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LLE Review

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Contents

In Brief

This volume of the LLE Review, covering the period January–March 2000, includes a report on OMEGA cryogenic target designs for the soon-to-be-commissioned OMEGA Cryogenic Target Handling System. R. P. J. Town, J. A. Delettrez, R. Epstein, V. N. Goncharov, P. W. McKenty, P. B. Radha, and S. Skupsky use two-dimensional hydrodynamic simulations in conjunction with a stability analysis model to study the performance of OMEGA cryogenic capsules. They show that these targets are energy-scaled from the NIF ignition designs and have similar 1-D behavior and stability properties. This similarity will facilitate the extrapolation of cryogenic target studies on OMEGA to ignition targets on the NIF.

Additional research highlights reported in this issue are

- T. J. B. Collins and S. Skupsky describe the physics of a novel technique for laser-imprint reduction in OMEGA cryogenic capsules. Laser nonuniformities can imprint the target with a "seed" that can cause debilitating hydrodynamic instabilities. In their article, the authors show, using the two-dimensional hydrodynamics code *ORCHID*, that an initial spike in the laser pulse can reduce laser imprint by about a factor of 2 for typical target configurations and especially for the nonuniformity modes considered most dangerous for target performance. Further, they show that this modification to the laser pulse need not significantly degrade target performance and is accompanied by only a modest decrease in the one-dimensional neutron yield.

- Through a judicious choice of materials and target dimensions, B. Yaakobi, C. Stoeckl, T. R. Boehly, D. D. Meyerhofer, and W. Seka have experimentally inferred fast-electron preheat due to laser irradiation on OMEGA. Significant fast-electron preheat can substantially decrease the effectiveness of a direct-drive implosion. In this article, the authors report on their experiment in planar geometry. The results from this measurement will be used as a reference point to determine fast-electron preheat in ignition-relevant direct-drive spherical targets.

- T. J. Kessler, J. Barone, C. Kellogg, and H. Huang present results from their ongoing experimental and theoretical work relating to holographic grating design and fabrication. These high-diffraction-efficiency and high-wavefront-quality gratings are used on the OMEGA laser primarily for laser-beam smoothing and spectroscopy. The authors report that for the high-optical-quality gratings required on OMEGA, it is critical to control environmental factors including humidity, thermal gradients, and air turbulence during grating fabrication. Future work will involve improved modeling of these gratings and further experimental investigations.

- Experimental measurements of target irradiation nonuniformity in the absence of smoothing by spectral dispersion (SSD) have indicated lower-than-expected levels of nonuniformity. Shots without SSD are base-line measurements for OMEGA, and consequently modeling these shots provides for a more complete understanding of the target irradiation nonuniformity. In this article, J. A. Marozas, S. P. Regan, J. H. Kelly, D. D. Meyerhofer, W. Seka, and S. Skupsky compare numerical simulations of laser smoothing with these measurements. They identify intensity-dependent phase accumulations by the OMEGA laser (*B*-integral) as the mechanism for this observed smoothing. The authors conclude that they can successfully model these *B*-integral-related smoothing mechanisms and find them to be relatively minor compared to the dominant smoothing effect of SSD.

- J. D. Schnittman and R. S. Craxton describe their simulations of capsule implosions in tetrahedral hohlraum experiments carried out on OMEGA in a collaboration between LLE and Los Alamos National Laboratory. These hohlraums are particularly well suited to the OMEGA target chamber geometry and have been shown to provide an extremely uniform radiation drive. The authors use a three-dimensional (3-D) view-factor code with time-dependent radiation transport both in the hohlraum wall and as a perturbation on a spherically symmetric hydrodynamic implosion of the capsule. They also simulate x-ray images of the imploded core with a 3-D x-ray postprocessor and find close agreement with experiment on several quantities including radiation drive temperatures, fusion yields, and core deformation.

- Knowledge of the hardness of abrasive particles is a key to understanding the mechanisms of material removal in polishing of optical glass. A. B. Shorey, K. M. Kwong, K. M. Johnson, and S. D. Jacobs report on measurements of the nanohardness of magnetic and nonmagnetic particles used in the magnetorheological finishing (MRF) process. Their nanoindentation technique allows for the characterization of mechanical properties of small abrasive particles that is not possible through traditional microhardness measurement methods. With abrasive particle characterization now possible, subsequent experiments with different combinations of abrasive particles can provide information regarding removal mechanisms in MRF.

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Editor