The Cryogenic Equipment for Fielding Fill-Tube Targets: LLE is developing cryogenic equipment to field targets on OMEGA that are filled with the deuterium–tritium fuel through a tube (Fig. 1). This equipment combines design features from the National Ignition Facility (NIF) Cryogenic Target System[1] with the specific requirements for direct-drive targets, and in the future it can be straightforwardly modified to field direct-drive cryogenic targets on the NIF. The reasons for fielding targets with a fill tube are: (1) to field nonpermeable targets; (2) to preserve a clean environment around the target that cannot be accomplished with a permeation-filling process; and (3) to study the effect of the fill tube on the implosion for a more-meaningful extrapolation to future direct-drive experiments on the NIF.

The target is both supported and filled through a tube that has a 10-μm-outer-diam where it connects to the target. (This target assembly is provided by General Atomics.) The target and fill tube are surrounded by a thermal envelope (commonly referred to as the layering sphere) and it is the geometry of this environment that controls how precisely the target can be filled and how uniformly the DT ice layer can be made. Different designs for this environment have been evaluated using a dedicated cryogenic test facility. The thickness of the ice layer was varied from 50 to 100 μm, controlled to ± 4 μm of the desired value, and measured with an accuracy of ± 2 μm. DT ice layers without any visible grooves or defects were formed, and the effect of the fill tube on the ice roughness was negated by controlling the temperature of the fill tube separate to that of the environment that surrounds the target (Fig. 2). The roughness of the ice layer was less than 1-μm rms. All imaging was done using shadowgraphy and x-ray phase contrast imaging.

Work on the cryogenic fill tube project for the Omega Laser Facility is now on schedule for completion in the second quarter of FY20.

Omega Facility Operations Summary: Omega Facility Operations: During December, 2018, the Omega Facility conducted 134 target shots with an average experimental effectiveness (EE) of 98.9%. The OMEGA laser performed 53 shots with EE of 100%, while the OMEGA EP laser carried out 81 shots with an EE of 98.1%. The ICF program accounted for 38 target shots for experiments led by LANL and LLE and the HED program had 84 shots for experiments led by LANL, LLNL, SNL, and LLE. One LBS program experiment led by LANL accounted for 12 target shots.

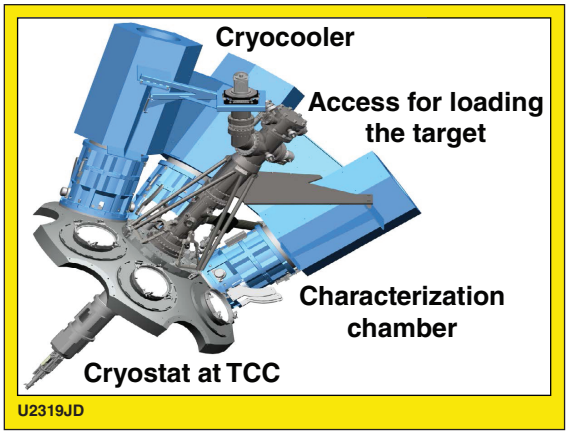

Figure 1. The cryogenic equipment for fielding fill-tube targets will be located permanently at the H5 port on the OMEGA target chamber. Targets will be filled, layered, and fielded from the chamber over a four-day period. TCC: target chamber center.

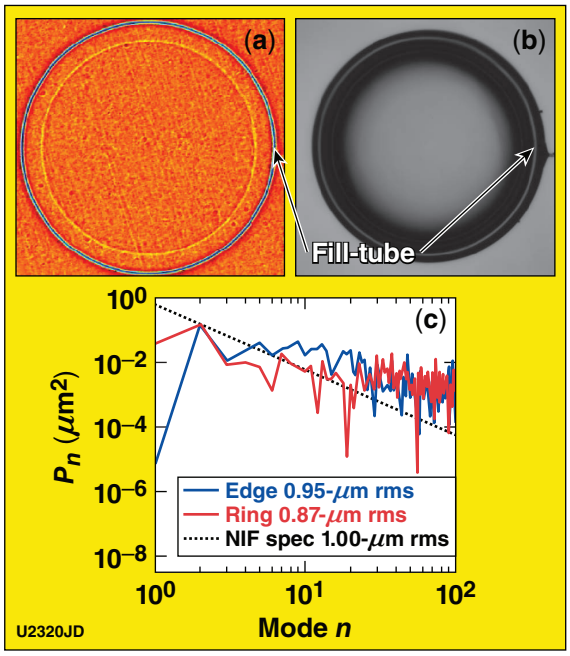

Figure 2. (a) X-ray phase contrast and (b) optical (shadowgram) images of the same DT ice layer in a 0.86-mm-diam layering sphere. The 64-μm-thick ice layer consists of nominally 50:50 tritium and deuterium. (c) The power spectral density of the ablator and ice layer shows a rms roughness of 0.95 μm for the ablator and 0.87 μm for the ice layer with most of the power in modes greater than 20. Importantly, the low-mode perturbation from the fill tube is effectively mitigated.

1. T. Parham *et al.*, Fusion Sci. Technol. **69**, 407 (2016).

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