Shock-Timing Validation: Indirect-drive ignition targets require that the first three shocks be timed so they coalesce at a precise instant (±50 ps relative to each other) and the compression wave ("fourth shock") be timed to that event to ±100 ps. The National Ignition Campaign (NIC) includes shock-timing shots for optimization of drive conditions. LLE assumed responsibility for developing and validating the technique to measure NIC shock timing. Shock timing is performed with optical diagnostics (VISAR and SOP) requiring targets with re-entrant cones that penetrate the capsule inside the NIF hohlraum. The capsule and cone are filled with liquid deuterium and an external window allows the optical diagnostics to view the internal surface of the capsule along the axis of the cone. Figure 1 shows the experimental configuration. The precision of the diagnostics and their ability to observe shocks has been recently demonstrated.

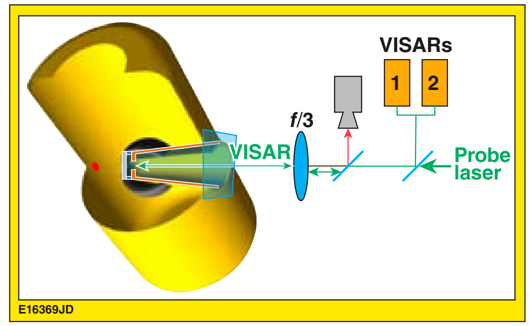

Figure 1. Experimental configuration for shock-timing measurements.

The OMEGA validation experiments use NIF-sized cones (~5 mm from capsule to window) inserted into an OMEGA scale-1 hohlraum (2.55 mm × 1.6 mm). Figure 2 shows data from an OMEGA experiment (49448) driven by a 2-ns pulse, where the peak radiation temperature reached 130 eV. Figure 2(a) shows the ablator configuration comprising layers of Be (75 μm), Cu (0.5 μm), and Be (75 μm) that mimic the opacity of the Cu-doped Be ablator planned for ignition targets. Figure 2(b) shows the VISAR data, which are interference fringes whose change in vertical position is proportional to velocity. The bright horizontal fringes at the top and bottom of the record are the signal reflected from the surface of the stationary gold cone around the aperture. In the center are fringes that result from reflection: first off the rear side of the Be ablator, then off the shock wave in deuterium. Before the shock arrives, the fringes dim in brightness because x-ray preheat alters the reflectivity of the Be surface. Figure 2(c) shows the shock optical self-emission profile measured by the streaked optical pyrometer (SOP). Early in the record the edge of the gold aperture begins to "glow." The arrival of the shock (~6 ns) in the deuterium is seen as the sharp increase in intensity; later the arrival of the shock at the aperture can be seen. The latter is significant because it provides a spatial fiducial that calibrates the position of the shock.

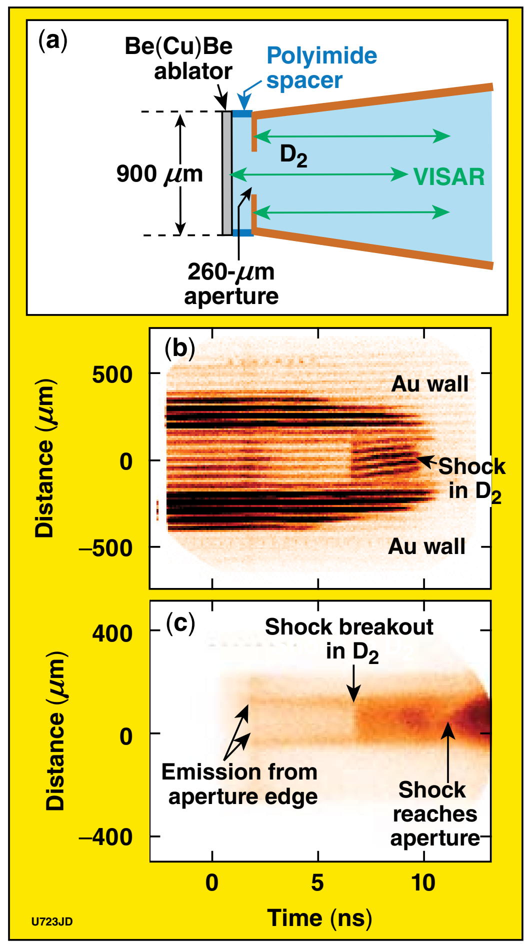

Figure 2. Experimental configuration (a), VISAR (b), and SOP (c) data from shot 49448.

At 130 eV, OMEGA produces nearly five times more x-ray flux (>1.5 keV) than expected on the NIF because the OMEGA drive beams are more tightly focused. Experiments with thicker (more opaque) ablators produced successful data for a radiation temperature of ~165 eV. These results, plus those from open-geometry experiments that show that windows can survive NIF-like fluxes for 12-ns durations, validate the technique for use on the NIF.

OMEGA Operations Summary: OMEGA conducted 80 shots in November with an effectiveness rate of 94.4%. NIC shots accounted for 73.8% of the shots (taken by PI's from LLE) while the 21 non-NIC shots were taken by groups led by PI's from LLNL and AWE. OMEGA EP integration activities continued in November.