Effect of Nonlocal Thermal-Electron Transport on the Symmetry of Polar-Drive Experiments

Experimental image
\( (R = 450 \ \mu m; \ CR \sim 2.4) \)

- Intensity (arbitrary units)
  - 2600
  - 2200
  - 1800
  - 1400

- Distance (\( \mu m \))
  - X-ray flux (arbitrary units)
    - 6
    - 4
    - 2

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A 2-D nonlocal electron thermal-transport model (iSNB)\* has been added to the 2-D hydrodynamics code DRACO.

The warm CH shell NIF** shot N130731 was simulated with both flux-limited electron-heat transport and the iSNB model.

The iSNB model resulted in higher drive near the equator from
- higher electron temperatures than at the pole
- larger effective radial flux limiter in the transport region

Simulations of polar-drive implosions requires modeling both nonlocal thermal electron transport and cross-beam energy transfer (CBET)***

\*Implicit Schurtz–Nicolaï–Busquet model
**National Ignition Facility
***J. Marozas et al., CO7.00004, this conference; T. J. B. Collins et al., UO4.00008, this conference.
Collaborators


University of Rochester
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University of Wisconsin
The 2-D iSNB scheme in *DRACO* was developed at the University of Wisconsin*

- One-dimensional simulations have shown that nonlocal heat transport is required to reproduce experimental results**
- The iSNB scheme in *DRACO* uses a modified implicit version of the Schurtz–Nicolaï–Busquet model***
- A correction to the local Spitzer flux is obtained from a set of multi-energy-group diffusion equations, which are iterated to a self-consistent solution

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*D. Cao *et al.*, TP8.00081, this conference.


A Eulerian simulation was carried out for polar-drive NIF shot N130731* with the iSNB model.

Simulations were also carried out for two values of the flux limiter: 0.06 (standard) and 0.1.

\[ I_L \sim 8 \times 10^{14} \text{ W/cm}^2 \]
Nonlocal transport drives the equator more strongly than the $f = 0.06$ flux-limited Spitzer transport

Simulation images generated at $\sim 5.5$ ns with Spect3D*

The drive at the equator is more sensitive to the flux limiter and nonlocal transport than at the pole.

- Profiles taken at 6 ns

![Graphs showing mass density vs. distance at the equator and the pole.](image-url)
The radial effective flux limiter \( f_{\text{eff}} \) is higher at the equator than at the pole because of the higher coronal temperature.

\[
f_{\text{eff}} = -\frac{Q_{\text{iSNB}}}{Q_{\text{fs}}}
\]

Larger laser deposition in the iSNB model produces higher temperatures than for \( f = 0.1 \).
The nonlocal radial effective flux limiter at the equator is larger than that for \( f = 0.1 \) near the peak laser deposition.

Simulations cannot be carried out with a single flux limiter.
Simulations with CBET will make the oblate simulation image prolate*

CBET reduces absorption mostly at the equator, reducing the drive and improving agreement with the experimental shape.

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Nonlocal electron transport must be considered to model polar-drive implosions

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