

August 1999 Progress Report on the Laboratory for Laser Energetics Inertial Confinement Fusion Program Activities



OMEGA Prepulse Contrast: In collaboration with LLNL, we have examined the effect of pulse-shape contrast on OMEGA targets. Specifically, we used LLNL's active shock breakout (ASBO) diagnostic to observe the breakdown of the 1000-Å-thick Al barrier layer placed on most OMEGA targets. In this work we observed the front side of a planar target and detected the breakdown of the Al barrier layer by observing when the VISAR fringes were disrupted. In addition, soft x-ray emission from these layers was monitored using photoconductive detectors (PCD). Targets were irradiated by six OMEGA UV beams having SG3 DPP's and a 1-ns temporally square pulse, producing an intensity of $\sim 10^{15}$ W/cm². Figure 1 depicts the streak record from the ASBO diagnostic, where the horizontal bands are the VISAR fringes. The fringes persist from ~ 18 ns before the pulse up to the point where they are disrupted by the OMEGA pulse and the target self-emission (vertical band) dominates the streak record. On this shot, the laser had a control prepulse at $t = -1$ ns with an intensity $\sim 3 \times 10^{-6}$ of the main pulse, used to calibrate the optical contrast measurements on the laser. Note that some fringes are disrupted by this prepulse at ~ 1 ns before the self-emission. The fact that only portions of the fringes are disrupted implies that the peak prepulse intensity was nearly equal to the breakdown intensity for the barrier layer (that intensity is $\sim 3 \times 10^9$ W/cm²). Analysis of laser-performance history indicates that, under normal conditions, the OMEGA laser contrast is typically in the 10^7 to 10^8 range—a factor of 30 to 300 below the threshold for the breakdown of the barrier layers. The PCD data are consistent with these observations. This study has produced a calibration for the optical prepulse monitor and demonstrated that OMEGA's optical contrast is acceptable.

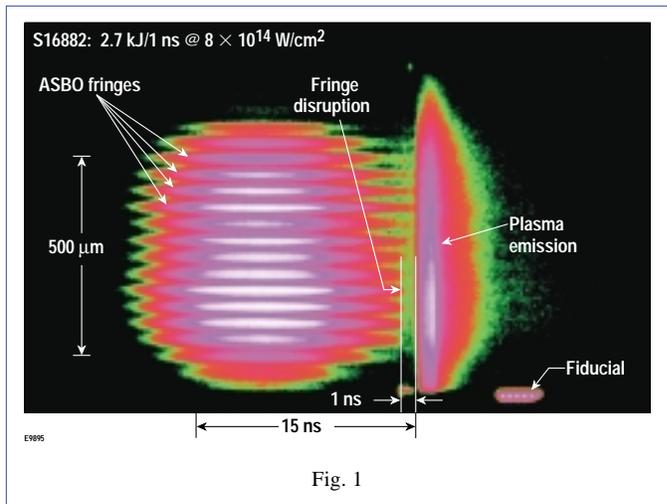


Fig. 1

Diode-Pumped Multipass Pre-amplifier: A new diode-pumped multipass pre-amplifier has been installed in the OMEGA oscillator room to boost the master oscillator energy by up to 10 times to satisfy the output-energy requirements of the multichannel pulse-shaping system. The eight-pass pre-amplifier is pumped by a 5-W fiber-coupled cw laser diode array (Fig. 2). A 16-ns flat-top pulse has been amplified up to 2 mJ without pulse-shape distortion. The single-mode fiber-launching efficiency is slightly decreased because of a small beam-profile distortion due to off-axis lens propagation. No significant thermal problems have been found up to a 300-Hz pulse repetition rate.

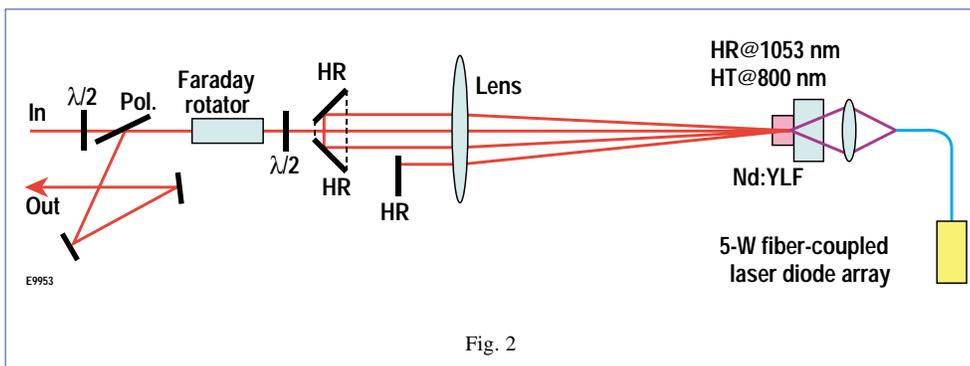


Fig. 2

system maintenance. The highlight of this quarter's maintenance week was the installation of the Cryogenic Target Handling System's (CTHS) lower pylon assembly. Subsystem checkout of the CTHS lower pylon included transport of a room-temperature payload from a moving transfer cart to the target chamber center. Internal LLE shot campaigns included integrated spherical experiments (ISE – 26 shots), planar Rayleigh–Taylor (RTI – 30 shots), and long-scale-length plasma (LSP – 13 shots). The LSP campaign was followed by an NLUF LSP campaign (12 shots). The last day of the month was divided between LLNL equation-of-state experiments (4 shots) and NLUF x-ray diffraction diagnostic development (2 shots). The remainder of the shots for the month were dedicated to diagnostic checkout and x-ray focus characterization (9 shots).

OMEGA Operations Summary: During August a total of 96 target shots were taken, and one week was dedicated to quarterly