The scattered spectra from direct drive targets indicated that the hydrodynamic modeling was missing essential physics.

Energy is extracted from the shallow angle rays and transferred to the larger angle rays.
Cross-beam energy transfer is required to match the measured scattered light from standard OMEGA direct drive implosions.

- Light that is not absorbed by the target is measured by a series of diagnostics around the chamber.
- A model is implemented in LILAC (1D hydro-code) that calculates the beam-to-beam resonant coupling of laser light through the ion-acoustic waves.
- A clamp* on $dn/n$ is required when ion-acoustic wave amplitude exceed $dn/n=10^{-3}$.

Cross-beam energy transfer model agrees with experiments over a large range of intensities and pulse shapes.

* $dn/n=2x10^{-3}$ NOVA CO$_2$ Thomson scattering measurements

The cross beam energy transfer model predicts that reducing the energy in the wings of the laser spots will eliminate the transfer.

Cross-beam energy transfer in standard OMEGA direct drive implosions reduces the 1-D neutron yield by a factor of 2 to 4.

Narrow beams produce more short-wavelength perturbations and less long-wavelength perturbations.

An optimal hydro-design that includes cross-beam energy transfer will trade-off uniformity with reduced beam transfer.
Reducing the energy in the high angle rays, increased the absorbed fraction in direct drive implosion experiments. Reducing the focal radius relative to the target diameter to 60% eliminated cross-beam transfer and increased the measured absorption.