***NLUF Proton Radiography Experiments:*** Initial experiments were conducted on OMEGA as part of a NLUF program led by a group from the MIT Plasma Science and Fusion Center to explore the use of proton radiography to study transient electric and magnetic fields generated by the interaction of OMEGA laser beams with plastic foils. In each experiment, a plastic foil was illuminated by a single OMEGA laser beam, and a projection radiograph was made of the foil using a source of nearly monoenergetic 14.7-MeV protons and a CR-39 area detector for image recording. The protons passed through a wire mesh (see Fig. 1) before impinging on the foil, and the distortion in the mesh pattern at the detector shows how the proton trajectories were deflected through interaction with the fields generated by laser–plasma interaction at the foil.

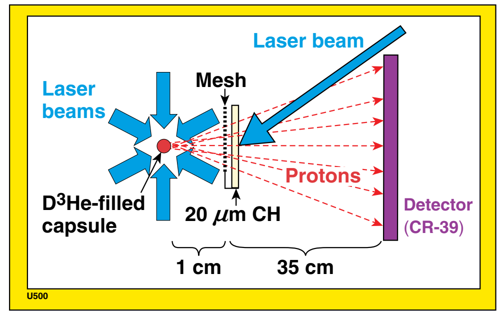


Figure 1. Physical arrangement of the proton backlighter (imploded $D^3He$-filled capsule), mesh, CH foil, CR-39 imaging detector, and OMEGA laser beams, as used for radiography.

The proton source for these experiments was formed by imploding a $D^3He$-filled, glass-shell capsule with 20 OMEGA laser beams in a 10-kJ, 1-ns pulse. The capsule diameter of the proton source target was unusually small, at about 440 $\mu$m, in order to provide a smaller-than-usual burn radius for optimal spatial resolution in the radiograph; the FWHM of the proton source was about 50 $\mu$m measured with proton emission imaging. The mesh was mounted on the foil assembly about 1 cm away, and the center-to-center spacing of the mesh wires was either 150 $\mu$m or 200 $\mu$m. The CR-39 detector was about 36 cm away. The burn duration of the $D^3He$ implosion was short (~100 ps) relative to the 1-ns duration of the foil illumination; adjusting the timing of the implosion relative to the foil illumination allows images to be recorded at different times. Sample images are shown in Fig. 2. Magnetic fields of the order of ~0.5 MG in the vicinity of the laser-irradiated foil are estimated on the basis of the proton deflection observed on these images (see Fig. 3).

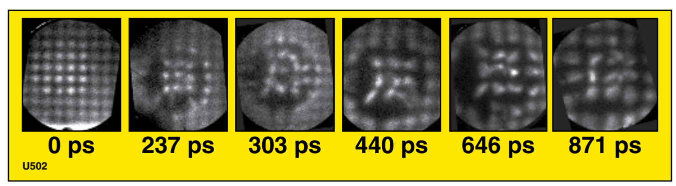


Figure 2. Images recorded on the CR-39 detectors during different OMEGA shots. Each image is labeled by the difference between the time at which the protons passed the foil and the time when the foil was struck by a laser beam. The first three images were made using a mesh with 150-$\mu$m (center-to-center) spacing, while the last three were made with a 200-$\mu$m mesh.

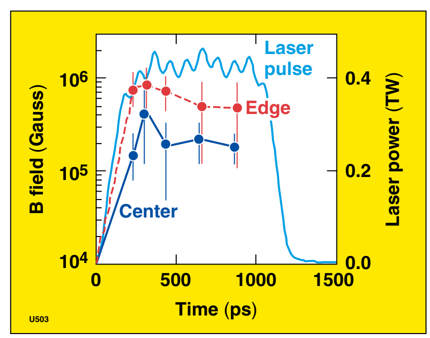


Figure 3. Time evolution of magnetic-field amplitude at two locations on the laser-irradiated foil (center and edge of laser beam)—referenced to the plasma-generating laser pulse (light blue line).

***OMEGA Operations Summary:*** During September, OMEGA conducted 87 target shots for LLNL, SNL, NRL, and LLE experiments. Forty-one target shots were taken by teams led by scientists from LLNL for several experiments including opacity measurements, hohlraum development, cocktail hohlraum, fill-tube simulation, and measurements of the equation of state of isentropically compressed iron. A SNL team conducted 6 shots to measure ablator burnthrough in Cu-doped Be. NRL carried out a 12-shot campaign to investigate the effect of high-*Z* layers on CH implosions. LLE scientists conducted 28 target shots for several campaigns including integrated spherical experiments, cryogenic target implosions, astrophysical jet investigations, and x-ray diffraction of isentropically compressed target samples. In addition, scheduled long-term maintenance and facility improvements were conducted on OMEGA during the last week of the month. This included the installation and activation of the integrated front-end sources (IFES) on the SSD and backlighter drivers. The IFES replaces the existing OMEGA master oscillators (OMO's) and single amplitude pulse-shape modulator. The IFES architecture consists of a Koheras cw-fiber laser source, dual-amplitude pulse-shape modulators, and a fiber amplifier that boosts the energy injected into OMEGA's diode-pumped regenerative amplifier. The IFES system requires significantly less maintenance, is easier to operate, and is much more reliable than the OMO system.

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