Cryogenic DT Target Implosions: During the week of 27 March 2006, LLE scientists imploded two fully β-layered DT capsules using the high-contrast pulse shape described below. The tritium fraction in each capsule was 13.5%. Both capsules were layered without external IR radiation, confirming earlier estimates that a tritium fraction of ~10% would be sufficient for β-layering to occur. This is the first time that a β-layered DT target was used in a laser-driven implosion. Figure 1 shows a typical shadowgraph of one of the targets. The layer quality of both targets (see the July 2005 and September 2003 monthly reports for details) was dominated by features associated with single crystal growth [and the relatively low heating power at this tritium fraction (see Fig. 1)]. The measured 4-μm-rms (all modes) smoothness is expected to improve significantly with a full 50/50 DT mixture. In addition, no adverse radiation dose effects were observed on the spider silk or the thin outer CH plastic shell. Both targets performed quite well with a 1-D DT yield over clean (YOC) of ~10% for each. Areal-density diagnostics were limited with the low tritium fraction. Wedged-range-filter spectrometers were fielded to measure the energy loss of both secondary and primary D^3He protons (the areal density of the fuel is inferred from this energy loss). The data is currently being analyzed—the high DT-neutron yield significantly complicates the analysis. The areal densities for both targets are predicted to be ~160 mg/cm^2. With 50/50 DT, we expect to be able to use the ratio of the tertiary-to-primary neutron yields to reliably infer the total fuel areal density.[1]

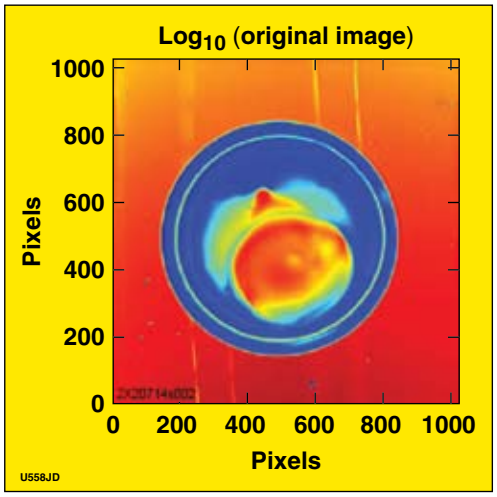

Figure 1. One of the 48 shadowgraphs used to estimate the 4-μm-rms (all modes) inner DT ice smoothness for the capsule in shot 43104. This layer was formed entirely because of the heating of the tritium β decay.

High-Contrast Pulse Shape Generator: Low-adiabat, high-contrast pulse shapes are required for OMEGA ignition-scaled cryogenic target experiments. Such pulse shapes are typically characterized by a narrow picket pulse on top of a low-intensity foot pulse followed by a high-intensity drive pulse. The new front end on OMEGA—the integrated front-end source (IFES)—is a highly stable optical pulse-generation system based on the fiber amplification of an optical signal that is temporally carved from a continuous-wave fiber laser. The use of fiber-optic lasers and amplifiers and waveguide temporal modulators makes IFES ideally suited to producing reliable, stable pulse shapes. Recent experiments on OMEGA have required ~100:1 contrast-ratio pulse shapes. The electrical waveform that drives the waveguide modulators to shape the pulse is produced using the LLE aperture-coupled strip line technology. The shape is designed to precompensate the temporal distortions in the laser due to amplifier gain saturation and nonlinear conversion in the frequency conversion crystals. Of particular importance to the recent cryogenic DT target implosions was pulse shape LA279901p. Figure 2 shows (on a logarithmic scale) the design template and the measured ultraviolet laser pulse produced on target by OMEGA for this pulse shape. The match between the designed and measured shapes is excellent, particularly in the following critical pulse parameters: the picket energy, ~100:1 contrast foot, and rising edge of the drive pulse.

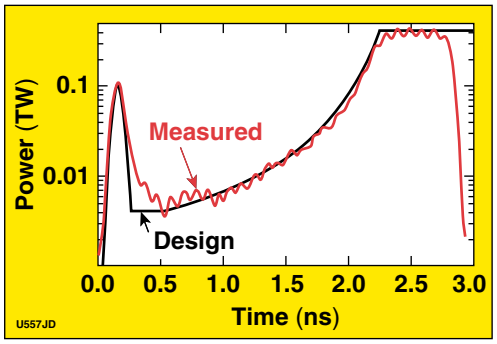

Figure 2. OMEGA single-beam pulse shape from low-adiabat cryogenic target implosions (shot #42966) using pulse shape LA279901p.

OMEGA Operations Summary: OMEGA carried out 133 target shots during March 2006. LLE programs accounted for 82, LLNL for 30, and LANL for 21 of these shots. LLE achieved a major milestone in March by imploding two layered DT cryogenic targets containing 13% tritium. The quarterly maintenance week originally scheduled for the last week in March was rescheduled for the first week in April to accommodate this milestone.

1. V. Yu. Glebov *et al.*, Rev. Sci. Instrum. **74**, 1717 (2003).

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