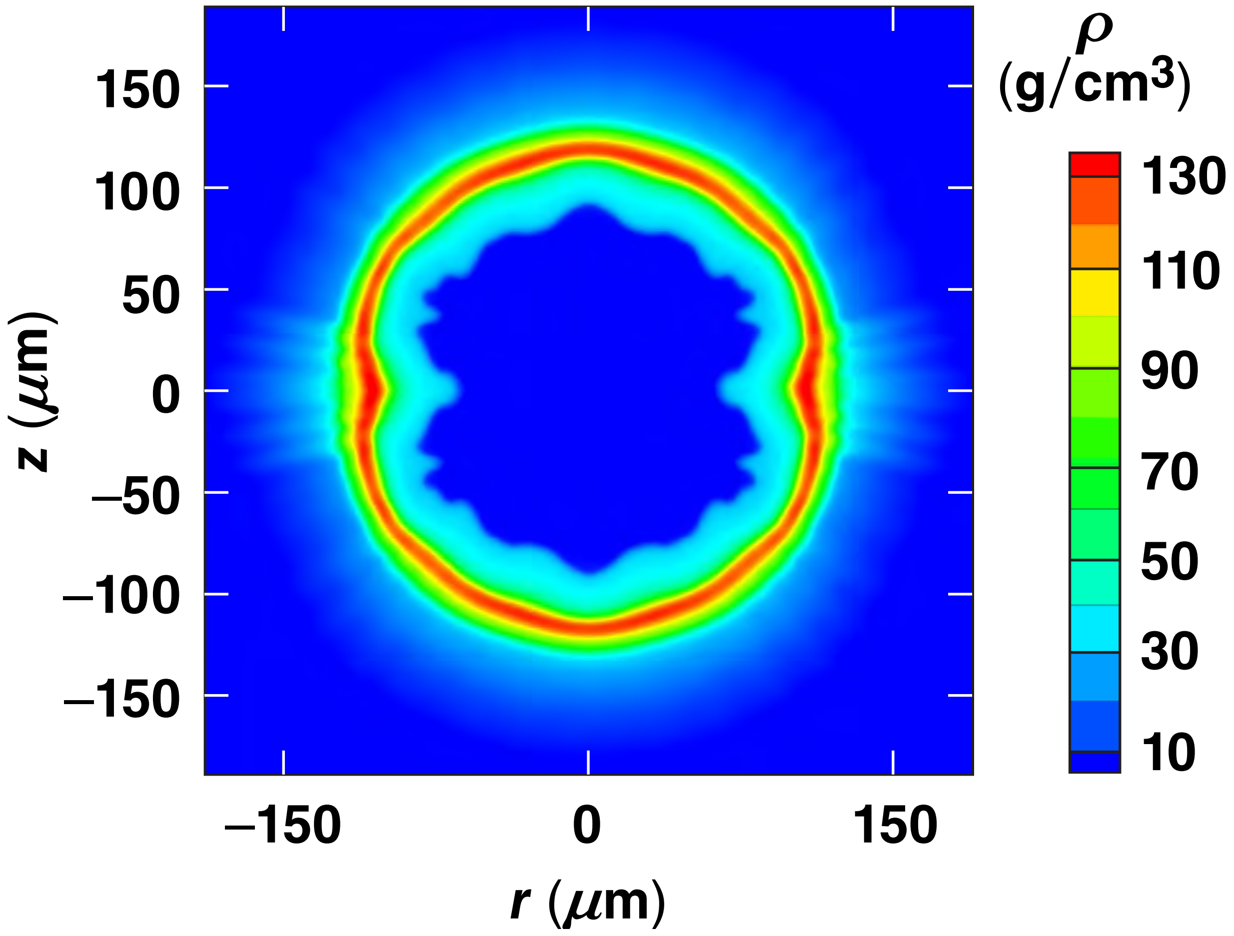
An Intermediate Far-Field Spot Design for Polar Direct Drive at the National Ignition Facility



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Summary

Far-field spot shapes have been designed for the National Ignition Facility (NIF) polar-direct-drive (PDD) experiments at intermediate energies

- Far-field spot shapes are based on a PDD ignition configuration using the nonlocal electron transport implicit Schurtz–Nicolaï–Busquet method (iSNB)
- The design shows increased target performance over the previous iteration
- Spot-shape envelope distortions caused by multi-FM do not decrease target performance

Collaborators

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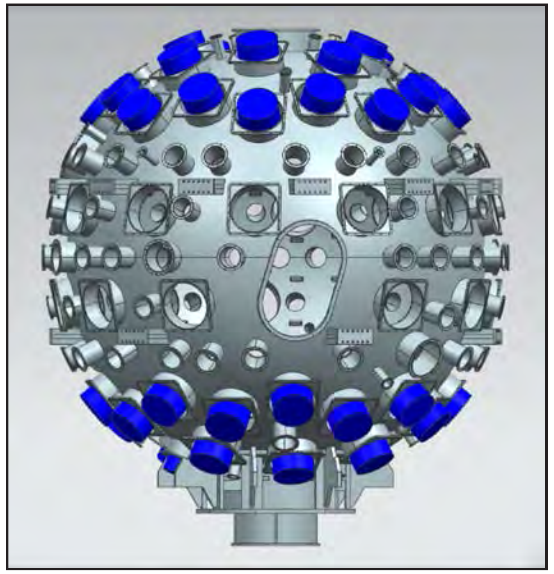
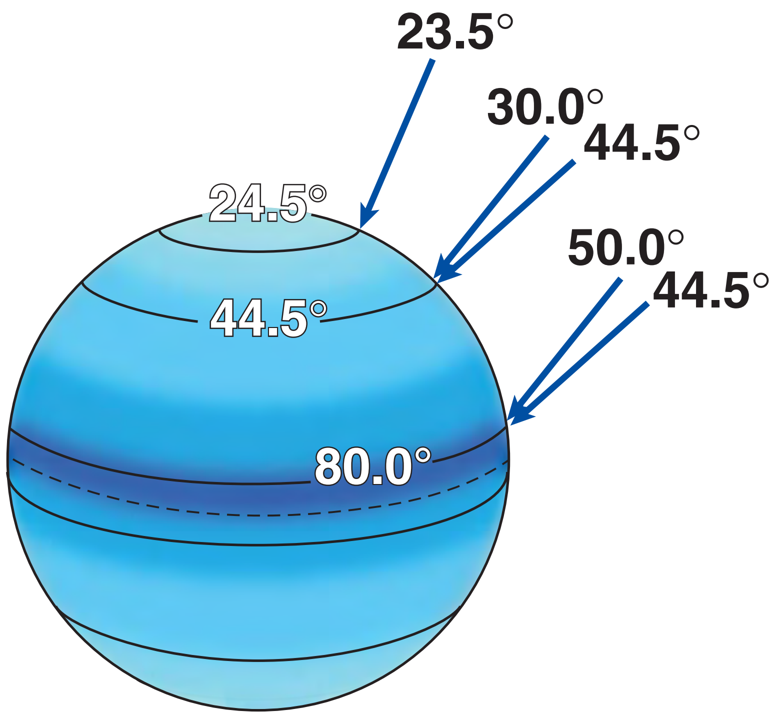
PDD experiments planned for the NIF will be done by repointing existing beamlines

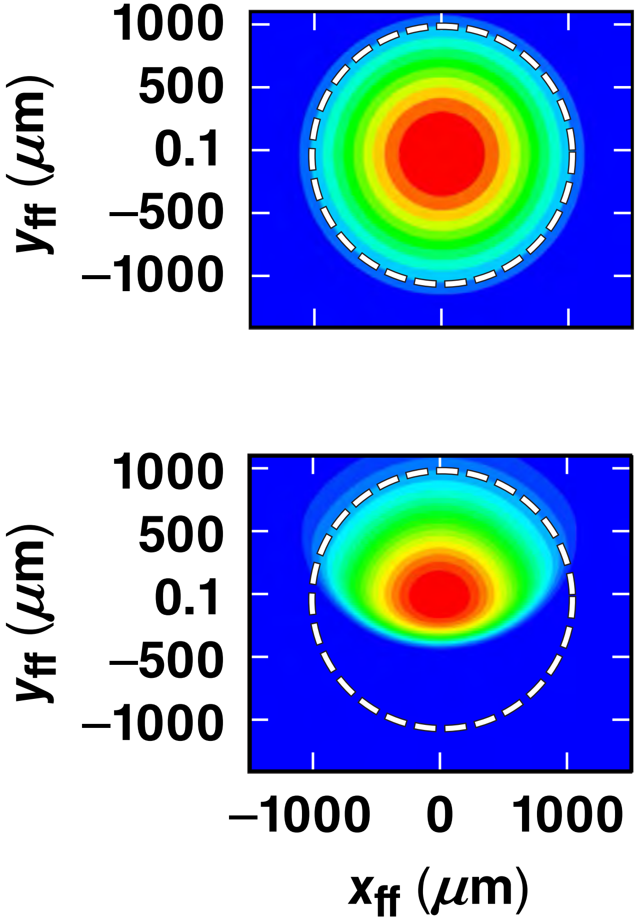
NIF beams configured for indirect drive (arranged around poles)



NIF beams repointed to fully illuminate the capsule



Far-field spot shapes modified to account for beam repointing



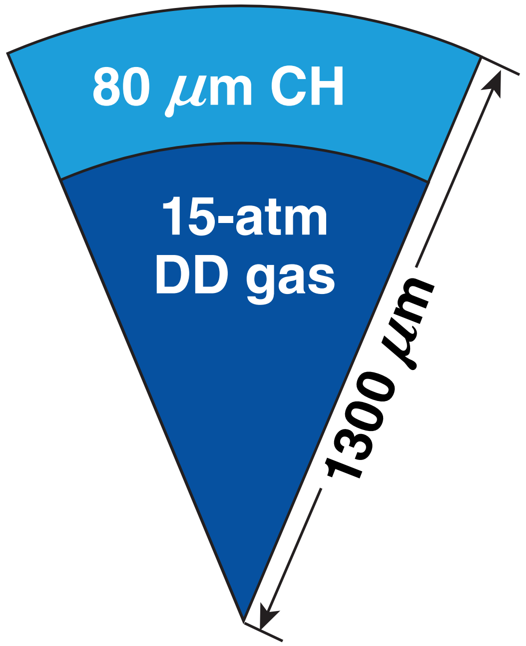
Polar beams remain relatively unchanged

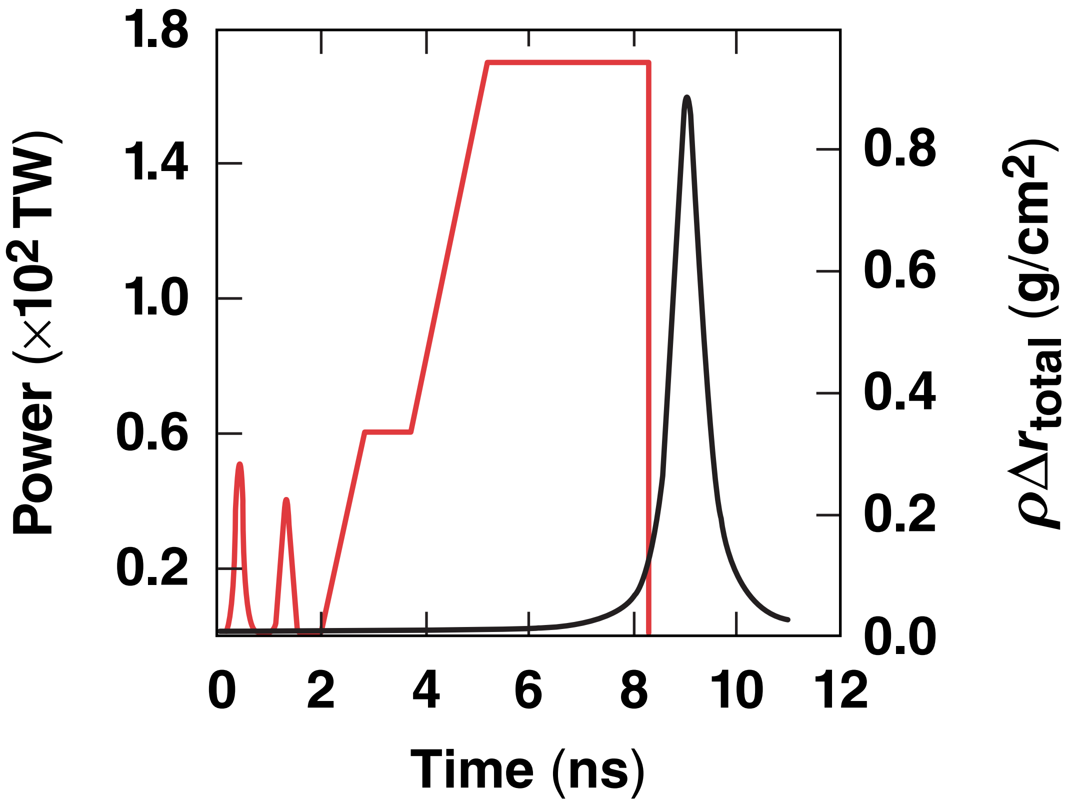
"Equatorial" beams require the most modifications (e.g., spot masking)

E23665c

The intermediate distributed phase-plate (iDPP) design uses a 1-D plastic-shell design* that was scaled from OMEGA

- NIF PDD implosions will be run at intermediate energies
  - ≤800 kJ
- Design objectives
  - a round, symmetric hot spot
  - a convergence ratio near or above 17



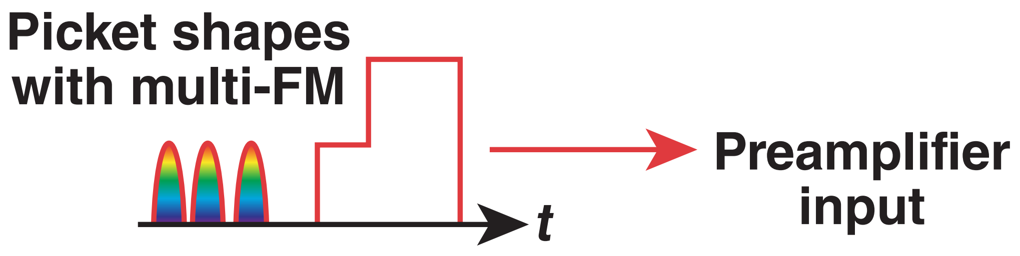


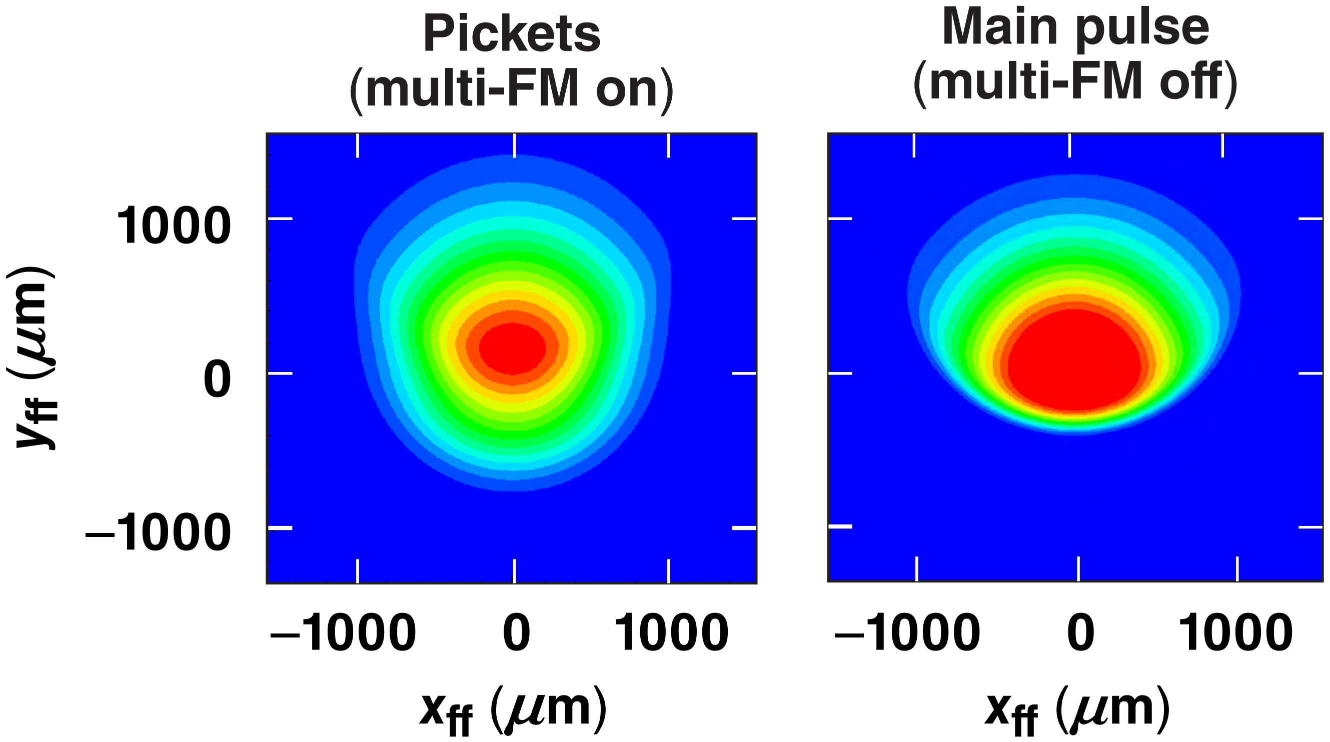
TC12470

*F. Weilacher *et al*., Phys. Plasmas 22, 032701 (2015).

Spot profile changes caused by dynamic bandwidth reduction are included in the design simulations

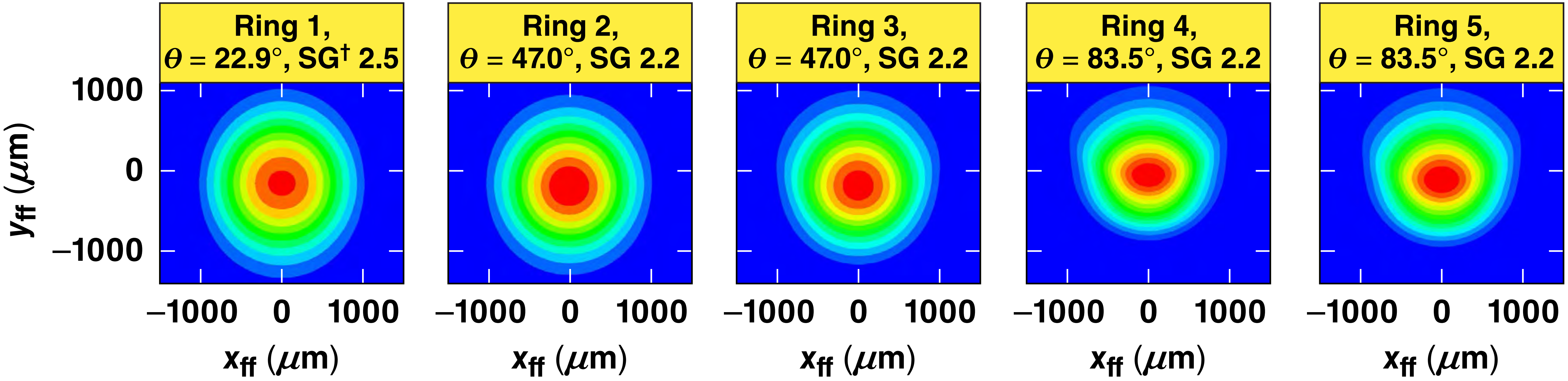
- Intermediate-energy NIF experiments will use dynamic bandwidth reduction (DBR) to increase drive energy
- 1-D multi-FM smoothing by spectral dispersion (SSD) is applied to only the pickets
  - – far-field spot shape side effects spread beam spots along the polar angle





TC12607

The iDPP design is based on an ignition PDD configuration, which accounts for nonlocal electron transport (iSNB)*



- All spots have an ellipticity of one before spot-masking and multi-FM are applied
- The spot-masking radius is 95% of the 1300-μm target radius
- There is a secondary ellipse on Rings 4 and 5

*T. J. B. Collins *et al.*, Phys. Plasmas 19, 056308 (2012).
†SG: super-Gaussian

E12471

The improved design was obtained using an established design procedure*

- Start with a *LILAC* simulation that is tuned for a given objective

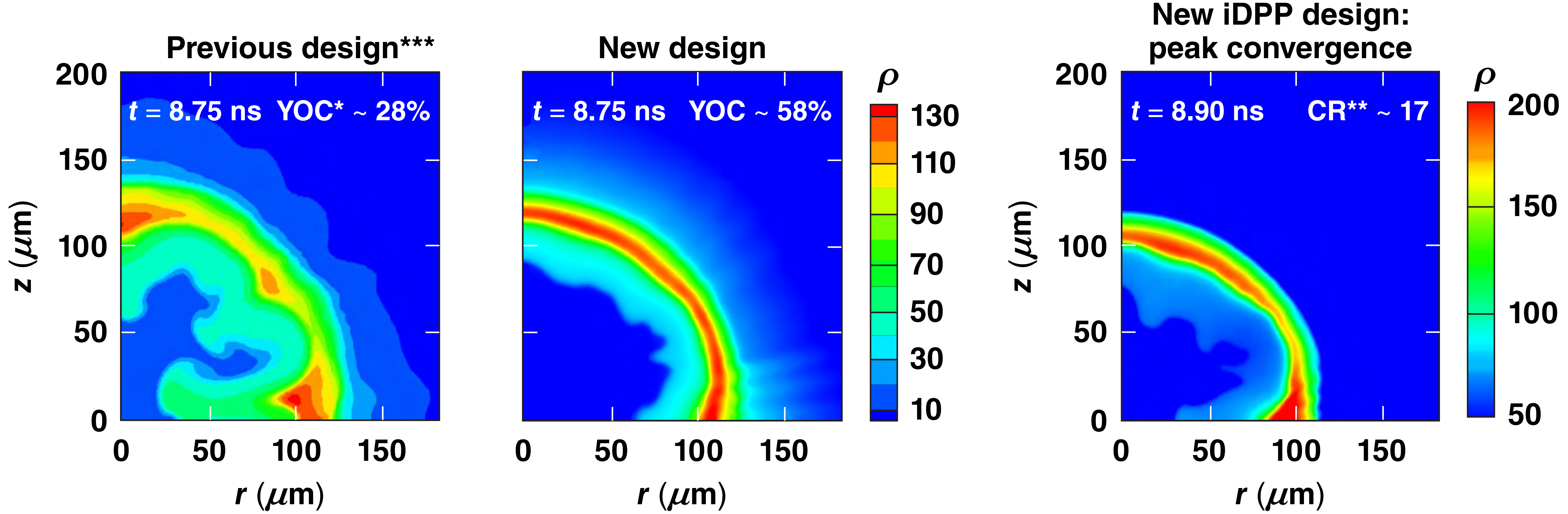
- Tune ring pointing angles, spot shapes, and ring energies in *DRACO* to reduce shell asymmetry with the goal of matching the *LILAC* shell trajectory and shock timing

- Design iteration guidelines determined during this project
  - once the spot shapes and pointing angles are determined, the picket ring energies determine the shock shape
  - the shell morphology is primarily determined by the drive-pulse energies and beam-pointing angles; *this is where most optimization iteration occurs*

*J. A. Marozas *et al*., Phys. Plasmas 13, 056311 (2006).

The improved design experiences less nonuniformity, leading to a higher neutron yield

- The spot shapes and pointing angles used for the igniting nonlocal design worked for the iDPP design as well



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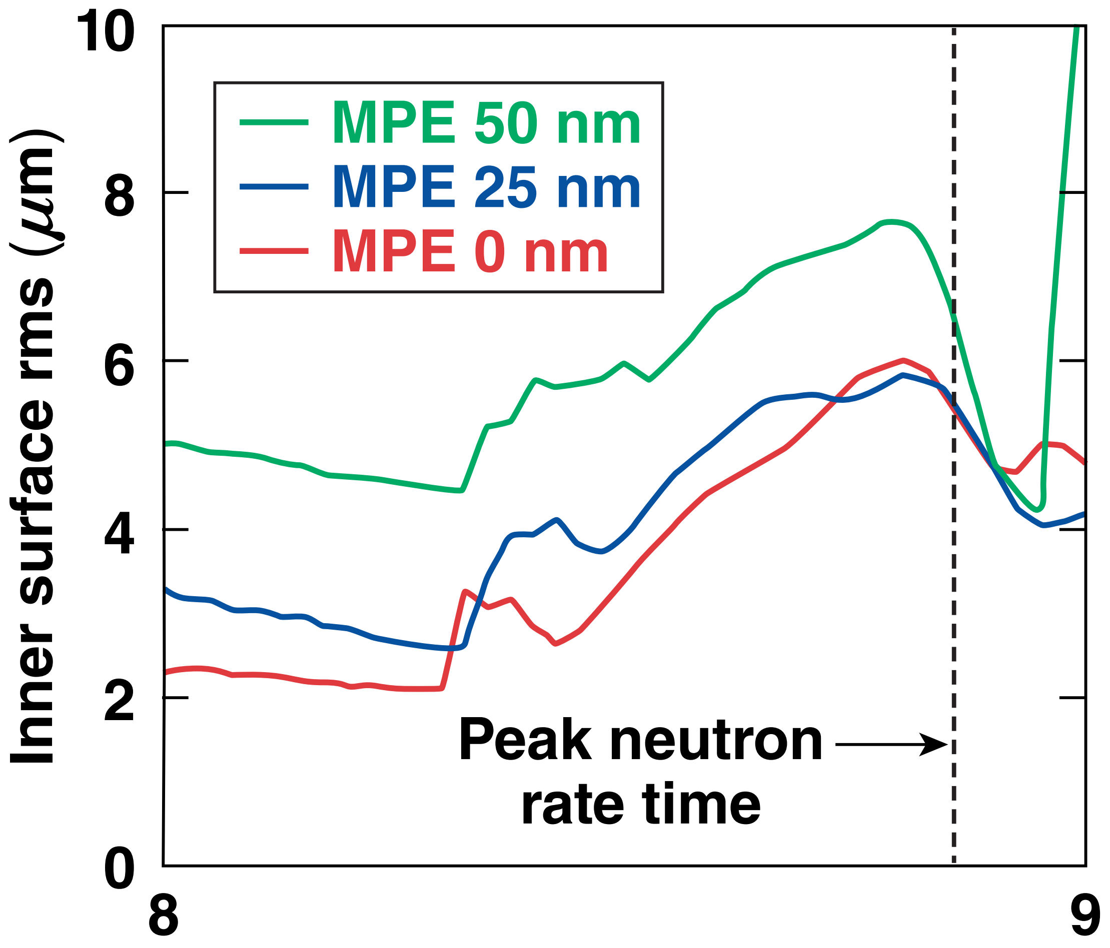
*YOC: Yield-over-clean

**CR: convergence ratio

***F. Weilacher *et al*., Phys. Plasmas 22, 032701 (2015).

TC12473a

For reduced cost per phase plate, manufacturing phase error (MPE) can be relaxed to 25 nm when accounting for worst-case wave front error (WFE)



Reducing iDPP MPE to below 25 nm gives a diminishing return for minimizing the inner surface rms.

TC12632

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