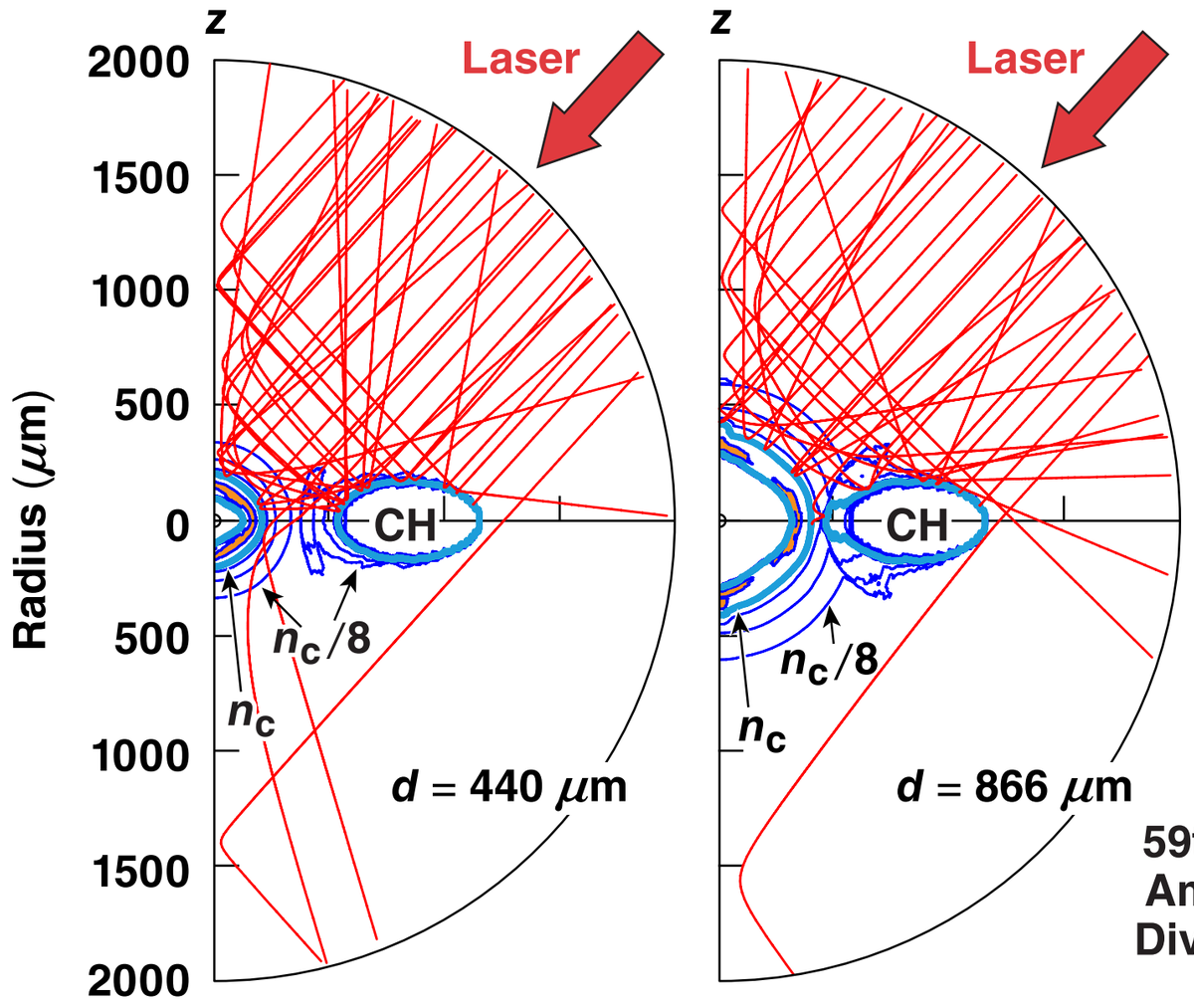
Saturn Designs for Small Proton-Backlighter Targets at the National Ignition Facility



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Summary

Saturn designs allow more energy to be safely deposited in small proton-backlighter capsules

- Small proton-backlighter capsules are desired for better spatial resolution
- Laser blowby limits the energy that can currently be delivered to small capsules ($d \lesssim 1$ mm)
- A single Saturn ring design allows capsules with diameters from 440 μm to 866 μm to be safely used

Collaborators

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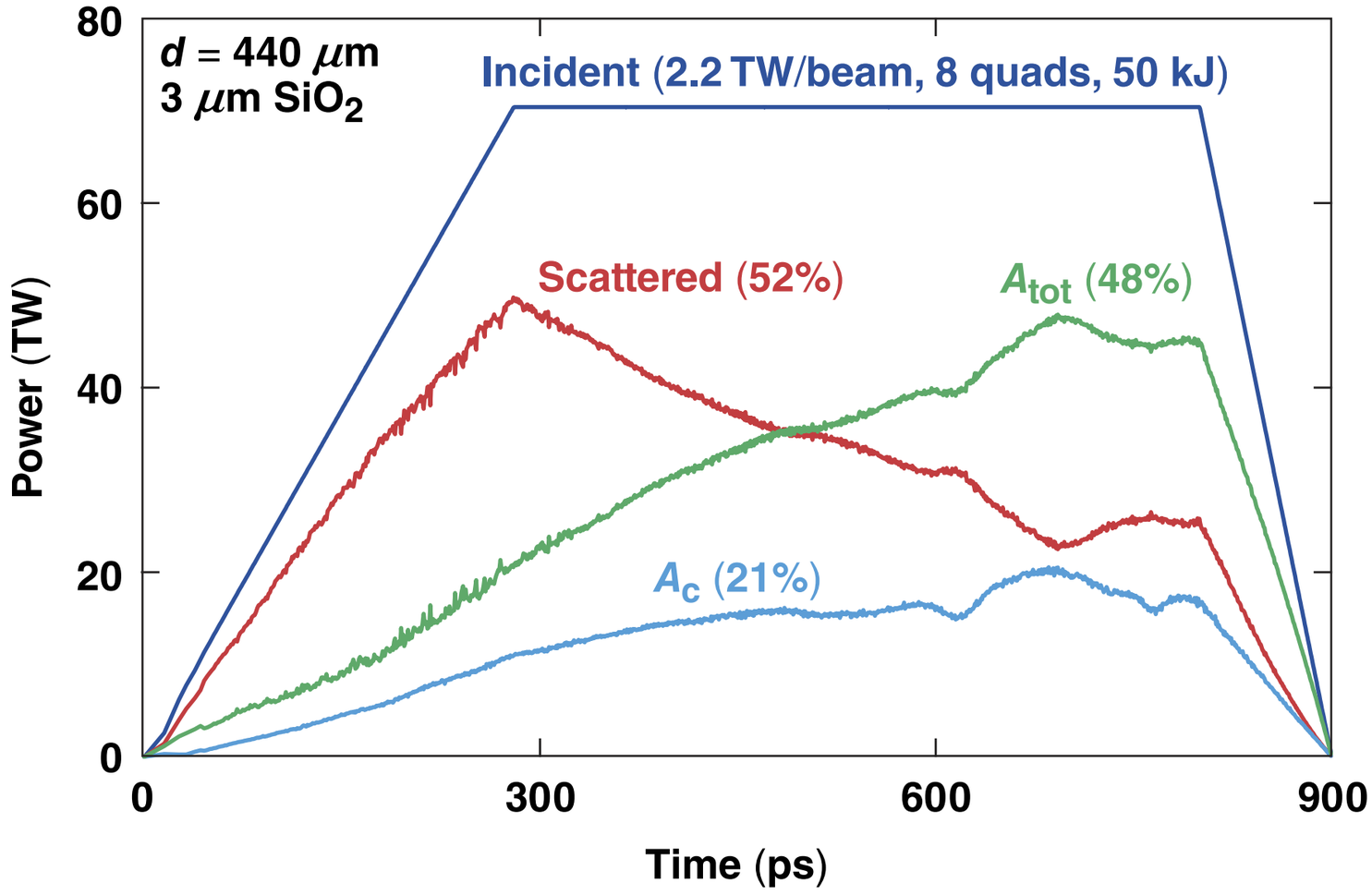
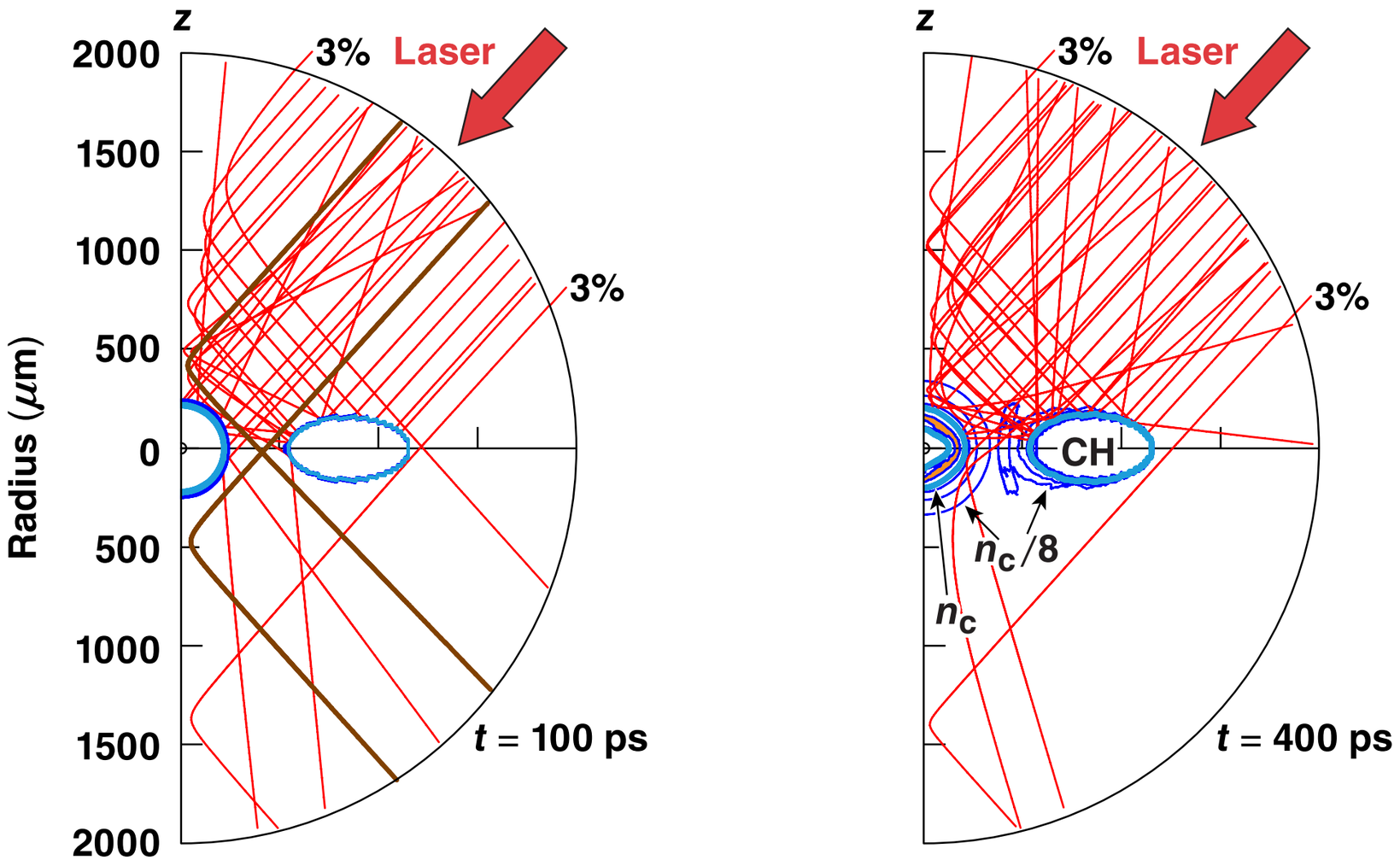
A realistic National Ignition Facility (NIF) laser pulse delivers 50 kJ, of which 21% is absorbed in the capsule



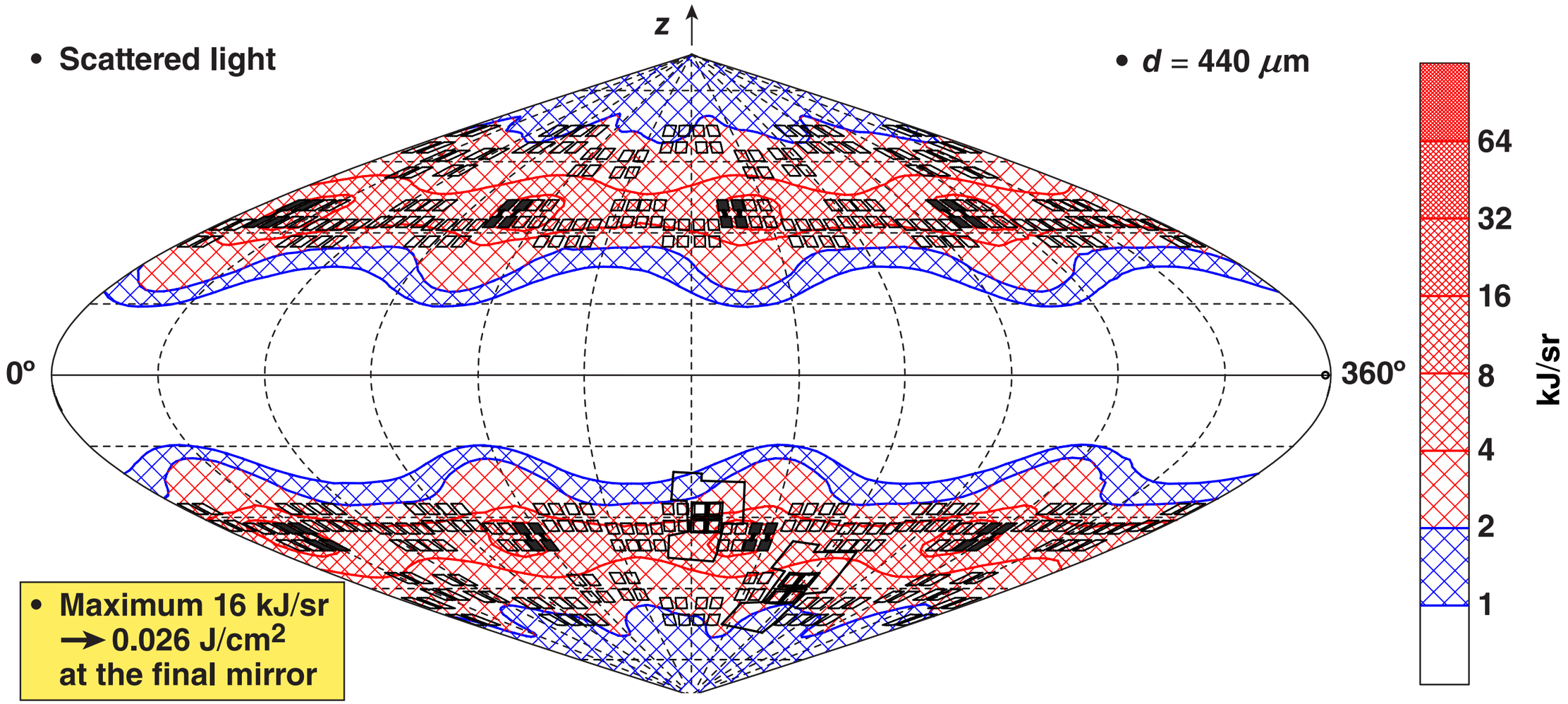
Run G2557
TC13649

A few rays pass between the capsule and ring at early times but they are blocked later



Run G2557
TC13650

The scattered-light flux is very small

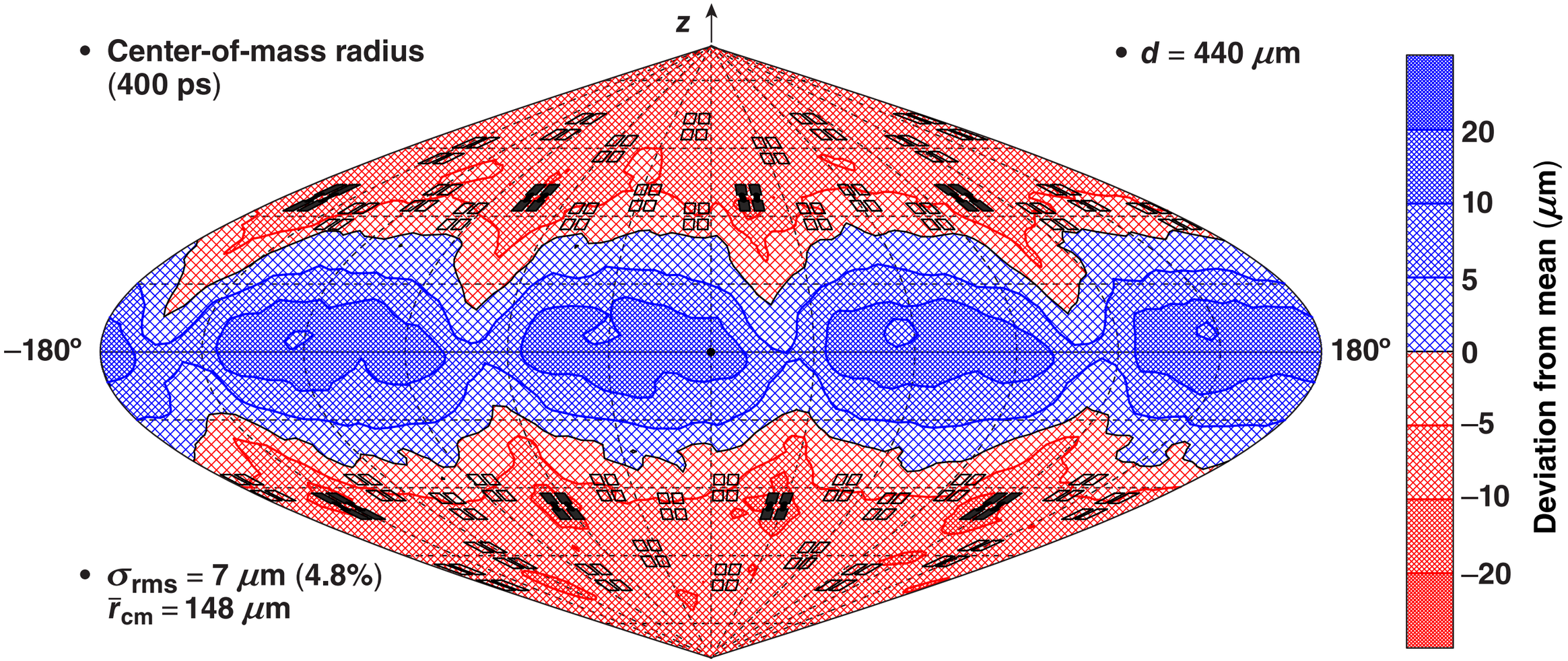


- Scattered light
- d = 440 μm
- Maximum 16 kJ/sr → 0.026 J/cm^2 at the final mirror

Run G2557
TC13651

The capsule implodes with reasonable uniformity in 3-D

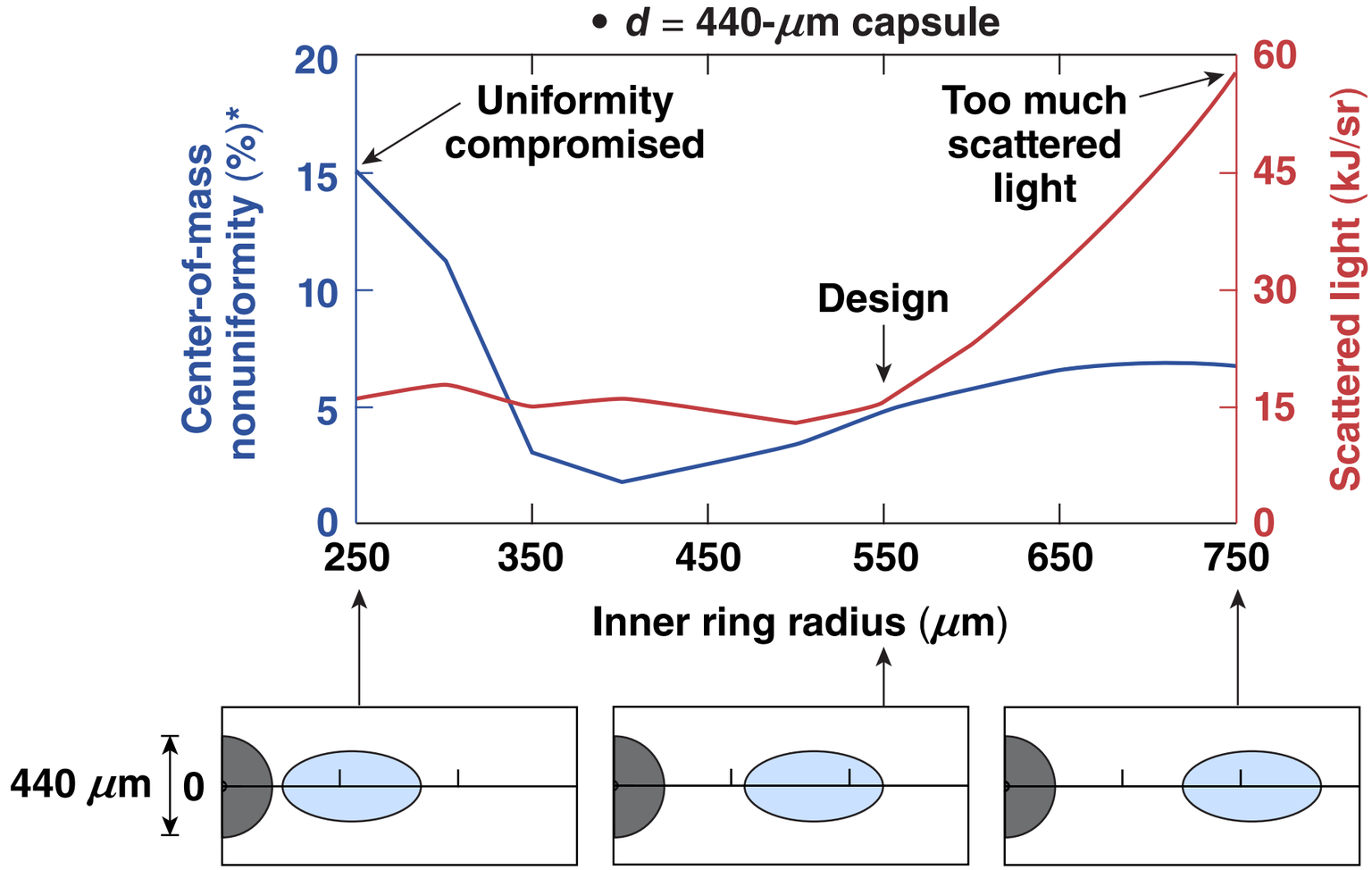
- Center-of-mass radius (400 ps)
- d = 440 μm



- σ_{rms} = 7 μm (4.8%)
  $\bar{r}_{cm}$ = 148 μm

Run G2557
TC13652

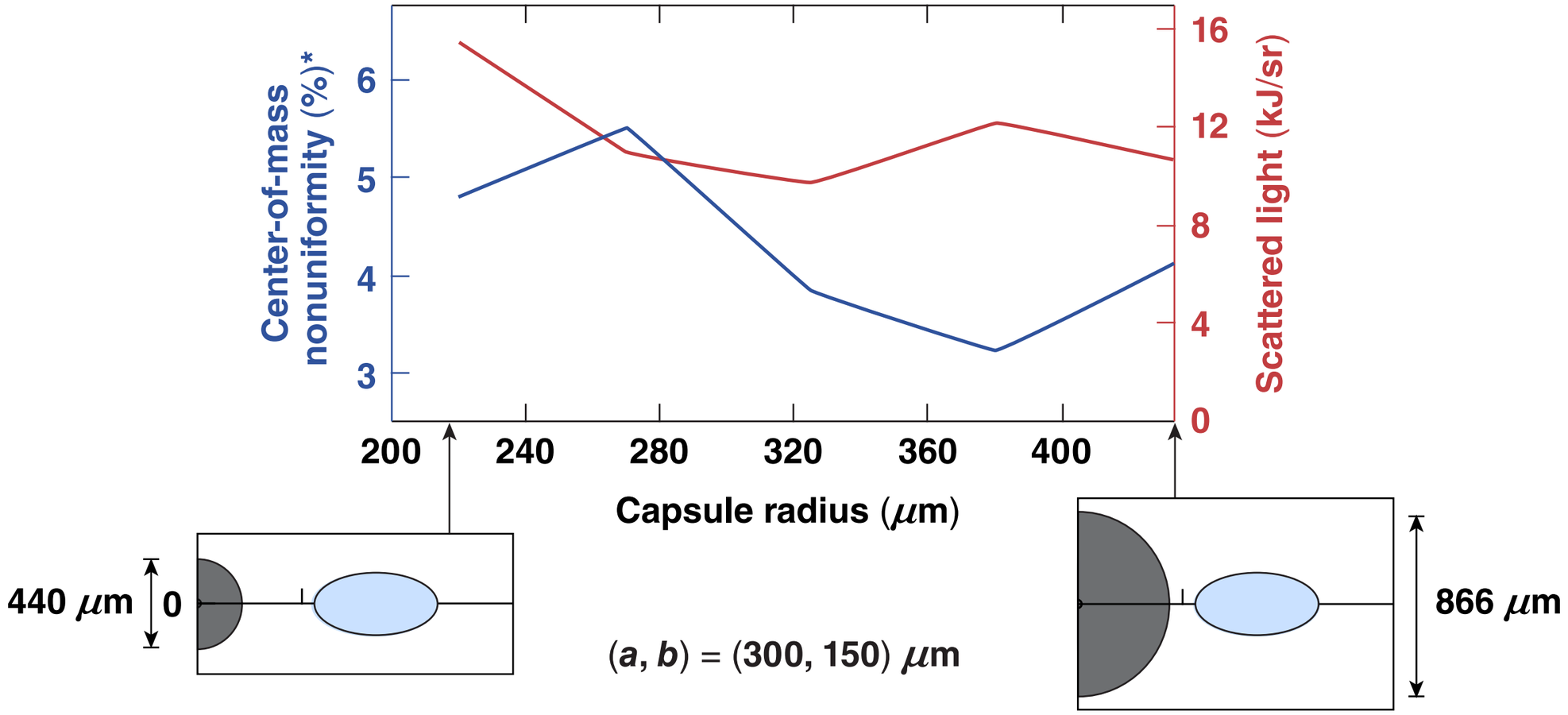
For a given capsule diameter (440 μm), there is a range of acceptable Saturn ring radii



Run G2570, G2557, G2579
TC13653

*At 400 ps

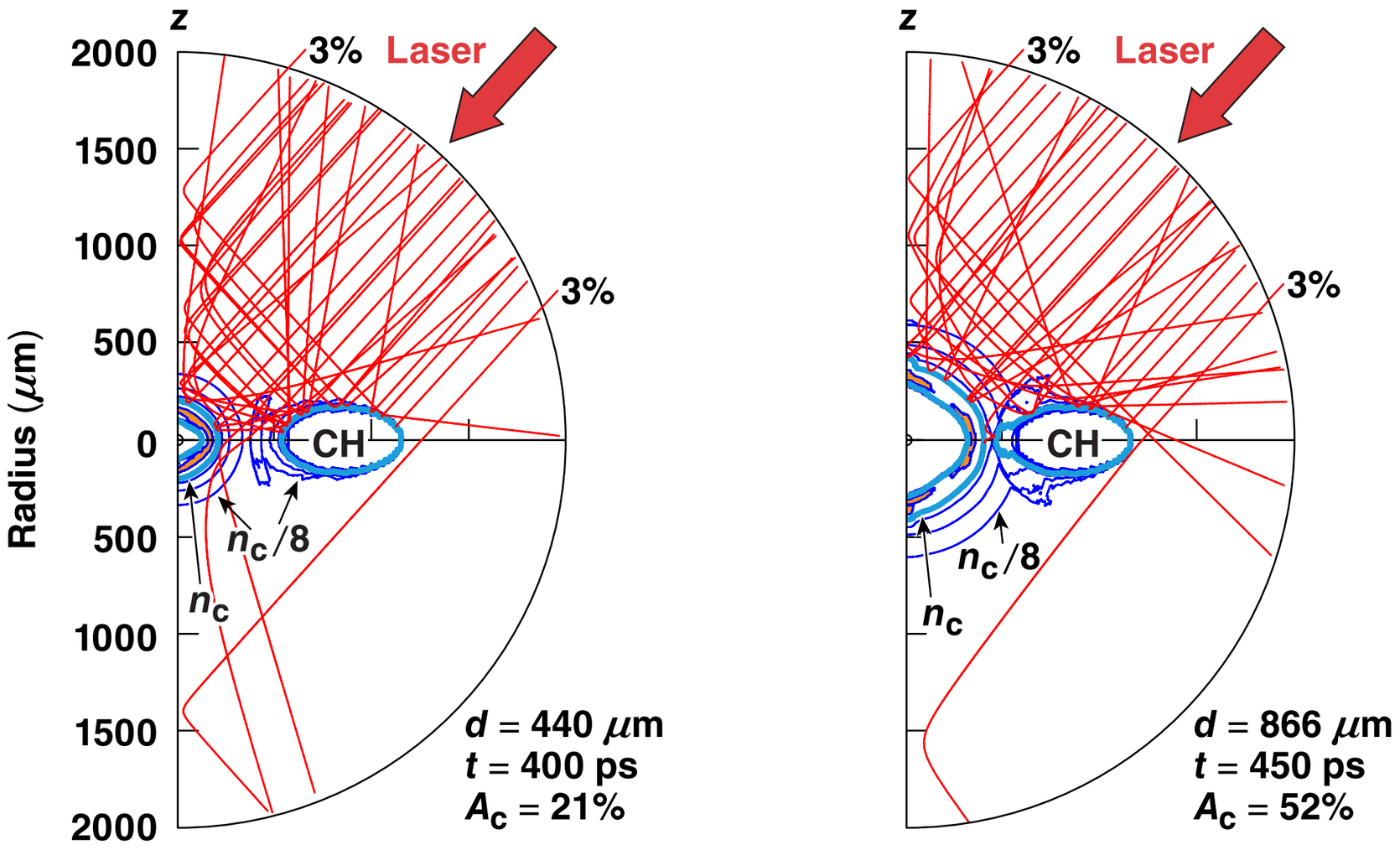
A Saturn ring with an inner radius of 550 μm is suitable for capsule diameters from 440 μm to 866 μm



Run G2557, 6684
TC13654

*At ~2/3 initial radius

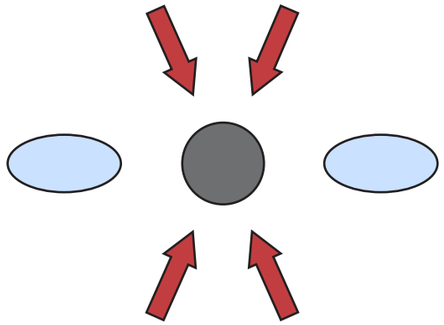
A single elliptical Saturn ring blocks laser blowby for capsule diameters from 440 to 866 μm



Runs G2557, 6685
TC13655

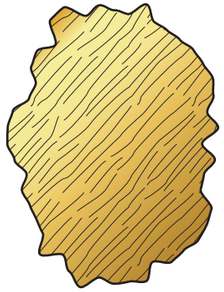
Proton probing can be carried out in the horizontal plane if a small portion of the Saturn ring is removed

Side view

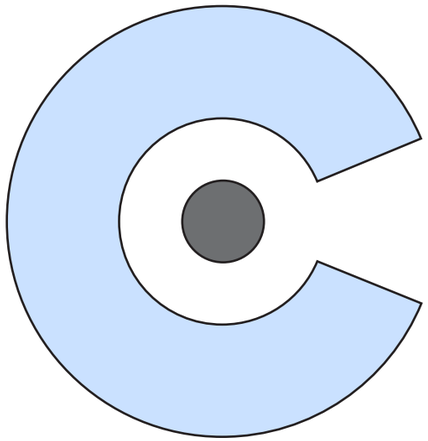


Protons

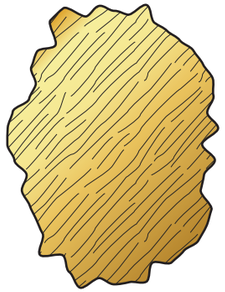
Primary target



Top view

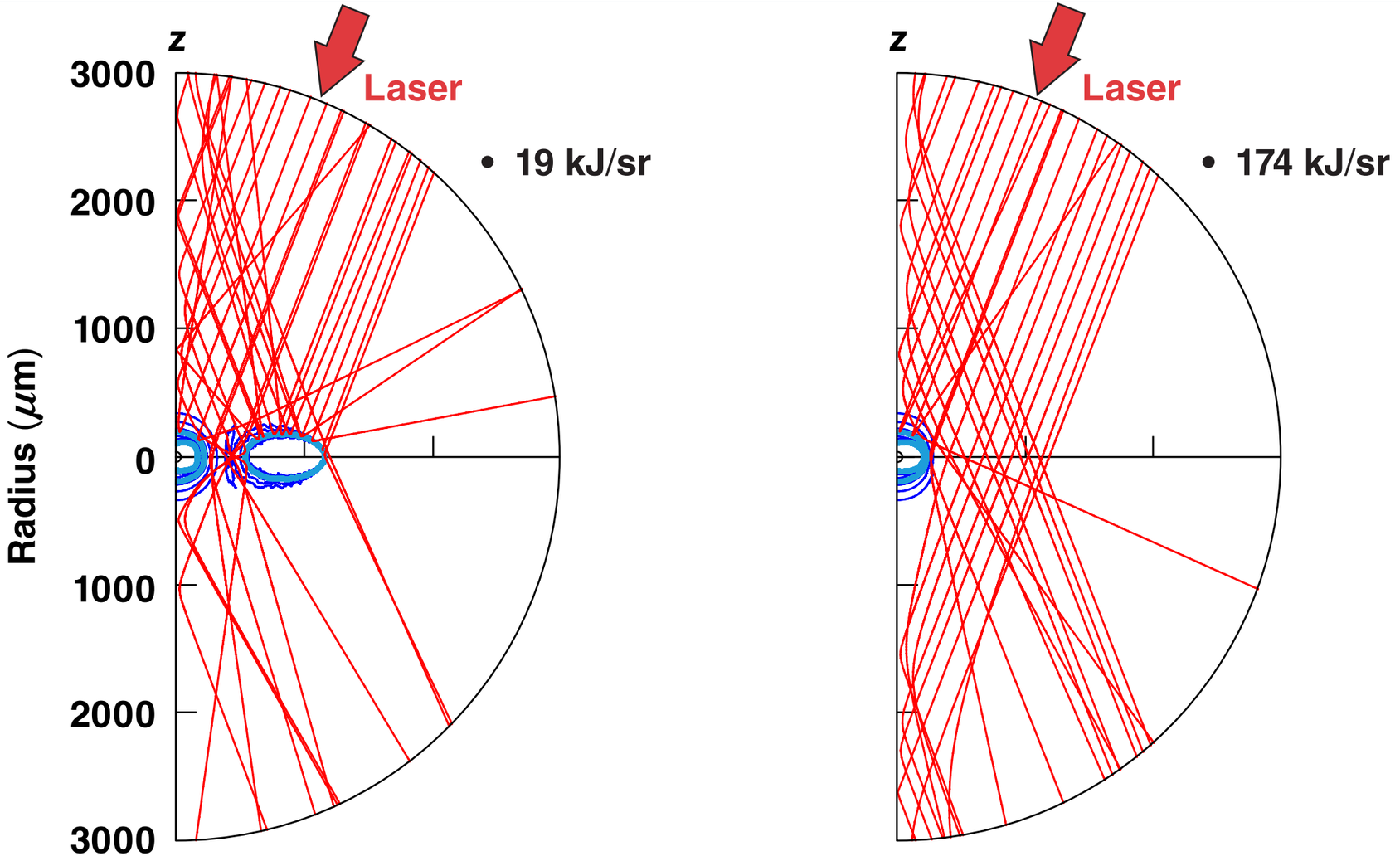


Protons



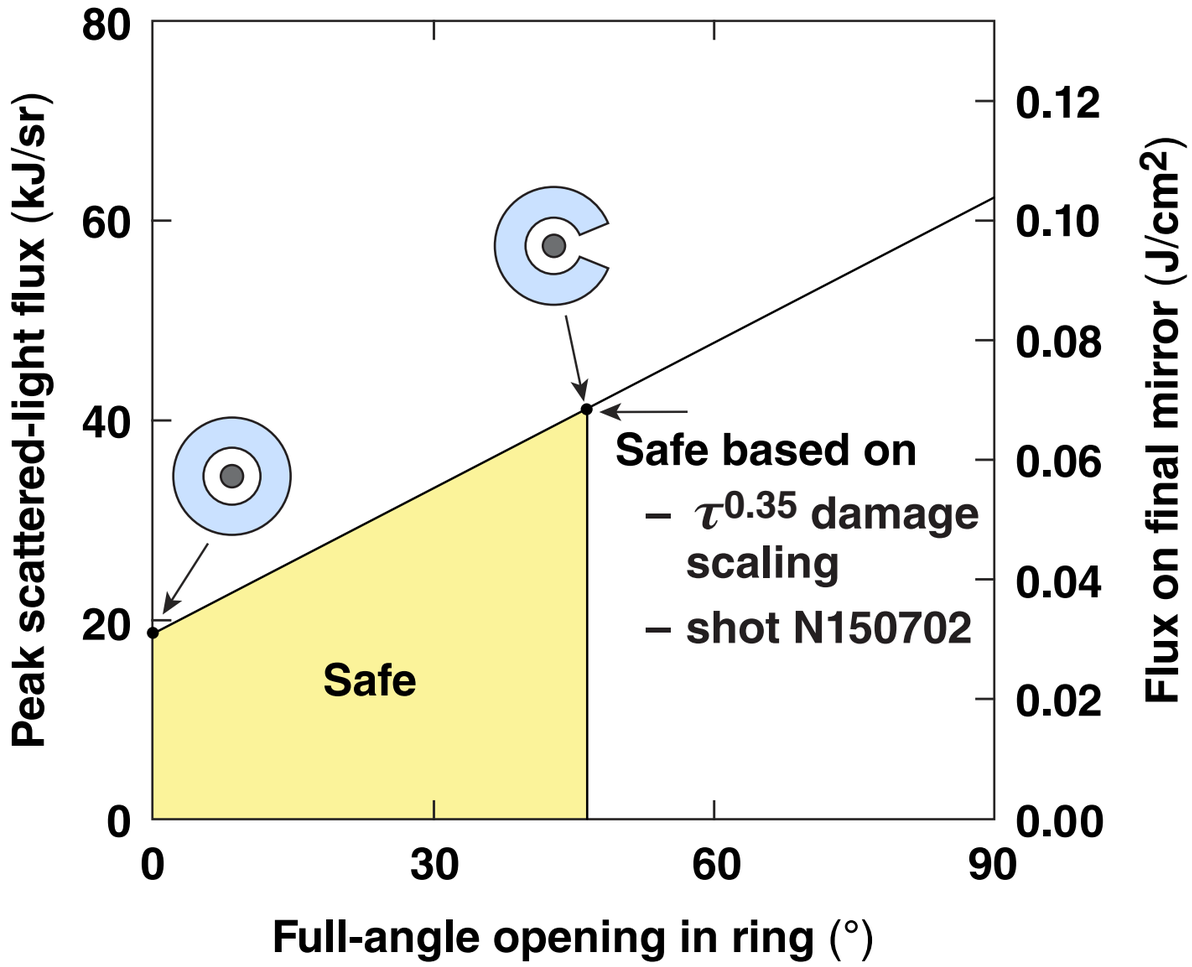
TC13656

For the worst case of 23.5° beams, the peak scattered light varies from 19 kJ/sr for the full ring to 174 kJ/sr for no ring



Run 6678, 6680
TC13657

Saturn rings with openings up to 46° are safe



τ = laser-pulse duration

Sub1
TC13658

Summary/Conclusions

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Probing in the horizontal plane is also possible.

TC13648a