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Contents

In Brief

This volume of the LLE Review, covering July–September 2002, features an investigation of the radial structure of shell modulations near peak compression of spherical implosions, by V. A. Smalyuk, S. B. Dumanis, F. J. Marshall, J. A. Delettrez, D. D. Meyerhofer, T. C. Sangster, and B. Yaakobi (p. 151). They describe the measurement of the structure of shell modulations at peak compression of implosions using absorption of titanium-doped layers placed at various distances from the inner surface of 20-μm-thick plastic shells filled with D^3He gas. Their results show that the peak-compression, time-integrated areal-density modulations are higher at the inner shell surface, which is unstable during the acceleration phase of an implosion, than in the central part of the shell. The outer surface of the shell, which is unstable during the acceleration phase of an implosion, has a modulation level comparable to that of the inner shell surface.

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

- Measurements of the neutron emission from inertial confinement fusion (ICF) implosions provide important information about target performance that can be compared directly with numerical models. For room-temperature target experiments on OMEGA at the Laboratory for Laser Energetics (LLE) the neutron temporal diagnostic (NTD), originally developed at Lawrence Livermore National Laboratory (LLNL), is used to measure the neutron burn history with high resolution and good timing accuracy. Since the NTD is mechanically incompatible with cryogenic target experiments because of the standoff required to remain clear of the Cryogenic Target Handling System, a new cryogenic-compatible neutron temporal diagnostic (cryoNTD) has been designed for LLE's standard ten-inch-manipulator (TIM) diagnostic inserters. This instrument provides high-resolution neutron emission measurements for cryogenic implosions. C. Stoeckl, V. Yu. Glebov, S. Roberts, and T. C. Sangster of LLE along with R. A. Lerche, R. L. Griffith, and C. Sorce of LLNL (p. 156) present the first experimental results of the performance of cryoNTD and compare them to NTD measurements of room-temperature direct-drive implosions.

- V. Yu. Glebov, C. Stoeckl, T. C. Sangster, D. D. Meyerhofer, and P. B. Radha of LLE along with S. Padalino, L. Baumgart, R. Colburn, and J. Fuschino of SUNY Geneseo (p. 161) report on the use of carbon activation as a diagnostic for tertiary neutron measurements. The yield of tertiary neutrons with energies greater than 20 MeV has been proposed as a method to determine the areal mass density of ICF targets. Carbon activation is a suitable measurement technique because of its high reaction threshold and the availability of high-purity samples. The isotope ^{11}C decays with a half-life of 20.3 min and emits a positron, resulting in the production of two back-to-back, 511-keV gamma rays upon annihilation. The present copper activation gamma-detection system can be used to detect tertiary-produced carbon activation because the positron decay of ^{11}C is nearly identical to the copper decay used in the activation measurements of 14.1-MeV primary deuterium–tritium (DT) yields. Because the tertiary neutron yield is more than six orders of magnitude lower than primary neutron yield, the carbon activation diagnostic requires ultrapure carbon samples, free from any positron-emitting contamination. Carbon purification, packaging, and handling procedures developed in recent years that reduce the contamination signal to a level low enough for OMEGA are presented. Potential implementation of a carbon activation system for the National Ignition Facility (NIF) are also discussed.

- D. Harding, F. Y. Tsai, and R. Q. Gram (p. 167) describe the development of polyimide shells suitable for ICF cryogenic experiments on OMEGA. They have also determined the associated mechanical properties needed to define the processing conditions for operating the OMEGA Cryogenic Target Handling System (CTHS). Overall, polyimide targets offer a viable alternative to plasma polymer capsules currently in use. The principal advantages of the polyimide material are its high radiation resistance for tritium application and its excellent mechanical properties, which lessen the demanding specifications for the equipment needed to provide cryogenic targets. The single biggest limitation to using polyimide, based on PMDA-ODA chemistry, is the low permeability of the material at room temperature. Methods to increase the permeability are described.

- R. W. Short (p. 181) presents a linear model of anomalous stimulated Raman scattering from electron-acoustic waves in laser-produced plasmas. Stimulated Raman scattering (SRS) from heavily Landau-damped plasma waves and from electron-acoustic (EA) waves has recently been attributed to nonlinear Bernstein–Green–Kruskal (BGK) wave modes. These phenomena find a simpler, more comprehensive explanation in terms of linear waves in a locally flattened distribution function. The flattening arises from Landau damping of SRS plasma waves (in the case of anomalous SRS) or from perturbations at the EA phase velocity that are then maintained by SRS. Local flattening allows undamped linear EA waves to propagate, as in the original description of these waves by Stix.

- J. Zhang, W. Slysz, A. Verevkin, and Roman Sobolewski of LLE and the University of Rochester along with O. Okunev and G. N. Gol'tsman of Moscow State Pedagogical University (p. 186) have measured the time delay of the resistive-state formation in superconducting NbN stripes illuminated by single optical photons. They observed a 65(±5)-ps time delay in the onset of a resistive-state formation in 10-nm-thick, 200-nm-wide NbN superconducting stripes exposed to single photons. This delay in the photoresponse decreased down to zero when the stripe was irradiated by multiphoton (classical) optical pulses. The NbN structures were kept at 4.2 K, well below the material's critical temperature, and were illuminated by 100-fs-wide optical pulses. The time-delay phenomenon is explained within the framework of a model based on photon-induced generation of a hotspot in the superconducting stripe and subsequent, supercurrent-assisted resistive-state formation across the entire stripe cross section. The measured time delays in both the single-photon and two-photon detection regimes agree well with the Tinkham model's theoretical predictions of the resistive-state dynamics in narrow, ultrathin superconducting stripes.

- This volume concludes with a summary of LLE's Summer High School Research Program (p. 190), the FY02 Laser Facility Report (p. 192), and the National Laser Users' Facility and External Users' Programs (p. 194).

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Editor