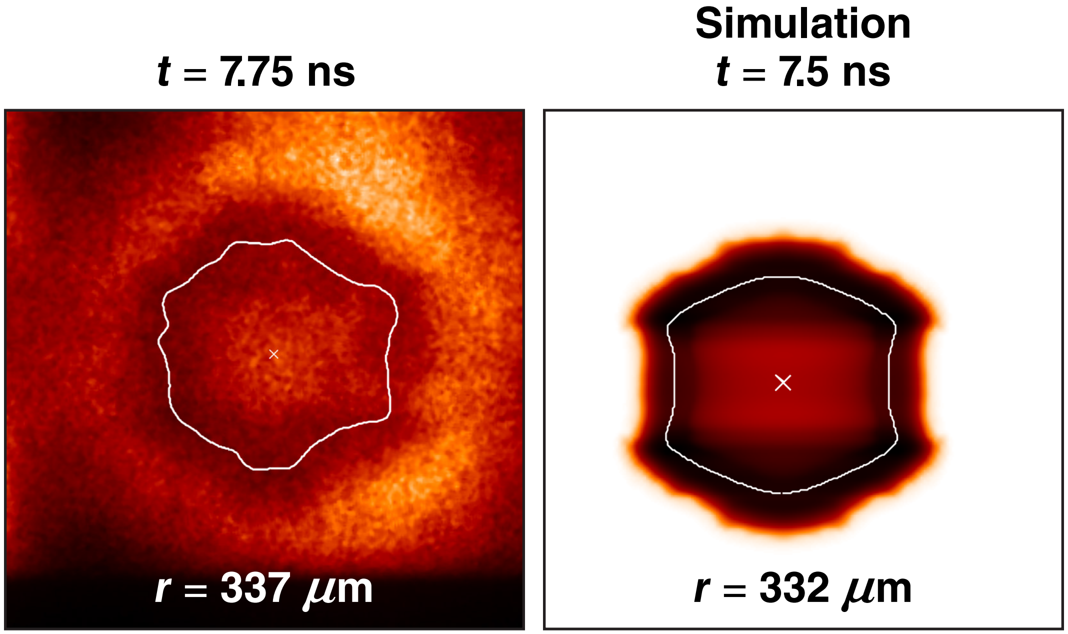
Polar Direct Drive at the National Ignition Facility

N140612-001 (CR ~ 3)



1500 × 1500-μm regions

P. B. Radha
University of Rochester
Laboratory for Laser Energetics

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Summary

Inferred trajectories from the National Ignition Facility (NIF) polar-direct-drive (PDD) implosion experiments suggest a decompressed shell

- **Trajectories from both backlit and self-emission images lag simulations**
- **Inferred shell thickness is larger than simulated, consistent with a scenario including decompression caused by either nonuniformity or preheat**
- **A consistent scenario also requires a velocity reduction in addition to that predicted by the current model of cross-beam energy transfer (CBET) in *DRACO***
- **Future experiments should clarify the effect of CBET versus that of nonuniformity in observed trajectories**

Collaborators

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

University of Rochester
Laboratory for Laser Energetics

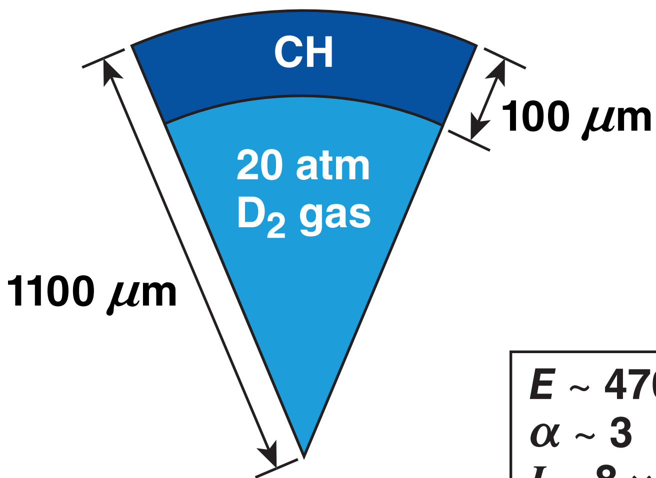
M. Rosenberg, H. Rinderknecht, and R. D. Petrasso

Plasma Fusion Science Center, MIT

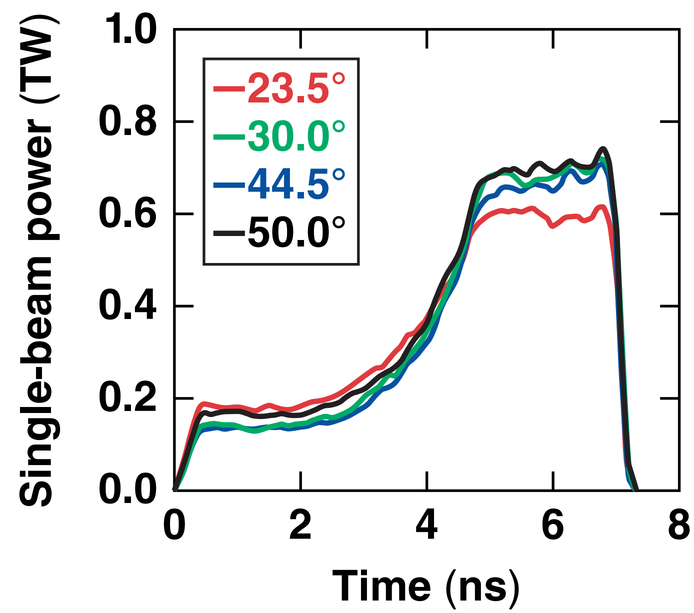
S. LePape and A. J. MacKinnon

Lawrence Livermore National Labs

Low-adiabat PDD implosions* on the NIF are used to study energetics and preheat



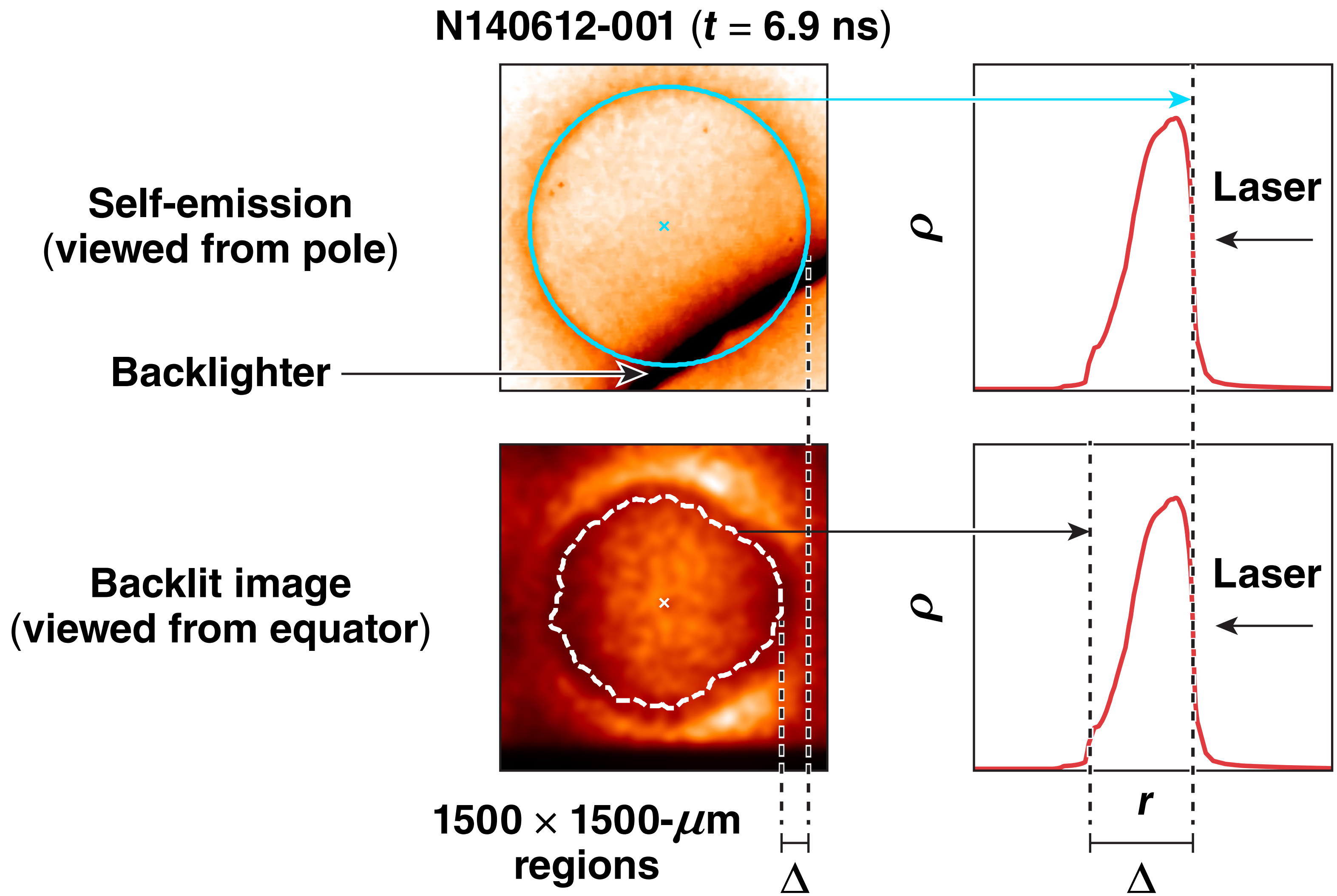
E ~ 470 to 660 kJ
α ~ 3
I ~ 8×10^{14} W/cm^2
$V_{imp} = 1.8 \times 10^7$ cm/s
$IFAR_{2/3} = 19$



- Existing x-ray drive beam profiles defocused by 1 cm are used in these implosions

M. Hohenberger, CI1.00001, this conference.
*P. B. Radha *et al*., Phys. Plasmas 20, 056306 (2013).

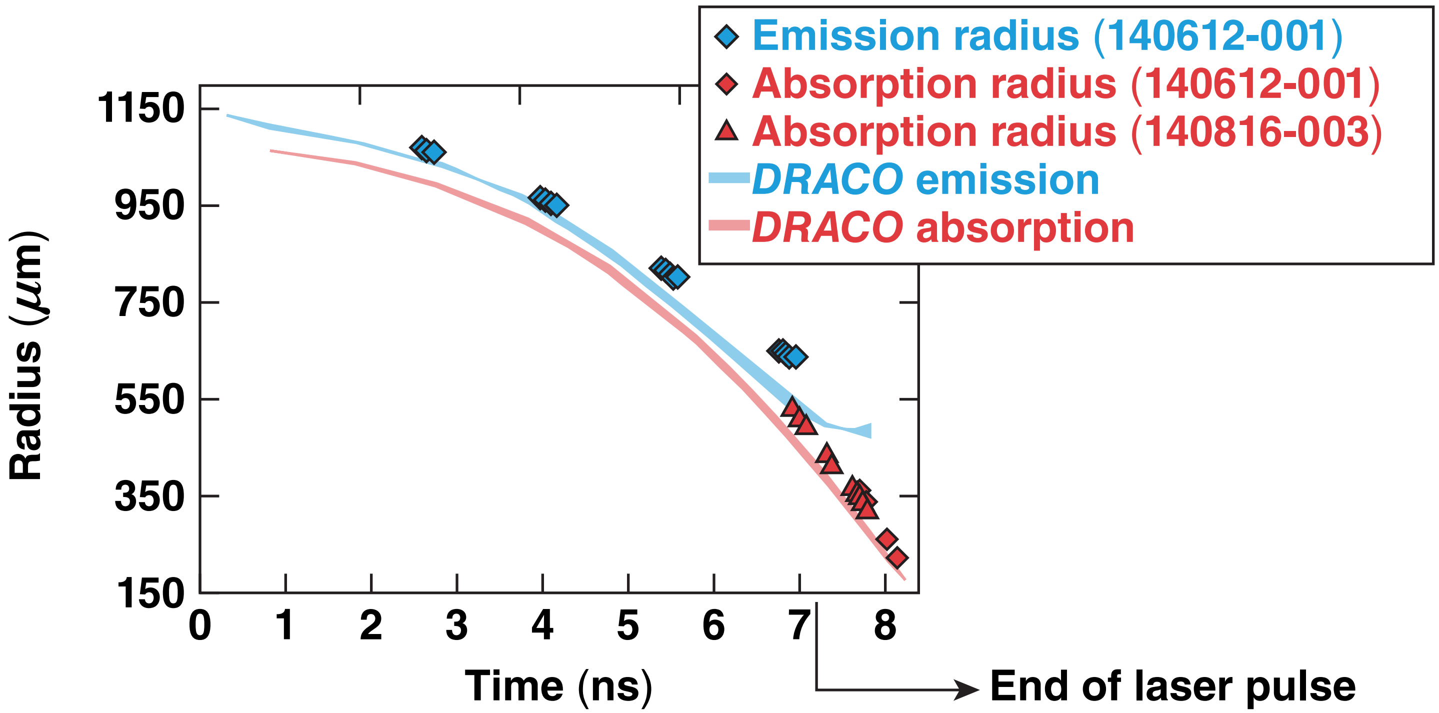
Implosion trajectory* and width of emission** region are obtained from self-emission and backlit x-ray images



*D. T. Michel *et al.*, Rev. Sci. Instrum. 83, 10E530 (2012).
**F. J. Marshall and P. B. Radha, Rev. Sci. Instrum. 85, 11E615 (2014).

Trajectories from self-emission and backlighting are delayed when compared to simulation

- **Simulations include the effect of CBET* and nonlocal heat conduction****
- **CBET reduces the absorption from 93% to 80% and reduces velocity by ~15% compared to a model that includes only collisional absorption**



*C. J. Randall, J. R. Albritton, and J. J. Thomson, Phys. Fluids 24, 1474 (1981); J. A. Marozas *et al*., NO4.00014, this conference.
**D. Cao *et al*., Bull. Am. Phys. Soc. 58, 310 (2013).

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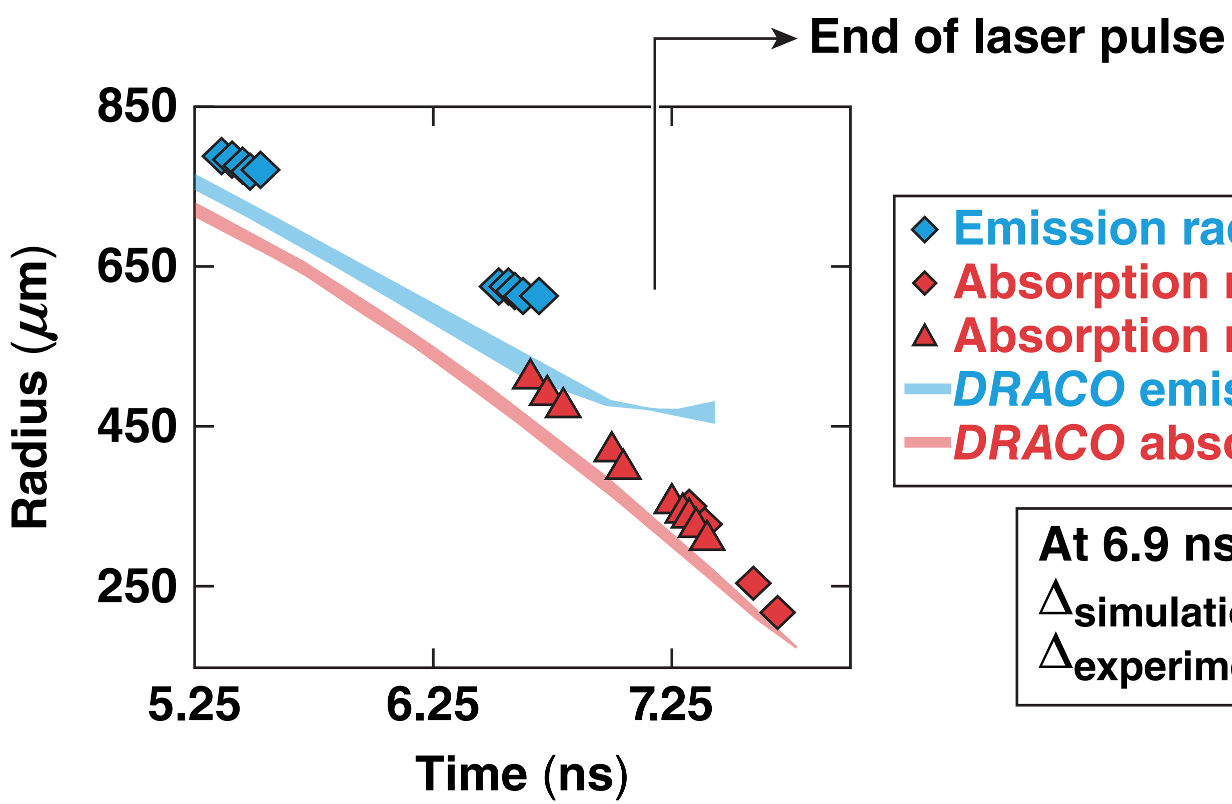
The converging shell is decompressed in the experiment relative to simulation



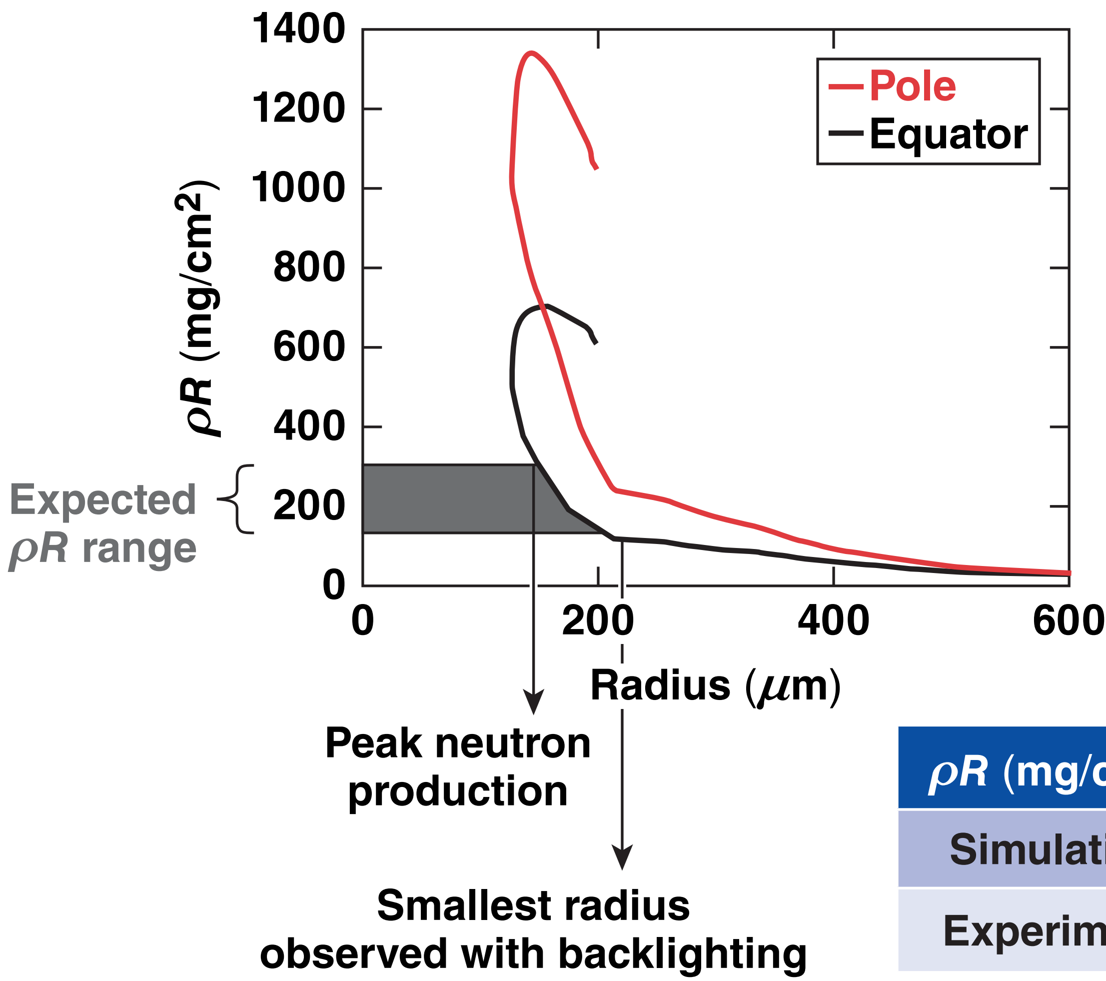
At 6.9 ns
$\Delta_{simulation} \sim 60\ \mu m$
$\Delta_{experiment} \sim 110\ \mu m$

- The low measured low areal density indicates decompression:

$\rho R_{meas} = 125 \pm 25\ mg/cm^2$ (Ref. 1) $\rho R_{sim} = 120$ to $280\ mg/cm^2$

[1]F. H. Séguin *et al.*, Phys. Plasmas 9, 2725 (2002); measured using wedge range filters (WRF's)

Areal-density measurement is suggestive of decompression



- Areal density is inferred only at the equator
- ρR measurements at additional locations are important to understand the magnitude of decompression

ρR (mg/cm^2)	Minimum	Maximum
Simulation	120	280
Experiment	110±30	

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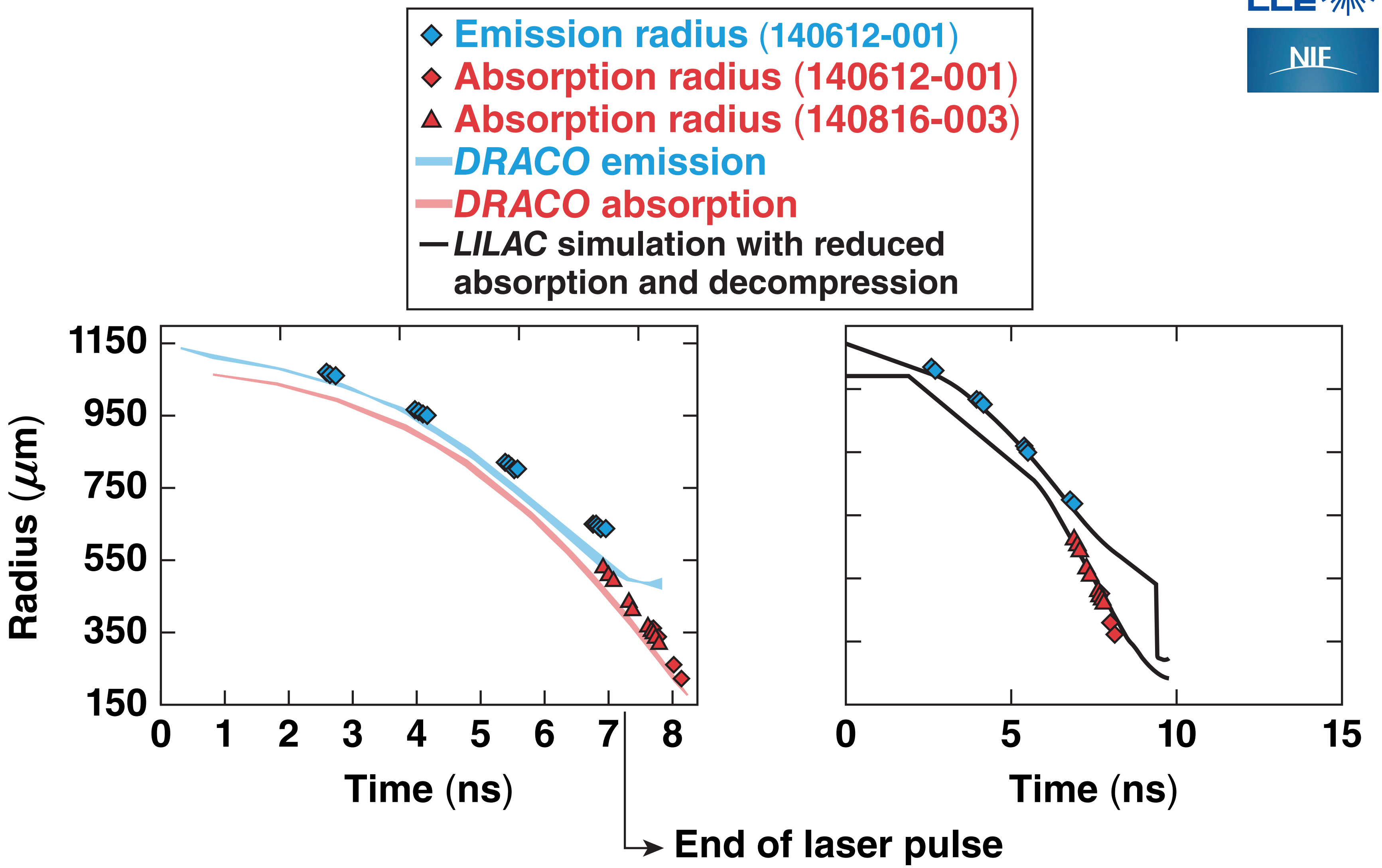
Consistent trajectories can be recovered with the assumption of reduced drive and a decompressed shell



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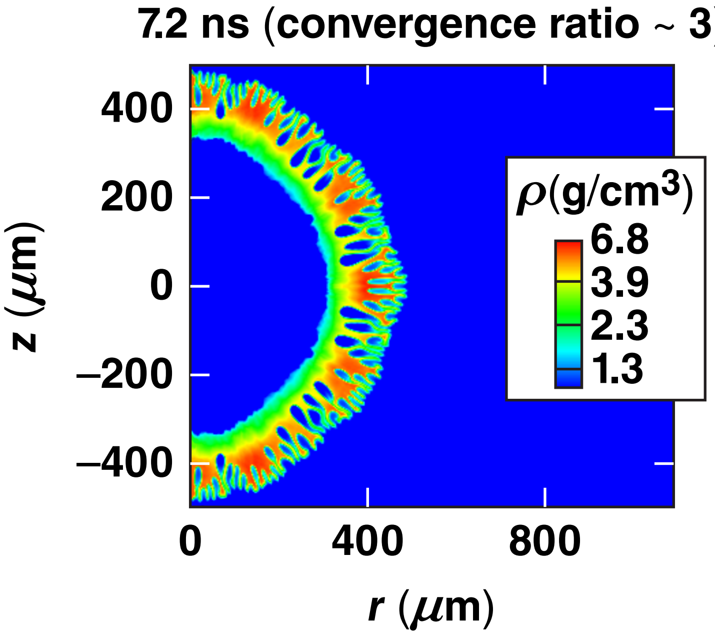
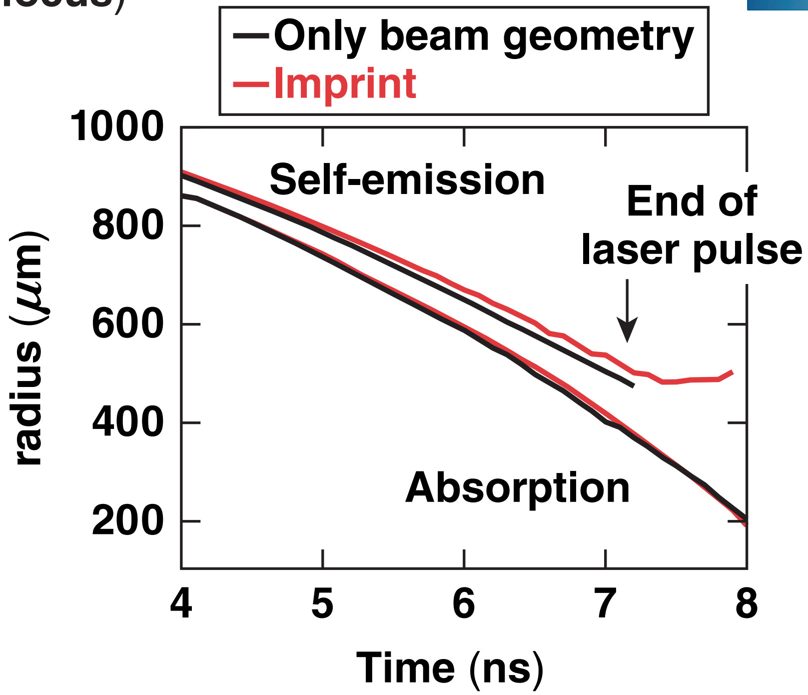
Nonuniformity can potentially explain the observed slowing of the self-emission trajectory

- *DRACO* PDD simulation (imprint with $\ell \leq 200$; no target roughness; no additional imprint from beam defocus)





- Nonuniformity sources will be investigated in FY15
  - cone-in-shell imprint experiments*—November and March
  - PDD implosions (smoother targets, 400-Å Au overcoat**)—January

*A. Shvydky, UO4.00008, this conference.

**A. N. Mostovych *et al.*, Phys. Rev. Lett. 100, 075002 (2008).

Summary/Conclusions

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NIF

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