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LLE Review

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Contents

In Brief

This volume of the LLE Review, covering October–December 2002, features "Direct-Drive Cryogenic Target Implosion Performance on OMEGA" by T. C. Sangster, J. A. Delettrez, R. Epstein, V. Yu. Glebov, V. N. Goncharov, D. R. Harding, J. P. Knauer, R. L. Keck, J. D. Kilkenny, S. J. Loucks, L. D. Lund, R. L. McCrory, P. W. McKenty, F. J. Marshall, D. D. Meyerhofer, S. F. B. Morse, S. P. Regan, P. B. Radha, S. Roberts, W. Seka, S. Skupsky, V. A. Smalyuk, C. Sorce, J. M. Soures, C. Stoeckl, and K. Thorp, along with J. A. Frenje, C. K. Li, R. D. Petrasso, and F. H. Séguin of MIT, K. A. Fletcher, S. Padalino, and C. Freeman of SUNY Geneseo, and N. Izumi, J. A. Koch, R. A. Lerche, M. J. Moran, T. W. Phillips, and G. J. Schmid of LLNL (p. 1). This article describes progress toward validating the predicted performance of direct-drive capsules that are hydrodynamically equivalent to the baseline direct-drive ignition design for the National Ignition Facility (NIF). These experiments measure the sensitivity of the direct-drive implosion performance to parameters such as the inner-ice-surface roughness, the adiabat of the cryogenic fuel during the implosion, the laser power balance, and the single-beam nonuniformity. These capsules have been imploded using ~17 to 23 kJ of 351-nm laser light with a beam-to-beam rms energy imbalance of less than 5% and full beam smoothing (1-THz bandwidth, 2-D smoothing by spectral dispersion, and polarization smoothing). Near 1-D hydrocode performance has been measured with a high-adiabat drive pulse on a capsule containing a 100-μm-thick layer of D_2 ice, and near 2-D hydrocode performance has been measured on a similar capsule with a low-adiabat drive. Improvements in cryogenic target alignment that will lead to improved implosion symmetry are also described.

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

- V. A. Smalyuk, J. A. Delettrez, S. B. Dumanis, V. Yu. Glebov, V. N. Goncharov, J. P. Knauer, F. J. Marshall, D. D. Meyerhofer, P. B. Radha, S. P. Regan, S. Roberts, T. C. Sangster, S. Skupsky, J. M. Soures, C. Stoeckl, R. P. J. Town, and B. Yaakobi along with J. A. Frenje, C. K. Li, R. D. Petrasso, and F. H. Séguin of MIT, D. L. McCrorey and R. C. Mancini of the University of Nevada, Reno, and J. Koch of LLNL (p. 11) describe the growth of inner-surface modulations near peak compression in deuterium–helium 3 (D^3He)-filled spherical targets imploded on OMEGA by using differential imaging of titanium-doped layers placed at various distances from the inner surface of the shell. Time histories of shell temperature and density were measured with titanium *K*-shell absorption spectroscopy, and the shell areal density was estimated using 14.7-MeV D^3He proton spectra. These experiments provide a better quantitative understanding of the evolution of inner-shell modulations that grow due to the Rayleigh–Taylor instability and Bell–Plesset convergence effects in the deceleration phase of a spherical direct-drive implosion.

- V. N. Goncharov, J. P. Knauer, P. W. McKenty, T. C. Sangster, S. Skupsky, R. Betti, R. L. McCrory, and D. D. Meyerhofer (p. 18) present an analytical description of improved target performance in direct-drive implosions using adiabat shaping with a high-intensity picket in front of the main-drive pulse. The picket is used to increase the entropy of only the outer portion of the shell, reducing the growth of hydrodynamic instabilities, while the inner portion of the shell maintains lower entropy to maximize shell compressibility. Experiments have demonstrated an improvement in target yields by a factor of up to 3 for the pulses with the picket compared to the pulses without the picket. Results of the theory and experiments with adiabat shaping are also extended to future OMEGA and NIF cryogenic target designs.

- L. J. Waxer, V. Bagnoud, I. A. Begishev, M. J. Guardalben, J. Puth, and J. D. Zuegel (p. 33) demonstrate a high-conversion-efficiency optical parametric chirped-pulse amplification (OPCPA) system using a spatiotemporally shaped pump pulse to maximize the conversion efficiency of the OPCPA process. Highly stable, 5-mJ pulses have been produced at a 5-Hz repetition rate with 29% overall pump-to-signal conversion efficiency. This system is a test bed for a similar OPCPA design that will be used for injection of a short-pulse, petawatt-class laser.

- R. Sobolewski, A. Verevkin, G. N. Gol'tsman, A. Lipatov, and K. Wilsher (p. 38) present a new class of ultrafast, superconducting single-photon detectors for counting both visible and infrared photons. The detection mechanism is based on photon-induced hotspot formation, which forces supercurrent redistribution and leads to the appearance of a transient resistive barrier across an ultrathin, submicrometer-width, superconducting stripe. Applications for these devices range from noncontact testing of semiconductor CMOS VLSI circuits to free-space quantum cryptography and communications.

- J. Li, W. R. Donaldson, and T. Y. Hsiang (p. 46) measure the temporal response characteristics of fast metal–semiconductor–metal ultraviolet photodiodes fabricated on GaN with finger width and pitch ranging from 0.3 μm to 5 μm. These detectors are attractive because they are relatively easy to fabricate and have no response in the visible region of the spectrum. A temporal response of less than 26 ps at low illumination is reported.

- S. H. Chen, P. H. M. Chen, D. Katsis, and J. C. Mastrangelo (p. 50) describe novel glassy liquid crystals with tunable spectral characteristics that have been developed for photonic applications. The authors also describe the molecular design of photoresponsive systems that combine reversible spectral tunability with superior fatigue resistance and thermal stability.

- A. Hartschuh (LLE), E. J. Sánchez (Portland State University), X. Sunney Xie (Harvard University), and L. Novotny (LLE) (p. 61) present near-field Raman spectroscopy and imaging of single-walled carbon nanotubes (SWNT) with unprecedented spatial resolution of less than 30 nm. This high-resolution capability is applied to resolve local variations in the Raman spectrum along a single SWNT that would be hidden in far-field measurements.

Mark J. Guardalben
Editor