Polar-Drive Implosions on the NIF

NIF polar-drive implosion
Convergence ratio (CR) \(\sim 2\)

Data (framing-camera image)

\[\theta\]

Fractional radial deviation

\(1200-\mu m \times 1200-\mu m\) region

\[\text{Data} \quad - \quad \text{CBET model}\]

Angle \(\theta\) (°)

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Summary

Polar-drive (PD) implosions provide valuable information about laser coupling at National Ignition Facility (NIF) scales

- Room-temperature plastic shells are imploded with an adiabat $= 3$ laser pulse shape on the NIF
- Velocities are reduced relative to collisional absorption models and in better agreement with a cross-beam-energy-transfer (CBET) model.
- The CBET model also provides better agreement on the overall symmetry of the implosions

The goal of experiments in FY14 is to demonstrate CBET mitigation through the use of mid-Z ablators and/or wavelength difference between the NIF cones.
Collaborators


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Velocity and symmetry are being measured in PD implosions on the NIF to validate laser-coupling models.

- Velocity and symmetry are diagnosed from x-ray framing-camera images.
- Current beam nonuniformity precludes high-performance compression experiments.
- Low-intensity implosions are relatively insensitive to thermal-transport models—an excellent test for laser-deposition models.

CBET* reduces absorption near the equator relative to the pole

Instantaneous laser energy deposited versus polar angle (CR ~ 2)

Laser deposit (W/cm³)
- 1.7 x 10^16
- 1.0 x 10^16

Collisional absorption only
\( f_{\text{abs}} = 89\% \)

CBET
\( f_{\text{abs}} = 67\% \)

*J. A. Marozas et al., CO7.00004, this conference.
Inclusion of CBET in the *DRACO* simulation improves agreement with inferred trajectory.
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Inclusion of CBET in the *DRACO* simulation improves agreement with inferred trajectory

- Several reasons may contribute to residual difference between simulation and experiment
  - uncertainty in beam profiles
  - resolution at quarter-critical surface in simulation
  - nonuniformity growth at ablation surface
  - limitation of CBET modeling
The observed shell shape is reproduced well in simulations when CBET is included in the modeling.

Images at $R \sim 500 \mu m$
N130128 CR $\sim 2$

TC11025
The observed shell shape is reproduced well in simulations when CBET is included in the modeling.

Images at $R \sim 500 \, \mu m$
N130128 CR $\sim 2$

Collisional absorption only

Collisional absorption
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Data

Fractional radial deviation

Angle $\theta$ (°)
The observed shell shape is reproduced well in simulations when CBET is included in the modeling.
Symmetry is well modeled when CBET is included in the simulation.

Legendre-mode amplitudes N130128

- $P_2$ (%)
- $P_4$ (%)
- $P_6$ (%)

- Collisional absorption only
- CBET
- Data
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