Cryogenic 1-D Implosion Campaign: The purpose of the 1-D Cryogenic Implosion Campaign is to perform experiments that are close to 1-D behavior. This is done by imploding cryogenic DT-filled targets with a high adiabat (fluid pressure/Fermi pressure) to minimize the in-flight aspect ratio and the Rayleigh–Taylor (RT) growth at the ablation interface. An adiabat of (α) = 7 has been used for the initial study. To date, 13 cryogenic targets have been part of this study. One signature that indicates that these experiments perform close to 1-D behavior is to check the effect of increasing the RT seed at the ablation interface. If the implosion is similar to 1-D, there should be little change in performance as a function of the initial ablation surface perturbation. A second indication of a 1-D–like implosion is that the neutron yield ion temperature (kT_i) dependence should agree with the reactivity (σv) kT_i dependence.

Figure 1 shows the DT neutron yield from implosions with smoothing by spectral dispersion (SSD) off versus equivalent implosions with SSD on. The SSD-off implosions have a higher initial RT seed than the ones with SSD on. The data are plotted as diamonds with error bars given by the experimental measurements. Three separate conditions are shown. Two sets of implosions were done with a high laser intensity (~8×10^{14} W/cm^2) but with different cryogenic layer thicknesses (53 μm and 47 μm) and one case where the laser intensity was low (~2×10^{14} W/cm^2). The solid line represents the condition where the SSD-off yield equals the SSD-on yield. Data from the low intensity and high intensity with the thin layer show little difference in the yield for either imprint amplitude, indicating that RT growth at the ablation interface is not a factor in these implosions. The two points at the larger distance from the line are for the high-intensity implosions with the thick layer. These implosions had an initial $\ell = 1$ perturbation (in one case the target was not centered in the laser illumination and the other target had a nonconcentric cryogenic layer).

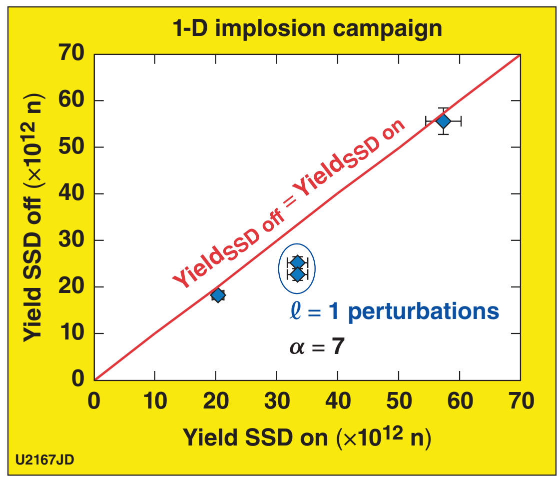

Figure 1. Plot of neutron yield with SSD off versus neutron yield with SSD on. Data are shown as diamonds with errors. The line represents the condition where the SSD-off yield is the same as the SSD-on yield. Circled points are implosions with an initial $\ell = 1$ perturbation.

Neutron yield as a function of the minimum kT_i is shown in Fig. 2. Measurements from the neutron time-of-flight (nTOF) diagnostics are shown as solid diamonds with their corresponding error bars. Yields calculated using the DT reactivity are shown as open diamonds. Reactivity error bars were calculated from the kT_i errors. A power law fit to the experimental data is shown as a line through the data. These data clearly show that the yield kT_i dependence is explained by the reactivity kT_i dependence. The lack of spread in the experimental data indicate that these are nearly identical implosions with yield depending only on the ion temperature. The next series of experiments will explore the effect of changing the D-to-T ratio on performance.

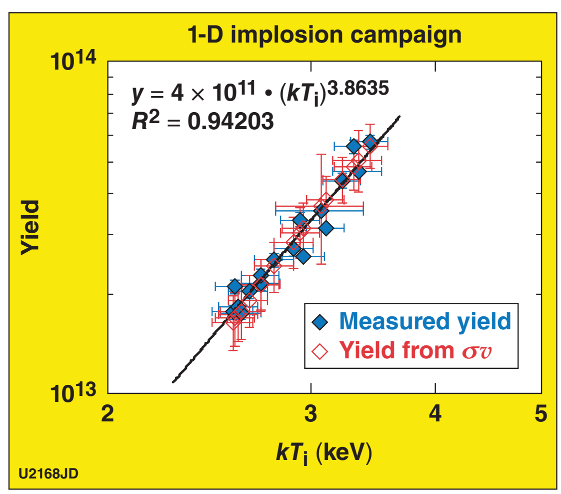

Figure 2. Neutron yield plotted versus the minimum ion temperature taken from the nTOF measurements. The data are shown as filled diamonds with measurement error bars. The open diamonds are yields calculated from the reactivity (σv) temperature dependence.

Omega Facility Operations Summary: During December, the Omega Facility conducted 144 target shots with an average experimental effectiveness (EE) of 91.3% (100 shots on the OMEGA laser with EE = 87.5% and 44 on OMEGA EP with EE = 100%). The ICF program accounted for 31 target shots for experiments performed by LLNL, NRL, and LLE, while the HED program had 72 shots for experiments led by LANL, LLNL, and LLE. Two NLUF experiments led by MIT and Rice University, respectively, carried out a total of 25 target shots and two LBS experiments carried out by LLNL and LLE, respectively, conducted a total of 16 shots.

Contact: John M. Soures (585) 275-3866; fax: (585) 256-2586; e-mail: jsou@lle.rochester.edu