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Contents

In Brief

This volume of the LLE Review, covering the period January–March 2007, features “Laser-Driven Magnetic Flux Compression for Magneto-Inertial Fusion,” by O. V. Gotchev, N. W. Jang, J. P. Knauer, M. D. Barbero, and R. Betti (LLE and the Fusion Science Center for Extreme States of Matter and Fast Ignition Physics); and C. K. Li and R. D. Petrasso (Plasma Science and Fusion Center, MIT). In this article (p. 65), the authors report on an experiment to explore the magneto-inertial fusion (MIF) approach to inertial confinement fusion. In MIF, a magnetized target would be directly irradiated by a laser to compress a preseeded magnetic flux to levels sufficient to inhibit thermal transport out of the hot spot. This approach could eventually lead to ignition of massive shells, imploded at low velocity. Higher gain than that possible with conventional ICF could be reached. In this initial OMEGA experiment, a compact magnetic pulse system is used to generate a >0.15-MG seed magnetic field in a cylindrical target that is compressed by 40 OMEGA beams. A proton deflectrometry technique is being developed to probe the magnetic field using 14.7-MeV protons generated by an independently targeted (with the 20 remaining beams) capsule filled with D^3He gas.

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

- A. A. Solodov, R. Betti, J. A. Delettrez, and C. Zhou (LLE and the Fusion Science Center for Extreme States of Matter and Fast Ignition Physics) present results of hydrodynamic simulations of high-gain, fast-ignition targets, including one-dimensional simulations of the implosion and two-dimensional simulations of ignition by a collimated electron beam and burn propagation (p. 74). These simulations are used to generate gain curves for fast-ignition, direct-drive inertial confinement fusion. It is found that realistic fast-ignition targets can be ignited by monoenergetic collimated electron beams with a radius of 20 μm, duration of 10 ps, and energy of 15 kJ. Simulations using ponderomotive temperature scaling for fast electrons and Gaussian laser pulses predict a minimum laser energy for ignition of 235 kJ (106 kJ) for the energy conversion efficiency from the laser to fast electrons of 0.3 (0.5) and a wavelength of 1.054 μm.
- S. Wu (Department of Physics and LLE); P. Geiser, J. Jun, and J. Karpinski (Solid State Laboratory, ETH, Zurich, Switzerland); and R. Sobolewski (Department of Electrical and Computer Engineering and LLE) report on experimental and theoretical studies of the time-resolved generation and detection of coherent acoustic phonons (CAP’s) in very high quality bulk GaN single crystals (p. 88). These studies are performed using a femtosecond, two-color, all-optical pump/probe technique.
- S. N. Shafrir, J. C. Lambropoulos, and S. D. Jacobs (Department of Mechanical Engineering, Materials Program and LLE) demonstrate the use of spots taken with magnetorheological finishing (MRF) for estimating subsurface damage depth from deterministic microgrinding for three hard ceramics: aluminum oxynitride ($Al_{23}O_{27}N_5$/ALON), polycrystalline alumina (Al_2O_3/PCA), and chemical vapor–deposited (CVD) silicon carbide (Si_4C/SiC) (p. 98).
- A. V. Okishev, C. Dorrer, and J. D Zuegel (LLE); V. I. Smirnov (OptiGrate); and L. B. Glebov (College of Optics and Photonics/CREOLE, University of Central Florida) report on the demonstration of instrument-limited suppression of out-of-band amplified spontaneous emission (ASE) in a Nd:YLF diode-pumped regenerative amplifier (DPRA) using a volume Bragg grating (VBG) as a spectrally

selective reflective element (p. 115). A VBG with 99.4% diffraction efficiency and 230-pm-FWHM reflection bandwidth produced a 43-pm FWHM output spectral width in an unseeded DPRA compared to 150-pm FWHM in the same DPRA with no VBG.

- Z. Jiang and J. R. Marciante discuss beam-quality factor measurements for an amplified emission source based on ytterbium-doped, large-mode-area (LMA), multimode fiber (p. 120). The measurements indicate that the beam-quality factor decreases until the gain becomes saturated. A model using spatially resolved gain and transverse-mode decomposition of the optical field shows that transverse spatial-hole burning (TSHB) is responsible for the observed behavior.

- J. R. Rygg, J. A. Frenje, C. K. Li, F. H. Séguin, and R. D. Petrasso (Plasma Science and Fusion Center, MIT); and V. Yu. Glebov, D. D. Meyerhofer, T. C. Sangster, and C. Stoeckl (LLE) present the first time-dependent nuclear measurements of turbulent mix in inertial confinement fusion. Implosions of spherical deuterated-plastic shells filled with pure He gas require atomic scale mixing of the shell and gas for the D-^{3}He nuclear reaction to proceed (p. 130). The time necessary for Rayleigh–Taylor growth to induce mix delays the peak nuclear production time, compared to equivalent capsules filled with a D-^{3}He mixture, by 75±30 ps, equal to half the nuclear burn duration. These observations indicate the likelihood of atomic mix at the tips of core-penetrating RT spikes.

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Editor