January 1998 Progress Report on the Laboratory for Laser Energetics Inertial Confinement Fusion Program Activities

UR LLE

***Charged-Particle Spectrometer*:** In a collaboration that includes scientists from LLE, MIT, and LLNL, a magnetic charged-particle spectrometer using an array of CR-39 track detectors was fielded for the first time on OMEGA experiments. In initial target experiments with D_2 and D_2-He^3 filled targets, the spectrometer successfully resolved the spectra of 14.7-MeV protons, 3-MeV protons, 3.7-MeV alphas, and other fusion-product charged particles. In future experiments, this spectrometer as well as a CCD-based instrument will be used to characterize the conditions in high-density target implosions.

***Feedback Control System for Regenerative Amplifier*:** A regenerative preamplifier is used to boost the output of OMEGA's pulse-shaping system from an energy level of ~10 nJ to as much as 100 microjoules. To achieve the stability and control required for proper operation of the facility, a negative-feedback stabilization system was recently implemented that significantly enhances the performance of the amplification process in the regenerative amplifier. The performance data from this system presented in the accompanying figures demonstrate the best stability ever published for both flash-lamp–pumped and diode-pumped regenerative amplifiers.

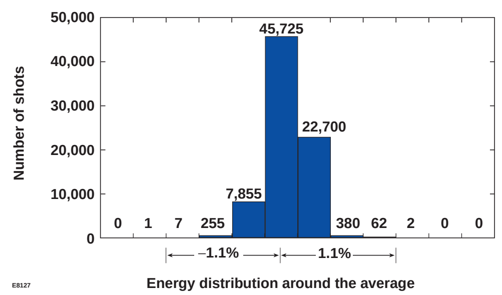

Fig. 1. Histogram (standard deviation 0.2%) for the single-shaped-pulses switchout from the feedback-controlled regenerative amplifier.

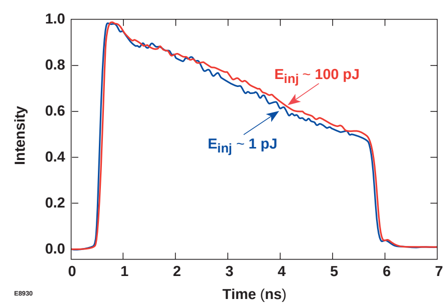

Fig 2. Regenerative amplifier with negative feedback is insensitive to the injected energy variations.

***National Ignition Facility Optics*:** LLE's Optical Manufacturing Group (OMAN) is developing optical-coating processes for the National Ignition Facility (NIF) optics. The NIF optics require low-defect, low-absorption coatings applied to large-area substrates that will be exposed to the high-fluence light of NIF. Cleaning and handling methods are carefully scrutinized to assure cleanliness of the coating and safe handling of the optics. The photograph shows the OMAN staff transferring a 686-mm-diam NIF interferometer collimator lens from the substrate cleaning area to the coating tooling. During coating, the optic rests on Vespel® pads to allow the optic to expand and contract during the heating cycle. The coating design uses the hafnia (metal)/silica process developed by OMAN for OMEGA and NIF coatings. In this process, metallic hafnium is heated to vaporization by an electron beam and is converted at the substrate (through collisions with oxygen) to hafnium dioxide. This method greatly reduces the defects typically produced in materials of high index of refraction during evaporation. The process is being developed for full-scale NIF polarizers and mirrors that will be coated using a unique counter-rotation planetary, thereby doubling the number of large optics that can be coated in the existing equipment.

***OMEGA Operations Summary*:** During January '98 OMEGA operations included a variety of campaigns to characterize target performance with the uniformity enhancement of the new DPP optics. Spherical implosions for convergence ratio (PP2), hydrostability (S3), and hydroequivalent implosions (HE1, cryosurrogate) were conducted for the LLE program. In addition, scientists from LANL conducted direct-drive cylinder experiments. For this campaign a new pulse shape was added to the system—a 2.5-ns linear ramp in intensity. The preliminary results are very encouraging for back-illuminated measurements of hydrodynamic instabilities in a convergent geometry. This first round of tests included benchmark comparisons to similar indirect-drive Nova experiments. In January, 62 target shots were performed over a three-week period; the fourth week was used to activate a new precision laser diagnostic that measures the far-field profile of the laser at various locations in the system (U5 campaign).

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