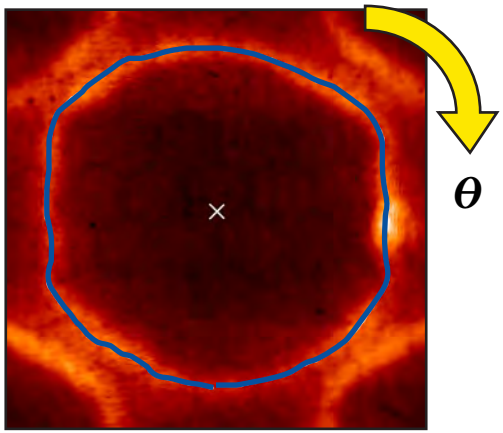
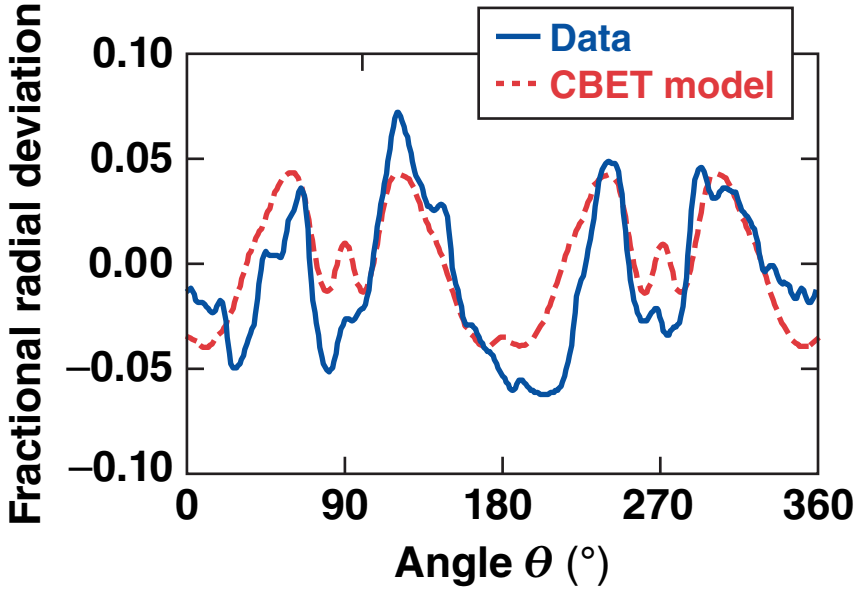
Polar-Drive Implosions on the NIF

NIF polar-drive implosion
Convergence ratio (CR) ~ 2

Data (framing-camera image)



1200-μm × 1200-μm region



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American Physical Society
Division of Plasma Physics
Denver, CO
11–15 November 2013

Summary

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

UR LLE

- 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

M. Hohenberger, R. S. Craxton, J. A. Marozas, F. J. Marshall, D. H. Edgell, R. Epstein, D. T. Michel, D. H. Froula, V. N. Goncharov, R. L. McCrory, P. W. McKenty, D. D. Meyerhofer, T. C. Sangster, A. Shvydky, and S. Skupsky

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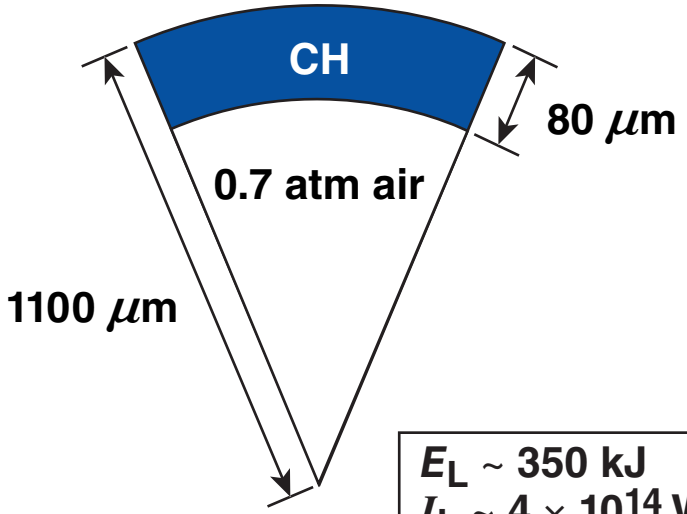
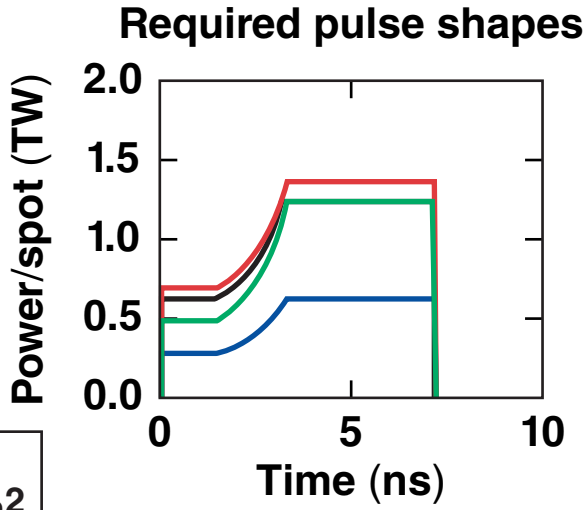
Velocity and symmetry are being measured in PD implosions on the NIF to validate laser-coupling models





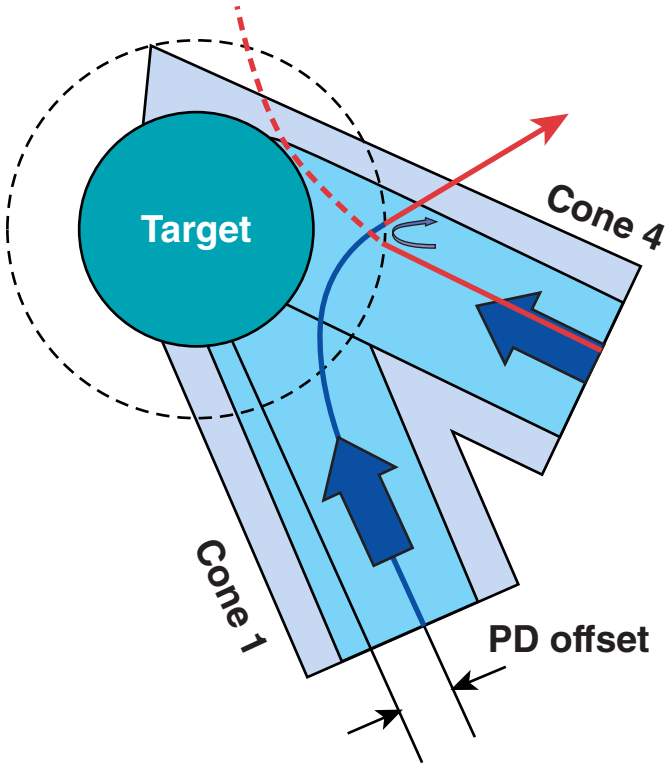
E_L ~ 350 kJ
I_L ~ 4 × 10^{14} W/cm^2
V_{imp} ~ 180 km/s
$\alpha = P/P_{Fermi}$ ~ 3

- 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

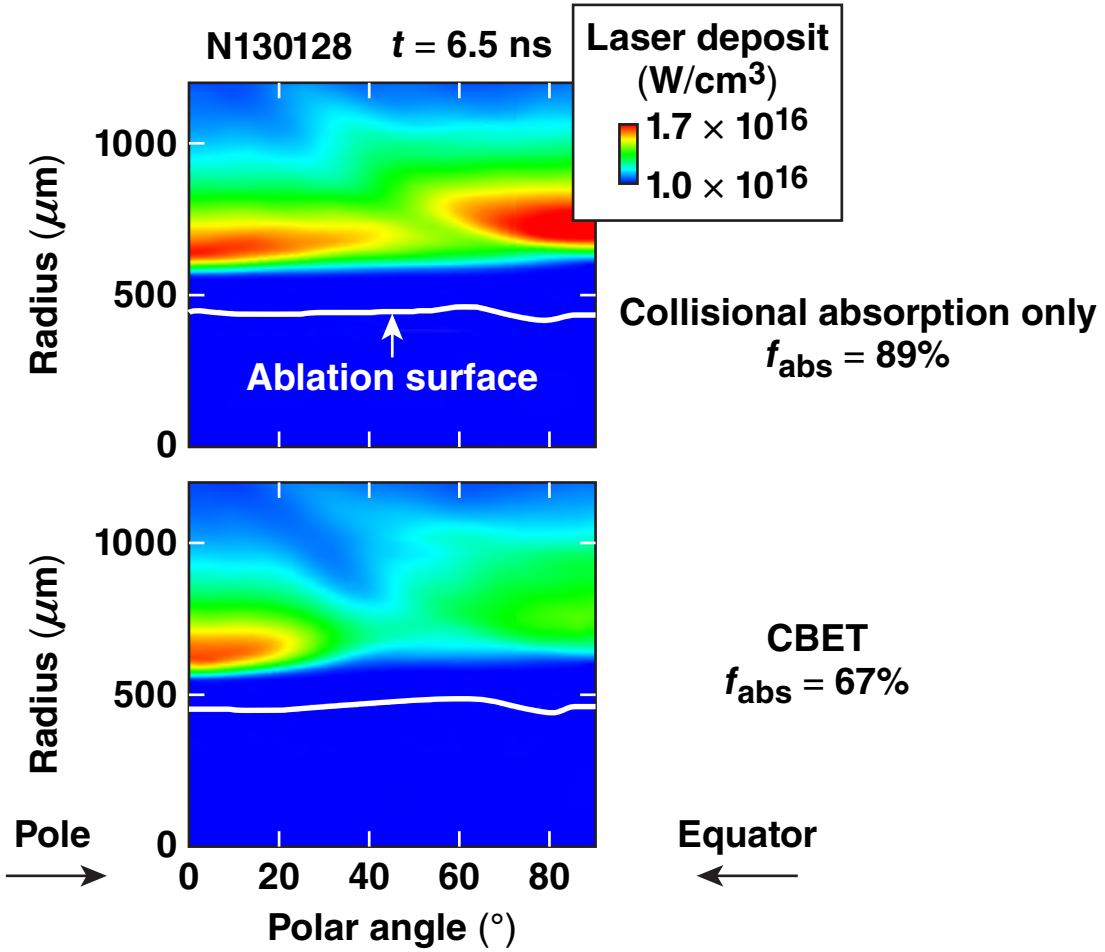
For high intensity implosions: D. D. Meyerhofer *et al.*, UO4.00002, this conference;
*D. T. Michel *et al.*, Rev. Sci. Instrum. 83, 10E530 (2012).

E22290b

CBET* reduces absorption near the equator relative to the pole



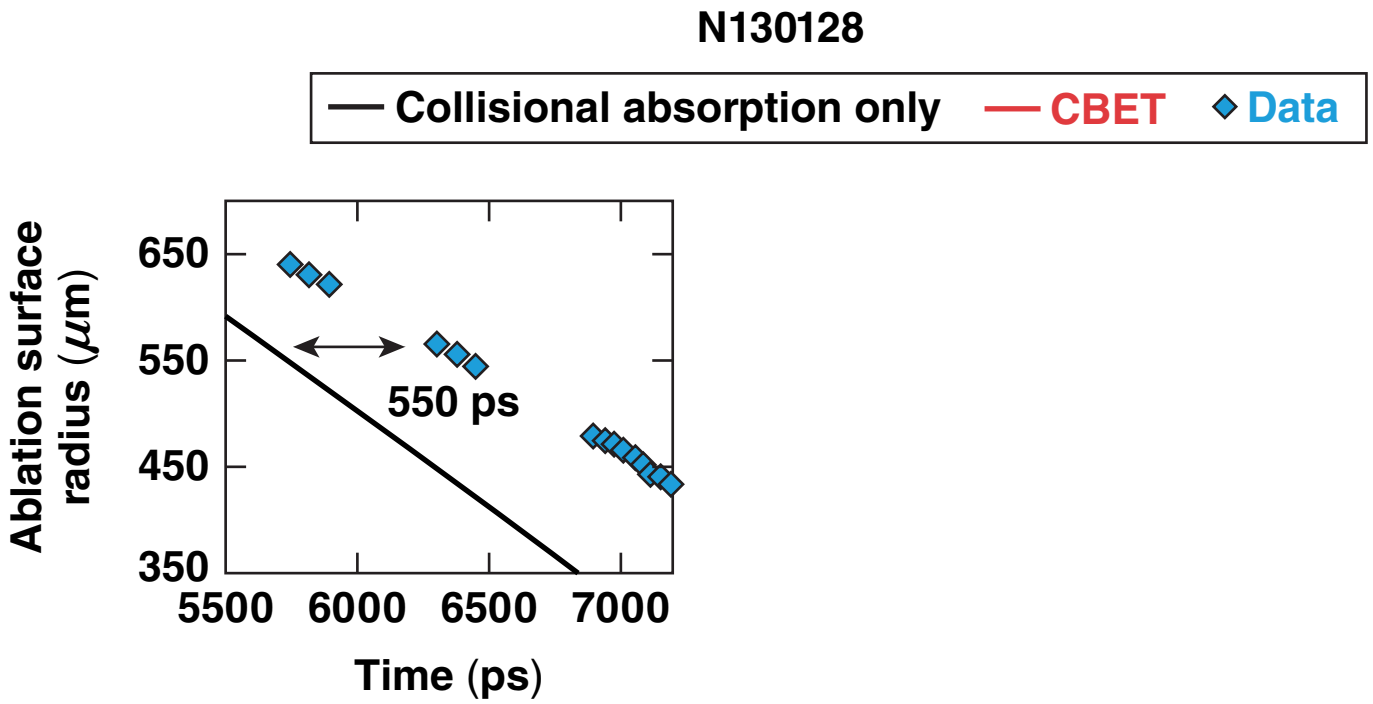
Instantaneous laser energy deposited versus polar angle (CR ~ 2)



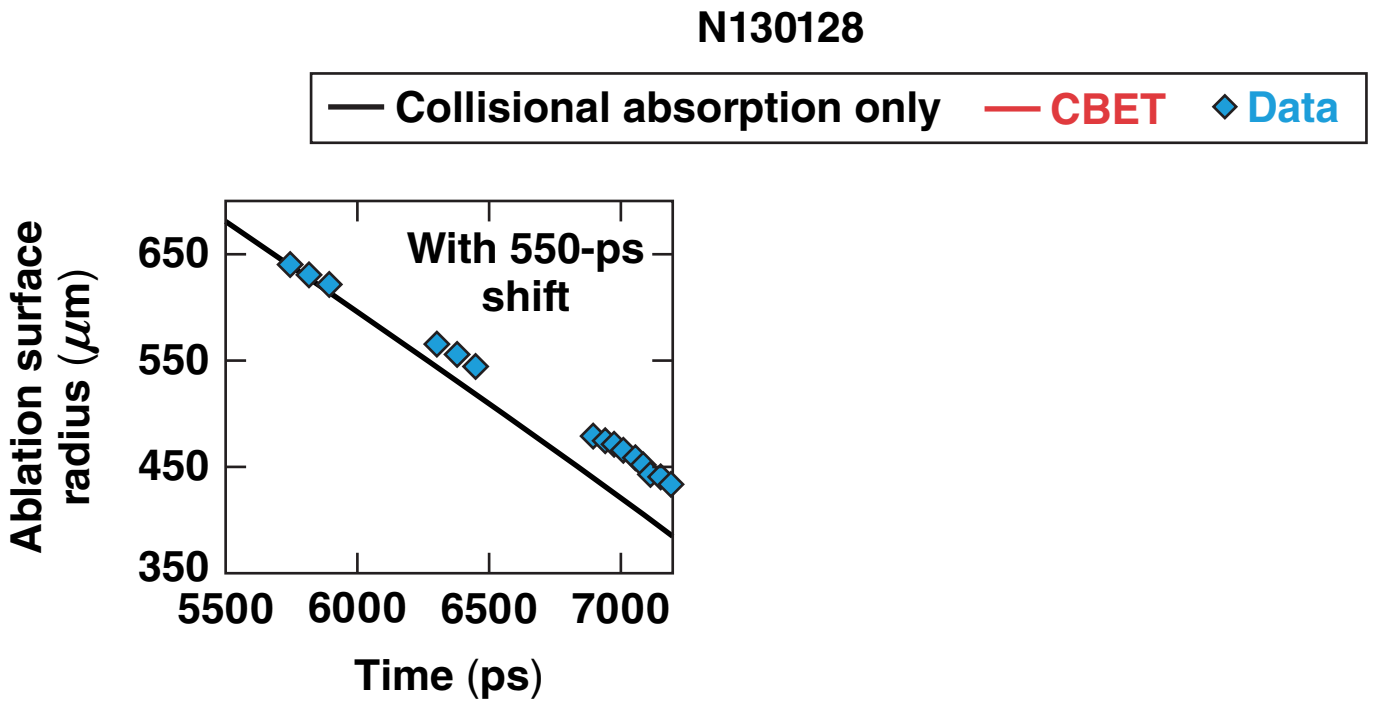
*J. A. Marozas *et al.*, CO7.00004, this conference.

TC11021

Inclusion of CBET in the *DRACO* simulation improves agreement with inferred trajectory



Inclusion of CBET in the *DRACO* simulation improves agreement with inferred trajectory



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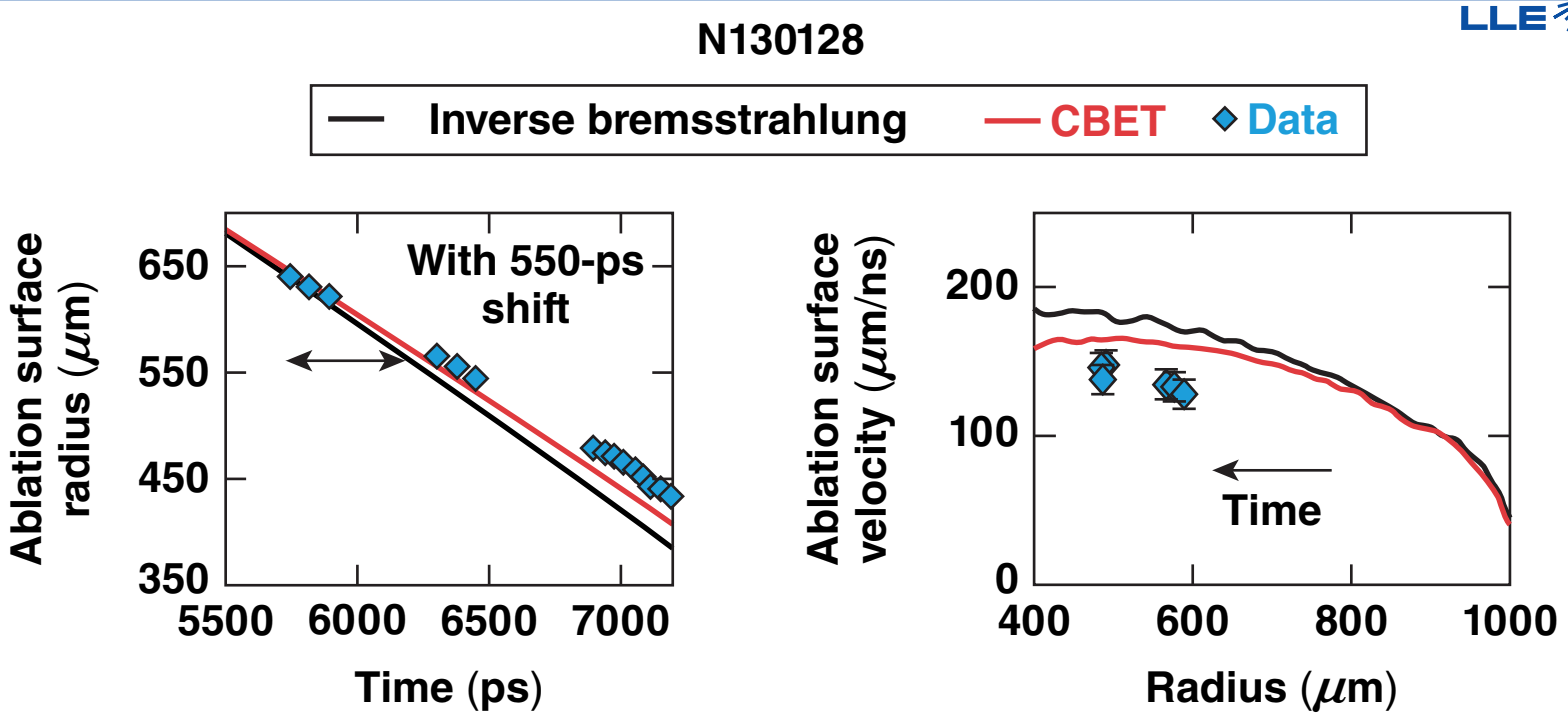
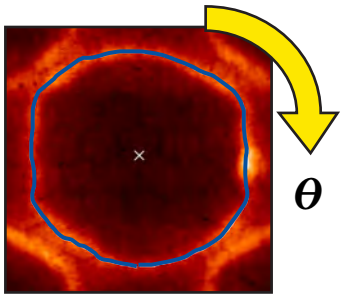


- Several reasons may contribute to residual difference between simulation and experiment
  - uncertainty in beam profiles
  - resolution at quarter-critical surface in simulation
  - nonuniformity growth at ablation surface
  - limitation of CBET modeling

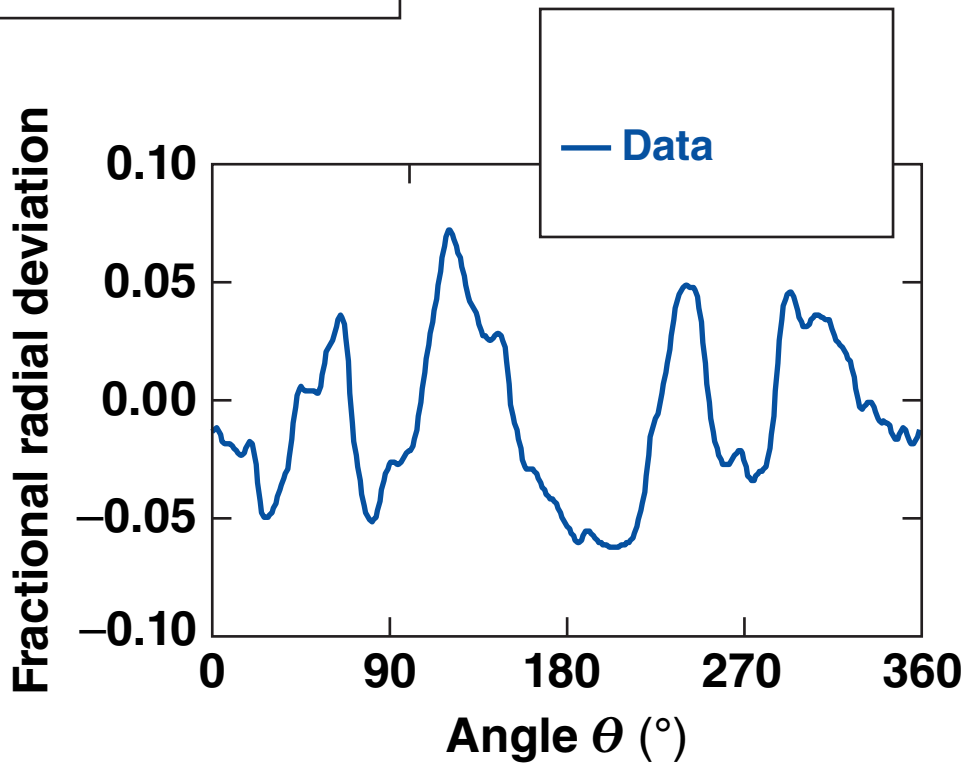
TC11024

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 ~ 2

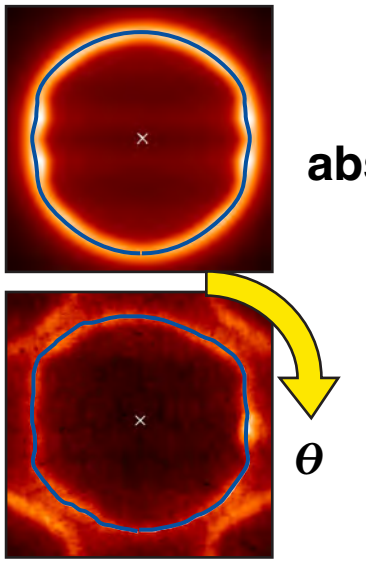


Data



TC11025

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

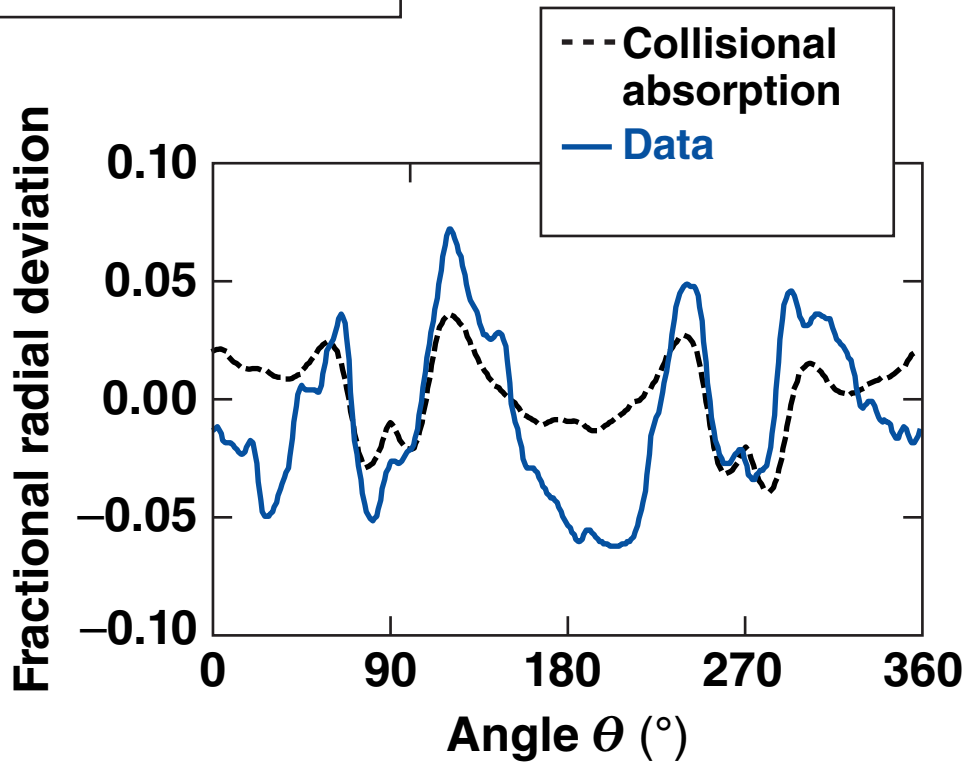


Collisional absorption only

Data

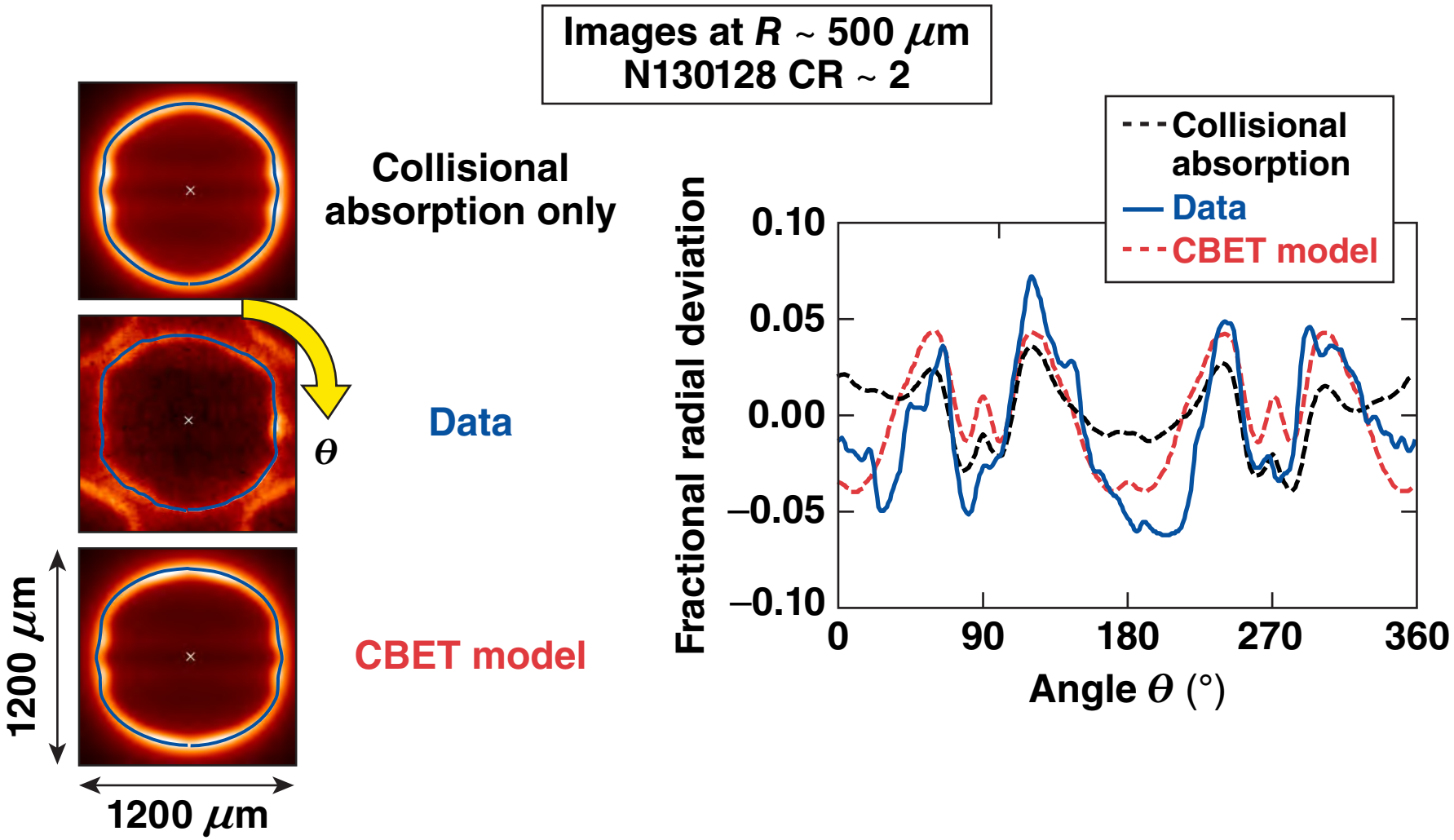
θ

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



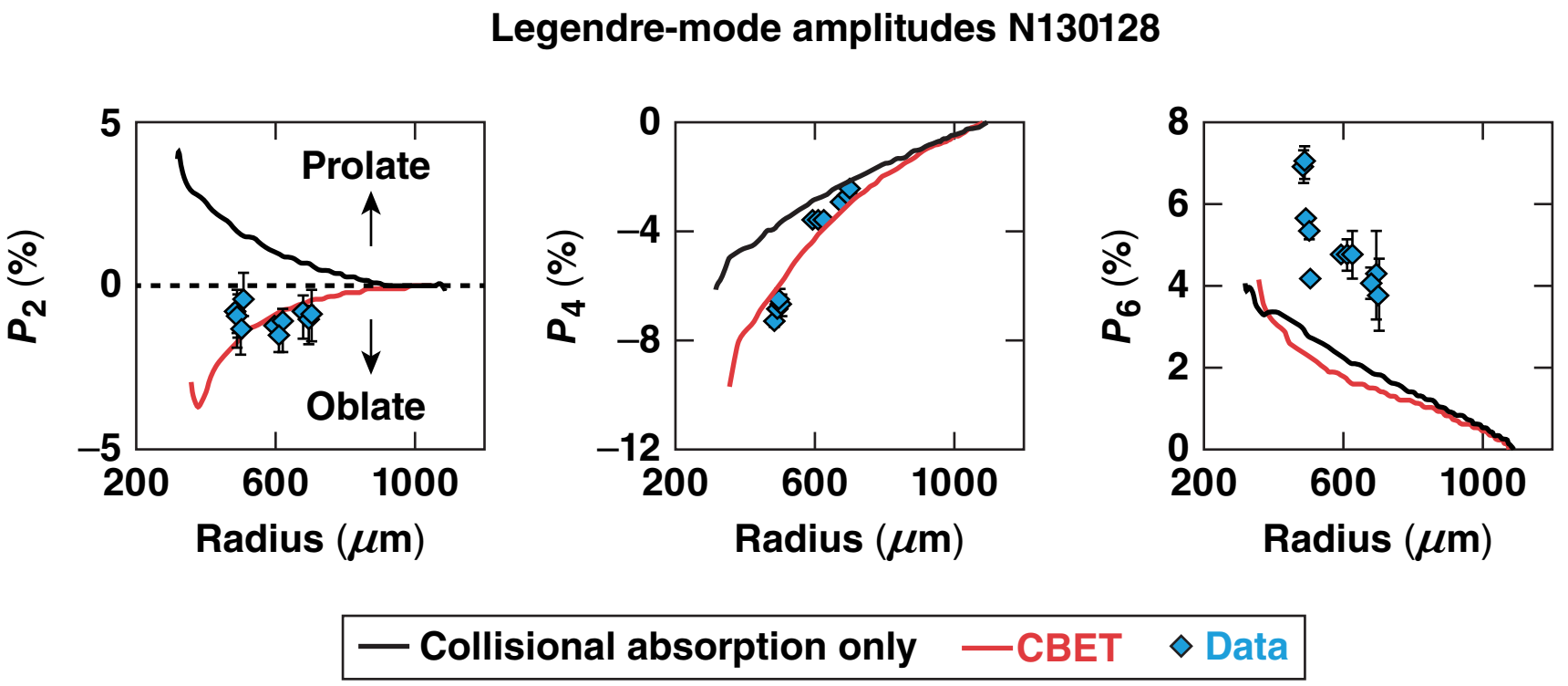
TC11025a

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



TC11025b

Symmetry is well modeled when CBET is included in the simulation



TC11026

Summary/Conclusions

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