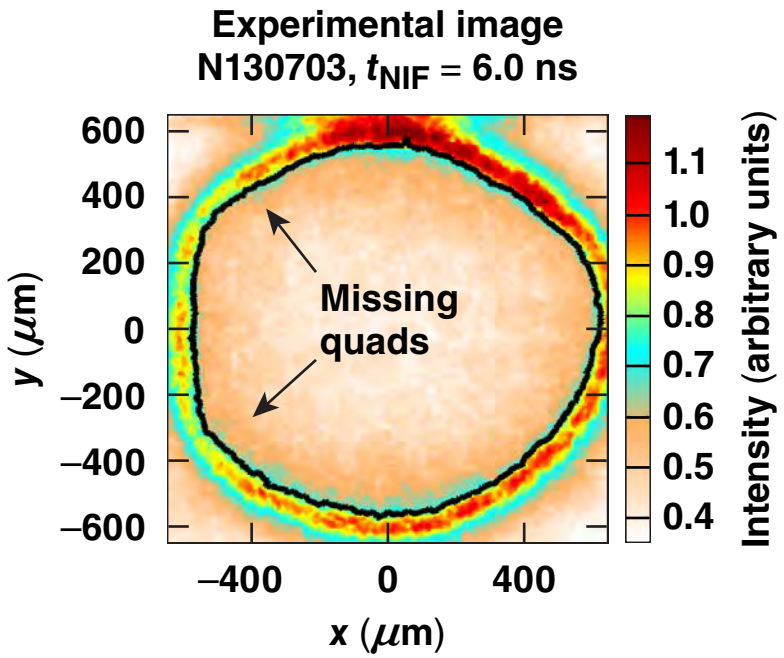
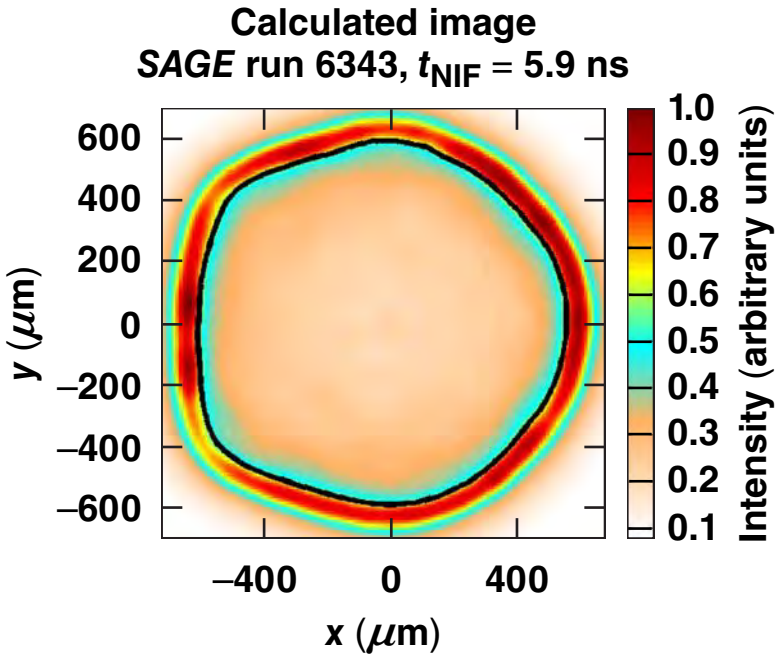
Three-Dimensional Modeling of X-Ray Self-Emission Images on NIF Polar-Drive Implosions





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Summary

X-ray self-emission imaging* was used on National Ignition Facility (NIF) polar-drive experiments to observe 3-D target nonuniformities during the implosion

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- A 3-D postprocessor was created to calculate self-emission images using 3-D profiles obtained from *SAGE* hydrodynamic simulations
- Modeling reproduces the target shape when two NIF quads were dropped
- Predicted deviations of ~10 μm resulting from beam-energy variations are observed with the self-emission diagnostic

*D. T. Michel *et al.*, Rev. Sci. Instr. 83, 10E530 (2012).

Collaborators

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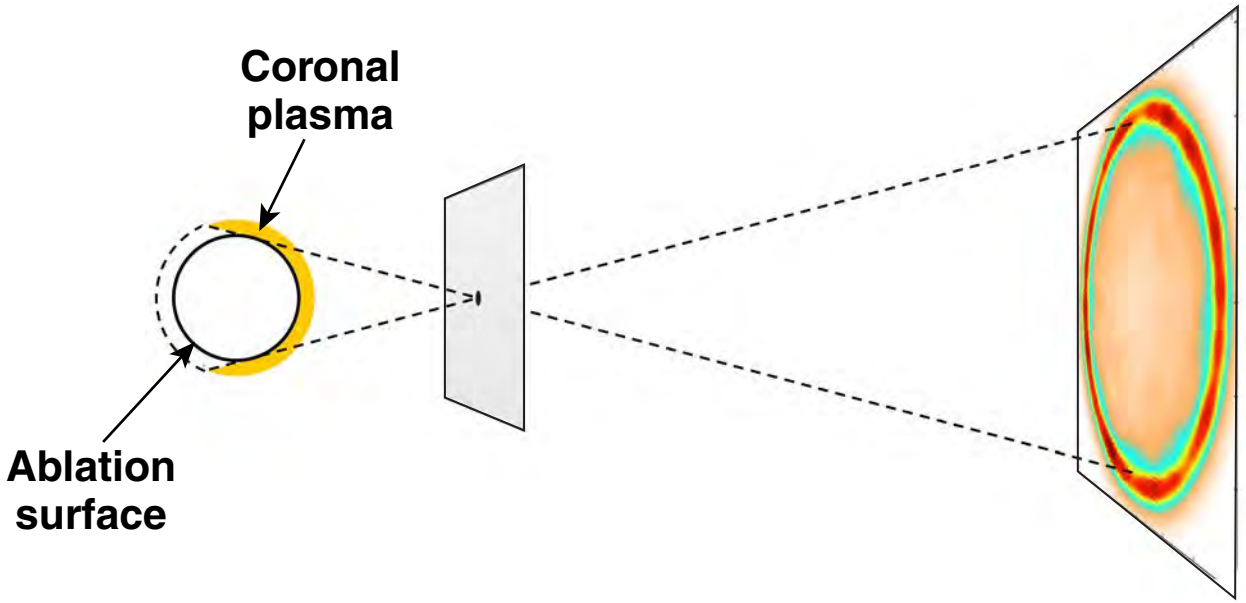
X-ray framing-camera images of the target self-emission provide information on the symmetry of the target outer radius



Self-emission imaging provides 3-μm accurate measurement of the radius perpendicular to the diagnostic plane.

The 3-D postprocessor calculates self-emission images by integrating the radiation transfer equation through a 3-D model of the target

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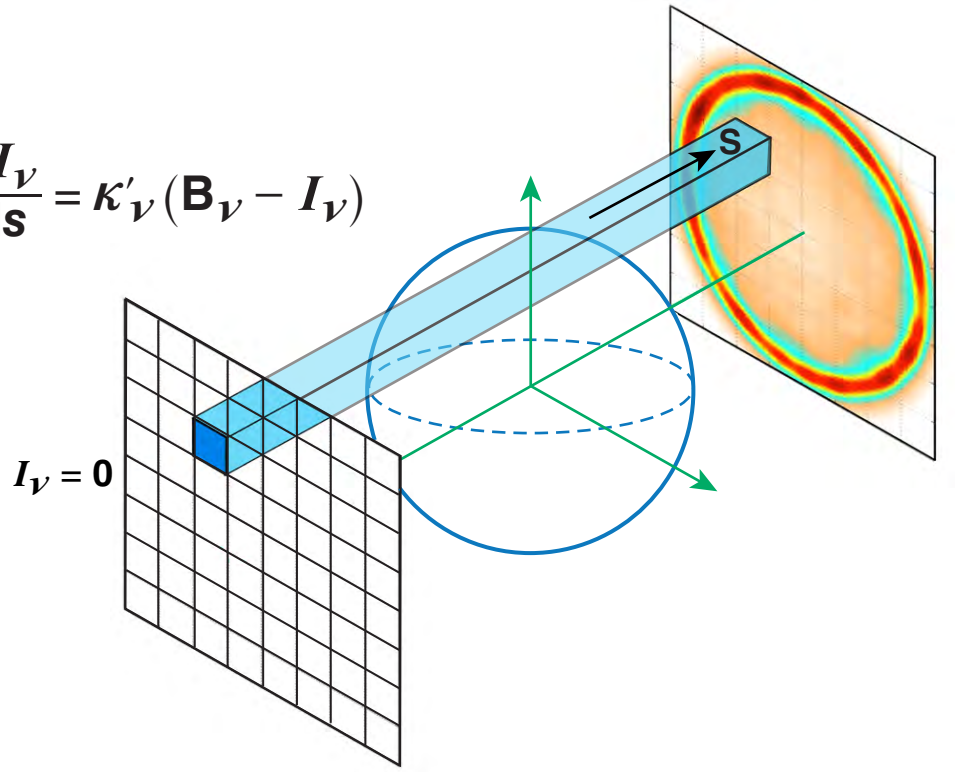
$$\frac{dI_\nu}{ds} = \kappa'_\nu (B_\nu - I_\nu)$$



I_ν = Specific intensity
B_ν = Blackbody term
κ'_ν = Opacity

The total intensity calculation incorporates a wide range of frequencies using multigroup methods.

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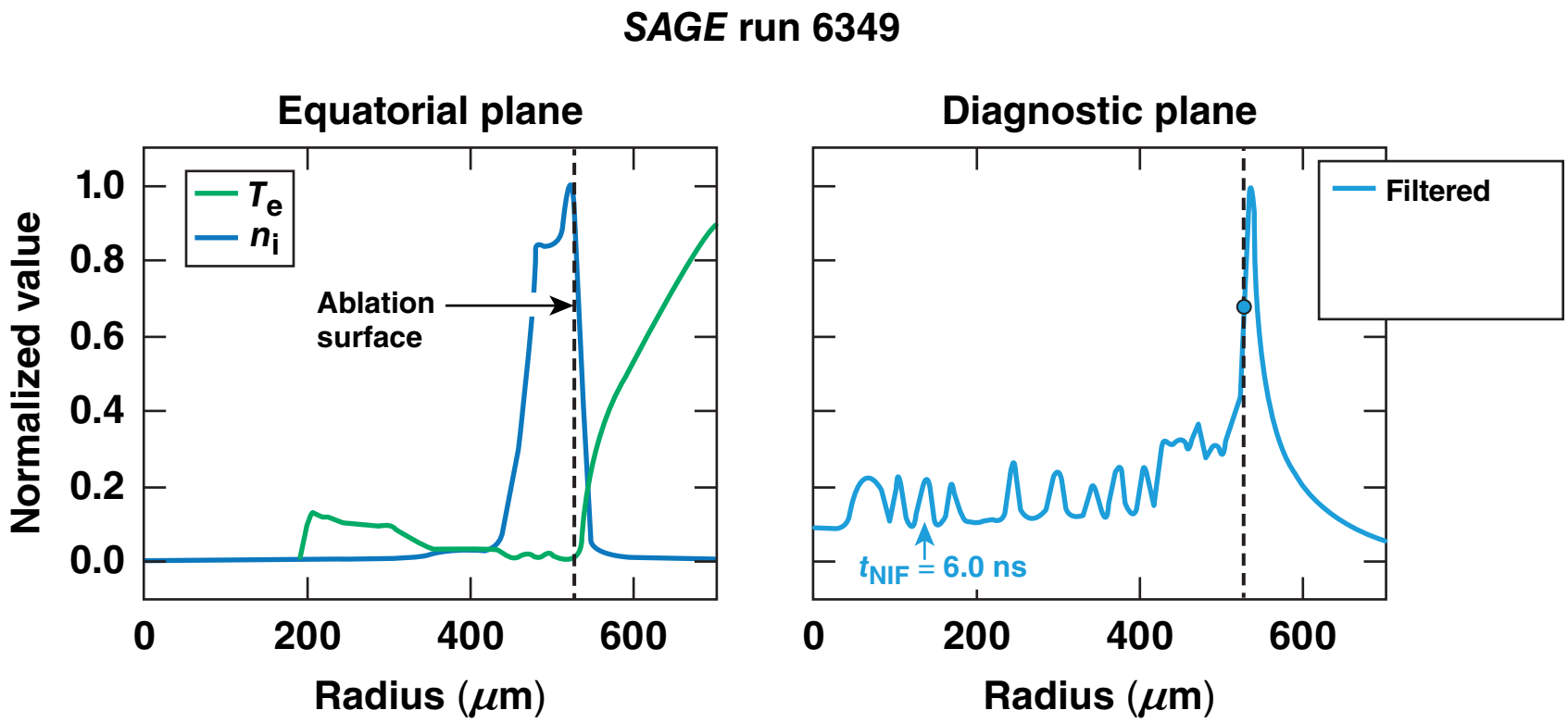
The calculated intensity is filtered and convolved to accurately compare with the experiment



For the NIF images, a 25.4-μm Be filter and a 60-μm convolution are used.

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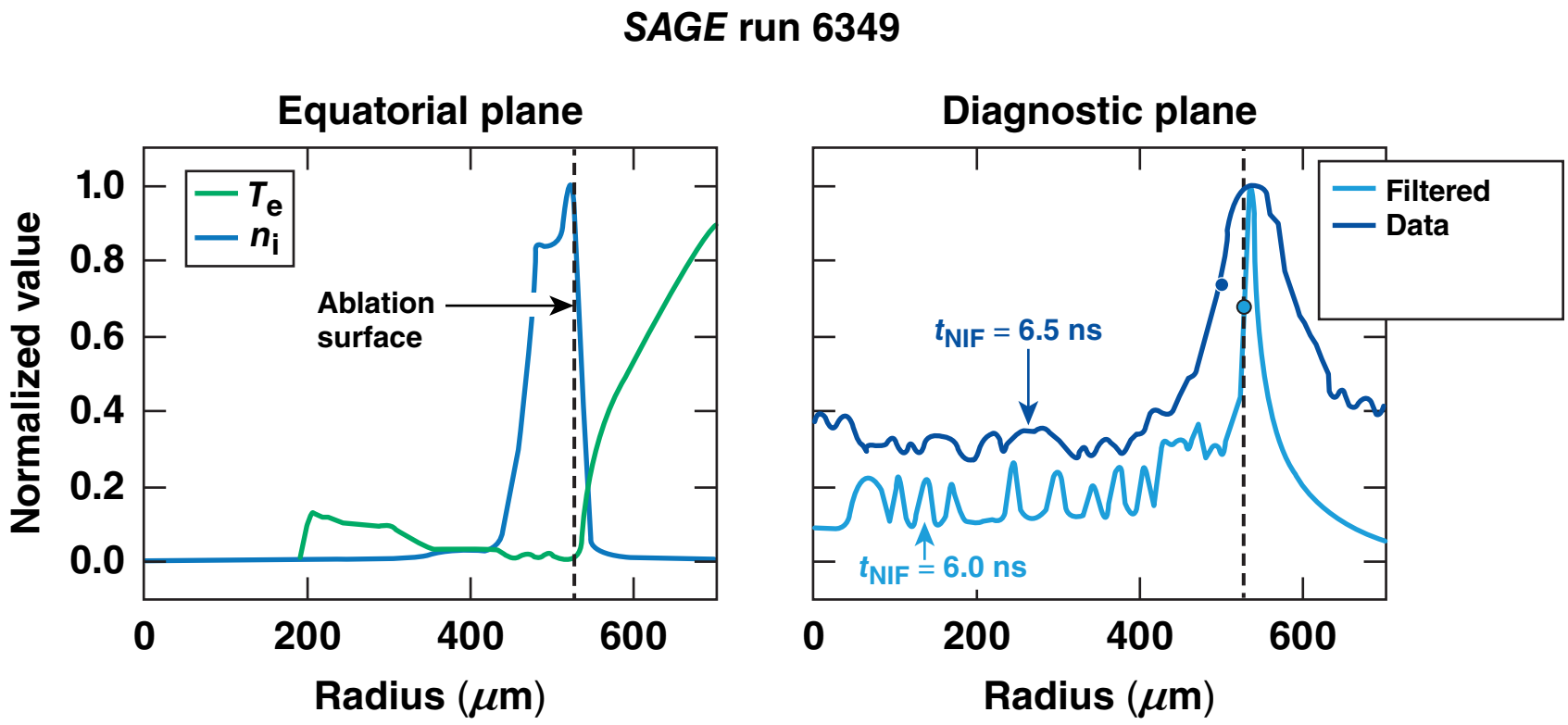
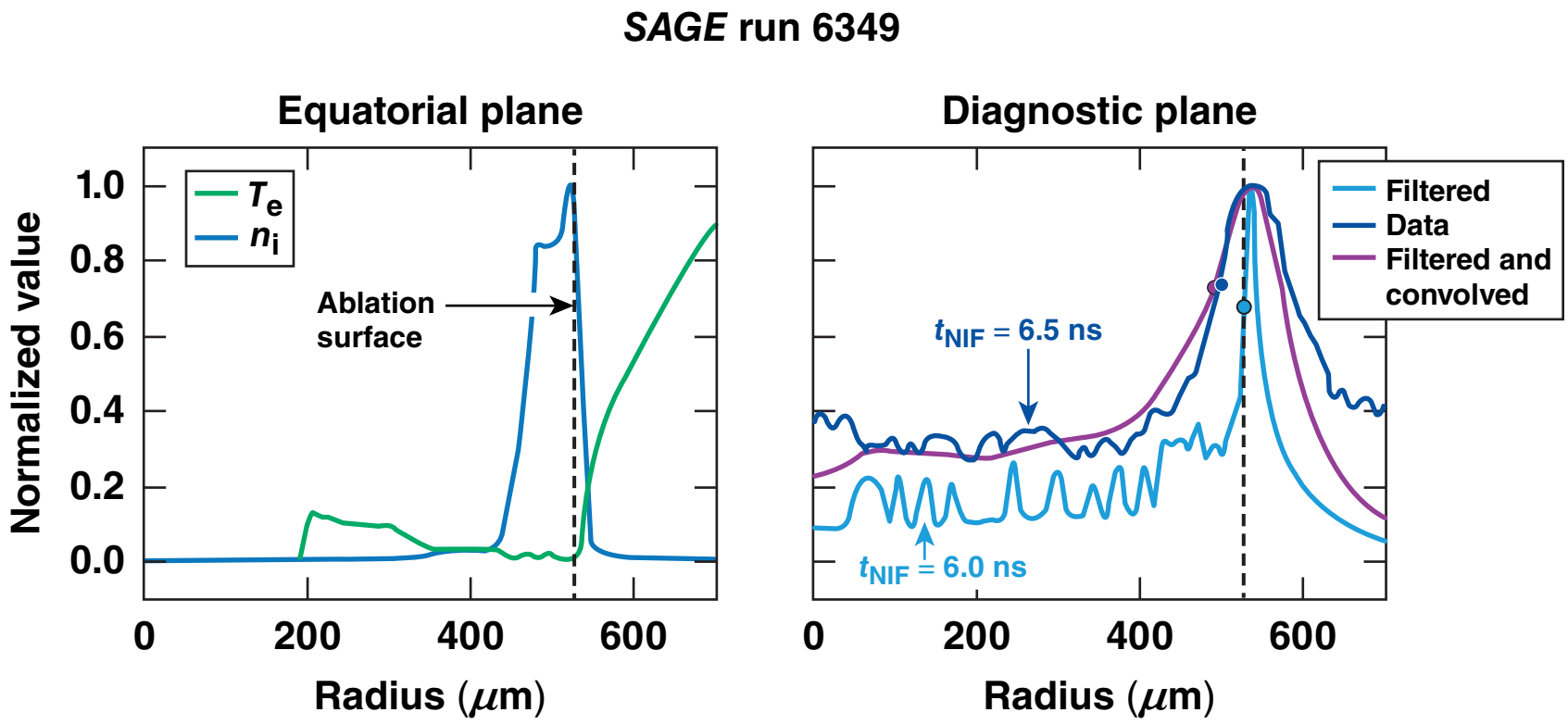
The calculated intensity is filtered and convolved to accurately compare with the experiment



For the NIF images, a 25.4-μm Be filter and a 60-μm convolution are used.

E22628a

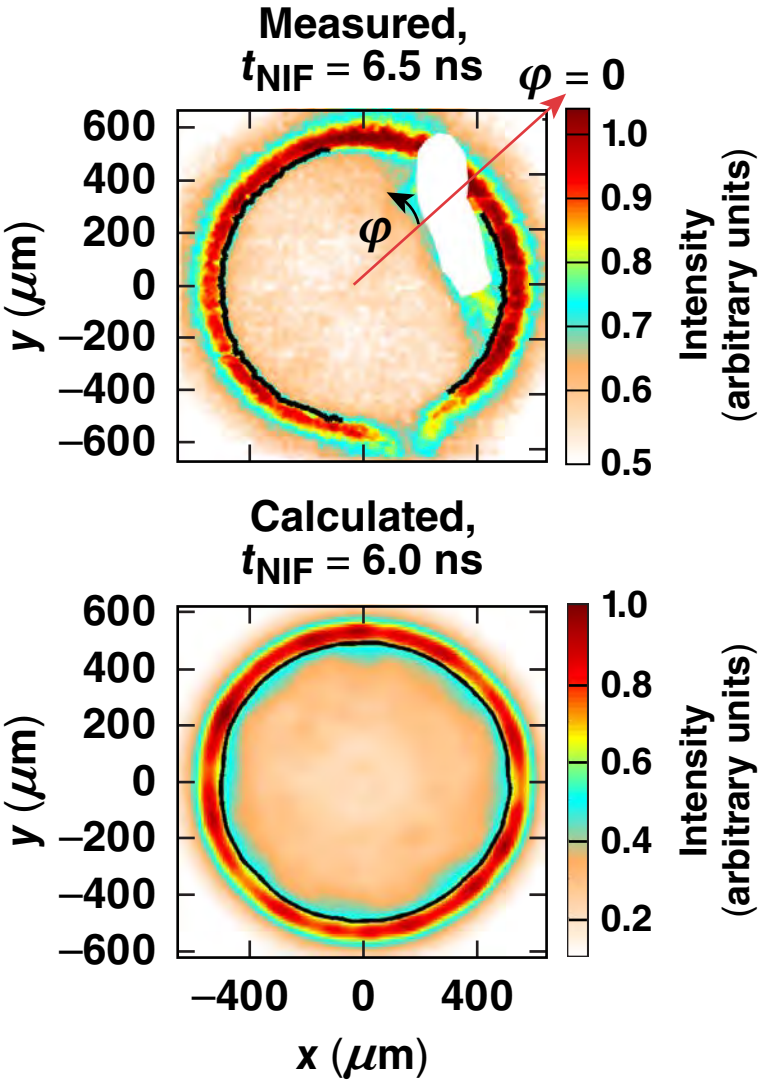
The calculated intensity is filtered and convolved to accurately compare with the experiment

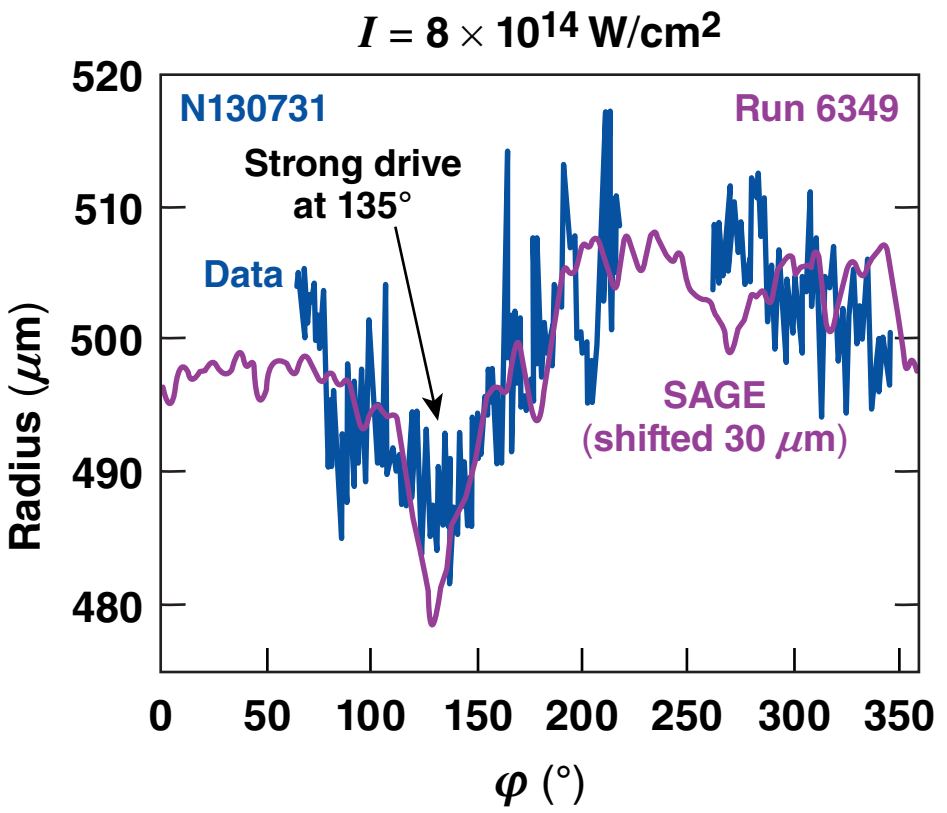


For the NIF images, a 25.4-μm Be filter and a 60-μm convolution are used.

E22628b

The effects of power balance are observed in the polar self-emission images for a uniform shot



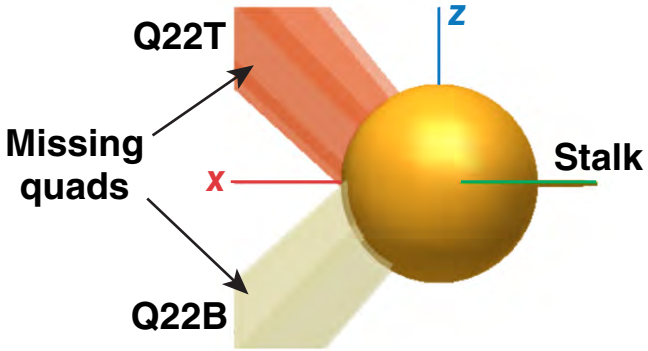


10-μm variations caused by beam-energy imbalance can be measured

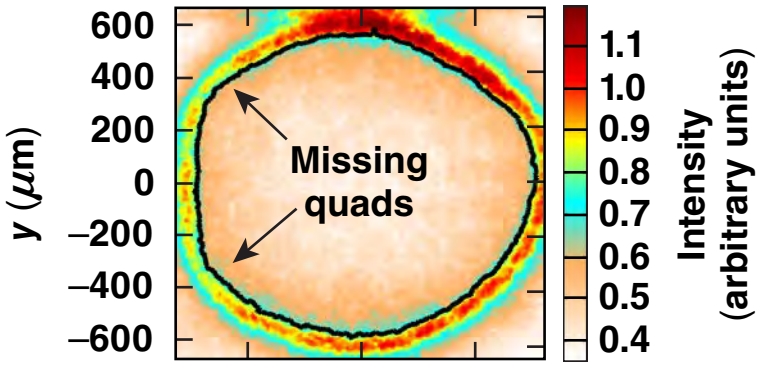
E22629

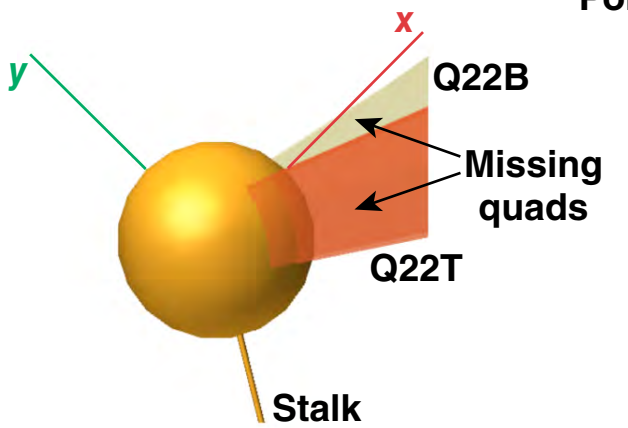
Two quads were dropped on a NIF polar-drive experiment, creating large nonuniformities observed in the self-emission images

N130703, $I = 4 \times 10^{14}$ W/cm^2

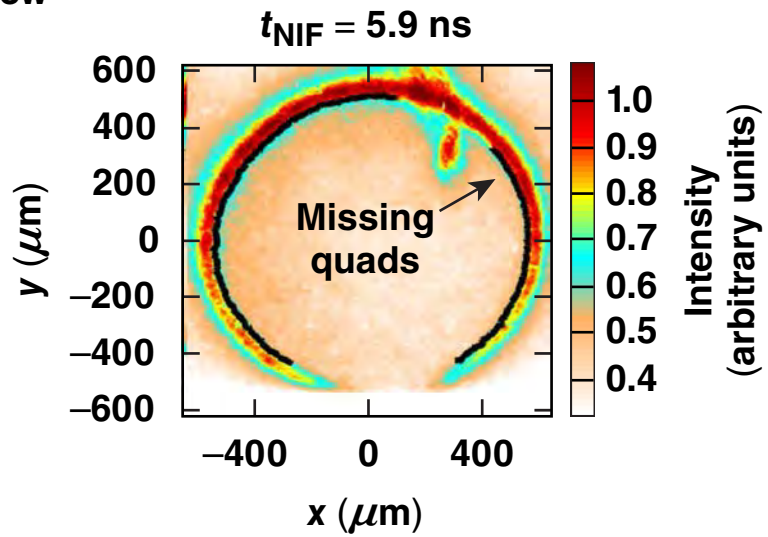


Equatorial view





Polar view



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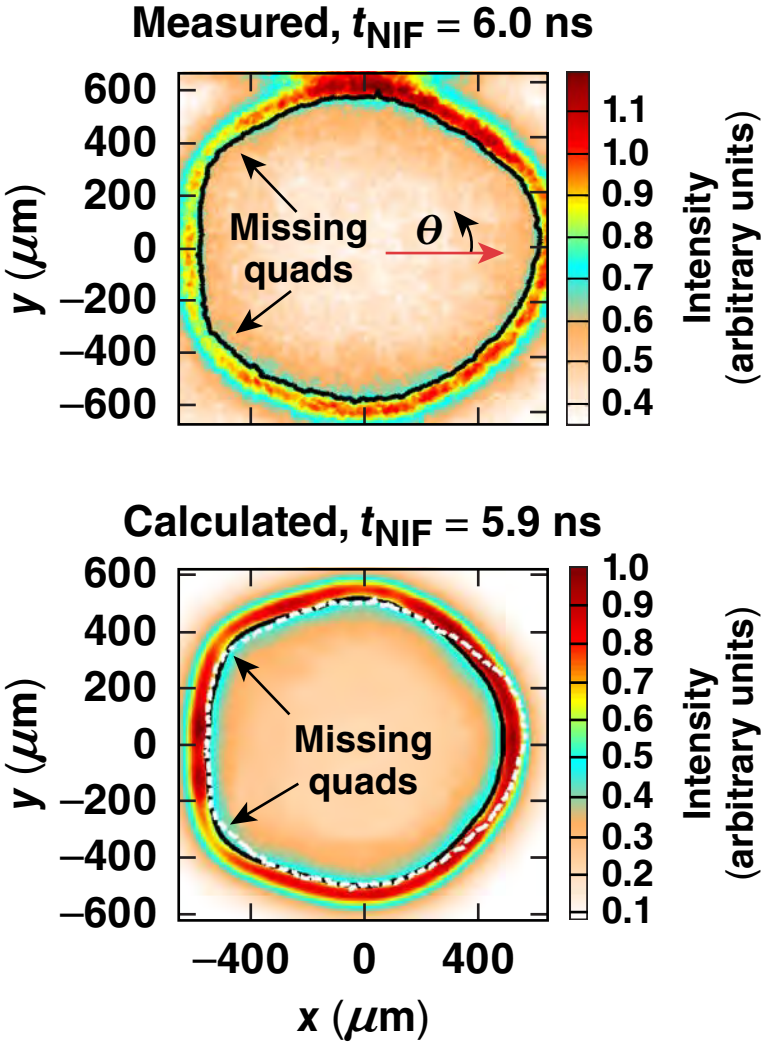
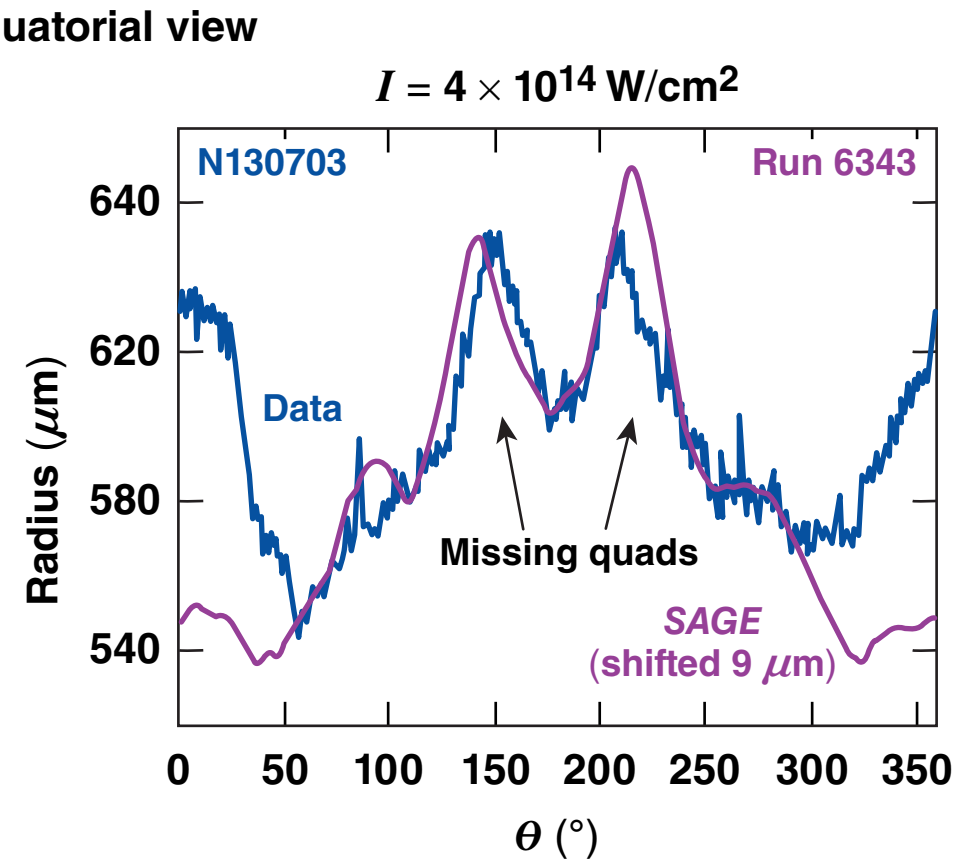
For $R \approx 600\ \mu$m, deviations in the target radius resulting from the missing quads are well-reproduced by the model

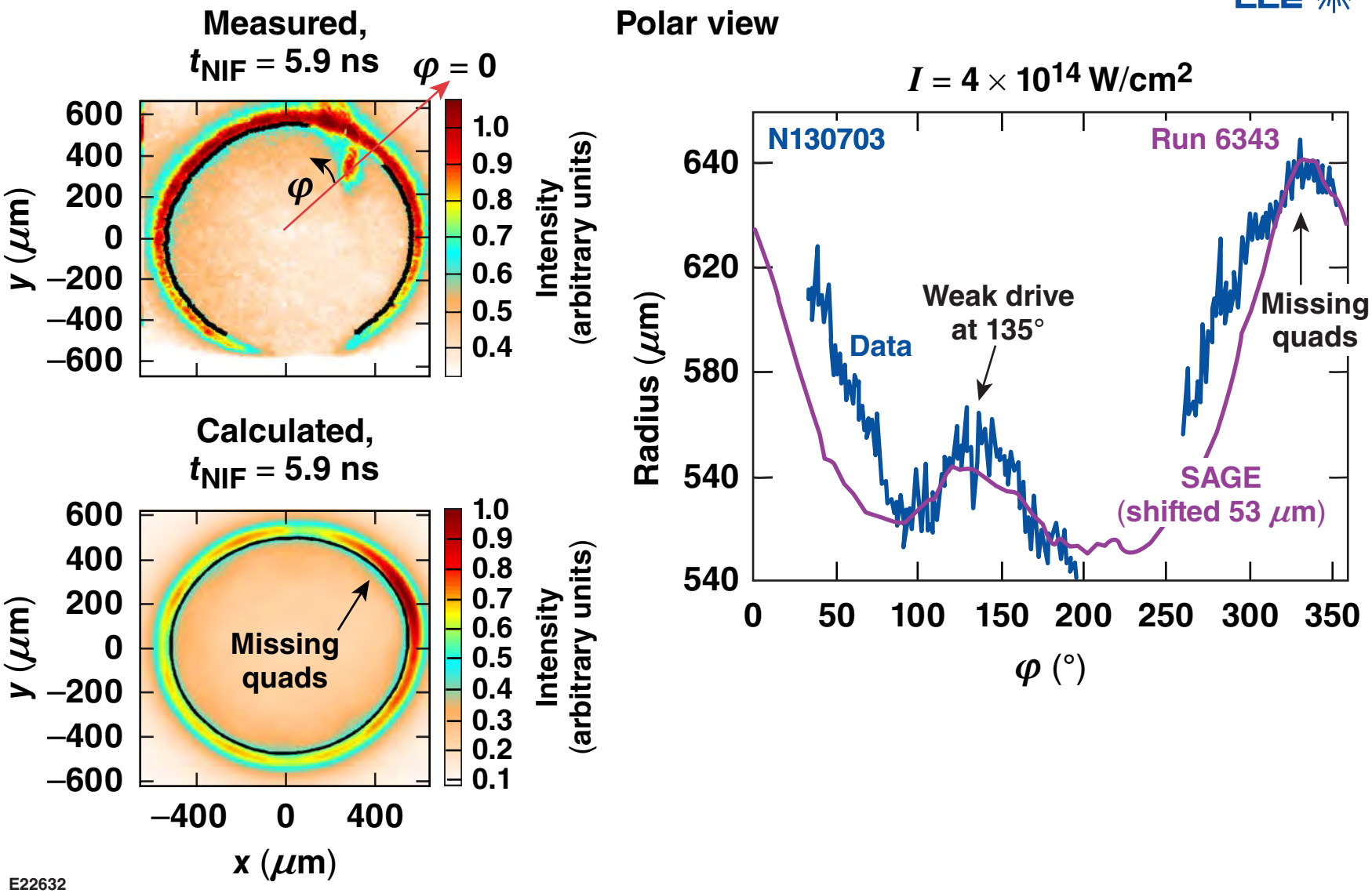




The equatorial radius on the correctly driven side is underestimated by the model.

E22631

Calculated self-emission images agree well with experimental images taken from the polar direction



E22632

Summary/Conclusions

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E22625