OMEGA Cryogenic Target Campaign: Over the past four months, 16 cryogenic D_2 implosions have been performed on the OMEGA laser. During the first week of April, eight implosions were performed with pre-shot characterization of the layer smoothness ranging between 2.8- and 7.0-μm rms. This shot series was designed to demonstrate the full capability of the permeation-fill–based Cryogenic Target Handling System (CTHS) and to test target-alignment accuracy and stability following mechanical upgrades to the lower pylon. The target offsets relative to target chamber center (TCC) at shot time ranged from 9 μm to 38 μm, averaging 19 μm. This is a significant improvement over previous shot series and close to the ultimate goal of 10 μm from TCC. All of these capsules were imploded using a high-contrast drive pulse designed to put the shell on an adiabat of ~4. The performance relative to the 1-D *LILAC* predictions (the yield-over-clean or YOC) ranged between 7% and 25%; better performance was associated with smaller offsets from TCC. The YOC-performance range of these experiments is consistent with multidimensional hydrodynamic code predictions that take into account the observed level of ice-layer smoothness. The highest average cryogenic areal density to date, 88 mg/cm^2 (based on secondary proton dE/dx), was recorded for one of these shots. This particular shot also recorded the highest-ever secondary-to-primary neutron ratio (a measure of the "hot spot" areal density) at 1.6%.

More recent shots were performed with significantly better layers. Shot 36499 had a pre-shot ice-layer characterization of 2.1-μm rms and an offset from TCC of 24 μm. The YOC was 21%, and the maximum areal density recorded was 110 mg/cm^2, the highest individual measurement seen on any cryogenic implosion (the average of five individual measurements was 76 mg/cm^2). Shot 35968 had a pre-shot ice-layer smoothness of 1.6-μm rms (the best layer shot to date) but a layer thickness of only 79 μm. This capsule was imploded with a square pulse (equivalent shell adiabat of ~25) and produced a neutron yield of 2.1×10^{11}—the highest cryogenic-D_2 yield ever. The YOC for this shot was 70%, confirming near 1-D performance for smooth ice layers and minimal imprint.

Finally, the most-recent cryogenic implosion (shot 36861) was performed with the ice layer cooled to 900 mK below the 18.7-K triple point. During the cooldown (the average rate was 1 mK/min), there was no discernable degradation of the layer smoothness (~2.1-μm rms). This is an important milestone since the baseline direct-drive ignition design requires an ice temperature of ~17.0 K to minimize the internal gas density for high convergence during the deceleration phase. Future physics-quality targets (ice layers of around 2-μm rms and below) will be cooled to ~17.0 K before final characterization. At these temperatures, the targets are expected to produce significantly higher areal densities.

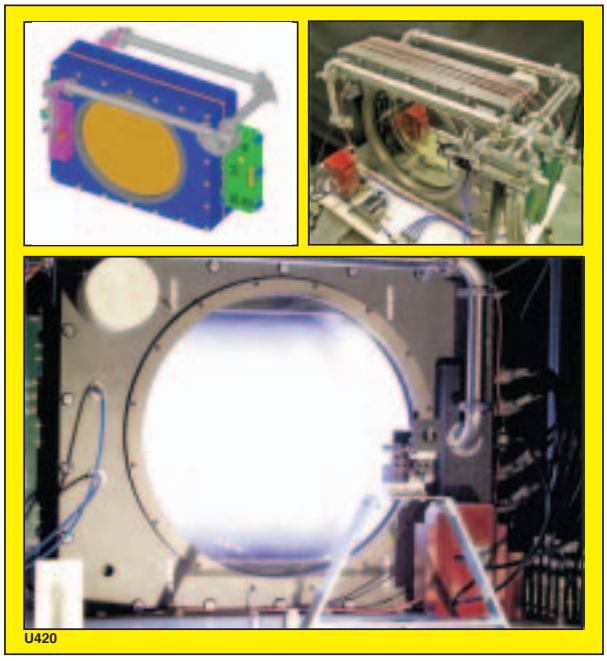

Figure 1. Schematic of PEPC (top left); photograph of PEPC assembly on test stand (top right); photograph of PEPC assembly during active plasma testing (bottom).

OMEGA EP Project Highlight: The LLE-engineered plasma electrode Pockels cell (PEPC) has been assembled, and active plasma testing has begun in the Laboratory. This single-unit electro-optic switch is an adaptation of the NIF PEPC design with circular windows and a single-beam plasma channel (see Fig. 1).

OMEGA Operations Summary: During July, 126 target shots were carried out on OMEGA. Of these shots, 42 were for LLE experiments for the ISE, cryo, and diagnostic-development campaigns. In addition, 42 shots were taken for LLNL programs; 14 shots for LANL experiments; 9 shots for LLNL/LANL collaborative experiments; 15 shots for two NLUF experiments led by MIT and the University of Nevada–Reno, respectively; and, finally, 4 shots for experiments led by CEA.

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