OMEGA EP Fourth-Harmonic Probe Activation: A 10-ps, 4ω (263-nm), 20-mJ probe beam has been activated on OMEGA EP along with an associated *f*/4 collection diagnostic capable of imaging 4-μm features over a 5-mm field-of-view at target chamber center.[1] This system provides a unique capability to diagnose and characterize spatial-density structures in a wide variety of plasmas. The diagnostic is designed to characterize long-scale-length plasmas over a field of view that is several millimeters in diameter and to detect localized channels with high spatial and temporal resolution. It is now available as a facility diagnostic for users.

Along with the standard imaging capabilities, the 4ω probe diagnostic has implemented a novel technique to measure the density scale length in laser-produced plasmas. This technique measures the refraction angles of the rays from the probe laser after propagating through the plasma. These angles are used to infer the plasma-density profile. The diagnostic uses an angular spectral filter [Fig. 1(a)] in the Fourier plane to generate contours of constant refraction angle. In the Fourier plane, rays that exit the plasma with a particular angle are mapped to a single annulus. When this exit angle maps to a solid ring on the angular spectral filter, the ray is blocked casting a "shadow" onto the image plane corresponding to the location in the plasma from where the ray originated. Each light–dark transition corresponds to a particular refraction angle (given by the angular spectral filter) and a series of contours with constant refraction are defined.

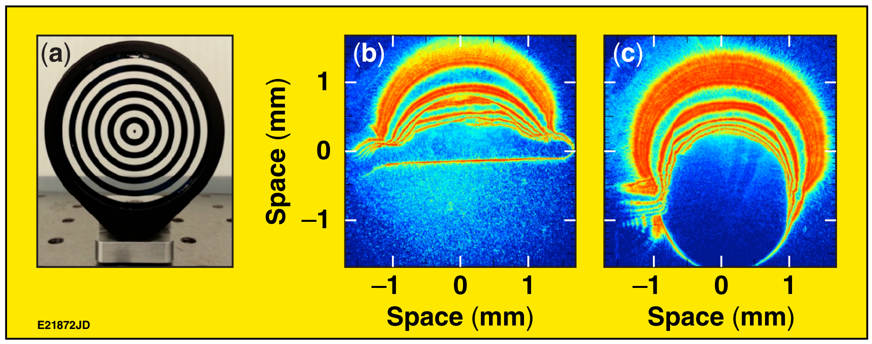

Figure 1. (a) The angular spectral filter is installed in the Fourier plane of the optical diagnostic. The filter has a 1-mm-diam central spot with 2-mm-thick rings forming 12 edges that produce contours of constant angular refraction on the image. The outer edge corresponds to an angular refraction of ~7°. The angular spectral images obtained from OMEGA EP experiments where four 351-nm, 2-ns-long laser beams deposited 9 kJ of energy in a ~1-mm-diam laser spot onto a (b) planar and (c) spherical target.

Figures 1(b) and 1(c) show two images obtained in an experiment where the target's radius of curvature was used to vary the plasma scale length. Twelve contour lines, corresponding to the six bands used on the angular spectral filter, are evident over ~1.5 mm of blowoff plasma. The outermost dark region corresponds to rays propagating far from the center of the plasma ($\gtrsim$1.5 mm) that are not refracted enough to propagate around the central stop on the angular spectral filter. The outermost light band in Fig. 1(b) (~1 mm to ~1.5 mm) represents refraction angles that correspond to the region between the central spot and the first ring on the angular spectral filter. The separation between these rings corresponds to rays that are refracted between ~0.5° (outermost edge, ~1.5 mm) and ~1° (inner edge, ~1 mm). The dark innermost region ($\lesssim$0.3 mm) is a result of rays that are refracted more than ~7°, which is outside of the *f*/4 collection aperture of the system. The map of angular refraction can be Abel inverted to determine the density-gradient profile. These results will be used in conjunction with the hot-electron measurements to study the effect of density scale length on the production of hot electrons from the two-plasmon–decay instability.

Omega Facility Operations Summary: The Omega Facility conducted 202 target shots during the month of January, with an average experimental effectiveness of 96.8%. The OMEGA 60-beam UV laser carried out 141 target shots during the period with an average experimental effectiveness of 97.5%, while OMEGA EP conducted 61 shots with an average experimental effectiveness of 95.1%. The ICF program accounted for 118 target shots during this period for experiments led by LANL, LLE, and LLNL scientists and 42 shots were taken for HED experiments led by LANL, LLE, and LLNL scientists. Two NLUF experiments led by scientists from MIT and Princeton University conducted 34 target shots and an LBS experiment led by LLE accounted for 8 target shots.

1. D. H. Froula *et al*., Rev. Sci. Instrum. **83**, 10E523 (2012).