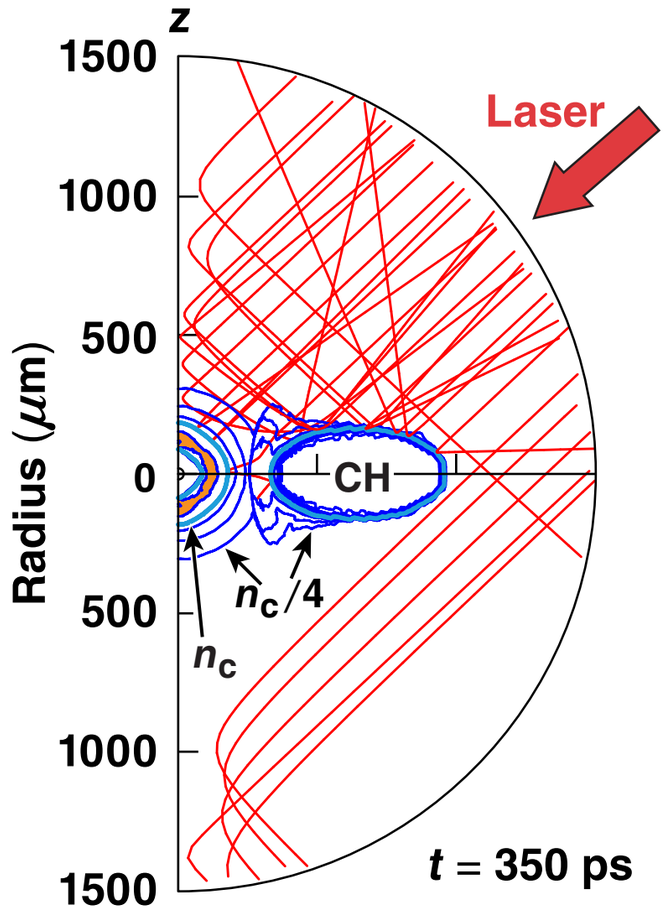
Beam-Pointing Designs for Exploding-Pusher Proton and X-Ray Backlighting Targets at the National Ignition Facility



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57th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Savannah, GA
16–20 November 2015

Summary

Designs have been developed for a variety of implosion targets to provide "point" sources of x rays or protons for backlighting experiments

- The larger capsules used for x-ray backlighters have uniformity issues related to the non-optimum θ angles of the available quads
- The smaller capsules used for proton backlighters have issues related to blowby laser light if phase plates are used
- Adding a Saturn ring offers solutions to both problems
  - better uniformity for the x-ray backlighters
  - elimination of blowby concerns for proton backlighters

Collaborators

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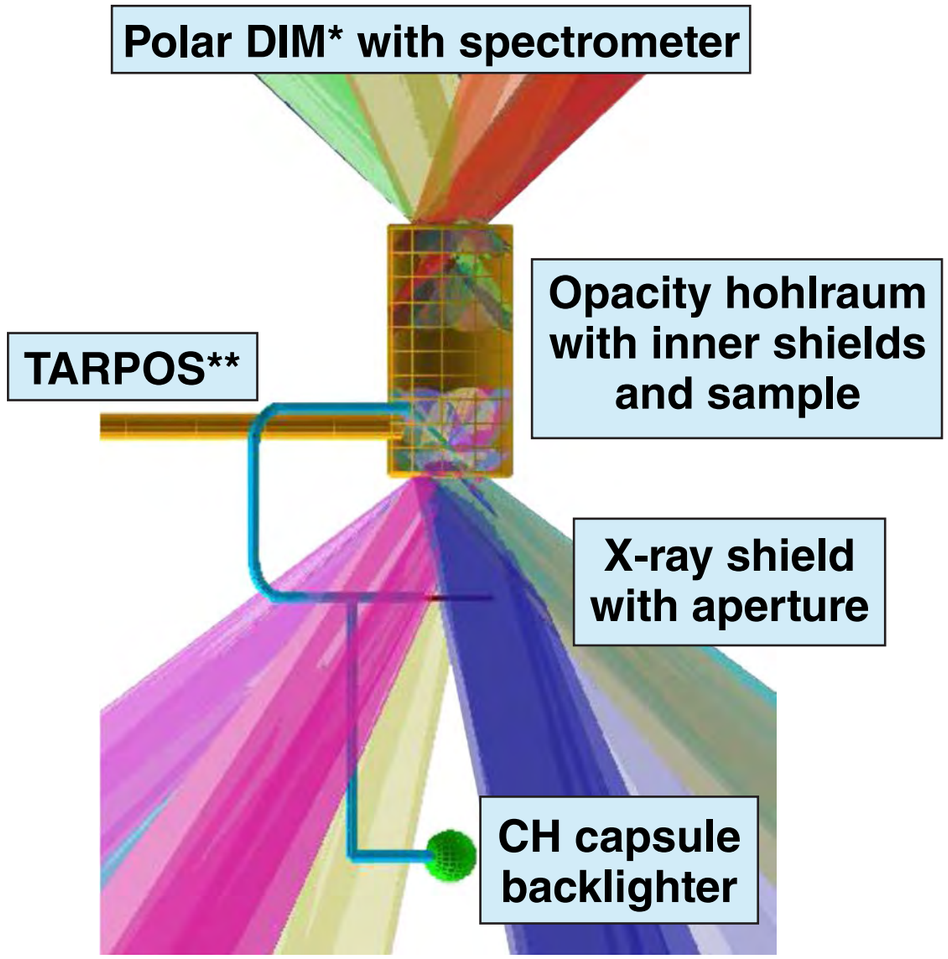
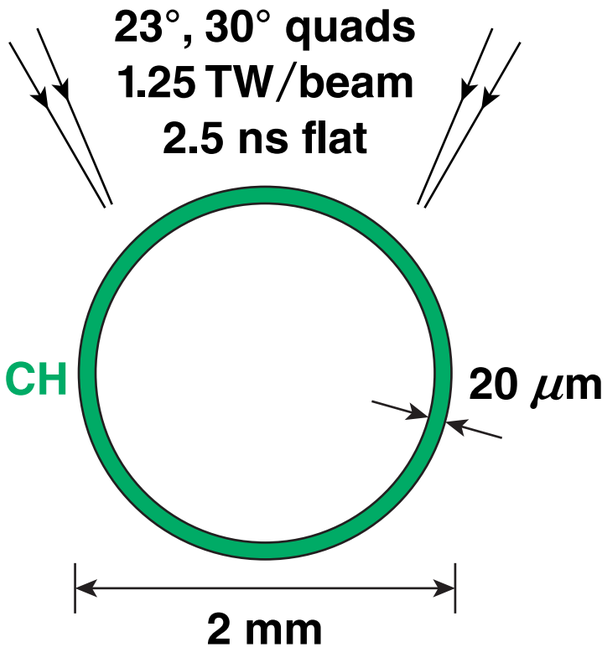
Different x-ray and proton backlighting platforms share common challenges

- Obtain adequate uniformity using a limited number of quads
- Avoid excessive laser blowby

The OpacCap platform, being developed to measure plasma opacities, requires the use of the 23° and 30° quads for the capsule backlighter

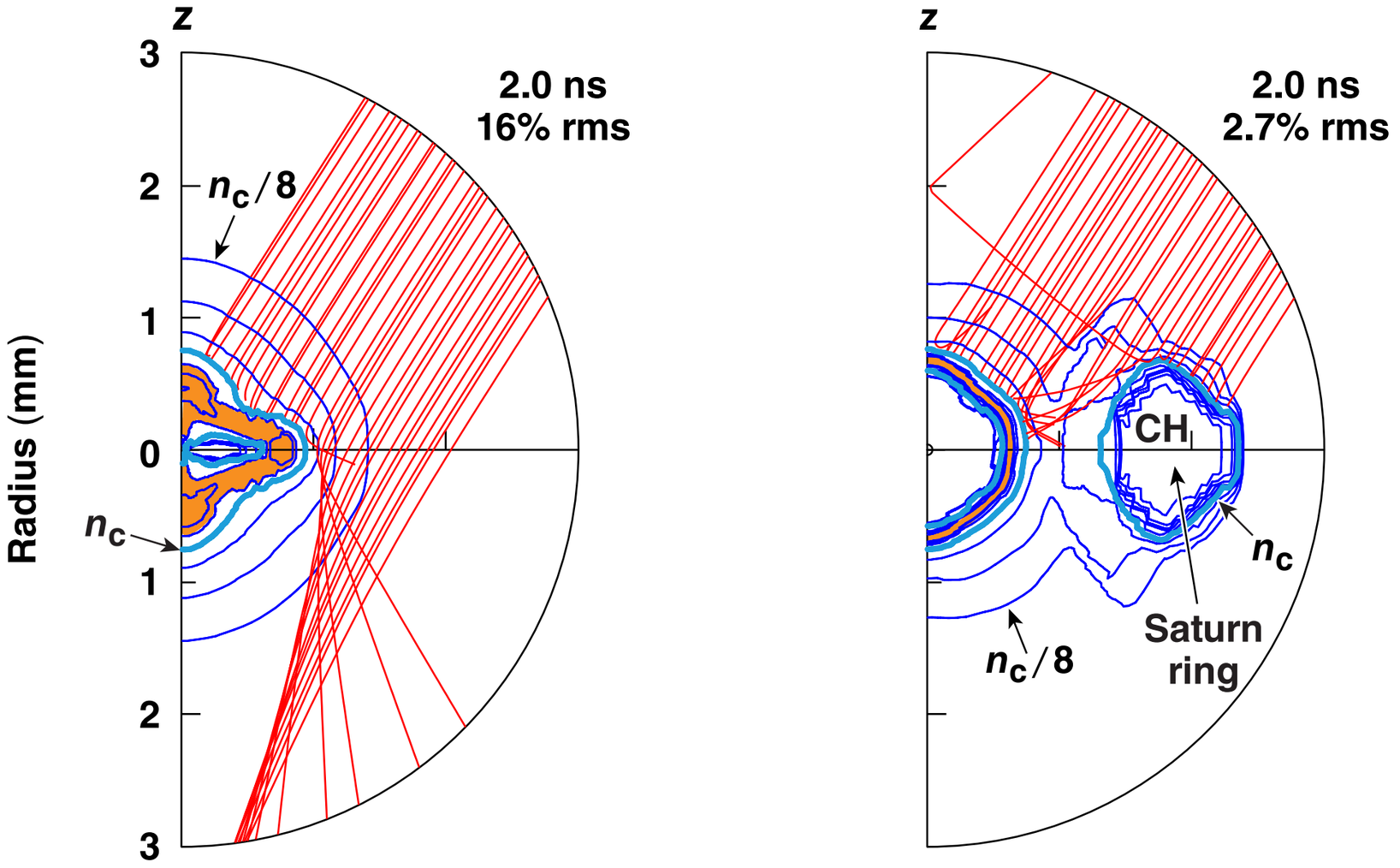




*DIM = diagnostic instrument manipulator
**TARPOS = target positioner

TC12397

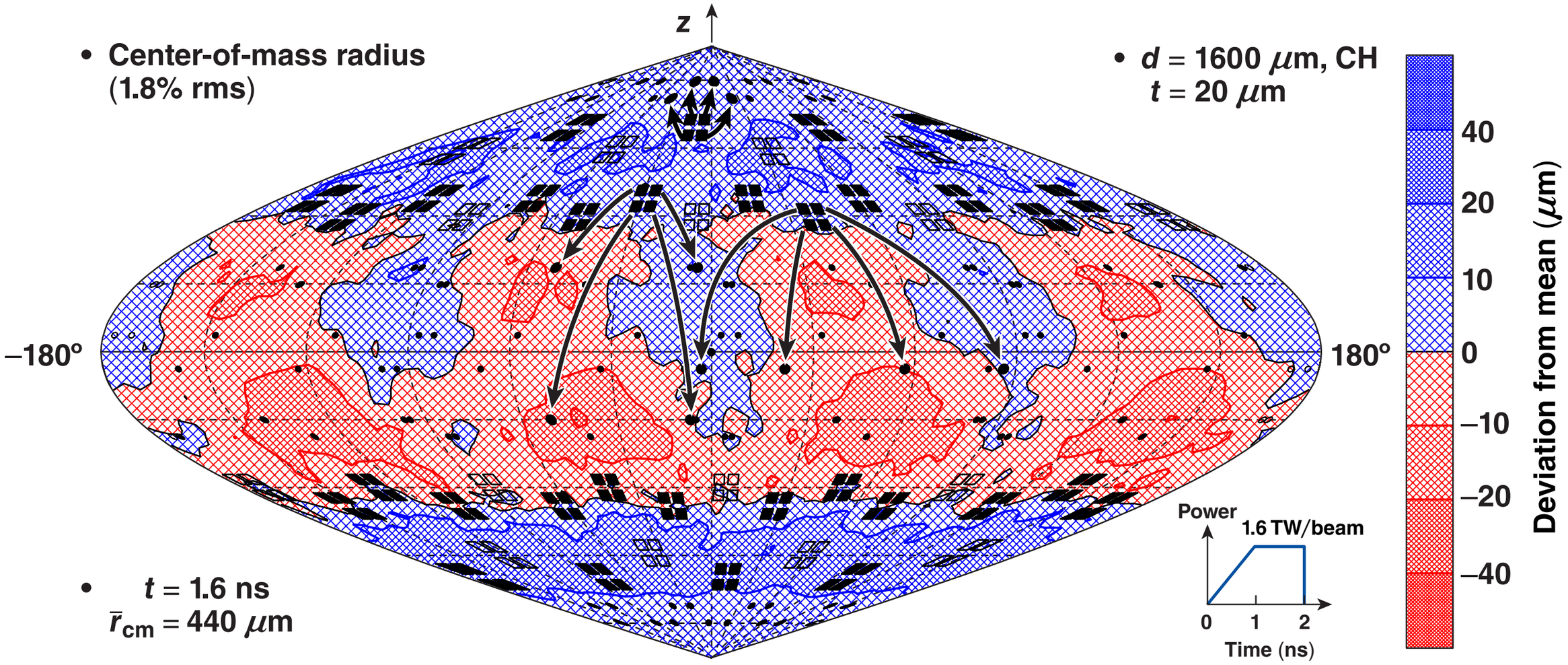
The experiment produced an implosion strongly underdriven at the equator, which could be corrected by the addition of a Saturn ring



Runs K1105, K1098
TC12398

A highly uniform design that uses 32 quads has been developed for EXAFS*

- Center-of-mass radius (1.8% rms)
- d = 1600 μm, CH t = 20 μm

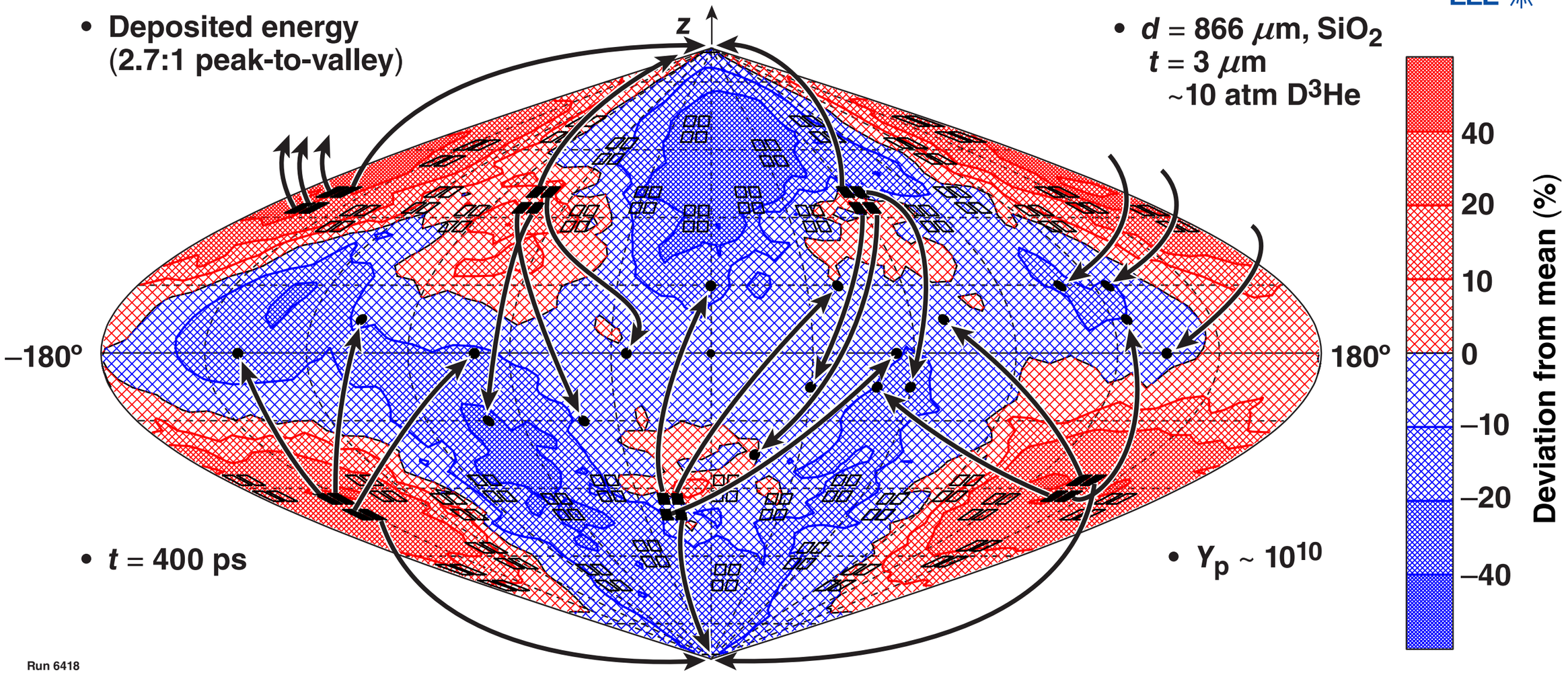


- t = 1.6 ns $\bar{r}_{cm}$ = 440 μm

Run 1970
TC12399

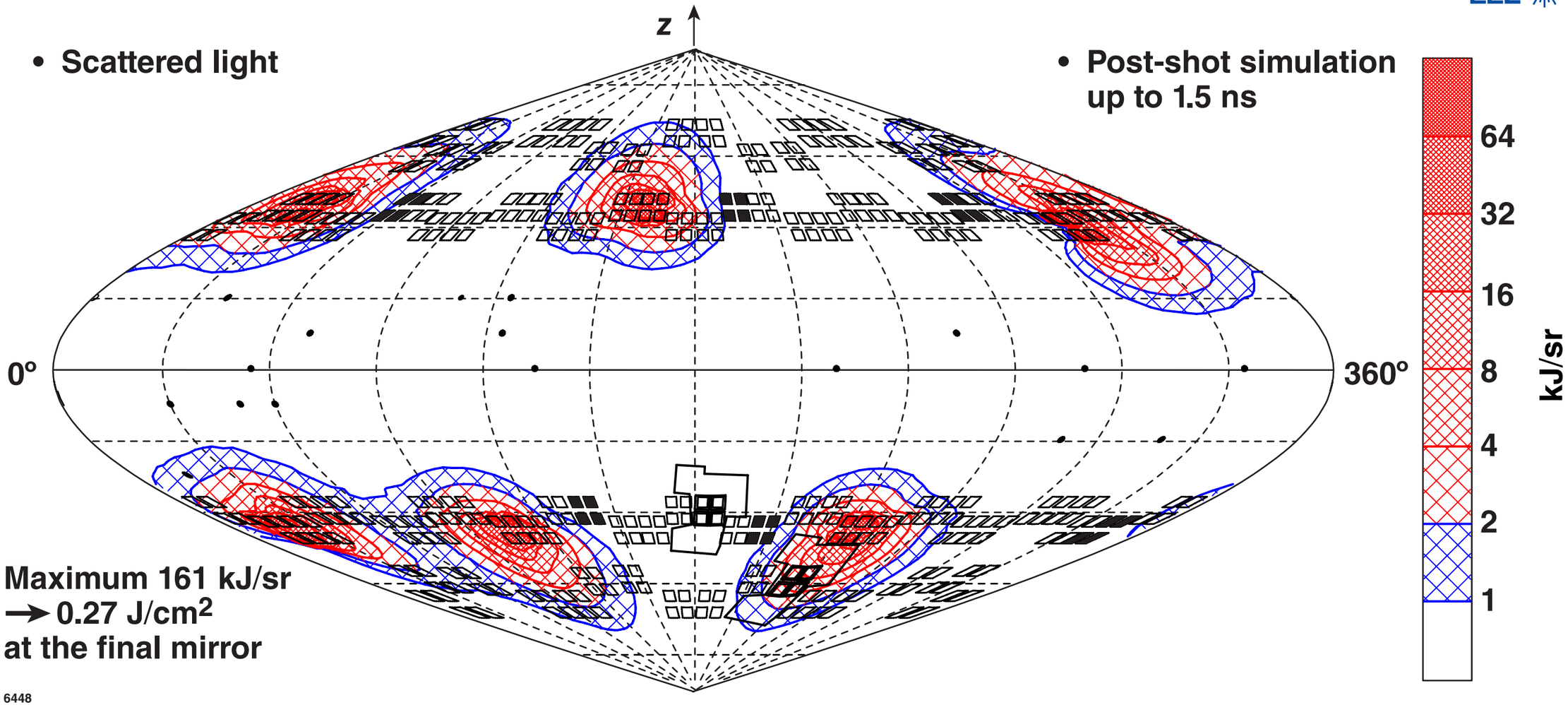
*Extended x-ray absorption fine structure

The first proton backlighter target (N150326) was driven by six quads, giving a highly nonuniform implosion



Run 6418
TC12400

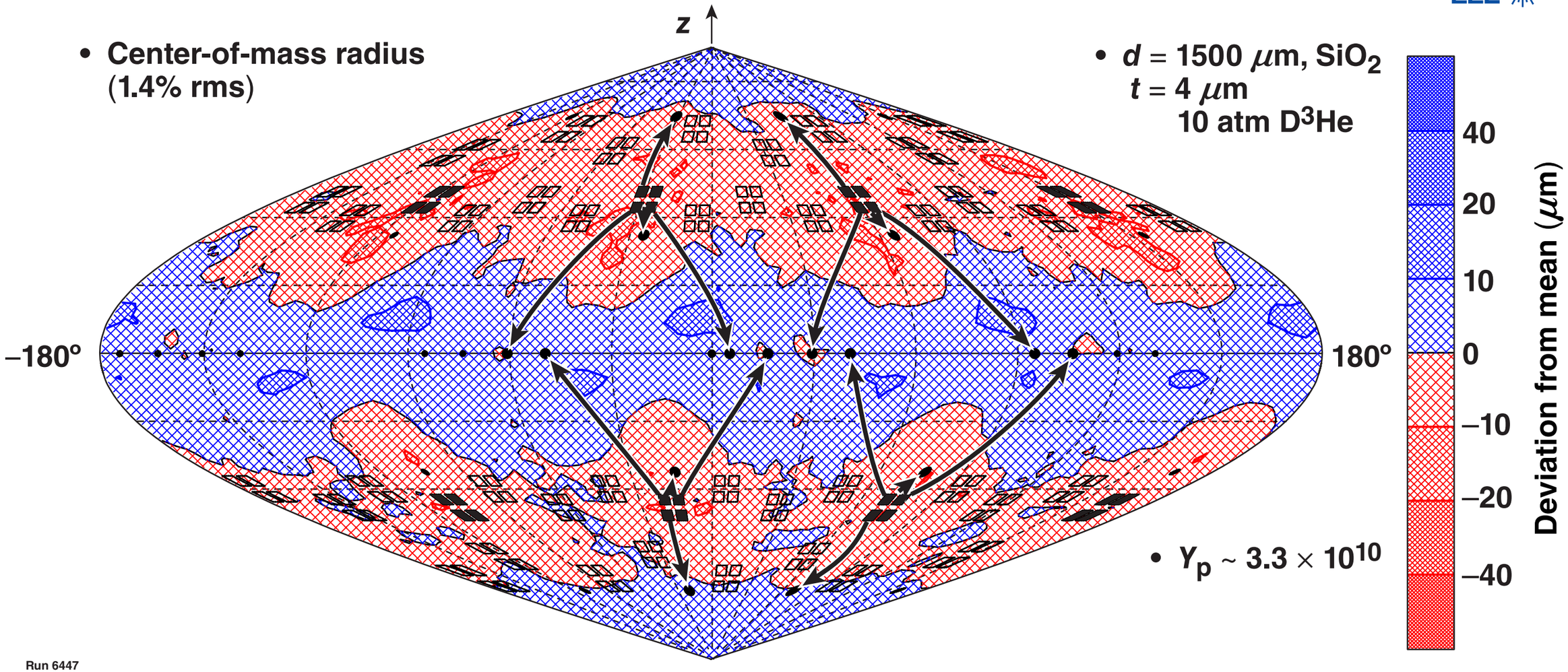
The predicted laser blowby was very large (~0.27 J/cm^2), requiring near-opposing ports to be blocked to avoid damage to the laser



- Scattered light
- Post-shot simulation up to 1.5 ns
- Maximum 161 kJ/sr → 0.27 J/cm^2 at the final mirror

Run 6448
TC12401

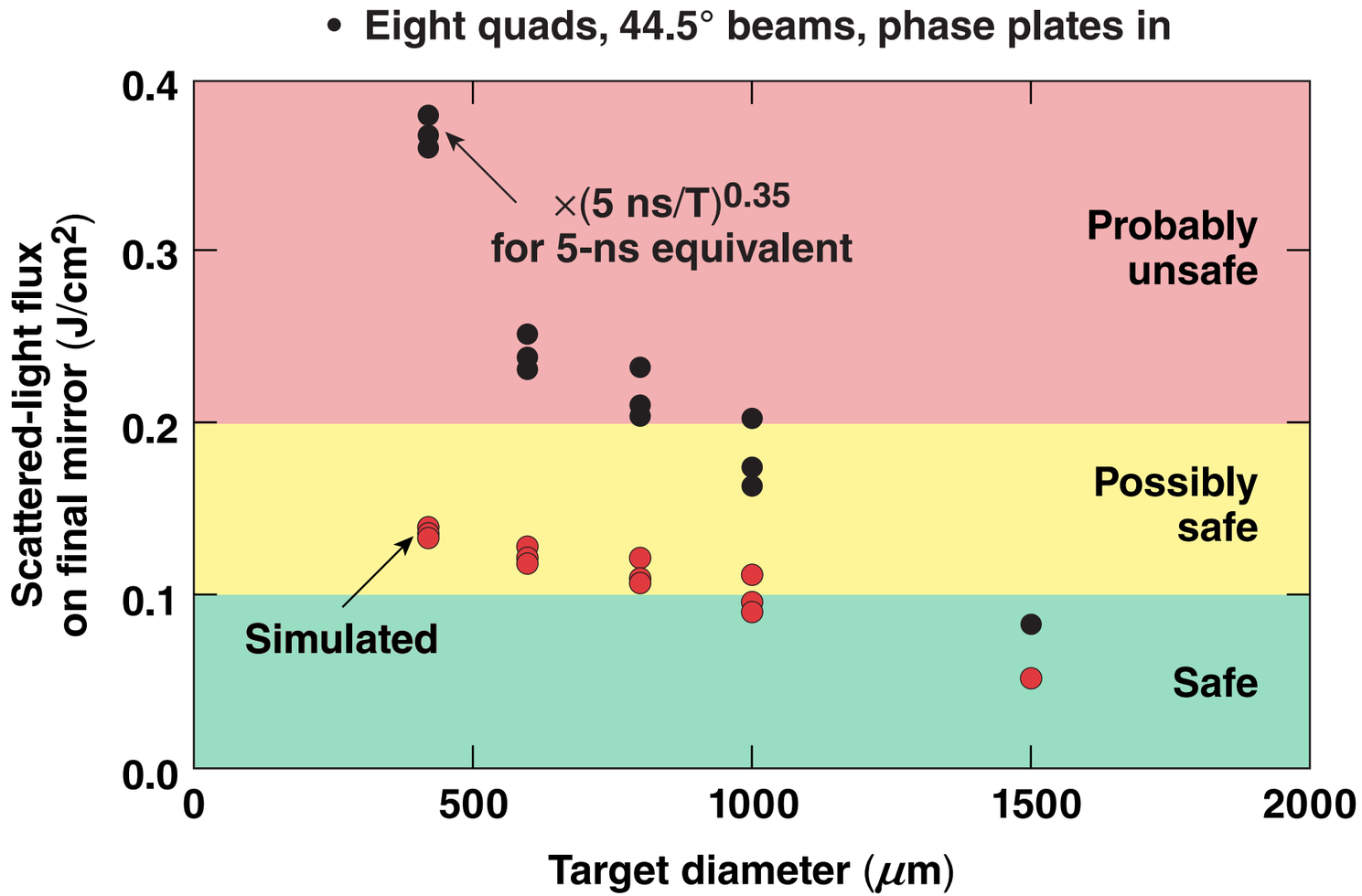
Greatly improved uniformity is obtained using four quads in each hemisphere



- Center-of-mass radius (1.4% rms)
- d = 1500 μm, SiO_2
  t = 4 μm
  10 atm D^3He
- $Y_p \sim 3.3 \times 10^{10}$

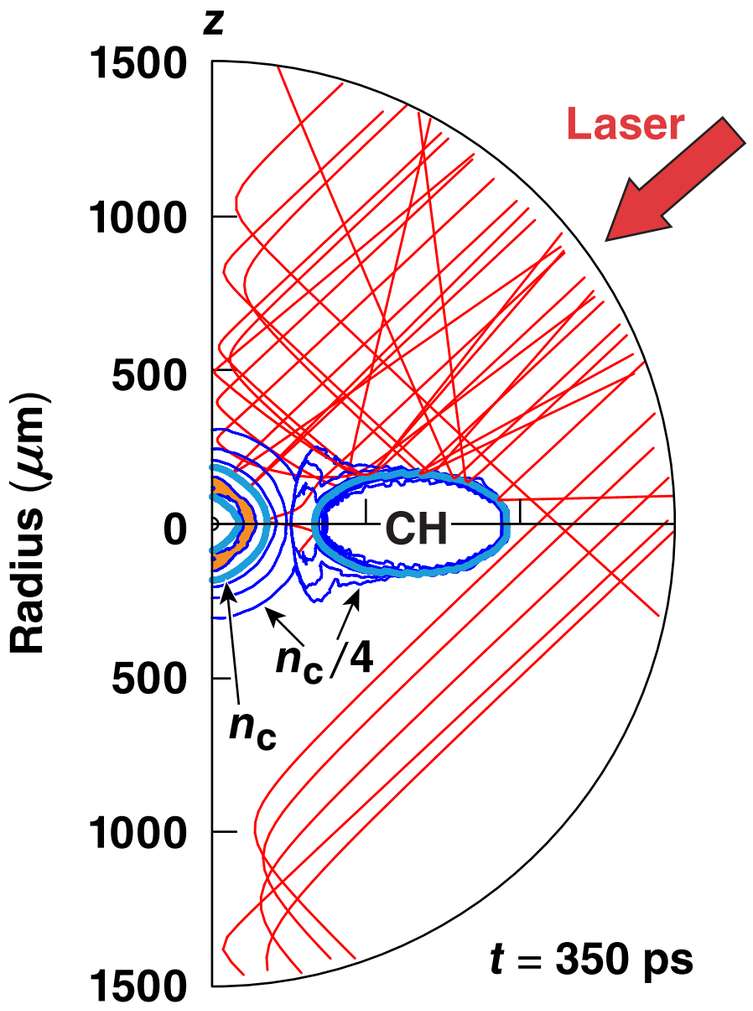
Run 6447
TC12402

With phase plates in, the damage risk increases for smaller targets



TC12403

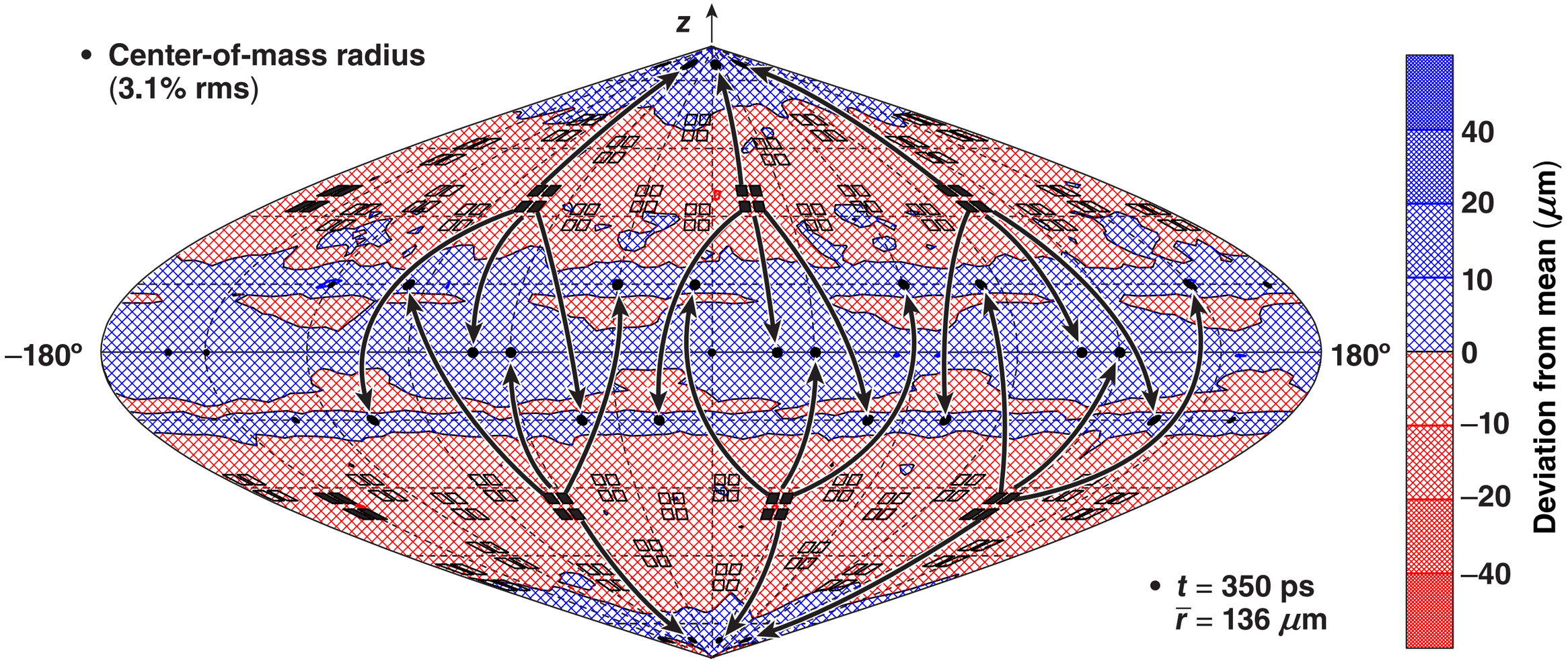
Small proton backlighter targets can be safely shot using a Saturn ring



- d = 420 μm, SiO_2
  t = 2 μm
- Same laser pulse as N150326 (to 1.1 ns)
- Eight quads at 44.5°

Run G2185
TC12404

The capsule implodes with good uniformity in 3-D

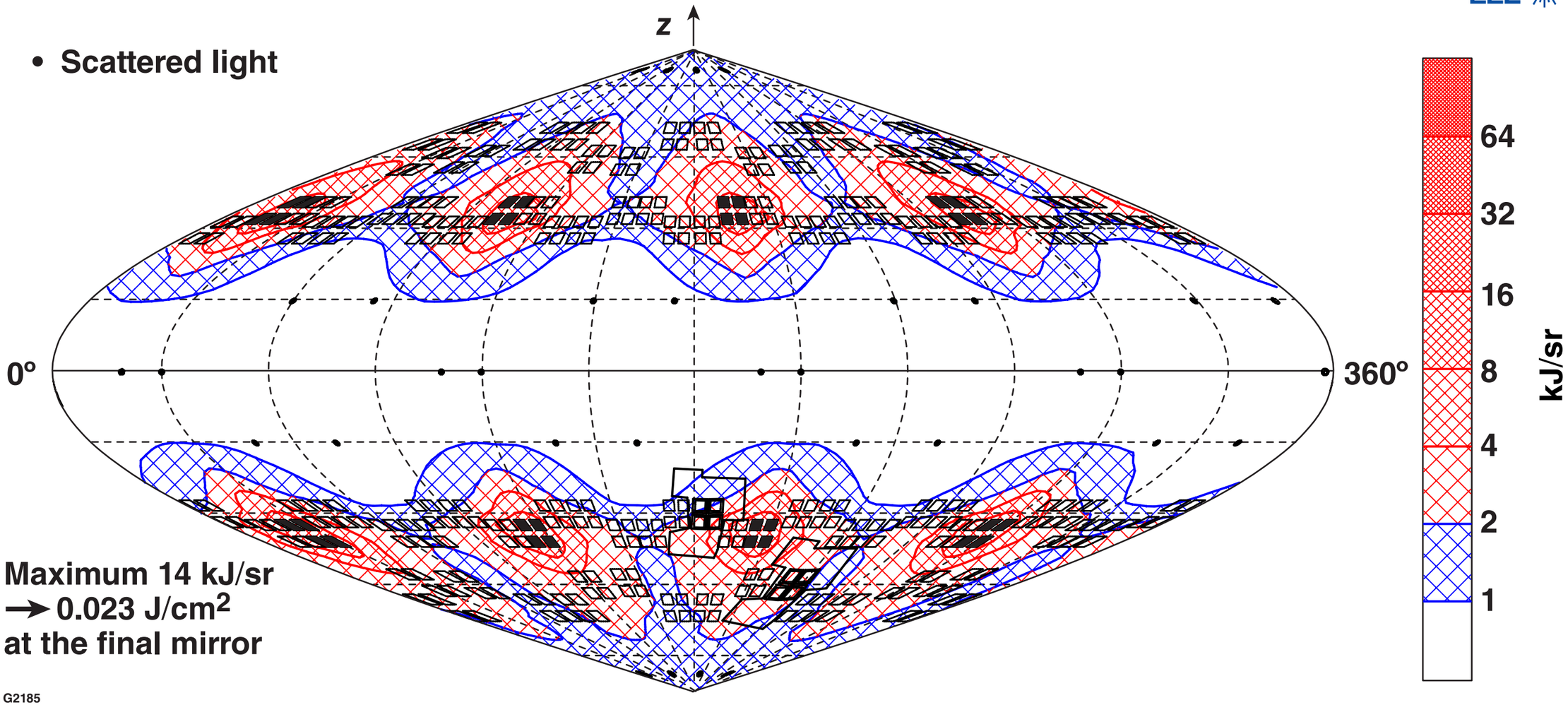


- Center-of-mass radius (3.1% rms)
- t = 350 ps
  $\bar{r}$ = 136 μm

Run G2185
TC12405

The scattered-light flux is very small and is dominated by reflections from the ring

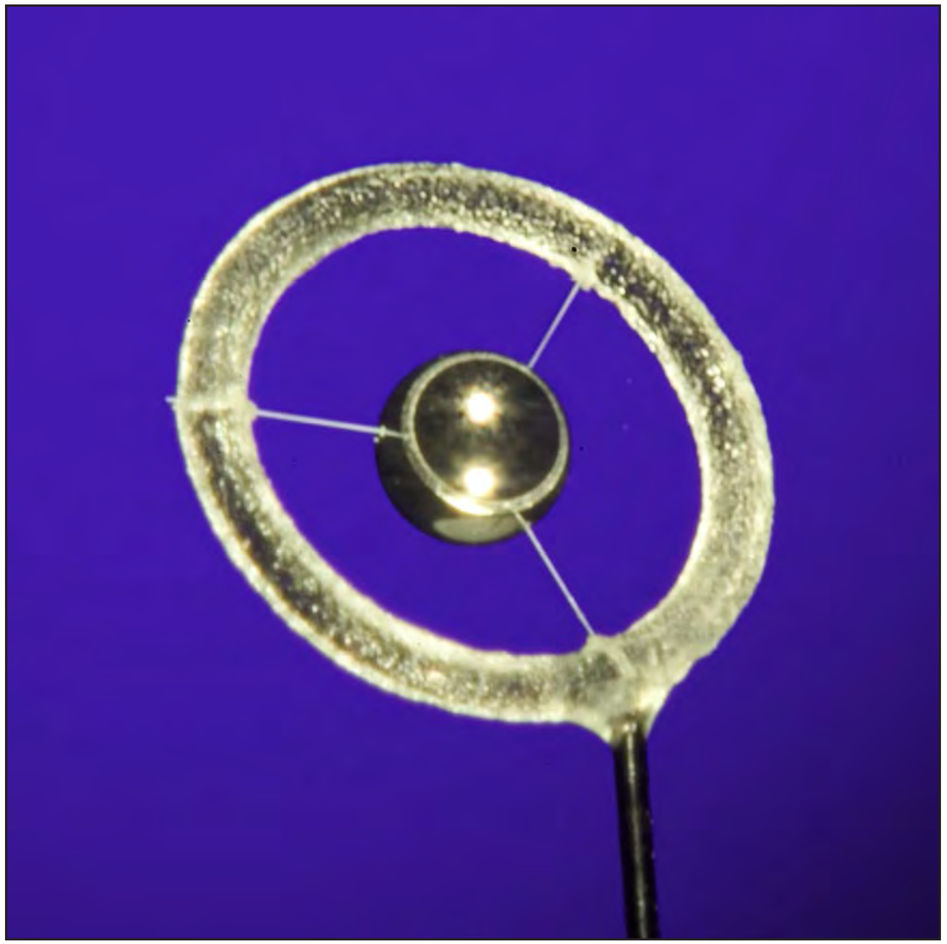
- Scattered light



- Maximum 14 kJ/sr → 0.023 J/cm^2 at the final mirror

Run G2185
TC12406

Saturn targets have been shot on OMEGA



R. S. Craxton *et al.*, Phys. Plasmas 12, 056304 (2005);
F. J. Marshall *et al.*, J. Phys. IV France 133, 153 (2006).

TC6970b

Summary/Conclusions

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