Cryogenic-DT Target Implosions: LLE made significant progress in August with cryogenic target alignment and drive-pulse consistency. A series of cryogenic-DT implosions is underway using the triple-picket drive pulse described in the November 2008 Progress Report. This pulse is designed to put the fuel shell on an adiabat of 2.5 at an implosion velocity of 3×10^7 cm/s. At this velocity the fuel is much more sensitive to drive and surface nonuniformities, especially the offset from target chamber center (TCC) at shot time. To reduce the measured offsets from TCC, a systematic study of target-alignment accuracy was undertaken last spring. Several months of careful measurements using high-speed video cameras to study cryogenic surrogate targets at TCC led to the development of an improved alignment procedure—the offsets in the current series of implosions are within 20 μm of TCC and half are within 10 μm. The result is that the targets with the smallest offsets produced an areal density, ρR, between 80% and 90% of the 1-D *LILAC* prediction (essentially the ρR evolution is 1-D up until burn truncation; the peak of the predicted areal density is undersampled by the neutrons as the burn shuts off because of cold fuel mixing into the hot spot). The ρR measurements were performed using the magnetic recoil spectrometer (MRS) to measure the neutron down-scatter fraction; this technique was described in the December 2008 Progress Report. Two measurements of the knock-on-deuteron (KOd) spectrum were performed on each implosion using the charged particle spectrometers (CPS's). This ρR can be inferred from the shape of the KOd spectrum as described in a recent paper by Frenje.[1] The limitation of the KOd technique is that the inferred ρR saturates for values greater than about 180 mg/cm^2. Above this level, the shape of the spectrum no longer changes as the ρR increases. The KOd measurements place a lower limit on the areal density for high-performance cryogenic-DT implosions. Two-dimensional simulations and past experience with multiple line-of-sight cryogenic-D_2 measurements indicate that the variation in the areal density should be <20% for offsets below 10 μm. The MRS measurement is a reasonable measure of the average fuel ρR. The results of current experiments are shown in Fig. 1. The experimental areal density is plotted against the 1-D prediction for four DT implosions with TCC offsets below 20 μm (red diamonds). The experimental values are taken from the MRS and KOd data for three points and the fourth is assigned an areal density of 180 mg/cm^2 since both KOd measurements were saturated and no MRS data is available. Four D_2 points taken using the continuous pulse described in the April 2007 Progress Report are also shown (yellow stars). The implosion velocity of the D_2 shells was ~2.2×10^7 cm/s, and the measured ρR was ~80% of the prediction (consistent with burn truncation under sampling of the peak ρR). The new DT data confirm full compression at the higher-implosion velocity and indicate the shell is intact at the start of the burn (i.e., the implosion is essentially 1-D). Upcoming experiments will increase the DT areal density by lowering the fuel adiabat and then increase the fuel ion temperature by increasing the implosion velocity to 3.5×10^7 cm/s. The goal of these experiments is to demonstrate hydrodynamic scaling of the target design to ignition at 1 MJ.

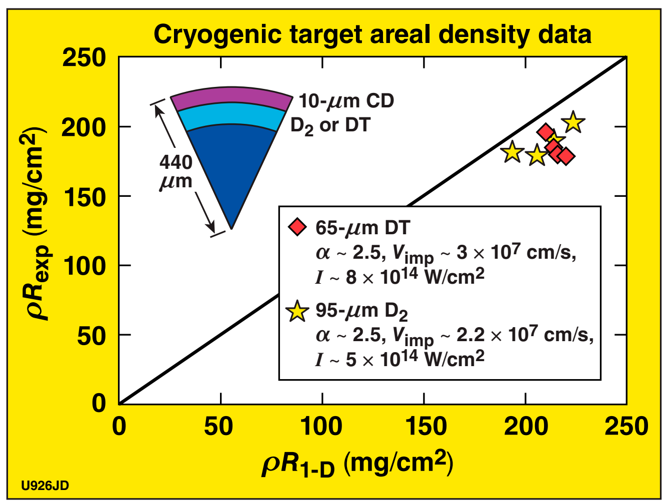

Figure 1. The ρR's inferred for the high velocity DT implosions are consistent with earlier low velocity D_2 implosions. The fraction of 1-D ρR measured is consistent with peak ρR undersampling because of burn truncation.

OMEGA Operations Summary: During August, a total of 148 target shots were taken at the OMEGA Laser Facility with an average experimental effectiveness of 97% (92 shots on OMEGA and 56 on OMEGA EP—experimental effectiveness of 97.3% and 96.4%, respectively). Seventy-two of the shots were taken by experimental teams from LLNL and LLE for NIC; 58 shots were taken for NLUF programs led by teams from the University of Nevada–Reno, MIT, University of California–San Diego, University of Michigan, and ARTEP, Inc., respectively. LLNL and LANL teams each conducted six HED shots, and six shots were taken for CEA.

1. J. A. Frenje *et al*., Phys. Plasmas **16**, 042704 (2009).