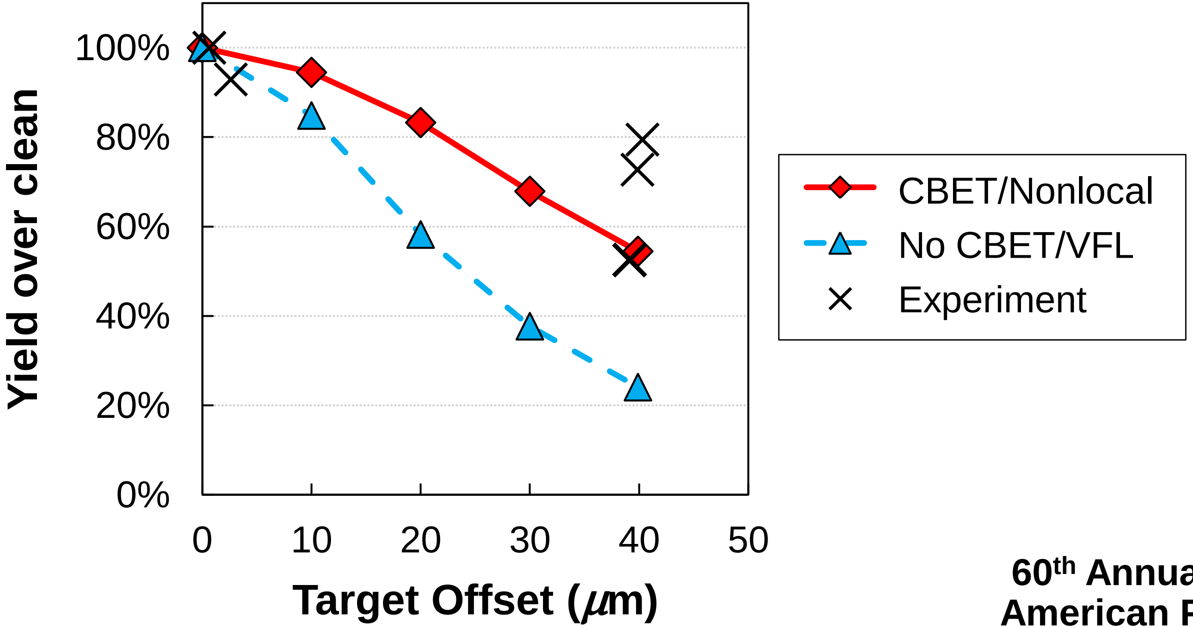
Modeling of Target Offset in Warm Implosions on OMEGA



K. S. Anderson
University of Rochester
Laboratory for Laser Energetics

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Simulations of direct-drive implosions that include target offset require a 3-D cross-beam energy transfer ray trace to model ℓ = 1 accurately

- **Implosions that are simulated including the effect of cross-beam energy transfer (CBET)* show less sensitivity to initial target offset then when modeled without**
- ***DRACO*** **** simulations with CBET show improved agreement in yield compared to experiment**
- **Simulated x-ray core offsets match experimental data better when CBET effects are included**

CBET reduces the ℓ = 1 mode perturbation induced by target offset

* I. V. Igumenshchev *et al*., Phys. Plasmas 17, 122708 (2010).
** J. A. Marozas *et al*., Phys. Rev. Lett. 120, 085001 (2018).

Collaborators

C. J. Forrest, O. M. Mannion, D. T. Michel, R. C. Shah, J. A. Marozas,

P. B. Radha, F. J. Marshall, J. P. Knauer, R. Epstein, and V. Gopalaswamy

University of Rochester
Laboratory for Laser Energetics

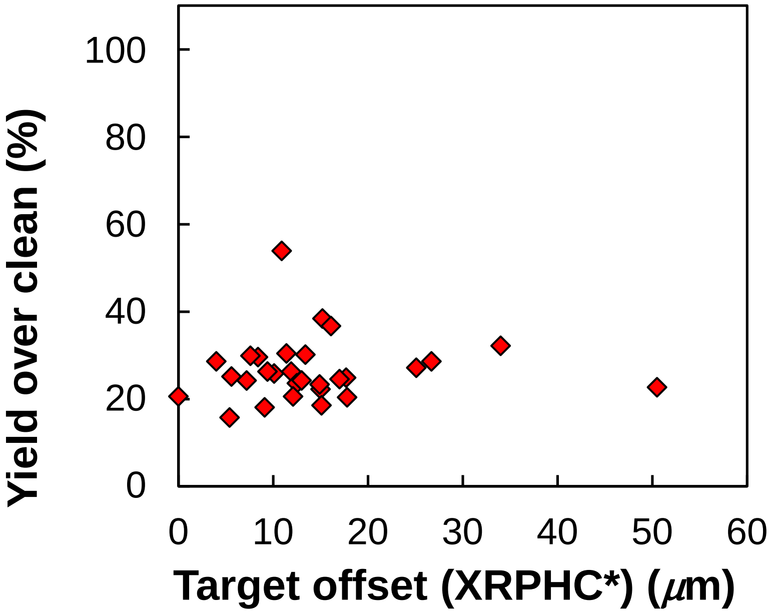
M. Gatu Johnson

Massachusetts Institute of Technology
Plasma Science and Fusion Center

S. Laffite

Commissariat à l'Energie Atomique, DAM

No clear correlation exists in OMEGA cryogenic experiments between YOC versus target offset for 2.5 ≤ α ≤ 3.5 and 14 ≤ CR ≤ 19

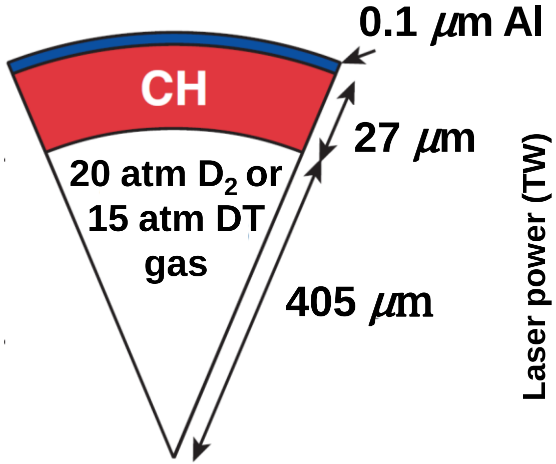


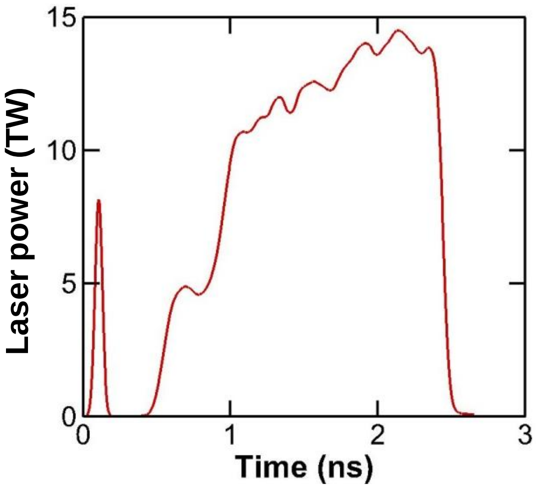
- Other sources of nonuniformity appear to dominate YOC in cryogenic implosions
- Simulations, however, have shown neutron yields have high sensitivity to target offset

α: adiabat
CR: convergence ratio
XRPHC: x-ray pinhole camera
YOC: yield over clean

*W. Grimble, F. J. Marshall, and E. Lambrides, Phys. Plasmas 25, 072702 (2018).

Warm target experiments with prescribed target offsets were conducted to compare experimental with simulated data





- Target offsets were nominally 40 μm
- Simulated both with CBET* + nonlocal heat transport and with variable flux limiter
- Compared data between simulation and experiment
  - yields
  - compressed core offsets
  - neutron-averaged core flows**

Warm targets allow for more control of the target positioning, and no ice layer to complicate analysis.

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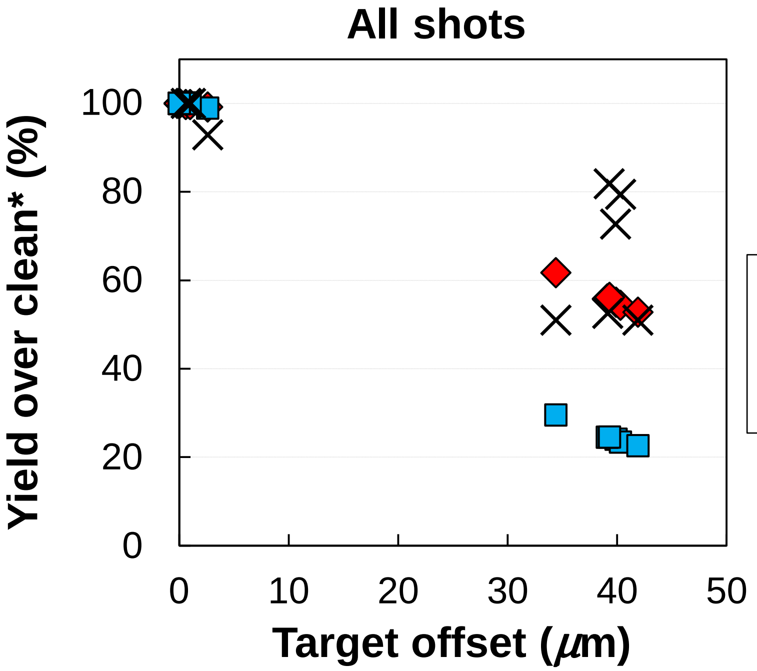
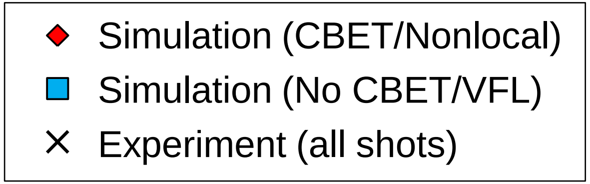
* 3-D CBET model: J. A. Marozas *et al*., Phys. Rev. Lett. 120, 085001 (2018).

**See O. M. Mannion et al., BO6.00010 (next talk).

Simulations with CBET and nonlocal thermal transport more accurately predict yield degradation from target offset



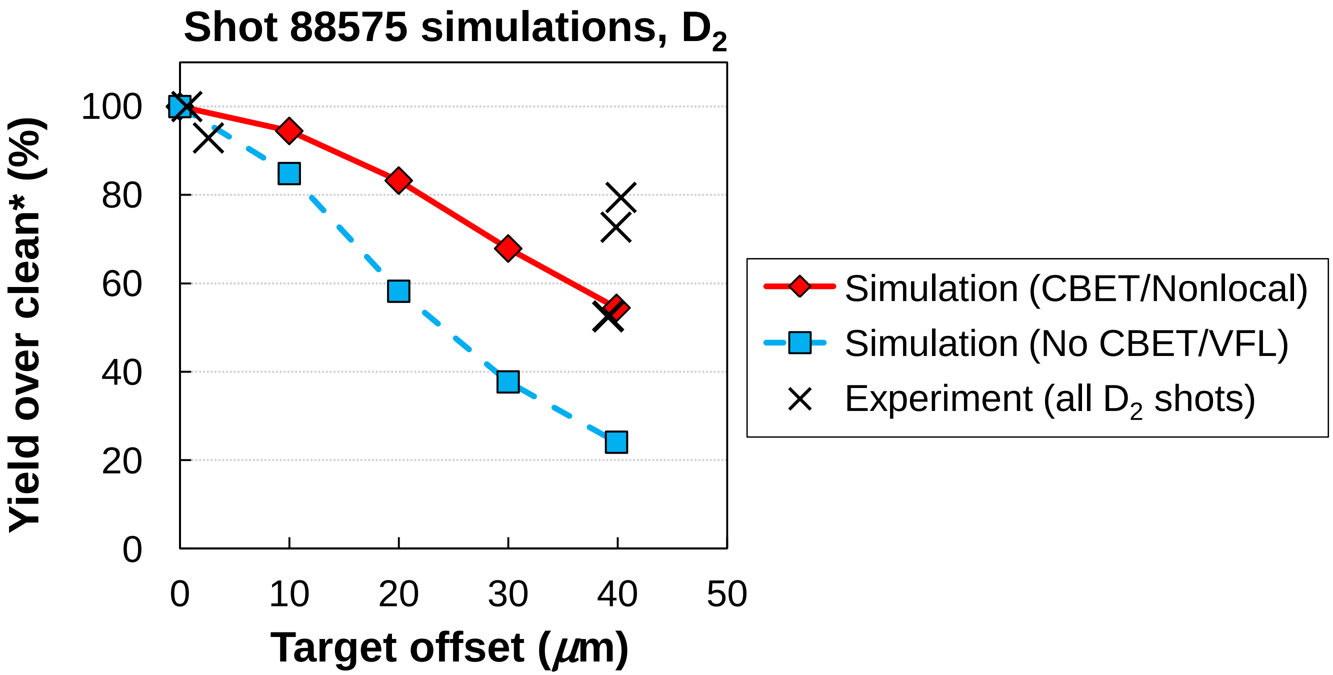


Values for the variable flux limiter (VFL) were chosen to match shock and shell trajectories with CBET + nonlocal transport

VFL shows 2× more yield degradation than CBET + nonlocal transport.

*Experimental yield is normalized to the best-shot, no-offset experiment; simulated yield is normalized to the no-offset simulated yield for the same shot.

Simulations with CBET and nonlocal thermal transport more accurately predict yield degradation from target offset



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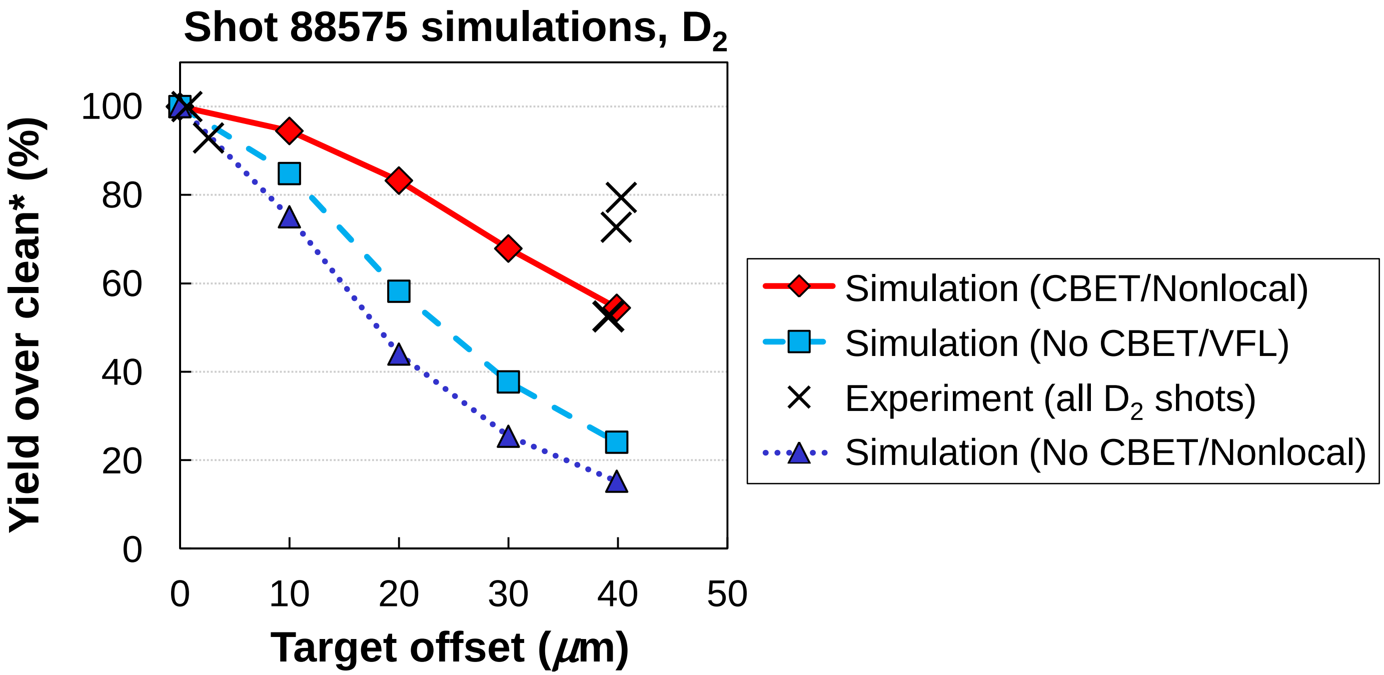
Simulations with CBET and nonlocal thermal transport more accurately predict yield degradation from target offset



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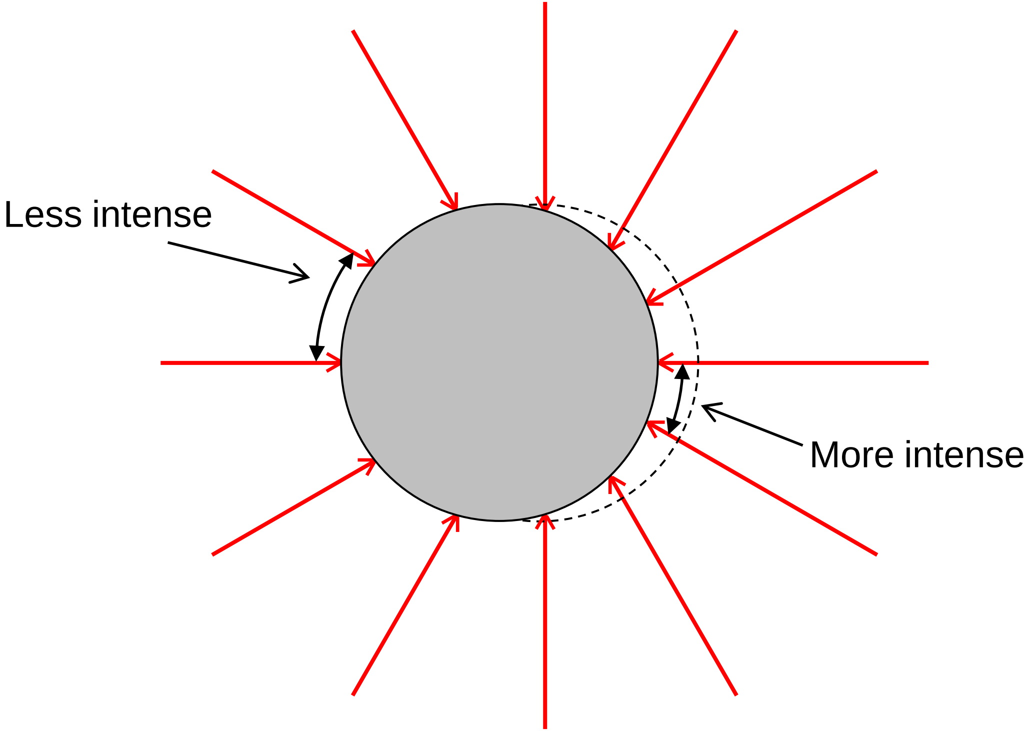
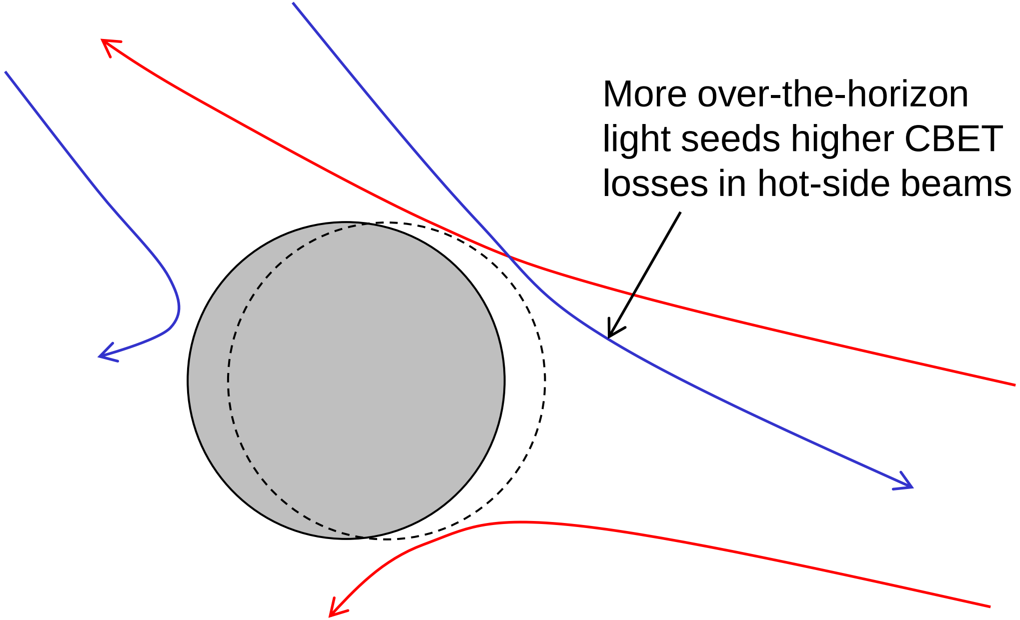
Target offset causes an ℓ = 1 mode in the laser illumination pattern



- Beam centers strike the target closer together on one side than the other

- This results in a dominant ℓ = 1 mode

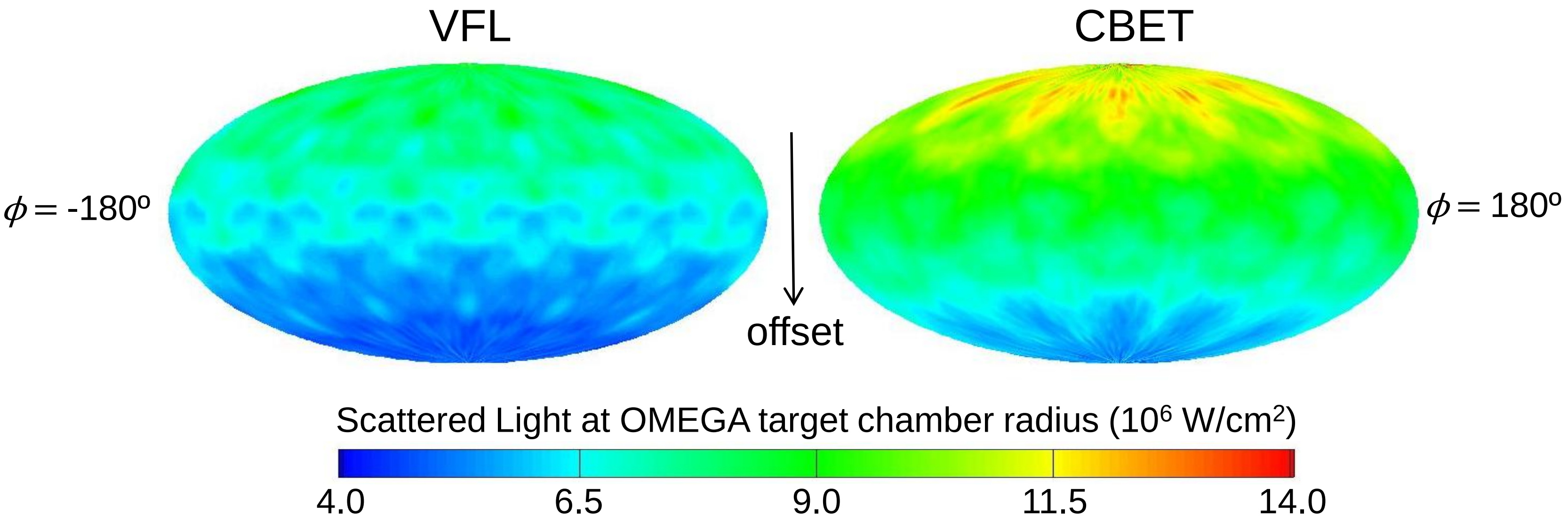
As the plasma forms, more over-the-horizon light reaches the "hot" side of the target



ℓ = 1 drive asymmetry from power imbalance is not mitigated by CBET; this is a geometric effect of target offset.

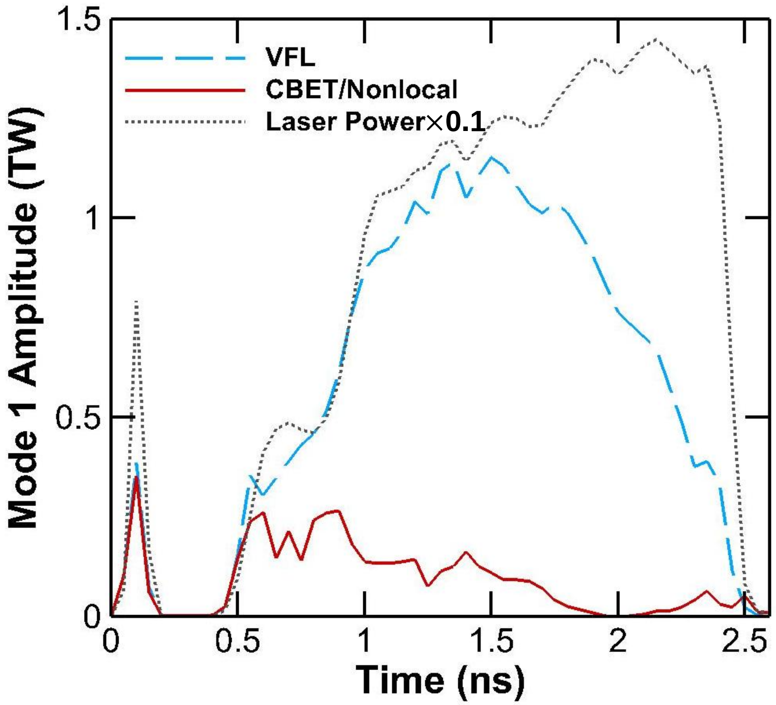
CBET is higher on the hot side of the target, effectively mitigating the ℓ = 1 drive asymmetry from target offset.

Scattered-light diagnostics in *DRACO* show CBET scatters more light from the hot-side beams



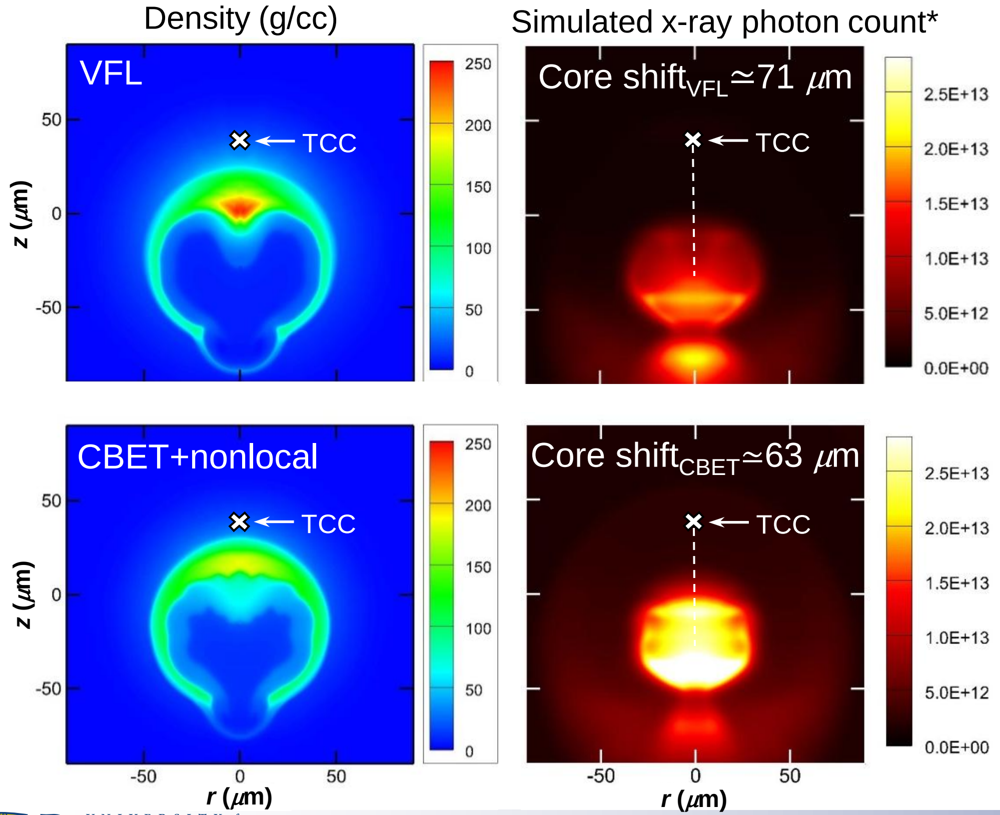
CBET increases the scattered light only on the hot side (north pole).

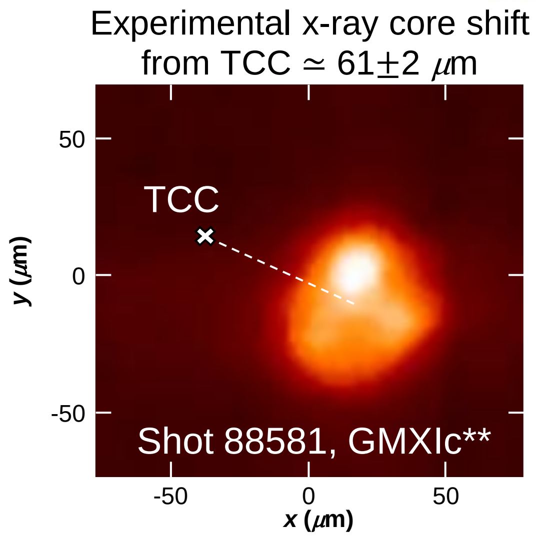
The power deposited by the laser in the ℓ = 1 mode is dramatically decreased by CBET



- During the picket and beginning of the foot, the mode amplitude is similar
- As the plasma scale length increases, CBET losses dramatically reduce the ℓ = 1 mode

The simulated shift of the compressed core away from target chamber center agrees better with experiment when CBET is included





Spect3D: MacFarlane *et al*., High Energy Density Physics 3, 181 (2007).
**W. Grimble, F. J. Marshall, and E. Lambrides, Phys. Plasmas 25, 072702 (2018).

TCC: target chamber center

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