***Soft X-Ray Backlighting of Cryogenic Implosions Using a Narrow-Bandwidth Crystal Imaging System:*** High-energy petawatt (HEPW) lasers such as OMEGA EP offer significantly improved backlighting capability by producing enhanced x-ray power and shorter emission times. A narrow-bandwidth x-ray imager with an astigmatism-corrected, aspherically bent quartz crystal for the 1.86-keV Si He$_{\alpha}$ line was used to record backlit images of cryogenic capsule implosions (see Fig. 1). X rays are generated by a backlighter foil irradiated by the OMEGA EP laser. The x rays pass through the high-density plasma object and are reflected off the aspherically bent crystal, which is oriented such that the x rays from the backlighter are incident at the Bragg angle for the given x-ray energy crystal combination. The reflected x rays form a magnified image on the detector.

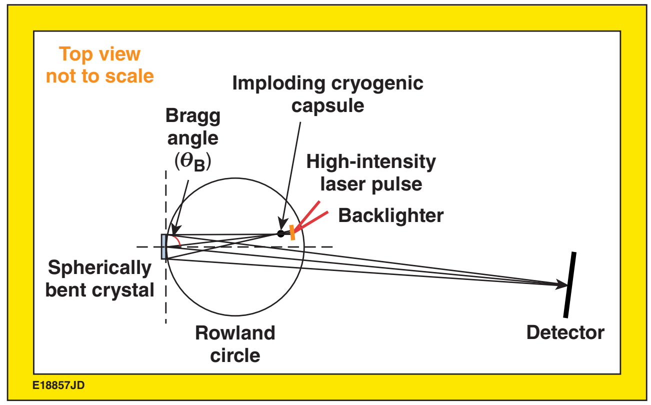


Figure 1. A schematic drawing of the setup of a narrowband crystal imaging system used to backlight cryogenic target implosions. The x rays generated by the backlighter foil pass through the high-density compressed capsule and are reflected off the aspherically bent crystal to form an image on the detector plane.

A time-gated x-ray framing camera with a 300-ps exposure time was used as the detector to minimize the background from the self-emission near stagnation. The backlighter target was inserted to within a few millimeters of the cryotarget using a fast insertion mechanism after the cryogenic shroud was removed. This fast target insertion system is capable of moving a target ~8 cm in less then 100 ms to position it with an accuracy of <50 $\mu$m. Figure 2 shows one of three radiographs obtained during a recent cryogenic shot day. The OMEGA EP laser delivered pulses with energy up to 1.25 kJ and duration of 10 ps to irradiate the Si backlighter foil. The dark ring-like structure in the top part of the image is generated by the absorption of the x rays by the compressed DT ice shell (at an in-flight diameter of ~300 $\mu$m) that attenuates the signal from the backlighter.

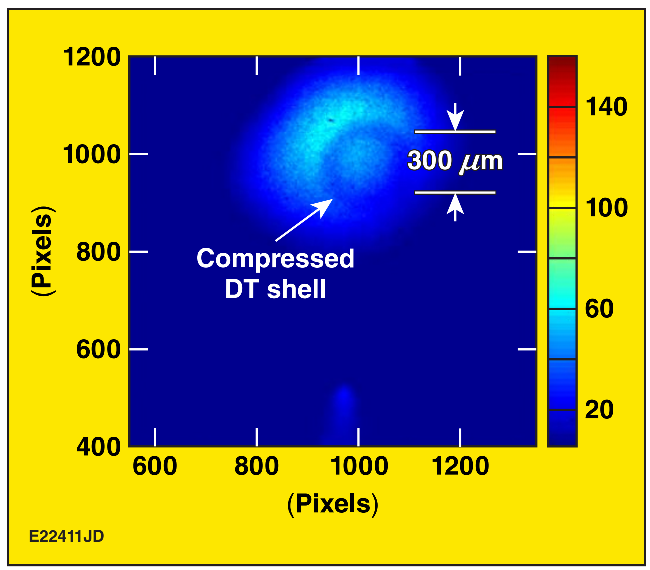


Figure 2. Radiograph of a cryogenic implosion using the narrow-bandwidth crystal imaging system at 1.86 keV (linear scale). The image was recorded using an x-ray framing camera with a 300-ps exposure time. The dark ring-like structure in the top part of the image is the absorption of the compressed DT ice shell with a ~300-$\mu$m diam that attenuates the signal from the backlighter. The initial cryogenic shell diameter was 860 $\mu$m.

These images will be used to compare shell symmetry and fuel $\rho R$ just prior to neutron production with predictions from the design hydrocodes. These measurements are sensitive to cross-beam coupling and thermal transport modeling.

***Omega Facility Operations Summary:*** In July 2013, the Omega Laser Facility conducted 163 target shots with an average experimental effectiveness of 94.2%. The 60-beam OMEGA UV laser carried out 131 of the target shots with an experimental effectiveness of 94.7%, while the OMEGA EP laser accounted for 32 target shots with a 92.2% effectiveness. A total of 30 target shots were conducted for two experiments for the ICF program by LLE teams and the HED program accounted for 97 target shots for eight experiments carried out by LLNL and LANL scientists. The NLUF program received 12 target shots for an experiment led by the University of Michigan and three LBS experiments led by LLNL scientists accounted for 24 target shots.