Cryogenic Target Characterization: The OMEGA Cryogenic Target Handling System (CTHS) was put back into full operation following a six-month period during which the control system was upgraded and additional moving cryostats for accelerated target delivery were constructed. Initial tests with the CTHS have identified processing conditions required to fill and cool thin-wall targets (~3 μm of CD or CH). Currently, cryogenic targets with ~3-μm-CH or CD walls and 80 to 100 μm of internal D_2 ice layers have been produced. Given the fragility of these shells, the complete filling cycle takes ~5 days, although this time is not yet optimized. Subsequent tests identified protocols to layer cryogenic targets using IR heating. In these experiments, shadowgraphic analysis was used to measure the uniformity of the resulting ice layer. Figure 1 shows the shadowgram of the target; the bright band is an envelope of rays (caustic) generated by the interface between the ice and the gas along a great circle around the target. The measured nonuniformity for four different targets was 5- to 10-μm rms for ℓ modes 1 through 50. Rotating the target perpendicular to the viewing axis allows the surface roughness to be measured along different great circles of the capsule (see Fig. 2).

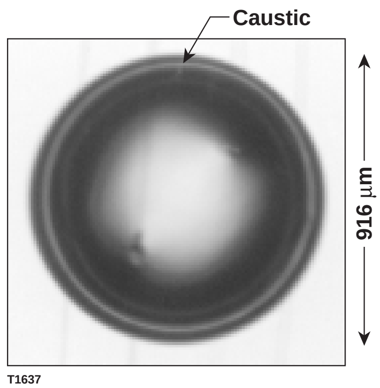

Figure 1. Shadowgraph of 3.6-μm-thick, 916-μm-diam CD shell containing an 80-μm-thick D_2-ice layer. The bright band is a caustic generated by the ice/gas interface. Detailed analysis of this band produces a measure of the uniformity of the ice layer. This measurement can be carried out with a spatial resolution of 1 to 2 μm.

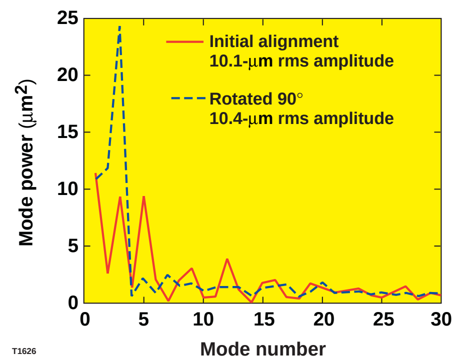

Figure 2. Measured D_2 ice layer nonuniformity for a CH shell of ~920-μm diameter and 3.5-μm wall containing a 100-μm D_2-ice layer. The solid line is the measurement from the initial target alignment, and the dashed line is the measurement for the target rotated by 90° from the original orientation.

Improved Capsule-Surface Roughness: General Atomics (GA) recently delivered to LLE a batch of (CH) shells made by using very smooth poly(α-methylstyrene) (PAMS) mandrels. These CH shells were measured to have surface rms nonuniformity as low as 17 nm in all spherical-harmonic modes $\ell > 2$. CH shells used by LLE in prior experiments had surface nonuniformity ~3× higher. A newly implemented LLE hydrodynamic stability/mix model (DF-MIX) indicates that this reduction in surface roughness should have a measurable effect on the neutron yield of OMEGA experiments. Results from a recent set of implosion experiments that used CH shells with surface roughness in modes $\ell > 2$ ranging from 17 to 55 nm confirmed these expectations. As seen in Fig. 3, the capsule performance in terms of the ratio of experimentally measured neutron yield to that predicted by clean, 1-D simulations (YOC) shows a 30% to 40% improvement for a factor-of-2 improvement in surface roughness. Work is currently underway to better define the range of modal roughness for which the target performance is most sensitive. This work will help define new experiments and provide important information for power imbalance studies for direct-drive implosions.

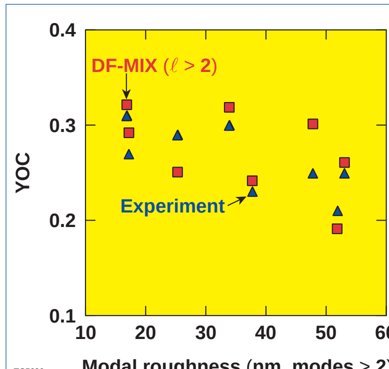

Figure 3. Measured (blue triangles) and DF-MIX–predicted (red squares) capsule performance (YOC) as a function of the measured capsule-surface roughness in all modes $\ell > 2$.

OMEGA Operations Summary: During July, nine days were dedicated to target shots and one week to planned maintenance activity on OMEGA. The cryogenic target campaign was restarted after planned upgrades and modifications were completed on the CTHS. A total of 80 target shots were delivered for the following LLE and LLNL campaigns: LLE ISE (33 shots), LLE SSP (16 shots), LLE Power Balance (8 shots), LLE Cryogenic Targets (4), LLNL LOWT (5 shots), LLNL Isentropic Drive (4 shots), LLNL EOS (8 shots), and LLNL Shock Melting (2 shots).

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