first measurements of a laser–plasma-generated magnetic (B) field structure and evolution over a time interval that is longer compared to the laser pulse duration. While a circular, long-pulse (1-ns), low-intensity (~10^{14} W/cm^2) laser beam illuminates a plastic foil, a hemispherical plasma bubble forms and grows linearly, surrounded by a symmetric B field. After the laser turns off, the bubble continues to expand, but field strengths decay and the field structure around the edge becomes asymmetric through the resistive-interchange instability.

- T. J. B. Collins, J. A. Marozas, R. Betti, D. R. Harding, P. W. McKenty, P. B. Radha, S. Skupsky, V. N. Goncharov, J. P. Knauer, and R. L. McCrory present simulation results of the performance of the 1-MJ, wetted-foam target design for the National Ignition Facility (p. 26). Wetted-foam designs take advantage of the increased laser absorption provided by the higher-atomic-number elements in a target ablator composed of plastic foam saturated with deuterium–tritium. A stability analysis of a 1-MJ design was performed using the two-dimensional hydrodynamic code *DRACO*. A nonuniformity-budget analysis has been constructed and suggests that two-dimensional smoothing by spectral dispersion (SSD) is needed to reduce single-beam nonuniformities to levels sufficient for ignition to proceed.

- J. Myatt, W. Theobald, J. A. Delettrez, C. Stoeckl, M. Storm, T. C. Sangster, A. V. Maximov, and R. W. Short present results of the modeling of petawatt laser-generated hot electrons in mass-limited, solid-foil–target interactions at "relativistic" laser intensities using copper targets and parameters motivated by recent experiments at the Rutherford Appleton Laboratory (RAL) Petawatt and 100-TW facilities (p. 37). Electron refluxing allows a unique determination of the laser–electron conversion efficiency and a test with simulations. Implications of the results for fast-ignition experiments on OMEGA EP are considered.

- D. H. Edgell, R. S. Craxton, L. M. Elasky, D. R. Harding, S. J. Verbridge, M. D. Wittman, and W. Seka present three-dimensional characterization of spherical cryogenic targets using ray-trace analysis of multiple shadowgraph views (p. 46). A 3-D ray-tracing model into the backlit optical shadowgraph analysis, which is the primary diagnostic for hydrogenic ice-layer characterization in cryogenic targets at LLE, was incorporated. The result is an improved self-consistent determination of the hydrogen/vapor surface structure for cryogenic targets up to mode numbers around $\ell_{max} = 16$.

- L. Sun and J. R. Marciante present filamentation analysis in large-mode-area fiber lasers (p. 55). Starting from the paraxial wave equation, an analytic expression for filament thresholds in fiber lasers is derived. The occurrence of filamentation is determined by the larger of two thresholds—one of perturbative gain and one of spatial confinement. The threshold value is around a few megawatts.

- J. R. Marciante, W. R. Donaldson, and R. G. Roides present a technique for enhanced-dynamic-range, single-shot measurement of nanosecond optical pulses by averaging of replicated pulses (p. 61). A dynamic-range enhancement of three bits is experimentally demonstrated and compared with conventional multi-shot averaging. This technique can be extended to yield an increase of up to seven bits of additional dynamic range over nominal oscilloscope performance.

Igor Igumenshchev
Editor