2-D Modeling of Cross-Beam Energy Transfer (CBET) in Direct-Drive Implosions: Cross-beam energy transfer[1] increases scattering of outgoing rays and removes energy from incoming rays and consequently reduces the overall laser absorption in direct-drive implosions. The energy tends to be redistributed to larger radii; this lowers the overall hydrodynamic efficiency.

The total energy gained by the outgoing beams is not, in general, equal to the total energy lost; the energy difference remains in the plasma waves, which can decay resulting in ion heating.[2] CBET and the additional ion heating are incorporated into the 2-D hdrodynamics code *DRACO*[3] as an integral part of the full 3-D ray trace. CBET is treated self-consistently as a feedback on the hydrodynamic evolution.

NIF polar-drive (PD) simulations including CBET produce polar-angle–dependent CBET gain variations. The highest level of CBET occurs near the equator in NIF PD simulations. The equatorial beams are found to exchange the majority of the CBET energy, i.e., they exchange energy with each other from opposite hemispheres (see Fig. 1). The central portion of the far-field beam profile is the primary source region of the rays that gain energy from CBET. For this reason, CBET for PD cannot be mitigated by merely reducing the relative size of the far-field spot because the seed source is interior to the far-field spot.

Some mitigation schemes that are being investigated include the use of wavelength shifts, modification of the target shell shim profiles, and beam-shape changes. The first mitigation scheme attempted in the simulations employed a large wavelength shift (too large to be realized on the current NIF system) of ±6-Å UV in each hemisphere plus a modified spot shape that occluded energy from going over the horizon as a result of the azimuthal angular shifts in the PD specification. By employing this mitigation scheme, the lost equatorial energy density was mostly recovered (see Fig. 2).

Omega Facility Operations Summary: The Omega Facility conducted 123 target shots in October, 89 shots on the OMEGA laser and 34 on OMEGA EP with average experimental efficiencies of 98.9% and 98.5%, respectively. The Inertial Confinement Fusion (ICF) program accounted for 81 target shots and the HED program for 25 target shots. One NLUF experiment led by Princeton University conducted seven target shots and the CRASH center at the University of Michigan carried out ten target shots.

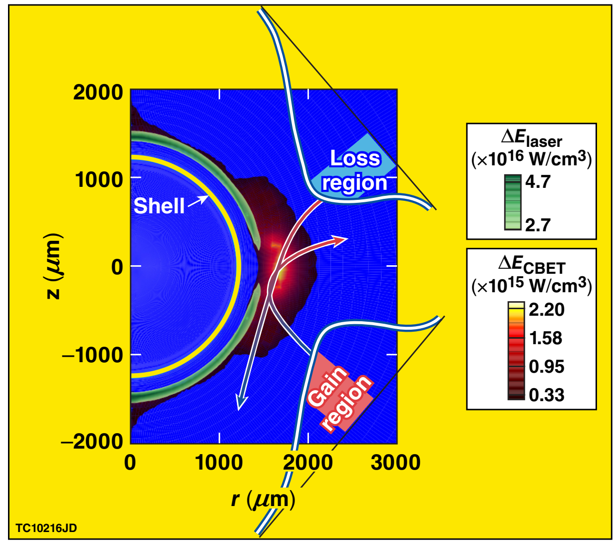

Figure 1. A NIF PD target during the acceleration phase illustrating CBET. The yellow circle represents the shell position and thickness. The green contours represent the laser energy deposition shown on a truncated scale (i.e., transparent for power densities below 2.5 × 10^{15} W/cm^3). The red-to-yellow contours represent the CBET energy gained shown on a truncated scale. Two equatorial beams are shown schematically, one in the northern and one in the southern hemisphere. A representative ray trajectory from each beam is shown to indicate the two main CBET regions: gain and loss.

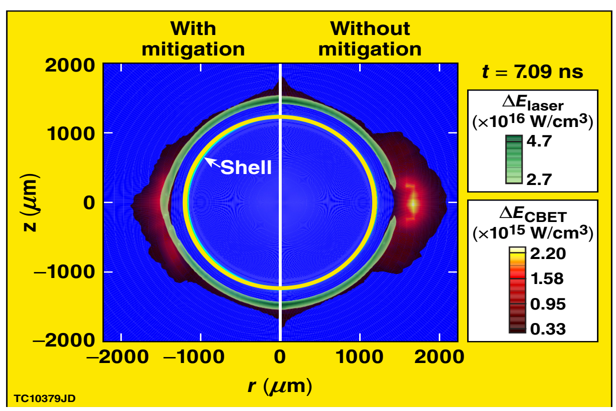

Figure 2. A NIF PD target during the acceleration phase shown with and without a CBET mitigation scheme. See caption of Fig. 1 for explanation

1. W. L. Kruer, *The Physics of Laser Plasma Interactions*, Frontiers in Physics (Westview Press, Boulder, CO, 2003), Chap. 5, p. 45.
2. E. A. Williams *et al*., Phys. Plasmas **11**, 231 (2004); P. Michel, Bull. Am. Phys. Soc. **57**, 368 (2012).
3. P. B. Radha *et al*., Phys. Plasmas **12**, 056307 (2005).

Contact: John M. Soures (585) 275-3866; fax: (585) 256-2586; e-mail: jsou@lle.rochester.edu