Multiple Shock Timing in Convergent Geometry: Timing of multiple shock waves with a precision of ~50 ps is critical to the performance of ignition targets. In support of the National Ignition Campaign (NIC) in 2007, LLE demonstrated an optical-measurement technique to time shocks in cryogenic hohlraum-driven targets under NIF-relevant x-ray-loading conditions.[1] Recent OMEGA experiments have applied this technique to study multiple shocks and the effects of spherical convergence using direct-drive, cone-in-sphere targets. Strong CD shells (900-μm diam with 10-μm wall) were fit with re-entrant gold cones similar to those used on the hohlraum experiments. The shells were coated with 1000 Å of aluminum to reduce the D_2 permeation rate. Figure 1 shows a schematic and photo of the target and the experimental setup used in these experiments. The liquid-D_2-filled cone-in-sphere target is mounted onto the target cryostat. Thirty-six beams irradiated the target opposite the VISAR diagnostic to produce spherically uniform irradiation of the partial sphere. The VISAR imaged the inside wall of the sphere, through a 5-mm-long column of liquid D_2. Targets were driven by shaped laser pulses (see Fig. 2) comprised of a short (100-ps) initial pulse followed by a slowly rising main pulse that reached peak intensity ~2.5 ns later. This pulse shape produced at least two shocks that ultimately coalesced in the liquid D_2 contained within the shell. The shock velocity in D_2 was measured (by VISAR) and contained distinct signature of shock coalescence. Figure 2 shows a VISAR fringe record for shot 50553 where the fringe position is proportional to shock velocity. During the initial signal from $t = 0$ to ~0.8 ns, the fringes are missing because of radiation-induced blanking of the CD shell. At ~0.8 ns, the shock exits the shell and the shock in D_2 is observed. This is the shock from the 100-ps-long pulse at the beginning of the drive pulse (see laser pulse in image), and it is decaying as it propagates inward. This decay continues until ~2.6 ns, when the shock from the main portion of the pulse overtakes this shock, forming a stronger coalesced shock. At ~3.6 ns, the fringes diminish in intensity and the signal is lost. This may be the result of several effects such as convergence, nonuniformity, and shock brightness. The reduction in intensity is not due to window blanking. Note that the signal from the aperture face persists well past this loss of signal. Additional experiments are needed to better understand this loss of signal. A nearly identical shot (shot 50548) produced a similar VISAR record, except that the velocity rose steeply after coalescence. This is apparently the result of a minor difference in the form of the low-intensity portion of the pulse. Figure 3 shows those pulse shapes with the corresponding VISAR trace as insets. These results will be used to validate hydrocode simulations of these experiments.

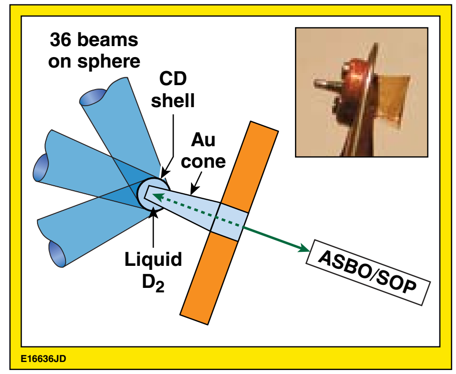

Figure 1. Schematic of experimental configuration and photograph of target (inset).

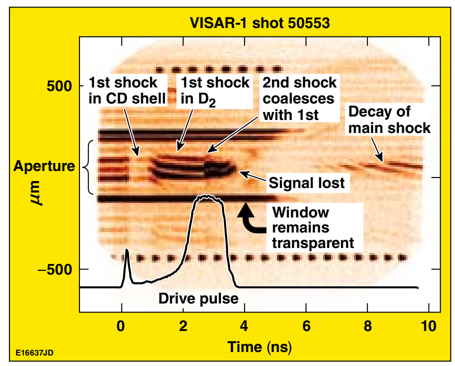

Figure 2. VISAR fringe record and laser pulse shape of shot 50553.

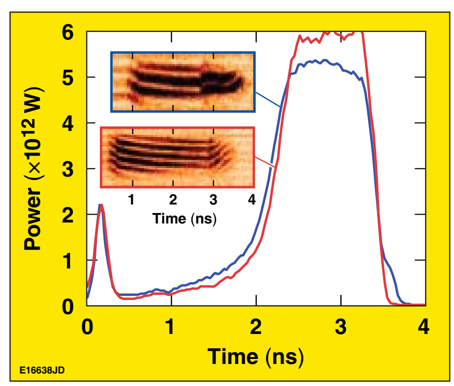

Figure 3. Pulse shape and VISAR fringe records from shot 50548.

OMEGA Operations Summary: OMEGA conducted 113 target shots in March with an overall experimental effectiveness of 95.5%. The National Ignition Campaign (NIC) accounted for 74 of these shots (36 for IDI and 38 for DDI). LLNL and LANL led 9 and 11 of these shots, respectively. A total of 39 non-NIC shots were taken in March including 24 for the LLNL HED program, 5 for an NLUF campaign led by the University of Nevada, Reno, and 10 by LLE.

1. T. R. Boehly *et al*., Bull. Am. Phys. Soc. **52**, 65 (2007).