UNIVERSITY OF ROCHESTER
LABORATORY FOR LASER ENERGETICS

Volume 123
April–June 2010
DOE/NA/28302-964

LLE Review

Quarterly Report

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Contents

In Brief

This volume of the LLE Review, covering April–June 2010, features "Two-Dimensional Simulations of the Neutron Yield in Cryogenic-DT Implosions on OMEGA" by S. X. Hu, V. N. Goncharov, P. B. Radha, J. A. Marozas, S. Skupsky, T. R. Boehly, T. C. Sangster, D. D. Meyerhofer, and R. L. McCrory. The article (p. 111) reports the use of two-dimensional *DRACO* simulations to systematically investigate the impact of nonuniformities seeded by target and laser perturbations on neutron yield in cryogenic deuterium–tritium (DT) implosions. Two sources of nonuniformity accounted for observed neutron-yield reduction according to the *DRACO* simulations: target offset from the target chamber center and laser imprinting. The integrated simulations for individual shots reproduce the experimental yield-over-clean (YOC) ratio to within a factor of 2. Typically, the YOC in OMEGA experiments is ~5%. The simulation results suggest that YOC can be increased to the ignition hydro-equivalent level of 15% to 20% (with $\langle \rho R \rangle$ = 200 to 300 mg/cm^2) by maintaining a target offset of less than 10 μm and employing beam smoothing by spectral dispersion.

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

- R. Epstein, J. A. Delettrez, V. N. Goncharov, P. W. McKenty, F. J. Marshall, D. D. Meyerhofer, P. B. Radha, S. P. Regan, T. C. Sangster, V. A. Smalyuk, W. Theobald, and B. Yaakobi (LLE); R. Tommasini, N. Landen, and A. MacKinnon (LLNL); and M.-J. Tsay and M. Young (LLE Summer High School Research Program) describe the use of x-ray radiography to characterize cryogenic implosions on OMEGA (p. 128). The first radiographs of cryogenic implosions on OMEGA have been obtained using short-pulse, K-shell emission-line backlighters driven by the OMEGA EP laser. Simulations show that radiography near peak compression is feasible. Backlighter composition is chosen so that the emission lines occur at energies where the opacity profiles of the imploded cores will provide a measurable range of optical depth, and the specific intensity of the backlighter is capable of overcoming the core self-emission. Simulations of the first measured implosion radiographs are used to assess the implosion performance at times in advance of peak compression. Radial mass distributions are obtained from the radiographs using Abel inversion and the known temperature and density dependence of the free-free opacity of the hydrogen shell. Radiography based on Compton scattering of hard backlight x rays is being investigated as an alternative approach. The relative advantages of both methods of radiography are compared.

- C. Stoeckl, M. Cruz, V. Yu. Glebov, J. P. Knauer, K. L. Marshall, C. Mileham, T. C. Sangster, and W. Theobald (LLE), and R. Lauck (Physikalisch Technische Bundesanstalt, Braunschweig, Germany) have developed a gated liquid-scintillator–based neutron detector to be used for fast-ignitor experiments and down-scattered neutron measurements (p. 145). The detection of neutrons in these experiments is very challenging since it requires the neutron-detection system to recover within 50 to 500 ns from a high background signal many orders of magnitude stronger than the signal of interest. The background signal is either the hard x-ray emission from a short-pulse laser interaction with a target for the fast-ignitor experiments or the primary neutron signals for the down-scattered neutron measurement. The liquid-scintillator–based detector uses a gated microchannel photomultiplier that suppresses the high background signal and an oxygen-enriched liquid scintillation material that eliminates the afterglow present in conventional plastic scintillators.

- W. Wang and T. B. Jones (Department of Electrical and Computer Engineering, University of Rochester), and D. R. Harding (LLE and Department of Chemical Engineering, University of Rochester) describe an on-chip double emulsion droplet assembly for laser-target fabrication (p. 149). The double emulsion droplets used to fabricate cryogenic foam targets for inertial confinement fusion experiments require precisely controlled volumes. On-chip, electric-field–actuated, microfluidic assembly of double emulsion droplets can be used to achieve such precision. The electrowetting-on-dielectric and dielectrophoresis effects make it possible to manipulate both conductive and dielectric droplets simultaneously on a substrate. Aqueous and non-aqueous liquid droplets precisely dispensed from two reservoirs on a microfluidic chip are transported and combined to form oil-in-water-in-air or water-in-oil-in-air double emulsion droplets. The dispensing reproducibility is studied as a function of a set of operation parameters. Conditions for spontaneous emulsification for double emulsion formation are developed in terms of droplet surface energies.

- F. J. Marshall, T. DeHaas, and V. Yu. Glebov report on a study of charge-injection-device performance in the high-energy-neutron environment of laser-fusion experiments (p. 159). Charge-injection devices (CIDs) are being used to image x rays in laser-fusion experiments on the OMEGA Laser System, up to the maximum neutron yields generated ($\sim 10^{14}$ DT). The detectors are deployed in x-ray pinhole cameras and Kirkpatrick–Baez microscopes. The neutron fluences ranged from $\sim 10^{7}$ to $\sim 10^{9}$ neutrons/cm^2, and useful x-ray images were obtained even at the highest fluences. It is intended to use CID cameras at the National Ignition Facility (NIF) as a supporting means of recording x-ray images. The results of this work predict that x-ray images should be obtainable on the NIF at yields up to $\sim 10^{15}$, depending on distance and shielding.

Brian E. Kruschwitz
Editor