Wavelength Detuning for Cross-Beam Energy Transfer Mitigation in Polar-Direct-Drive Ignition: Polar direct drive (PDD)[1] allows for direct-drive–ignition experiments at the National Ignition Facility (NIF) while the facility is configured for x-ray drive. For the first time, a PDD target design has been developed for ignition that includes the physical effects of cross-beam energy transfer (CBET) and nonlocal heat transport, both of which substantially alter the target drive. CBET involves electromagnetic (EM)-seeded, stimulated Brillouin scattering (SBS), where the EM seed is provided by the light from the edge of the beam. In the "backscatter" SBS mode, the center-beam light transfers some of its energy to outgoing light, reducing absorption and drive. CBET and nonlocal heat transport have complementary effects: the former reduces target drive, while the latter increases it (relative to flux-limited models). Previous ignition designs[2] incorporated these processes only in an approximate way through use of an *ad hoc* flux limiter applied to the classical expression for heat conduction. Proposals for CBET mitigation include modifications of the laser spot (either static or evolving in time), use of alternate ablators to raise the coronal electron temperature, and use of multiple laser wavelengths ("wavelength detuning"). This design employs primarily wavelength detuning; spot-shape modifications will be incorporated in future versions of the design.

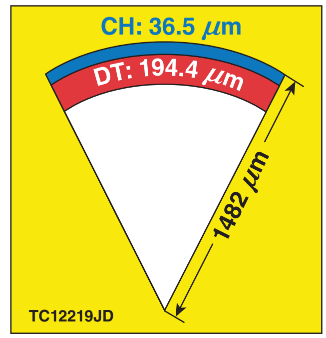

Figure 1. National Ignition Facility polar-direct-drive ignition target design obtains a gain of 41.

The design, using a 1.8-MJ incident energy, obtains a gain of 41. The ring-averaged peak quarter-critical intensity of this design is ~9×10^{14} W/cm^2, but the average equatorial intensity (equatorial power divided by the average quarter-critical spherical surface area) for this design rises as high as 1.2×10^{15} W/cm^2. A version of this design is under development that has a lower peak intensity in order to avoid exceeding NIF damage limits and reduce plasma instabilities. While the design described here, which has an outer radius of 1482 μm, uses a 36.5-μm CH ablator and a DT layer of 194.4 μm, it is anticipated that a higher-Z ablator will be needed to reduce the two-plasmon–decay gain factor during the laser pulse. The laser absorption efficiency is 69%, compared to 62% without detuning, resulting in a peak shell speed of 400 km/s. The minimum fuel adiabat at the end of the laser pulse is 2.8, with an in-flight aspect ratio of 23, both of which indicate sufficient stability for short-wavelength "imprint" modes during the acceleration phase of the implosion.[2] The convergence ratio for this design is 28, and the peak shell-averaged areal density is 1.7 g/cm^2. This ignition design employs a configuration in which the outer-cone beams are detuned by ±6 Å (UV) in the southern/northern hemispheres, with this pattern inverted in alternating quadrants in the azimuthal angle. The shell at a time (9.42 ns) near peak convergence, as simulated in 2-D using the radiation hydrocode *DRACO*, is shown in Fig. 2, indicating a relatively spatially uniform hot spot.

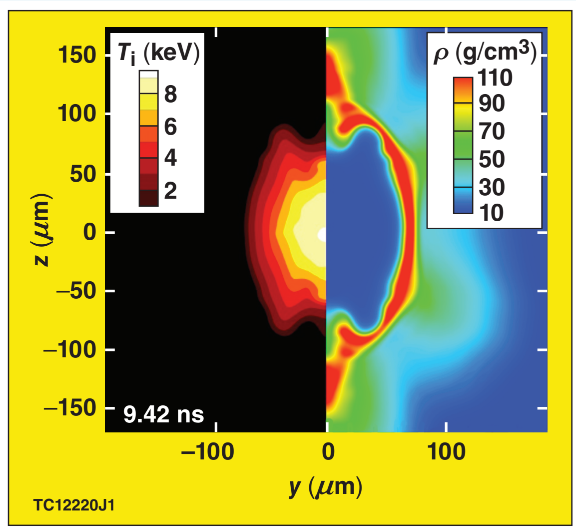

Figure 2. The ignition design is shown near the time of peak convergence. Contours on the right side of the plot show the mass density and contours on the left indicate the ion temperature. This target design achieves a gain of ~41.

Omega Facility Operations Summary: The Omega Facility conducted 192 target shots in June, 2015. The OMEGA and OMEGA EP lasers had 136 and 56 target shots, respectively, and achieved an average experimental effectiveness of 92.3% and 96.4%, respectively. The ICF program accounted for 63 target shots for LANL, LLNL, and LLE-led experiments and the HED program had 55 target shots for LANL and LLNL-led experiments. Thirty-one shots were taken for NLUF experiments led by Princeton University and the University of Michigan and 25 target shots were taken for the LBS program by LLNL-led teams. Two CEA experiments accounted for 18 target shots.

1. S. Skupsky *et al*., Phys. Plasmas **11**, 2763 (2004).
2. T. J. B. Collins *et al*., Phys. Plasmas **19**, 056308 (2012).