OMEGA Integrated Spherical Experiments (ISE): Major improvements in the OMEGA on-target laser uniformity were completed in the last two months. Sixty distributed polarization rotators (DPR's) and sixty sets of dual tripling crystals were installed. The DPR's provide an instantaneous $\sqrt{2}$ reduction of laser nonuniformity. The dual tripling crystals allow the efficient frequency conversion of single-cycle, 1-THz-bandwidth SSD. In addition, improvements to the laser system reduced the beam-to-beam "on-target" energy imbalance to ~±3% rms. The resulting on-target irradiation nonuniformity with all these improvements is σ_{rms} ~ ±1% when integrated over all modes up to $\ell = 500$.

The first spherical target implosion experiments with improved uniformity took place in August. CH shells (20 μm thick, ~ 910-μm diameter) filled with ~15 atm of D_2 or DT were imploded with ~23-kJ, 1-ns square-top pulses. A similar set of implosion experiments was carried out in June, but without DPR's and with three-color-cycle, 0.35-THz SSD. An 80% increase in the primary neutron yield was observed for D_2-filled as well as DT-filled capsules in the August experiments compared to those in June. There was also a 30% to 40% increase in the fuel areal density (ρR) as inferred by secondary neutron and proton measurements in D_2-filled shells and knock-on particle measurements in DT-filled shells. The ratio of the measured primary neutron yield (~1.6×10^{11} for D_2-filled shells and ~1.3×10^{13} for DT-filled shells) to the yield predicted by 1-D simulations assuming no mix (YOC) increased from ~18% to more than 30%. The inferred total areal density of these implosions (~65 to 70 mg/cm^2) is ~80% of that predicted by the same simulations (Fig. 1). The charged particle spectroscopy measurements are a result of a collaboration among LLE, the High-Energy-Density Physics Group at the MIT Plasma Science and Fusion Center, and SUNY Geneseo. Further analysis of target performance is ongoing.

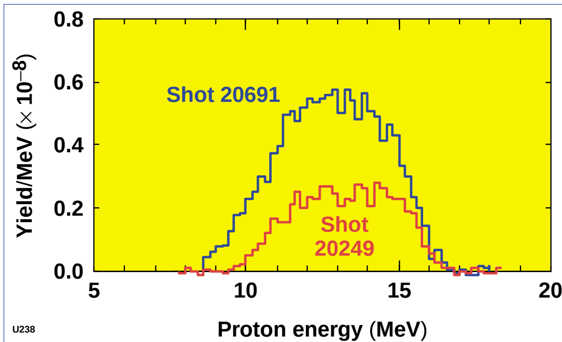

Figure 1. Comparison of secondary proton spectra from the August campaign (shot 20691) and an earlier experiment with reduced uniformity (shot 20249). The secondary proton yield for the higher uniformity shot (20691) is 2.3 times higher than that of shot 20249. Note also that the secondary protons are slowed down more in exiting the target of shot 20691 (12.77-MeV mean energy) compared to shot 20249 (13.23-MeV mean energy). This slowing-down data implies a total ρR of 69 mg/cm^2 and 56 mg/cm^2 for shots 20691 and 20249, respectively. 1-D hydrocode simulations carried out by *LILAC* predict a total ρR of ~82 mg/cm^2 for both of these implosions.

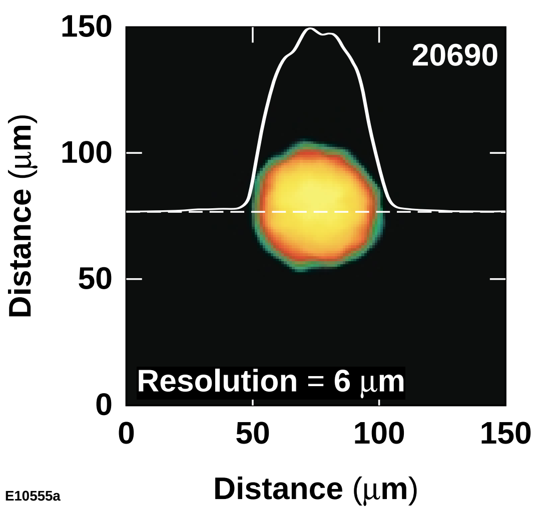

Figure 2. Time-gated (~40-ps frame time) x-ray image taken approximately at time of peak compression (~2 ns from start of pulse) of shot 20690, obtained with a 6-μm-resolution pinhole camera backed with a framing camera. The image is from an implosion of an ~900-μm-diam, ~20-μm-thick CH shell filled with 15 atm of D_2 driven with 23 kJ in an ~1-ns-square shaped pulse. This shot was taken during the August campaign and had 1-Thz, 1-color-cycle SSD with PS and produced 1.6×10^{11} primary neutrons and 3.6×10^{8} secondary neutrons.

X-ray images of the imploded capsules also confirm the improved core conditions of the higher irradiation uniformity implosions. Figure 2 shows an x-ray image obtained in these experiments. The core diameter ~60 μm, is smaller and more symmetric than the implosion cores observed previously with similar targets and laser conditions but with reduced uniformity.

OMEGA Operations: During August, OMEGA carried out 104 target experiments. These shots were distributed as follows: LLE integrated spherical experiments–41 shots; Lawrence Livermore National Laboratory–astrophysics experiments–13 shots; National Laser Users' Facility (NLUF) laboratory astrophysics experiments carried out by a multilaboratory team headed up by the University of Michigan–8 shots; NLUF optical mixing controlled stimulated scattering instability (OMCSSI) experiments carried out by a team led by Polymath Research–15 shots.

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