UNIVERSITY OF ROCHESTER
LABORATORY FOR LASER ENERGETICS

Volume 111
April–June 2007
DOE/SF/19460-772

LLE Review

Quarterly Report

UR LLE

Contents

In Brief

This volume of the LLE Review, covering April–June 2007, features "Pump-Induced Temporal Contrast Degradation in Optical Parametric Chirped-Pulse Amplification: Analysis and Experiment," by C. Dorrer, A. V. Okishev, I. A. Begishev, and J. D. Zuegel along with V. I. Smirnov (OptiGrate) and L. B. Glebov (College of Optics and Photonics/CREOL, University of Central Florida). In optical parametric chirped-pulse amplification (OPCPA) systems, the temporal fluctuations of the pump pulse are coupled to the spectrum of the chirped signal by the instantaneous parametric gain and lead to a reduction in the temporal contrast of the recompressed amplified signal (p. 135). The authors derive equations describing the contrast degradation in an OPCPA system due to the pump-amplified spontaneous emission. They also quantify the reduction of the contrast in the amplified pulse both analytically and via simulations for an OPCPA system. The placement of a Bragg grating in the regenerative amplifier produces a simple and an efficient pump-intensity reduction, demonstrating contrast improvements up to 30 dB.

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, Massachusetts Institute of Technology) along with J. A. Delettrez, D. D. Meyerhofer, and C. Stoeckl discuss the observations of the collapse of strong convergent shocks at the center of spherical capsules filled with D_2 and ^{3}He gas, which induces both D-D and D-^{3}He nuclear production (p. 148). Temporal and spectral measurements of products from both reactions verify data reliability and allow efficient and insightful alterations in ICF simulations.

- J. E. Miller, T. R. Boehly, and D. D. Meyerhofer, along with J. H. Eggert, S. C. Wilks, J. H. Satcher, and J. F. Poco (LLNL) present work on equation-of-state measurements in Ta_2O_5 aerogel (p. 154). Highly porous samples of tantalum pentoxide (Ta_2O_5) aerogel were compressed from initial densities of 0.1, 0.15, and 0.25 g/cm^3 by shock waves with strengths between 0.3 and 3 Mbar. A comparison of the compression measurements and an available high-energy-density equation-of-state (HED-EOS) model found that the model underestimates the level of compression achieved by shock loading below a Mbar. The thermal measurements also indicate less-significant heating than models predict.

- B. Yaakobi, T. R. Boehly, T. C. Sangster, and D. D. Meyerhofer, along with B. A. Remington, P. G. Allen, S. M. Pollaine, H. E. Lorenzana, K. T. Lorenz, and J. A. Hawreliak (LLNL) discuss EXAFS (extended x-ray absorption fine structure) measurements used to determine the temperature and compression in a vanadium sample quasi-isentropically compressed to pressures of up to ~0.75 Mbar (p. 167). VISAR (velocity interferometer system for any reflector) measurements, with aluminum substituting for the vanadium, are used to calibrate the drive pressure. The experimental results obtained by EXAFS and VISAR agree with each other and with the simulations of a hydrodynamic code. The role of a shield to protect the sample from impact heating and the role of radiation heating from the imploding target and the laser-absorption region are also studied.

- I. V. Igumenshchev, V. N. Goncharov, W. Seka, D. Edgell, and T. R. Boehly report on the effect of resonance absorption in OMEGA direct-drive designs and experiments (p. 179). Simulations demonstrate an important contribution of the resonance absorption during both the short laser picket (~100 ps) and

the first 200 to 300 ps in the long laser pulse. Planar reflection light experiments on OMEGA were conducted to validate the theoretical results.

- H. Sawada, S. P. Regan, D. D. Meyerhofer, I. V. Igumenshchev, V. N. Goncharov, T. R. Boehly, R. Epstein, T. C. Sangster, V. A. Smalyuk, and B. Yaakobi, along with G. Gregori (Rutherford Appleton Laboratory and Clarendon Laboratory, University of Oxford) and S. H. Glenzer and O. L. Landen (LLNL) present the diagnosing of direct-drive, shock-heated, and compressed plastic planar foils with noncollective spectrally resolved x-ray scattering (p. 191). Plastic (CH) and Br-doped CH foils were driven with six beams, having an overlapped intensity of ~1×10^{14} W/cm^2 and generating ~15-Mbar pressure in the foil. The uniformly compressed portion of the target was probed with 9.0-keV x rays from a Zn He$_\alpha$ backlighter created with 18 additional tightly focused beams. An examination of the scattered x-ray spectra reveals that an upper limit of $Z \sim 2$ and $T_e =$ 20 eV can be inferred, since low average ionizations (i.e., $Z < 2$) cannot be accurately diagnosed in this experiment.

Tanya Z. Kosc
Editor