Drive Uniformity Improvement: The on-target laser irradiation nonuniformity was reduced on OMEGA with the implementation of a new distributed phase plate (DPP).[1,2] The envelope of the single-beam, far-field intensity has a super-Gaussian shape, $I(r) \propto \exp\left[-(r/\delta)^n\right]$, where r is the radius of the beam, δ is the $1/e$ half-width, and n is the super-Gaussian order. The new SG4 DPP with $n = 4.1$ produces a more azimuthally symmetric far field than the SG3 DPP with $n = 2.3$ resulting in significant reductions in the nonuniformity levels in the low-ℓ-mode range ($3 < \ell < 8$) and in the intermediate range ($10 < \ell < 8$). The effects of the low- and intermediate-ℓ-mode nonuniformities on the target performance of high-adiabat, deuterium-filled-plastic-shell implosions were investigated. Implosions are categorized by the adiabat α or isentrope parameter of the shell, defined as the ratio of the shell pressure to the Fermi-degenerate pressure. Target performance is quantified by the ratio of measured primary neutron yield to 1-D predicted yield, which is defined as the yield over clean (YOC). As shown in Fig. 1, the YOC for 3-atm-deuterium-filled, high-adiabat plastic-shell implosions with 27-μm-thick shells increased by almost a factor of 2 with the reduced nonuniformity, while the YOC for the 20-μm-thick shells remained unchanged. The target performance of the unstable, thinner-shell target is not sensitive to the reduced low-ℓ-mode nonuniformities because it is dominated by the single-beam-irradiation nonuniformities. The thicker-shell target is less susceptible to the laser imprint from the high ℓ-modes and is sensitive to the reduction in the low- and intermediate-ℓ-mode nonuniformities.[3]

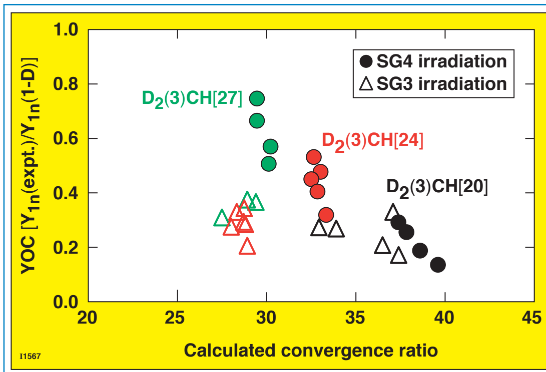

Figure 1. The YOC for 3-atm-deuterium-filled, high-adiabat plastic-shell implosions is plotted as a function of the calculated convergence ratio for the SG3 and SG4 irradiation conditions.

NIF Neutron Bang Time Detector (NBT): As part of the diagnostic development for the NIF, a prototype of a high-yield neutron bang time detector (NBT) was tested on OMEGA.[4] The NIF NBT prototype consists of two detectors based on synthetic polycrystalline diamonds produced by chemical vapor deposition (CVD). The first detector (CVD1) has a 10-mm-diam, 1-mm-thick diamond wafer; the second (CVD2) has a 5-mm-diam, 0.3-mm-thick wafer. Both detectors were biased at +1000 V and were tested in a lead case in a re-entrant tube at 75 cm from the target. Signals from the CVD diamond detectors, together with an optical fiducial, were recorded on a 3-GHz oscilloscope. Figure 2 shows signals from the two detectors relative to the 1-ns square laser pulse for shot 37591 (thin shell, DT fill), producing a yield of 7.9×10^{13}. CVD1 is more sensitive but slower than CVD2. Figure 3 shows the time difference between the two detectors as a function of shot number. The standard deviation of this difference is 13.6 ps. Therefore, the internal bang time precision of the CVD diamond channels of the NIF NBT prototype is better than 15 ps. The absolute bang time precision will depend on the NIF laser beam timing precision and could be as low as 30 ps.

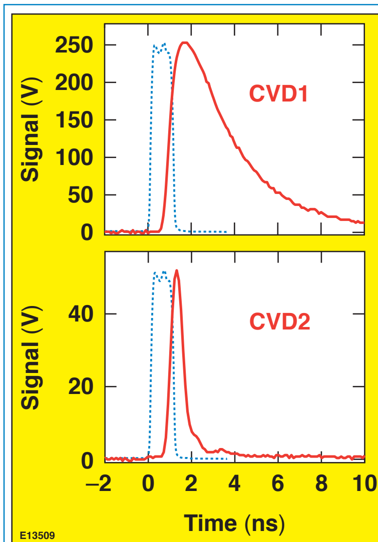

Figure 2. Signals from two CVD detectors (solid red lines) relative to a 1-ns square laser pulse (dotted blue) for shot 37591 (thin shell, DT fill) with 7.9×10^{13} neutron yield.

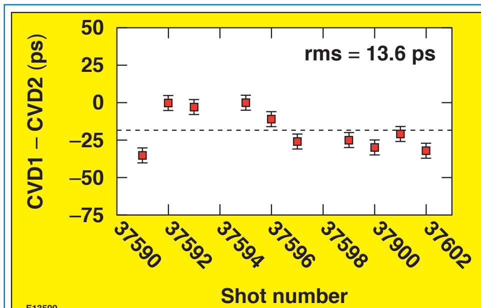

Figure 3. The time difference between the two CVD diamond detectors as a function of shot number.

OMEGA Operations Summary: A total of 120 target shots were conducted by OMEGA during November. Of these shots, 33 were dedicated to LANL experimental campaigns and 87 to LLE. The LLE campaigns included ASTRO, CRYO, DDI, ISE, SSP, LPI, and RTI.

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2. S. P. Regan *et al.*, Bull. Am. Phys. Soc **49**, 62 (2004).
3. P. B. Radha, "Multidimensional Analysis of Direct-Drive Plastic-Shell Implosions on OMEGA," submitted to Physics of Plasmas.
4. Laboratory for Laser Energetics LLE Review **99**, 202, NTIS document No. DOE/SF/19460-555 (2004).

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