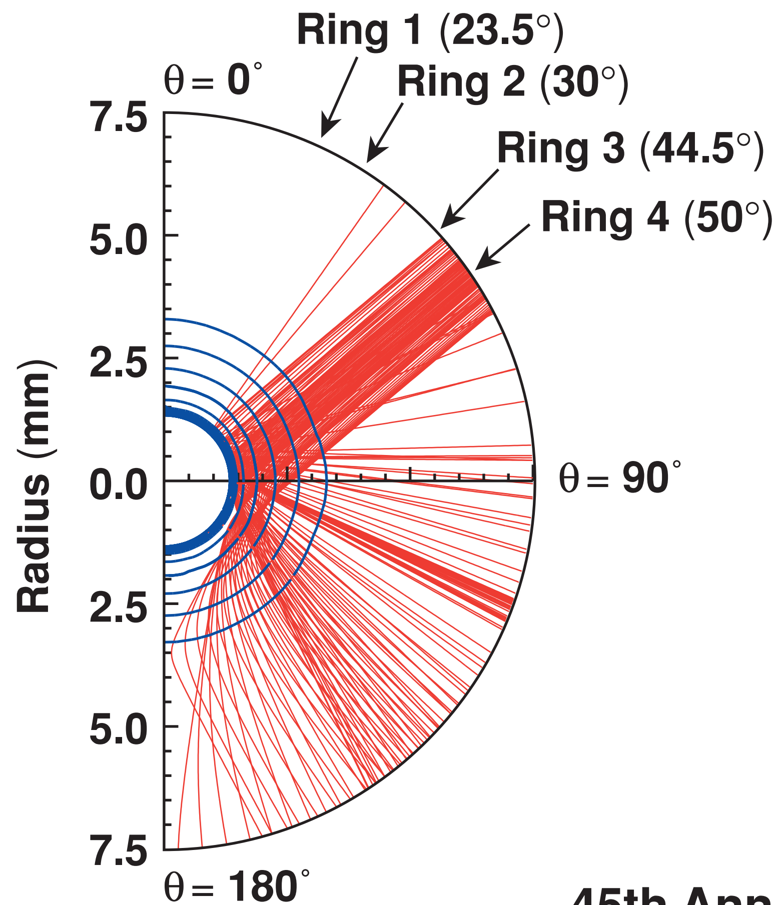
Hydrodynamic Simulations of Polar Direct Drive on the NIF and LMJ Based on Three-Dimensional Ray Tracing



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Summary

Polar direct drive is a promising approach for studying ignition physics on both the NIF and the LMJ

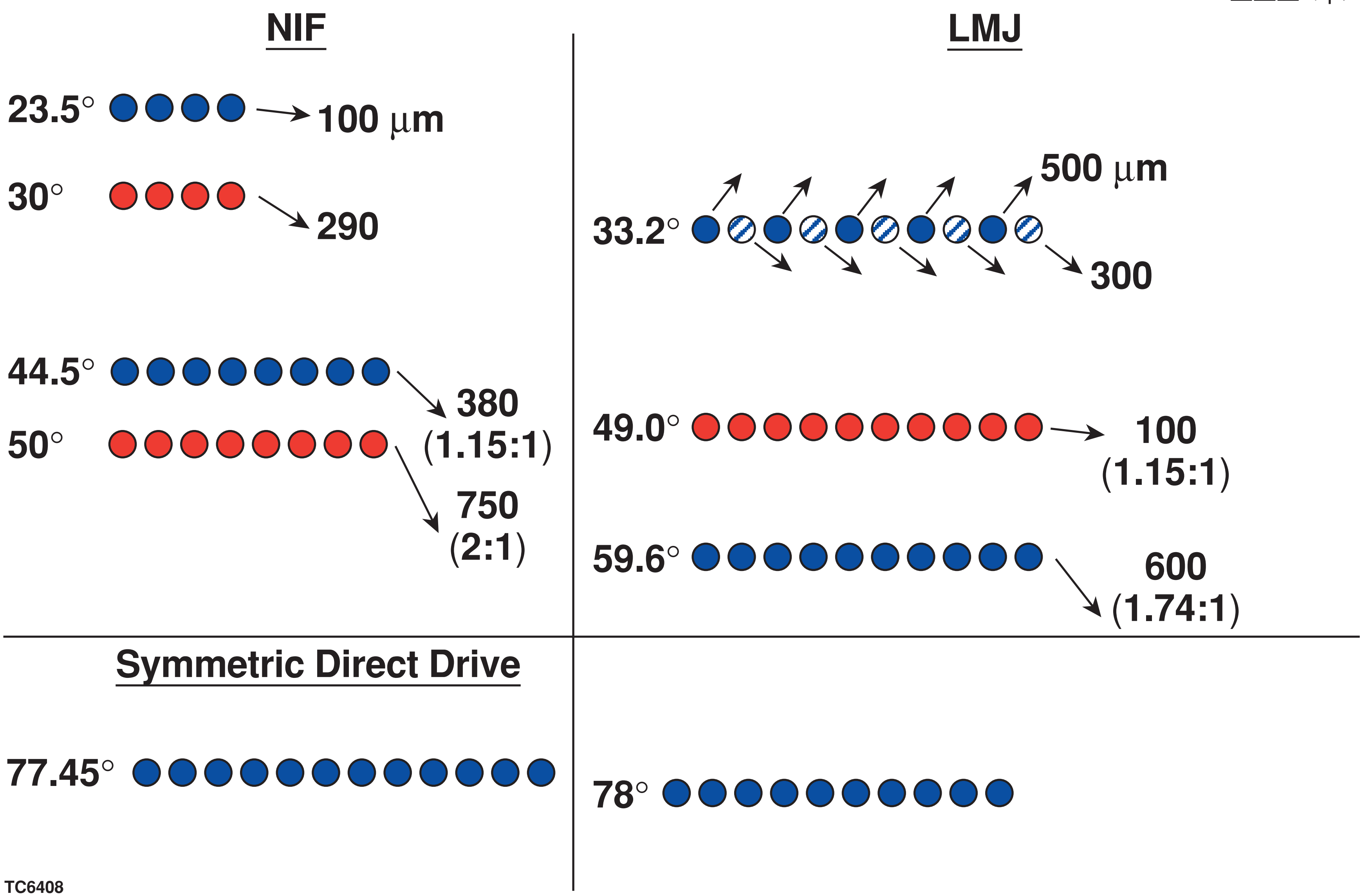
- 2-D implosions are driven by full 3-D ray tracing for all rings of beams.
- Elliptical phase plates are used for some beams.
- Implosion velocities at the end of the laser pulse are uniform to 3%–5% (rms).

TC6407

Outline

- Irradiation/target designs for polar direct drive
- Comparison of "polar" and "symmetric" cases for both the NIF and the LMJ
  - t = 5.8 ns (just before shock breakout)
  - t = 9.0 ns (end of laser pulse)

The different NIF and LMJ configurations lead to different designs for polar direct drive



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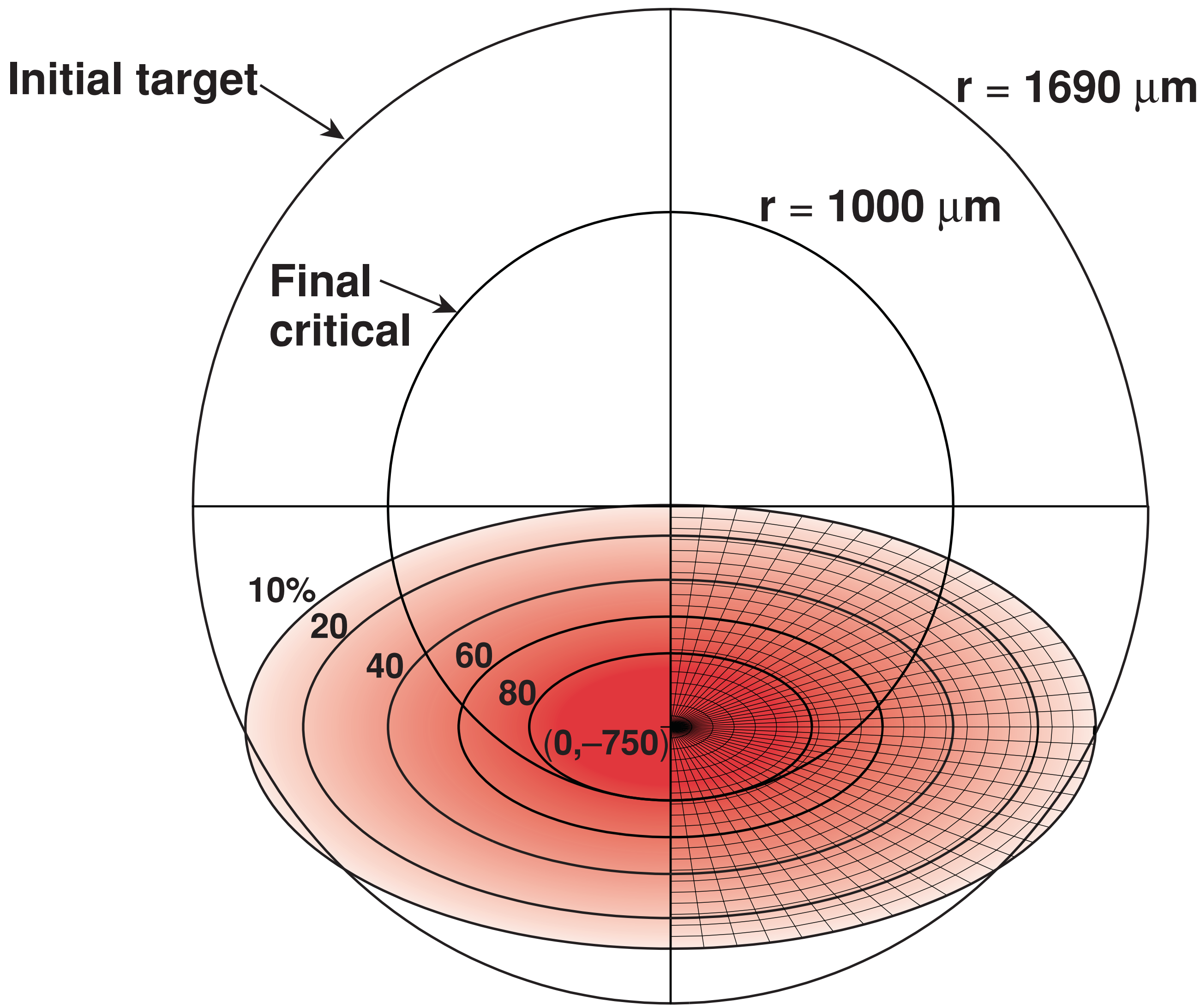
For the NIF, ring-4 beams are repointed 750 μm and use 2:1 elliptical phase plates



Sub26
TC6180

A large parameter space is being explored

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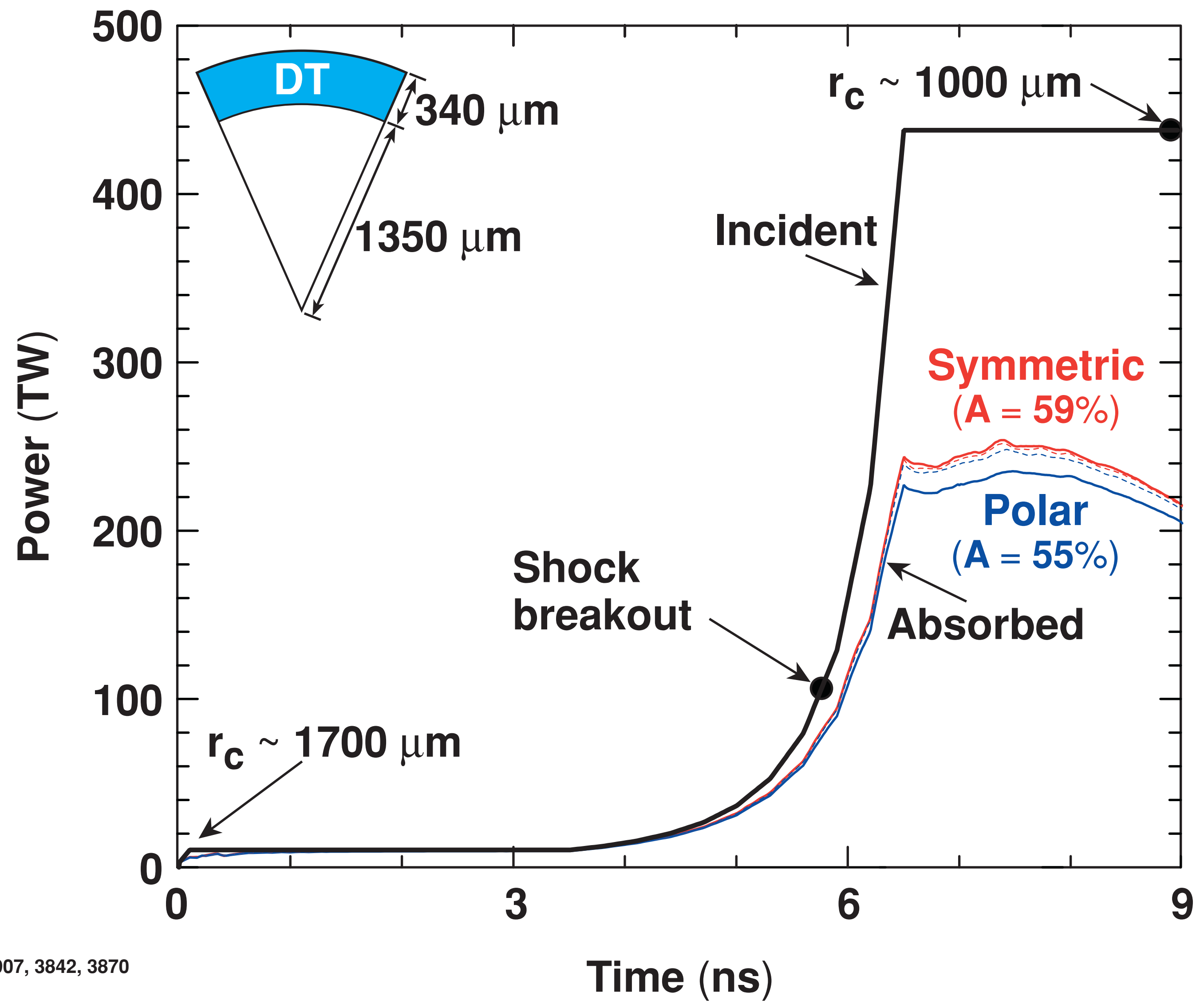
- These calculations have used
  - beam-pointing shifts
  - elliptical phase plates
  - varying spatial profiles*
  - varying beam energies

- Future calculations will consider
  - varying temporal profiles
  - modified target designs
  - shimmed targets

*$I(r) \propto \exp -(r/1200\ \mu m)^{2.5}$

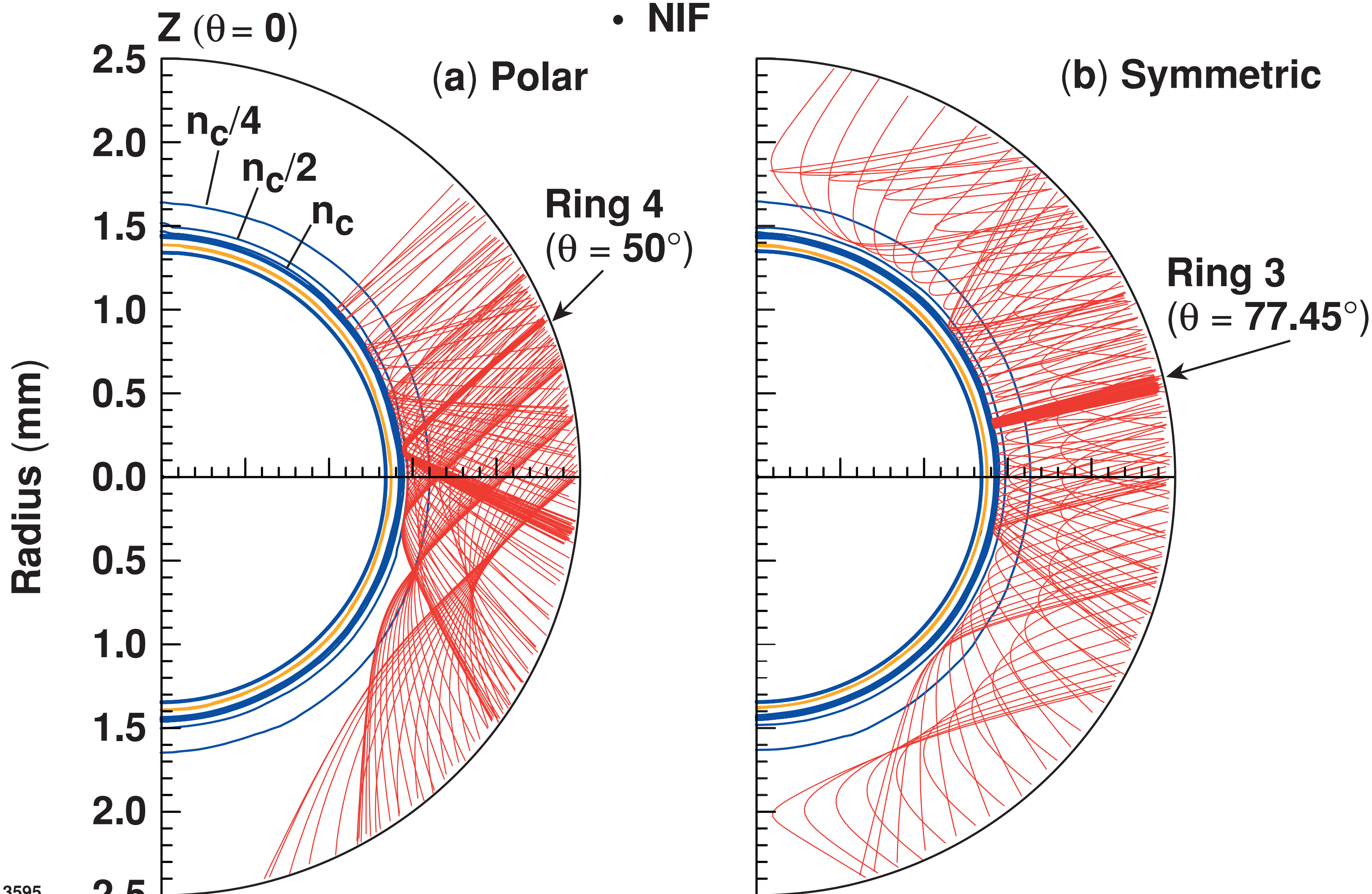
The polar designs result in small absorption losses for both laser systems



Runs 3595, 3907, 3842, 3870
TC6409

At 5.8 ns, a nearly spherical shock approaches the inner ice surface for both polar and symmetric drive

- NIF



Runs
3870, 3595
TC6410

At 5.8 ns, the electron-temperature contours in the polar case show an ~10% enhancement near the equator

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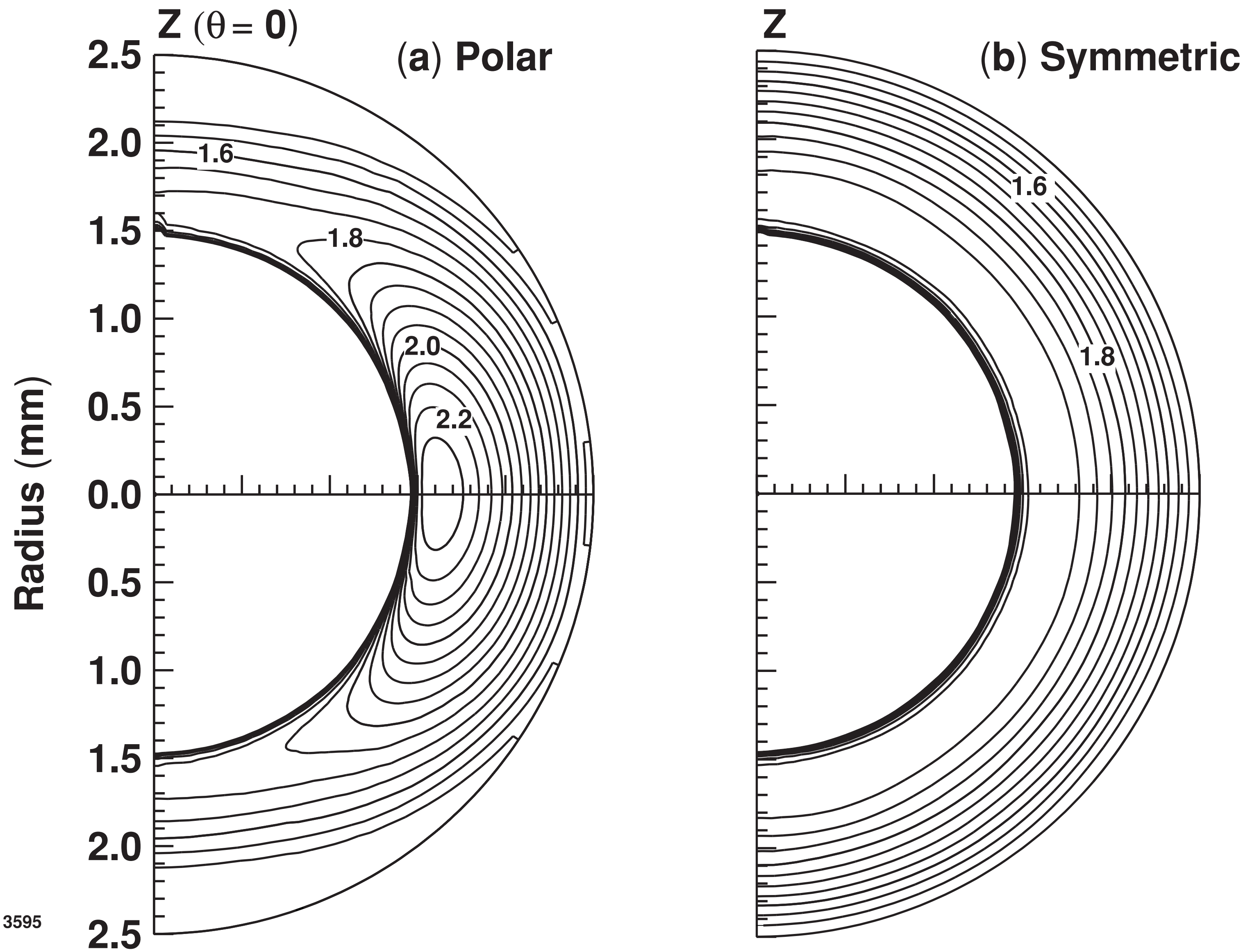
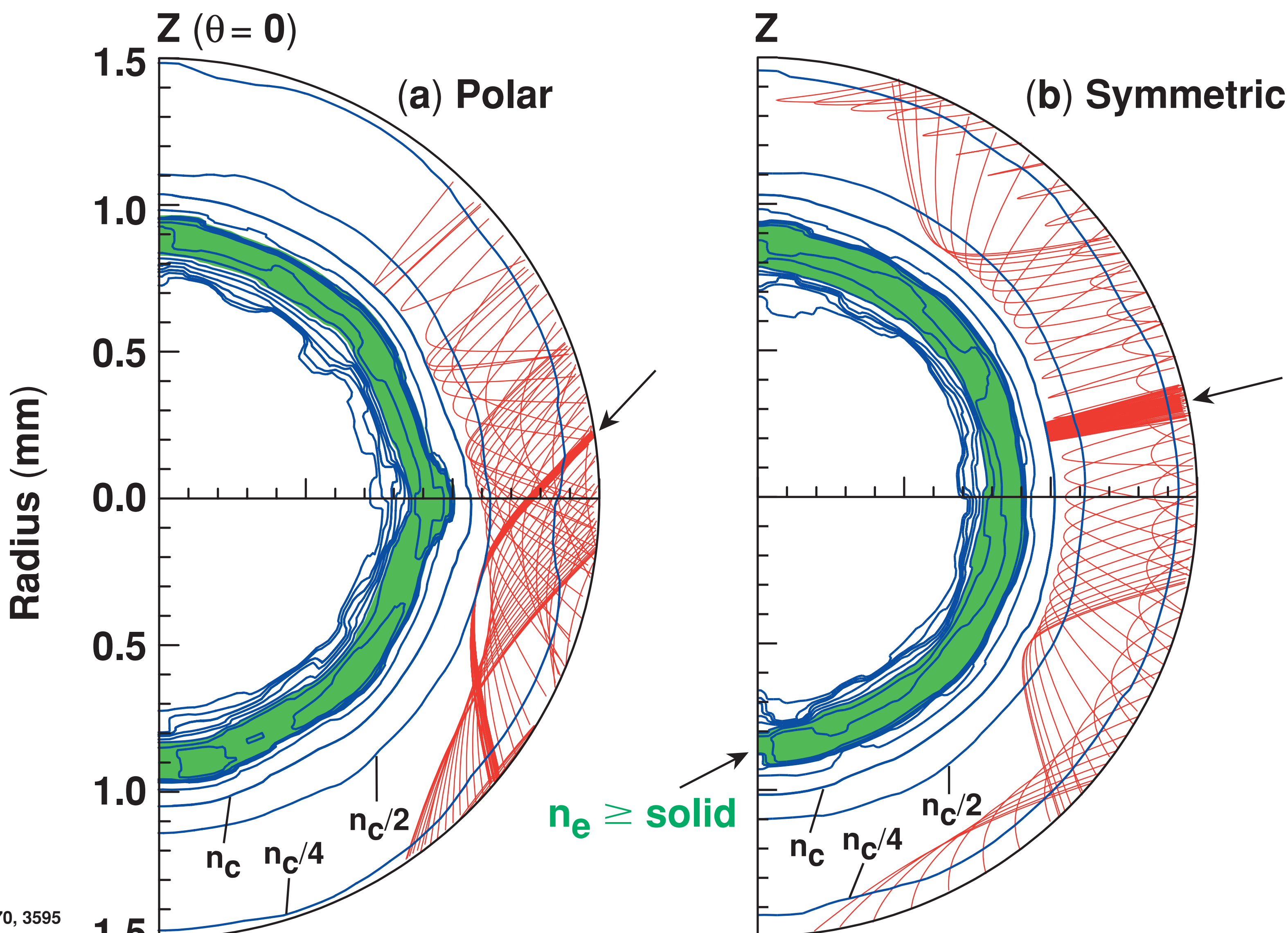
- NIF



Runs 3870, 3595
TC6411

At the end of the laser pulse (9 ns), the polar case is almost as uniform as the symmetric case

- NIF



Runs 3870, 3595
TC6412

At 9 ns, the error in the center-of-mass radius of accelerated DT for the NIF polar design is greatest near the equator

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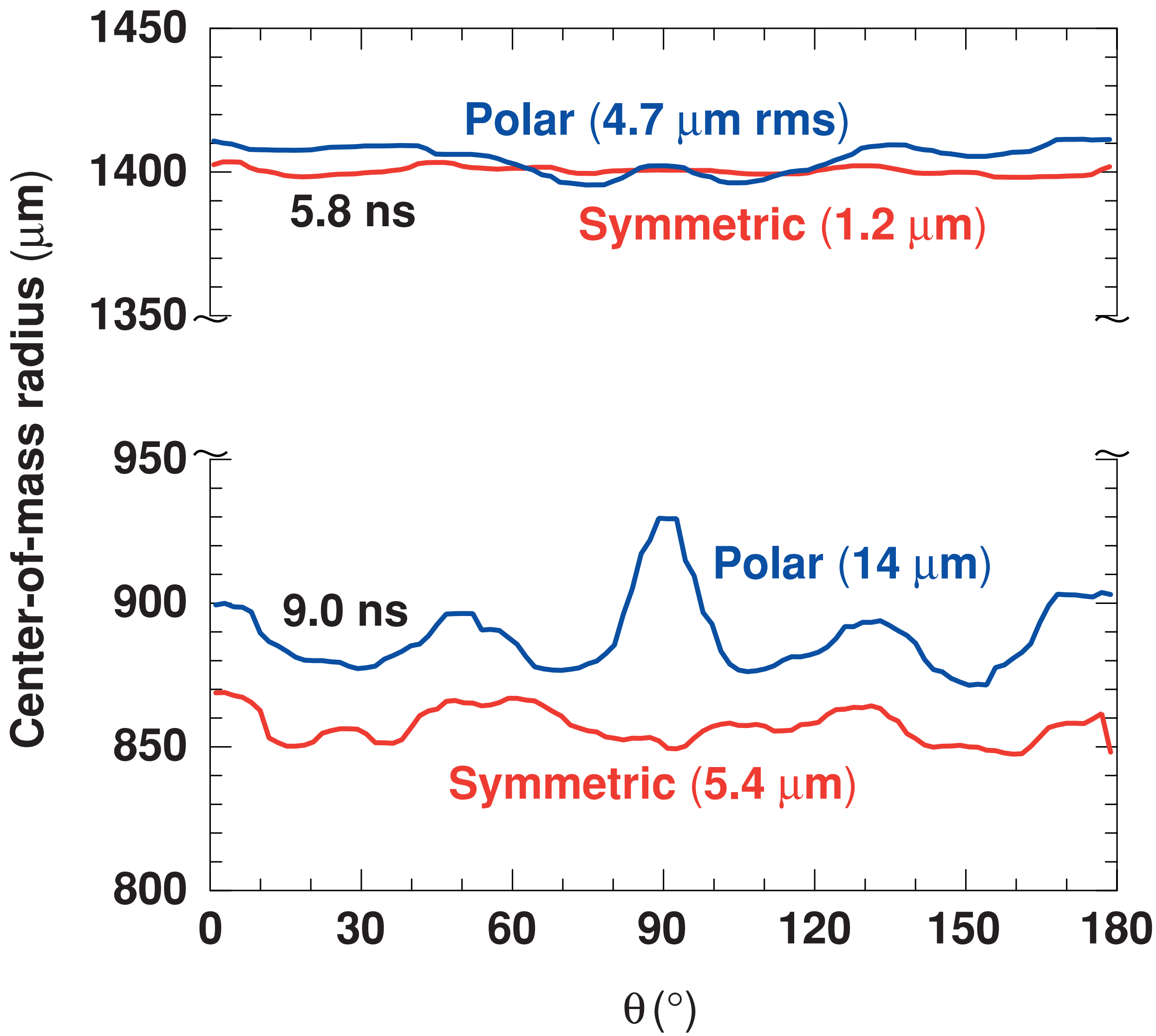
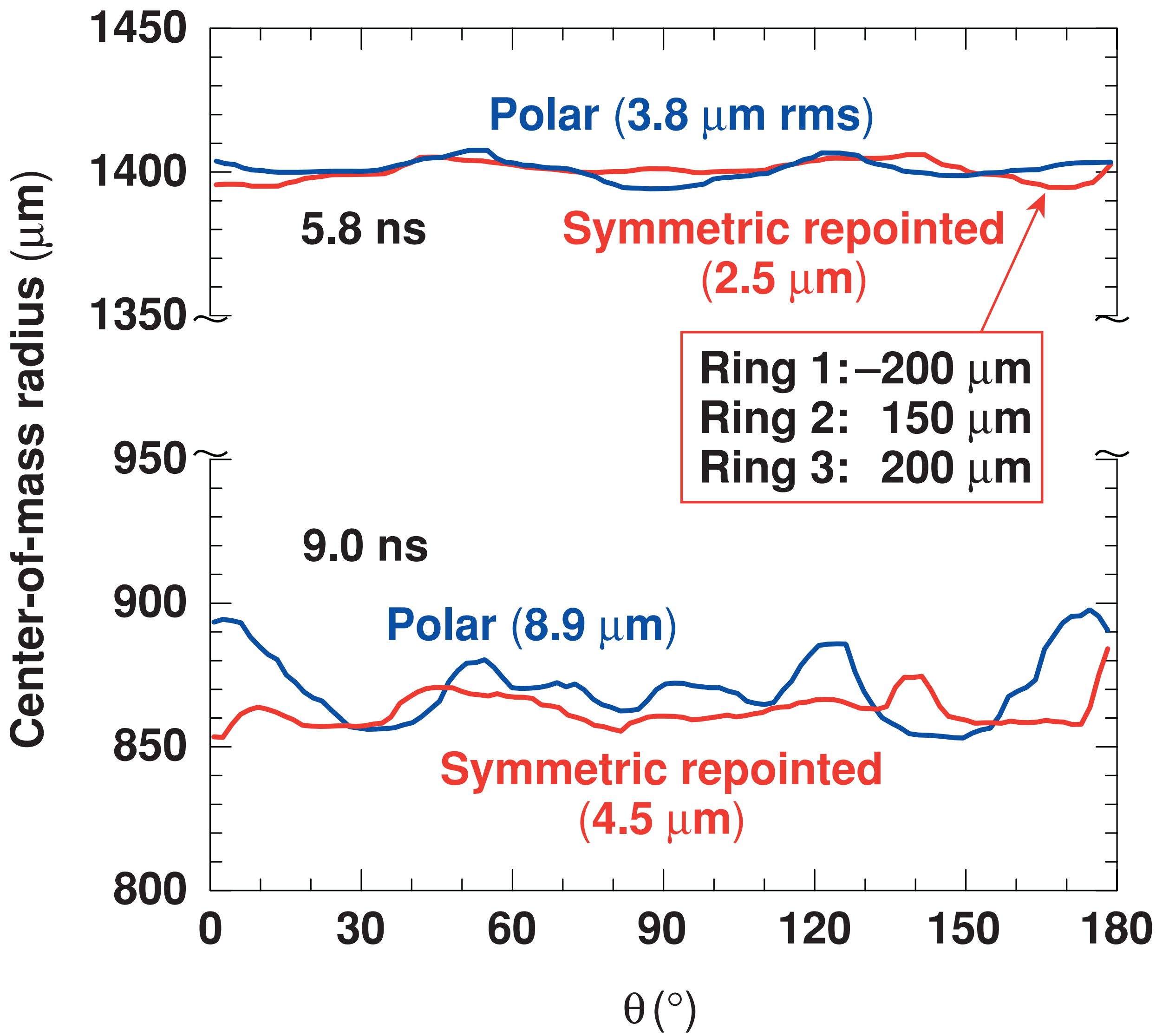


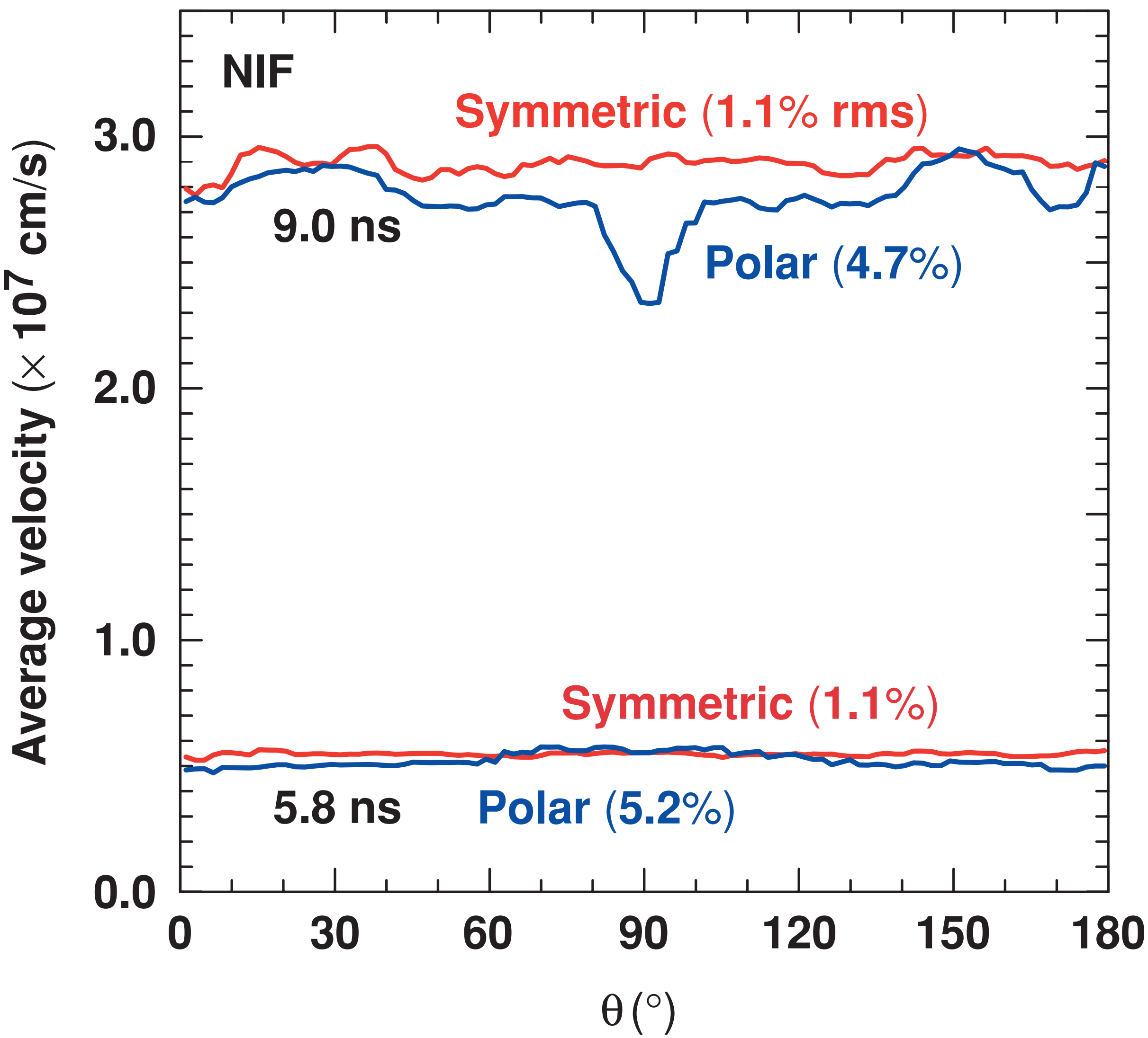
Runs 3870, 3595
TC6413

At 9 ns, the error in the center-of-mass radius of accelerated DT for the LMJ polar design is greatest near the poles



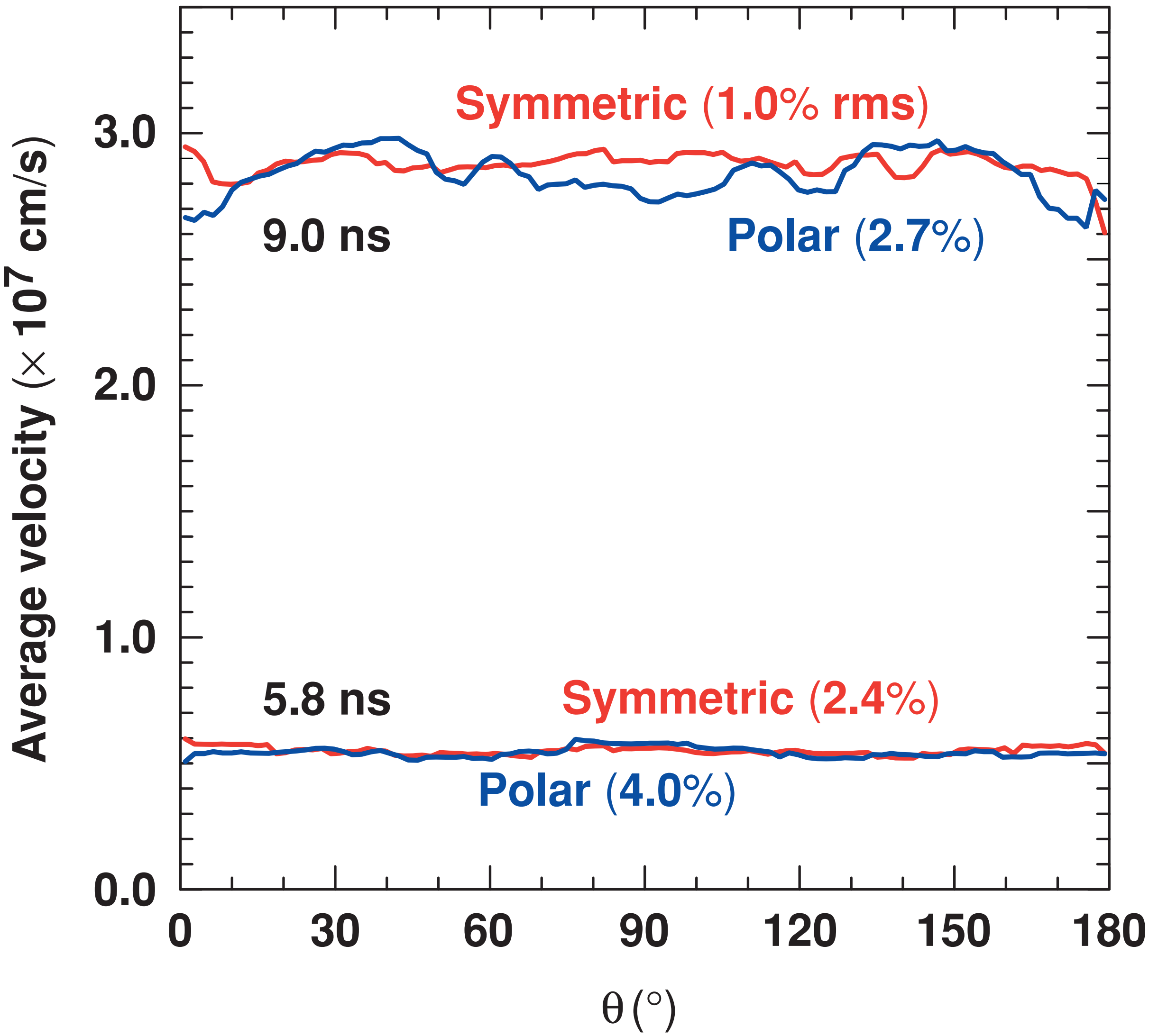
Runs 3842, 3907
TC6414

At 9 ns, the average velocity of accelerated DT is low near the equator for the NIF polar design



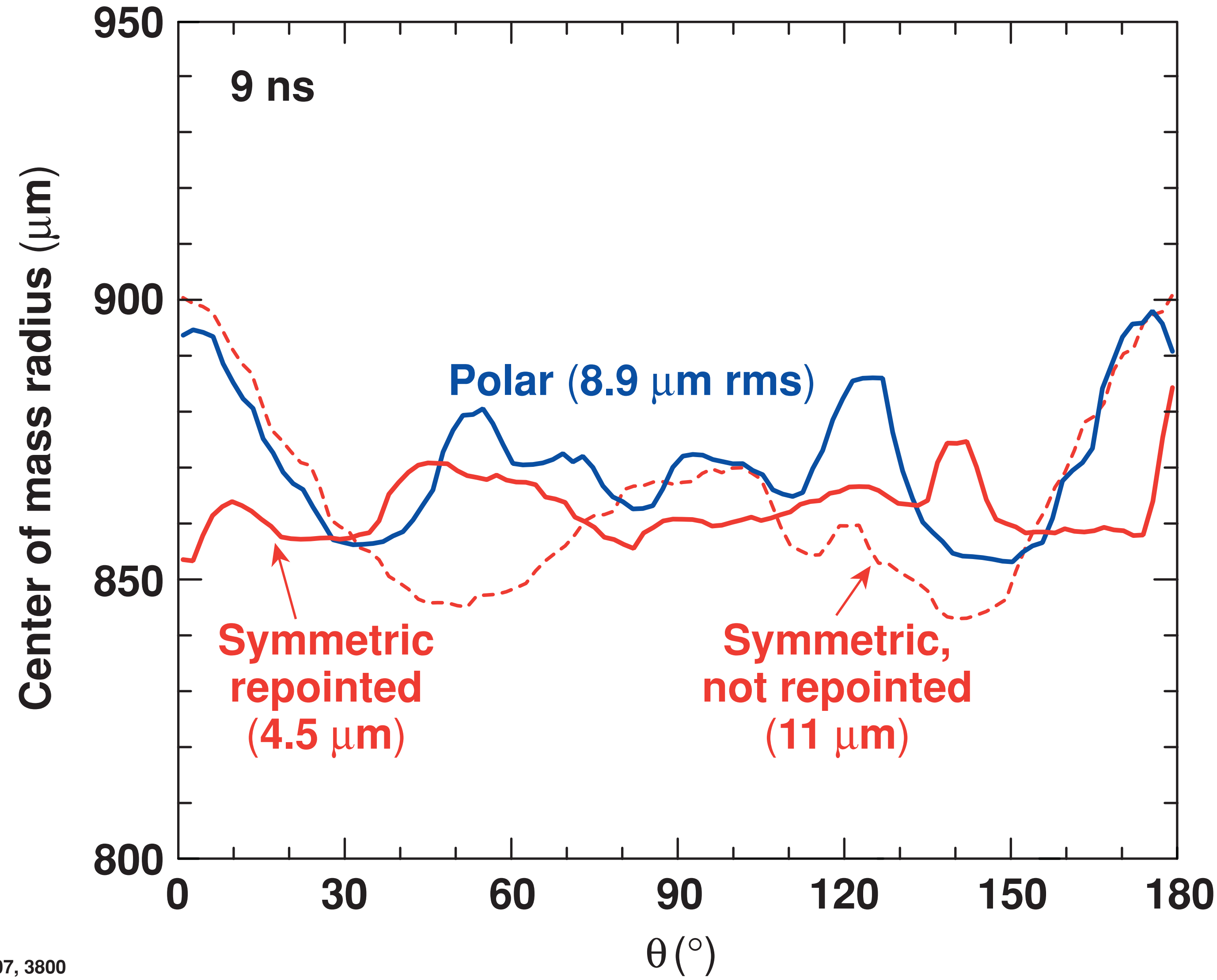
Runs 3870, 3595
TC6415

The problem at the equator is less for the LMJ



Runs 3842, 3907
TC6416

For symmetric drive on the LMJ, better results are obtained with modest beam repointings



Runs 3842, 3907, 3800
TC6417

Deviations in mean velocity are (not surprisingly) smaller for symmetric irradiation

- rms velocity variation at 9 ns

	NIF	LMJ
Polar	4.7%	2.7%
Symmetric (no repointing)	1.1%	2.0%
Symmetric (with repointing)	—	1.0%

Summary/Conclusions

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The next step is to include modest pulse-shape variations.