OMEGA Cryogenic Capsule Implosions: High neutron-averaged fuel areal density, $<\rho R>_n$, is one of the scaled ignition validation criteria for direct-drive cryogenic DT implosions on OMEGA. A fuel adiabat of $\alpha \sim 2$ (α is the ratio of pressure in the fuel to the Fermi-degenerate pressure) is required for high-convergence OMEGA implosions where the $<\rho R>_n$ of DT fuel is expected to approach 250 mg/cm^2 (200 for D_2 fuel). The cryogenic D_2 campaign on OMEGA is currently using pulse shapes designed to put the fuel on an $\alpha \sim 4$ adiabat, and consequently the expected $<\rho R>_n$ is less than 200 mg/cm^2. Typical 1-D hydrocode (*LILAC*) predictions for current shots vary between 120 and 170 mg/cm^2 and depend on the details of the pulse shape. A $<\rho R>_n$ of 98±22 mg/cm^2 was inferred from the data on a recent implosion (shot 37968) using a picket pulse[1] and an $\alpha \sim 4$ drive pulse. This is the highest $<\rho R>_n$ yet measured using cryogenic fuel.

The ice layer for shot 38968, characterized prior to the shot with full 3-D construction,[2] was 1.7-μm rms. The secondary-to-primary neutron yield ratio, an indicator of the fuel areal density during the burn, was 1.7%, the highest yet measured and consistent with the areal density inferred using the energy loss of the secondary protons (the standard measure of D_2 fuel $<\rho R>_n$ on OMEGA). The ratio of the neutron yield over the clean 1-D yield (YOC) for this implosion was 8% dominated primarily by the relatively large target offset from chamber center at shot time (~37 μm). For example, shot 35713 (a similar cryogenic implosion with 3.9-μm-rms ice but an offset of only 15 μm) achieved a YOC ~17% while the 2-D hydrocode *DRACO* predicted a YOC ~20% for this shot. Individual measurements of the ρR_n made by seven wedged-range-filter[3] (WRF) proton spectrometers are plotted in Fig. 1 as a function of detector angle with respect to the offset direction. An angle of 180° corresponds to the side of the capsule closest to target chamber center (TCC) at shot time and, consequently, the side of the target with the highest drive intensity. Since the low-ℓ-mode structure of the ice was quite small for this target, the individual measures of $<\rho R>_n$ are consistent with the expectation that the drive intensity variation caused by the capsule offset leads directly to the $<\rho R>_n$ correlation with the angle of the measurement seen in Fig. 1.

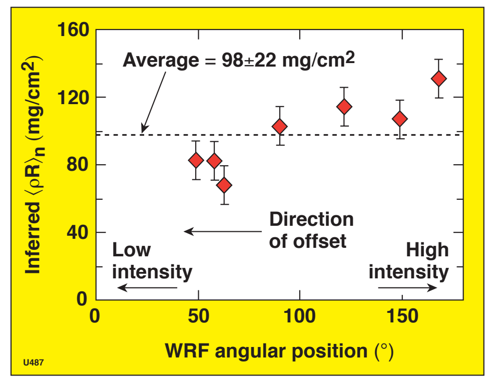

Figure 1. Inferred $<\rho R>_n$ from WRF's as a function of detection angle with respect to the offset direction.

Finally, the data from shot 37968 can be put into context with previous implosions. The graph in Fig. 2 shows the correlation between the experimentally inferred and 1-D $<\rho R>_n$ for all implosions in which the TCC offset at shot time was less than 60 μm and the ice roughness was less than 6-μm rms. The much more stable high-adiabat implosions (blue points) show 1-D performance for the assembly of the cold fuel. There is a strong correlation between the deviation from 1-D performance and the decrease in the fuel adiabat (decreasing shell stability). Two-dimensional *DRACO* simulations for some of the these lower-adiabat implosions show that the deviation from 1-D is caused primarily by the ice roughness and the laser illumination nonuniformity arising from the TCC offset. As the quality of the ice layer continues to improve and the planned mechanical upgrades required for good target alignment stability are realized, the experimentally inferred $<\rho R>_n$ is expected to increase in the near future.

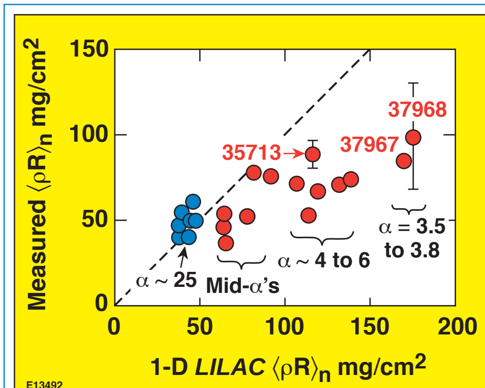

Figure 2. Meaured versus 1-D *LILAC*–predicted $<\rho R>_n$ for cryogenic capsule implosions with less than 60-μm offset and less than 6-μm-rms ice roughness.

OMEGA Operations Summary: In the month of December, OMEGA completed 90 target shots distributed as follows: LLE, 63 shots; LLNL, 26 shots; and NLUF, 1 shot. LLE's experiments included the study of astrophysical jets, absorption, fast-ignitor cone, and Rayleigh–Taylor growth. Scheduled maintenance on OMEGA was carried out during the last two weeks in December.

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2. Laboratory for Laser Energetics LLE Review **99**, 160, NTIS document No. DOE/SF/19460-555 (2004).
3. C. K. Li *et al*., Phys. Plasmas **8**, 4902 (2001).

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