Plasma Electrode Pockels Cell (PEPC): Based on NIF technology and developed with the assistance of LLNL scientists, a plasma electrode Pockels cell (PEPC) has been built and tested at LLE for use on the OMEGA EP Laser System. The LLE PEPC will perform two critical roles: (1) capturing the laser pulse in the amplifier cavity for four passes, as in the NIF laser, and (2) blocking retroreflected infrared light on its return path to the amplifiers, protecting the laser system from optical damage. The latter role requires a very high performance from the optical switch, and the PEPC is required to maintain a minimum switching contrast ratio at every point on the clear aperture greater than 500:1.

In order to achieve this performance, two major design changes were required. First, the LLE PEPC was designed to minimize stress-induced birefringence in the windows, which is commonly observed in these systems because of the pressure differential between the vacuum and atmosphere sides of the glass. The LLE PEPC features circular windows that are supported on compliant O rings. With this design, the stress developed in the windows under vacuum loading is evenly distributed; the birefringence is nearly cancelled between the inner and outer surfaces. The LLE PEPC was also designed to have a wider plasma channel relative to the clear aperture in order to mitigate plasma-pinching effects.

A contrast ratio map shows that the PEPC meets or exceeds its switching contrast performance goal in the full clear aperture. The contrast ratio was measured in a full-aperture polarimeter, which uses a *Q*-switched laser pulse expanded to illuminate the full PEPC aperture between two polarizers and synchronized with an 18-kV switch pulse. A scientific-grade camera images the PEPC aperture to measure the spatially resolved switching contrast. The results (Fig. 1) show that the contrast ratio exceeds 1000:1 everywhere in the clear aperture. Long-term testing of the LLE PEPC showed that the performance reliably exceeded the specification for over 2000 switch pulses in full-day testing.

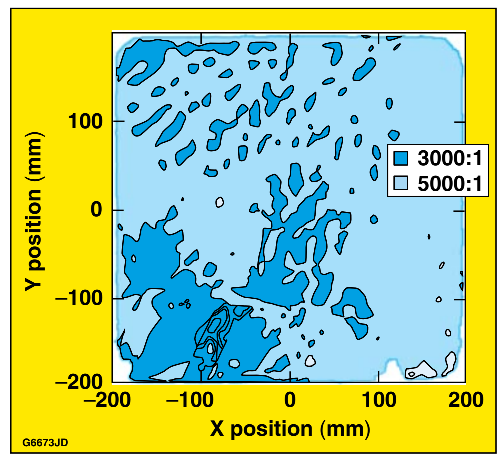

Figure 1. PEPC switching contrast ratio map. Minimum contrast ratio exceeds 1000:1 in the clear aperture.

Further development is focused on improving the vacuum system and developing electronics for double-pulsing the PEPC. The latter development is required for the short-pulse beamlines that require two PEPC switching operations in rapid succession; the first to hold the pulse in the amplifier cavity for four passes and the second to reject light retroreflected from target. LLE engineers are working with LLNL to incorporate a new solid-state inductive-adder pulse generator into the system that will provide this capability. The development will be completed in early 2006 for integration into the OMEGA EP beamlines.

OMEGA Operations Summary: During the month of August, OMEGA conducted 149 target shots for LLE (82), LLNL (28), and NLUF experiments (39). The LLE shots were conducted for the LPI, RTI, SSP, CRYO, ISE, and DDI campaigns. The target shots taken for the NLUF campaigns were led by teams from the University of Michigan, the University of California, Davis, and Rice University. Figure 2 shows data obtained in a May 2005 Rice University OMEGA experiment[1] in which a high-density jet was driven into a foam target. In the August campaign, a dense ball was embedded in the foam. Such experiments may help to understand many phenomena observed in star formation.

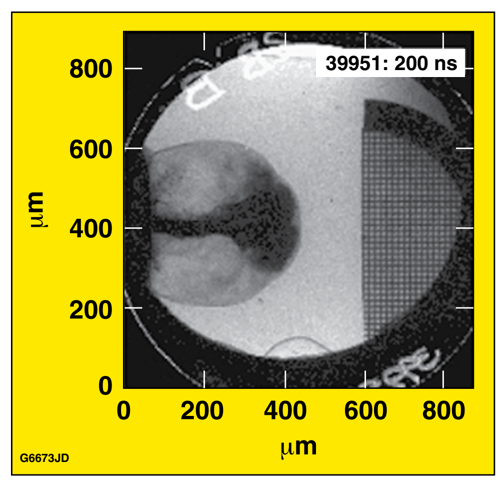

Figure 2. X-ray radiograph from an NLUF experiment that simulates astrophysical jets by driving a high-density jet into a foam.

1. P. Hartigan *et al.*, private communication (2005).

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