Improved Cryogenic-DT Implosion Performance: LLE has been working for more than a year to improve the drive uniformity and surface quality of cryogenic-DT targets. This effort followed from a computational study published in 2010 (Ref. 1) that showed the sensitivity of cryogenic-DT implosion performance to the target-surface qualities and alignment with respect to target chamber center (TCC). To this end, the moving cryostats used to layer and then deliver a cryogenic DT target to TCC were re-engineered to reduce target motion (both static shifts as well as vibration induced by the removal of the upper shroud) at shot time. The specifications on the surface quality of the CD shells produced by General Atomics were tightened and limited surface mapping using atomic force microscopy was implemented on all shells to be filled with DT. All capsule handling steps (inspection, mounting, and testing) were moved to a Class-100 clean room to minimize the possibility of particular contamination on the outer surface. Changes were implemented in the DT-permeation fill process to minimize the formation of 10- to 50-μm-scale defects caused by residual gas in the DT process lines (the gas condenses on the cold capsule). Finally, changes were implemented in the target transfer process to minimize temperature fluctuations and overpressurization inside the capsule.

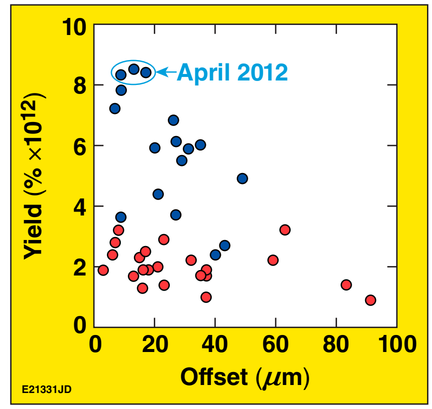

Figure 1. The absolute primary DT yield from cryogenic implosions is plotted as a function of the capsule offset from TCC. The data include all shots after January 2010 and have been filtered for good ice layer and pulse-shape quality. The blue points are implosions with improved capsule surface quality (since May 2011).

Many high-quality capsules have been imploded over the past year including seven targets in April. The absolute primary DT yield is plotted as a function of the target offset from TCC in Fig. 1. The blue points are the recent high surface quality shells (implosions since May 2011) and the red points are targets from 2010 and early 2011. (Targets in May 2011 were the first to realize significant improvement in the outer surface quality). The data shown have been filtered for consistent ice layers (<2.0-μm rms) and pulse-shape quality (calculated adiabats <2.5). The April 2012 implosions produced the highest absolute yields to date (three implosions with yields exceeding 8×10^{12}). The improved absolute performance is nearly a factor of 4 for the smallest offsets relative to implosions in 2010 and 2011. The rapid decrease in performance with increasing offset is consistent with Ref. 1. The same data are plotted in Fig. 2 but the yields are normalized to 1-D hydrodynamic simulations that account for differences in the D:T ratio, pulse shape, and shell thickness/implosion velocity [the ratio is typically referred to as the yield-over-clean (YOC)]. The best-performing targets have achieved a yield relative to the 1-D prediction of 25%. Ion temperatures for the most recent implosions using thinner ice to achieve a higher implosion velocity increased by about 0.2 keV on average, accounting for only a fraction of the 4× increase in absolute yield seen in Fig. 1.

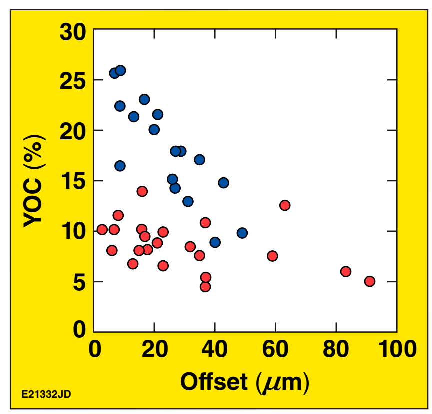

Figure 2. The yield-over-clean (YOC) for the same implosions shown in Fig. 1 is plotted as a function of the capsule offset from TCC. The >2.5× increase in the YOC for the smallest offsets is primarily due to improved target quality.

Omega Facility Operations Summary: The Omega Facility conducted 127 target shots in April 2012. OMEGA provided 122 shots with an average effectiveness of 93.4% and OMEGA EP performed 5 shots with an average effectiveness of 80%. NIC accounted for 63 target shots on OMEGA for experiments led by LLNL and LLE teams. Three NLUF experiments led by the University of Nevada at Reno, the University of Michigan, and Princeton University, respectively, carried out a total of 34 target shots including one day of joint target shots on OMEGA/OMEGA EP. Finally, the AWE (UK) conducted 12 target shots during the period.

1. S. X. Hu *et al.*, Phys. Plasmas **17**, 102706 (2010).