Diffractive Color Corrector for the OMEGA EP Laser: The OMEGA EP laser is designed to be a highly focusable, high-energy petawatt facility. Axial chromatic aberration, accumulating from the many refractive lenses used to image-relay light through the laser system, is one of several challenges that potentially limits intensity on target. Following pulse compression, chromatic aberration decreases focal irradiance due to both spatial and temporal spectral spreading.[1] Calculations show that lens dispersion within a short-pulse beamline of OMEGA EP would produce a spectral focal shift of 3.6 waves over 9 nm. This reduces the focal-plane fluence by nearly a factor of 5, while pulse-front curvature broadens the Fourier transform-limited pulse shape by a factor of 1.5. The combination of spatial and temporal spreading reduces the focal-plane irradiance by approximately a factor of 8 (Fig. 1).

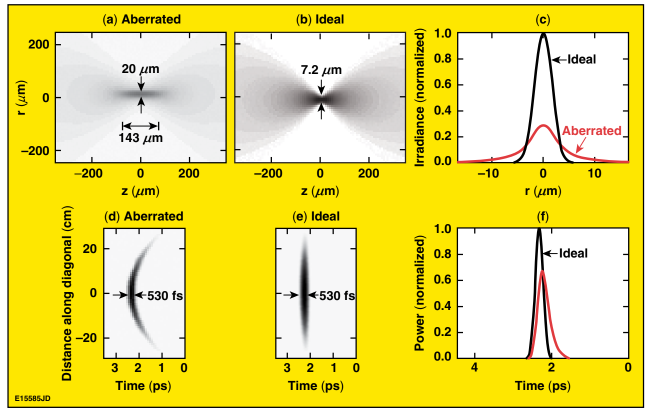

Figure 1. Modeling of the chromatic-aberration-induced fluence reduction [(a) to (c)] and pulse broadening [(d) to (f)] for OMEGA EP. The DCC simultaneously removes spatial and temporal distortions by compensation with negative dispersion.

A single diffractive color corrector (DCC) provides the magnitude and sign of dispersion to precompensate the cumulative axial color generated by a long cascade of refractive lenses.[2] Simultaneous correction of spectral spreading in space and time is achievable with this correction technique. The DCC is located at the input to the telescope that transfers the beam to the multipass amplifier within the OMEGA EP Laser System (Fig. 2). The input lens consists of an air-spaced doublet containing a 511-mm-focal-length diffractive lens on the flat surface of the second element. The diffractive surface is a kinoform generated by replication of a single-point diamond-turned mandrel using an acrylic polymer. LLE teamed with two local Rochester-based companies to complete both DCC development and production. The Rochester Photonics Corporation supported LLE by diamond-turning the mandrel and replicating the diffractive surface, while AccuCoat, Inc. provided a specialized antireflection coating for the patterned acrylic surface. The diffraction efficiency is 99%, while the damage resistance (20 J/cm^2 at 1-ns pulse width) far exceeds the requirements for long-term use. This is the first demonstration of a polymeric diffractive lens used to correct chromatic aberration within a laser system.

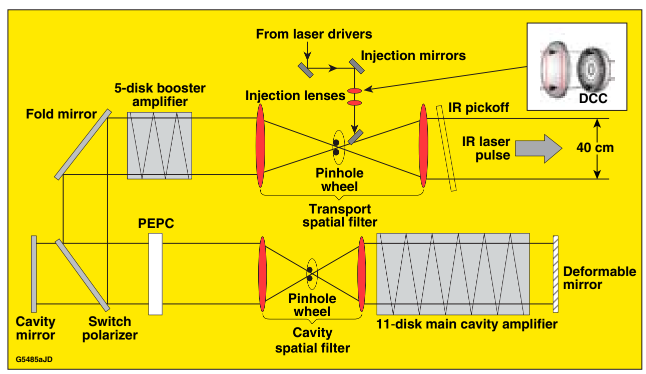

Figure 2. Schematic illustrating the use of the DCC on OMEGA EP. The transport spatial filter contains a three-element input lens consisting of an air-spaced doublet containing a diffractive lens on the flat surface of the second element. The DCC precompensates for the axial chromatic aberration accumulated by multiple passes through the cavity and transport spatial filters.

OMEGA Operations Summary: During June 2007, 84 OMEGA target shots were scheduled and 103 were conducted (with an overall shot effectiveness of 92.7%) for experiments led by LLE (53), LANL (26), and LLNL (24). The NIC IDI program accounted for 36 shots; 31 target shots were provided to the NIC DDI campaign; and a total of 36 non-NIC shots were taken during the month. The last week in June was a scheduled maintenance week and included the following tasks: CTHS upper pylon and linear-induction motor maintenance was performed, including replacement of the target chamber vacuum seals; the CTHS upper pylon was modified to allow for easier maintenance in the future; the OMEGA target chamber short-pulse beam-tube integration continued with installation of the final mirror housings; the magnetic recoil spectrometer installation commenced on port H10 of the OMEGA target chamber; the new ASBO off-axis telescope was qualified for use on the P6/P7 axis; and periodic optics replacement and maintenance activities were carried out.

1. H. M. Heuck *et al.*, Appl. Phys. B **84**, 421 (2006).
2. T. J. Kessler, H. Huang, and D. Weiner, presented at ICUIL 2006, Cassis, France, 25–29 September 2006.