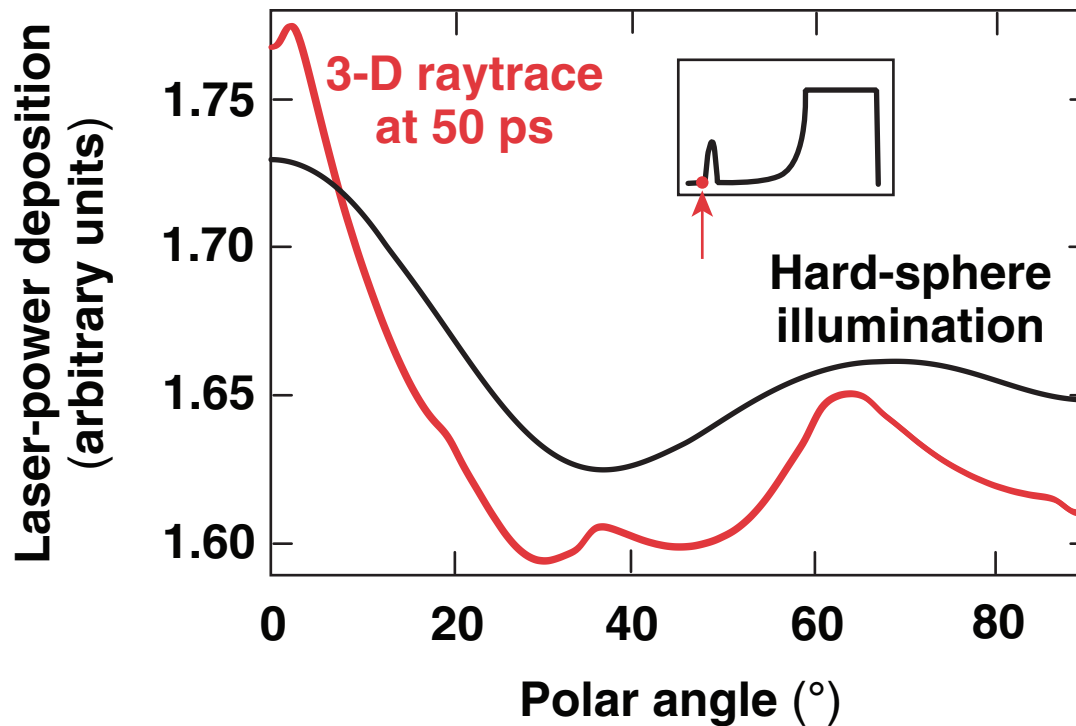


Irradiation Uniformity in Direct-Drive Simulations Using 3-D Raytrace



NIF symmetric drive



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49th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Orlando, FL
12–16 November 2007

Summary

The angular uniformity of laser deposition in ICF implosions is strongly affected by sharp density gradients near critical



- Shorter wavelength nonuniformities, which do not show up in the hard-sphere illumination analysis, appear in the laser deposition.
- A plasma-slab model agrees with the 3-D raytrace results.
- Integrity of the shell late in the implosion is not affected and near 1-D target performance is preserved.

Collaborators



P. W. McKenty

I. V. Igumenshchev

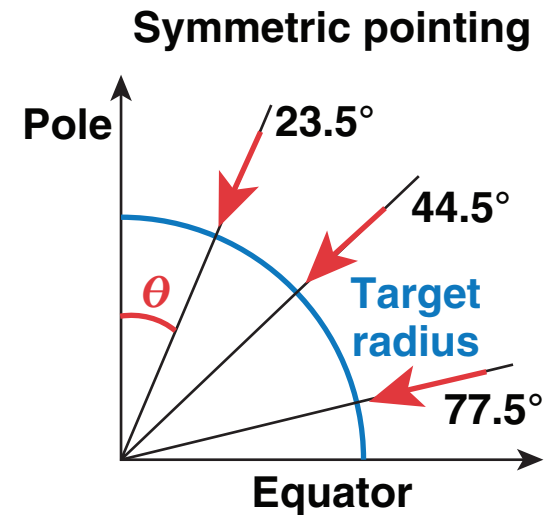
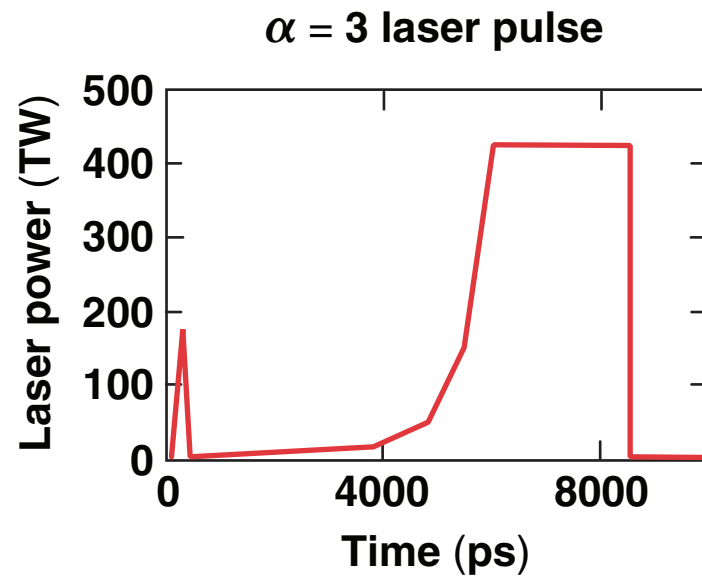
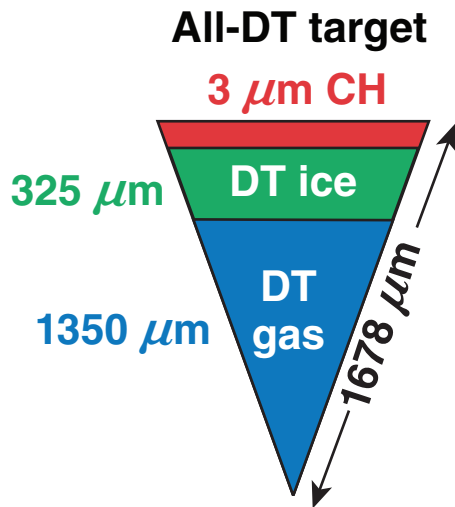
D. Keller

J. A. Marozas

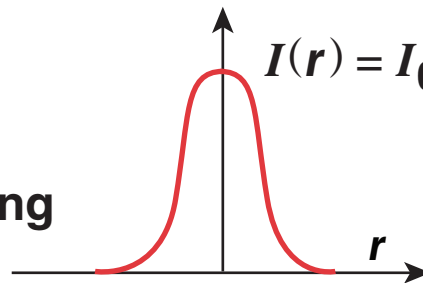
S. Skupsky

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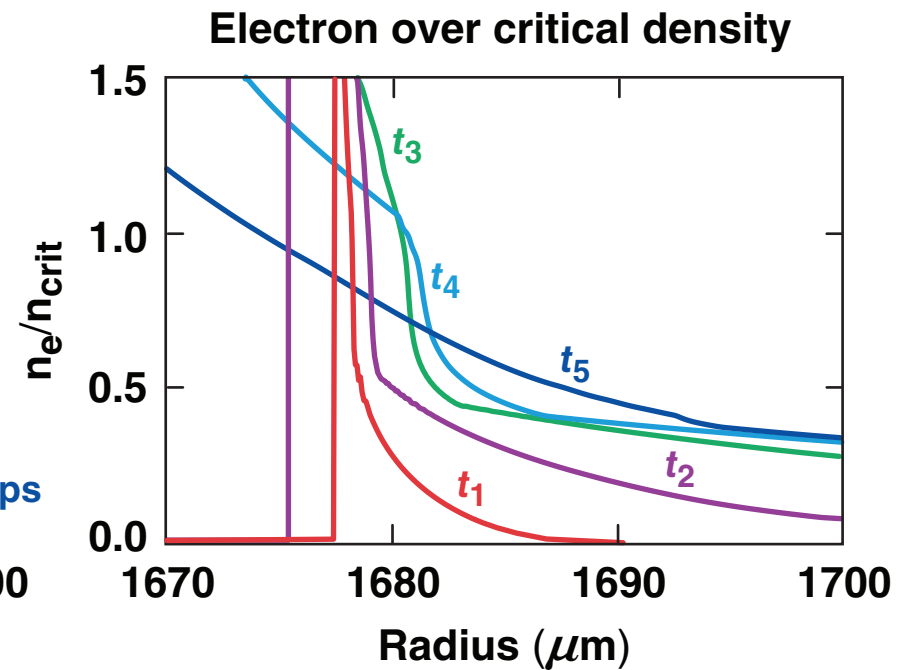
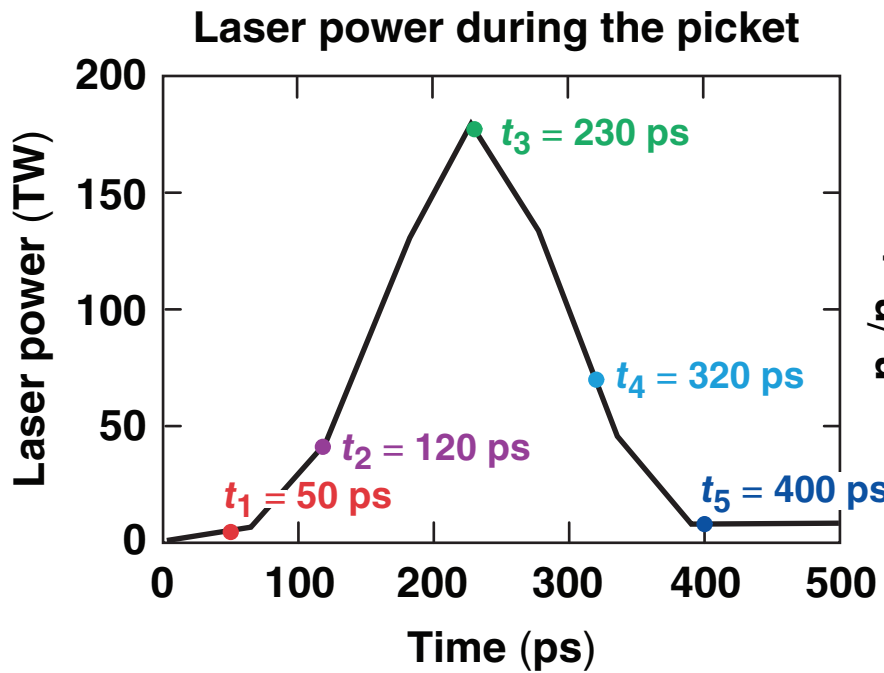
DRACO simulations of the NIF point design employ 3-D raytrace routines



- Geometrical optics propagation
- Inverse bremsstrahlung absorption

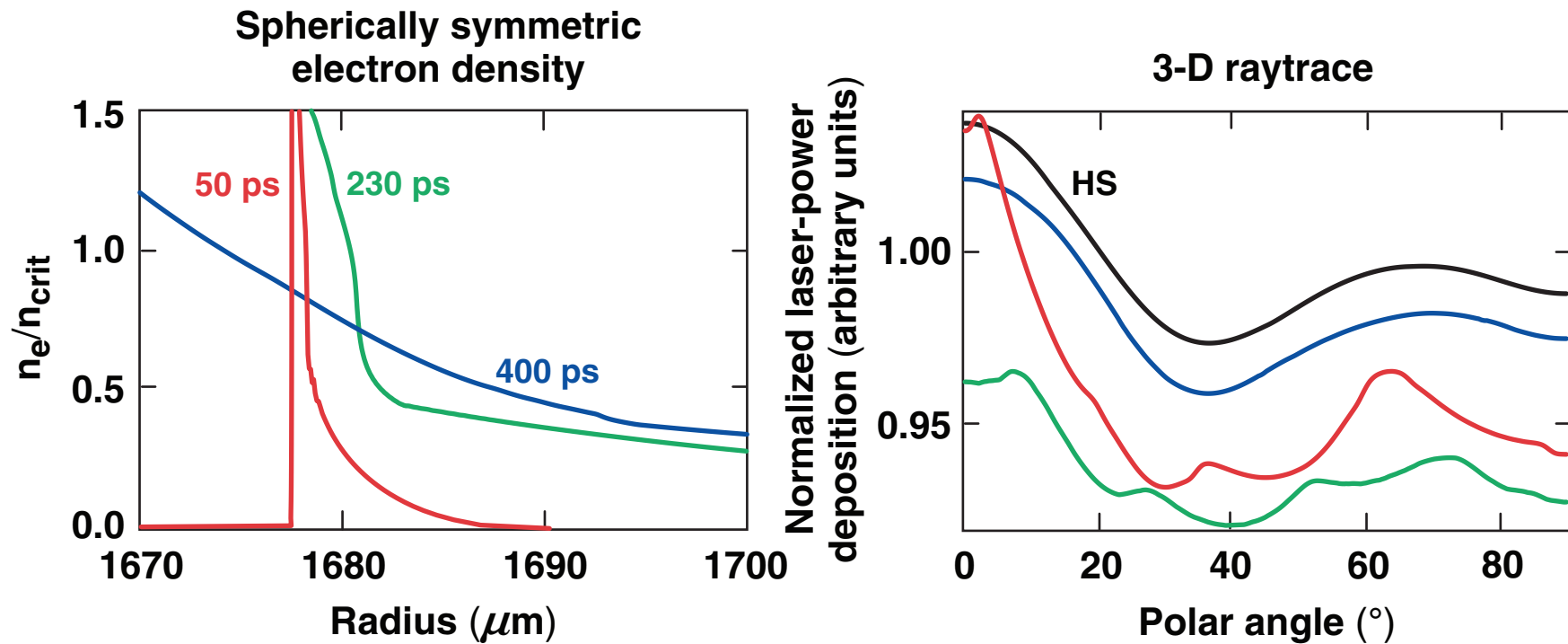


The electron-density profile exhibits sharp radial gradients near critical



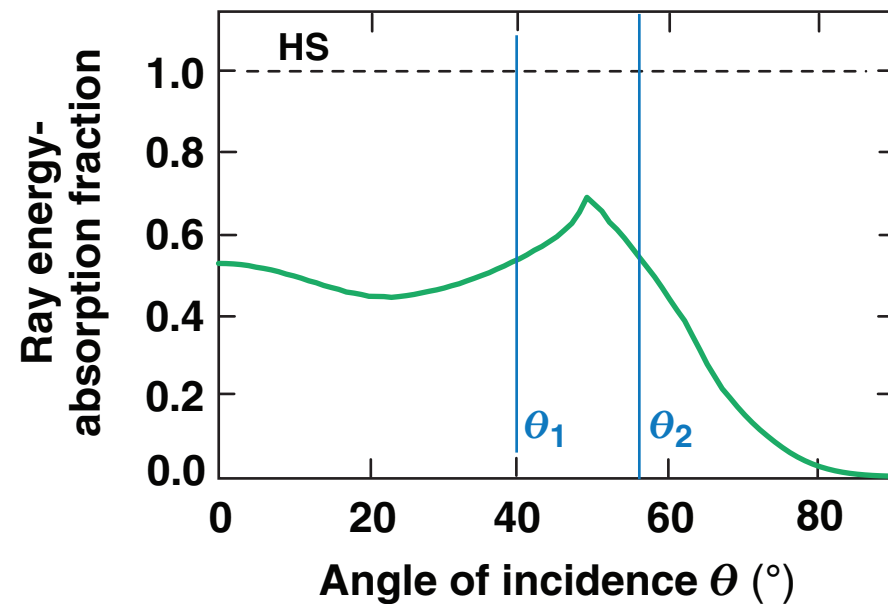
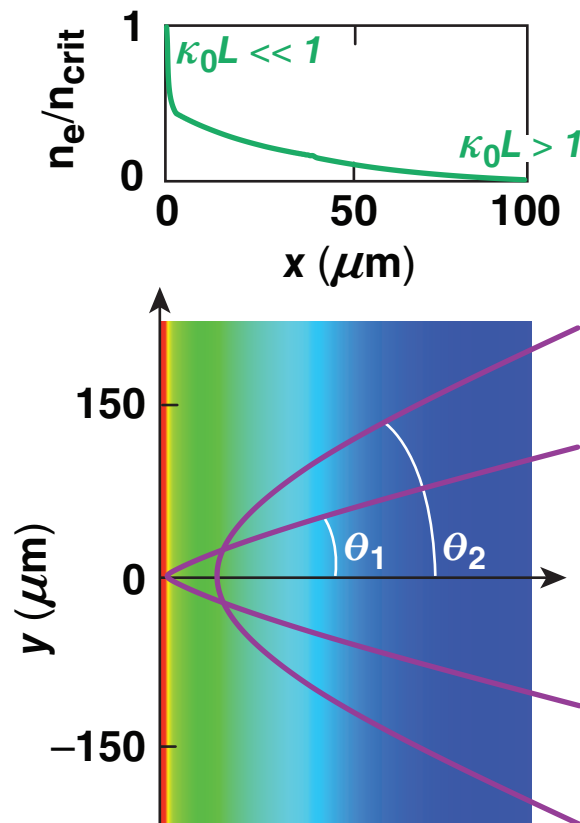
- The electron density is from a high-resolution 1-D *LILAC* simulation

The angular distribution of laser deposition contains short-wavelength components for sharp density gradients



The plasma-slab model shows angular cusps in absorbed energy

- The plasma slab has the same 1-D density profile as the imploding target.



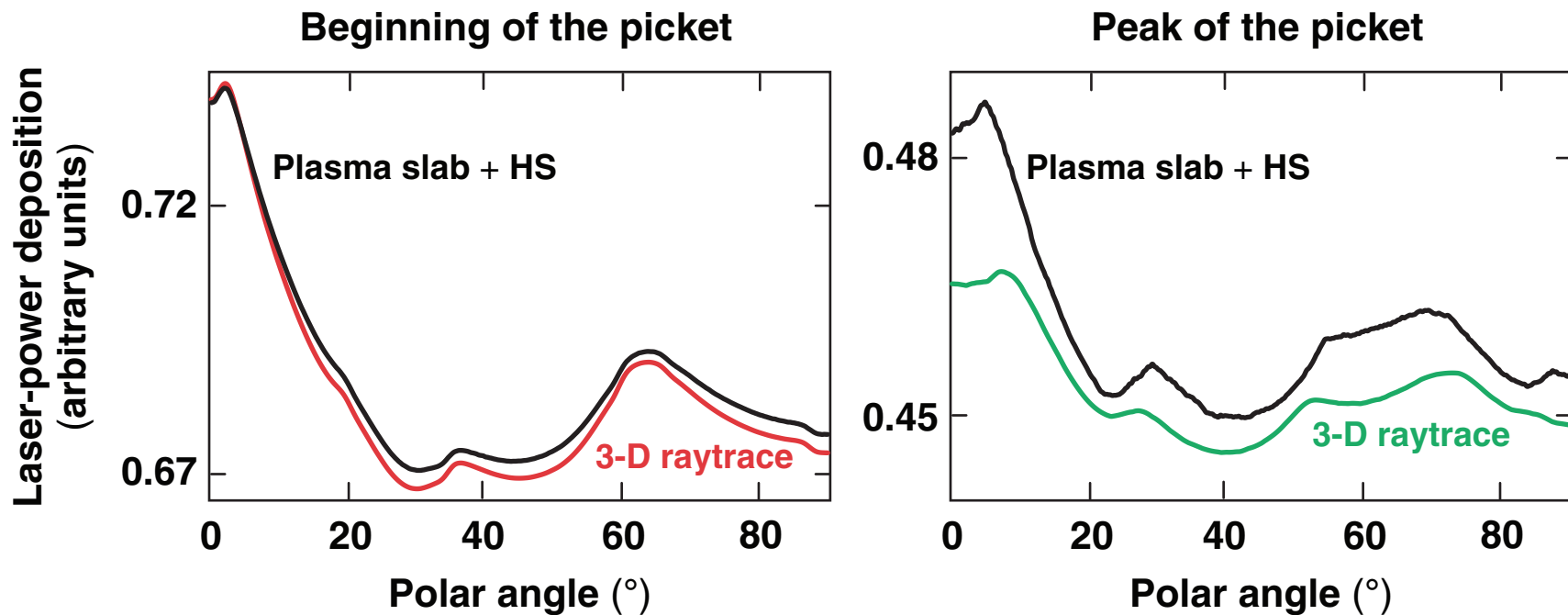
- Absorption fraction for a slab with an exponential electron-density profile $n_e = n_{\text{crit}} \exp(-x/L)$:*

$$f_A = 1 - \exp(-\kappa_0 L \cos^3 \theta)$$

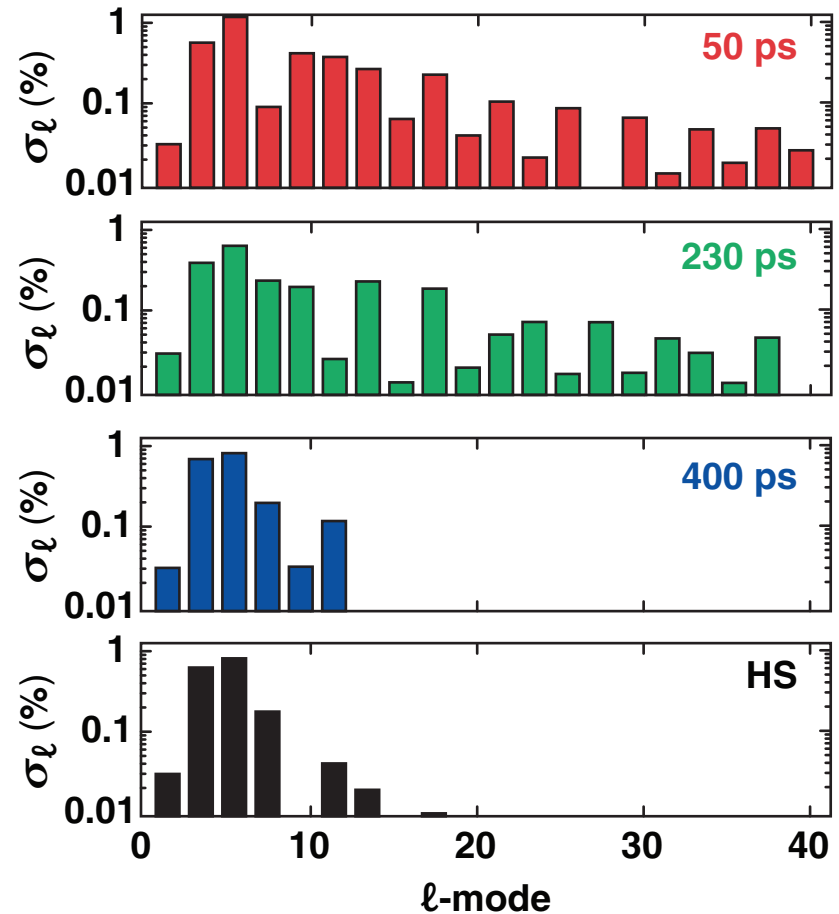
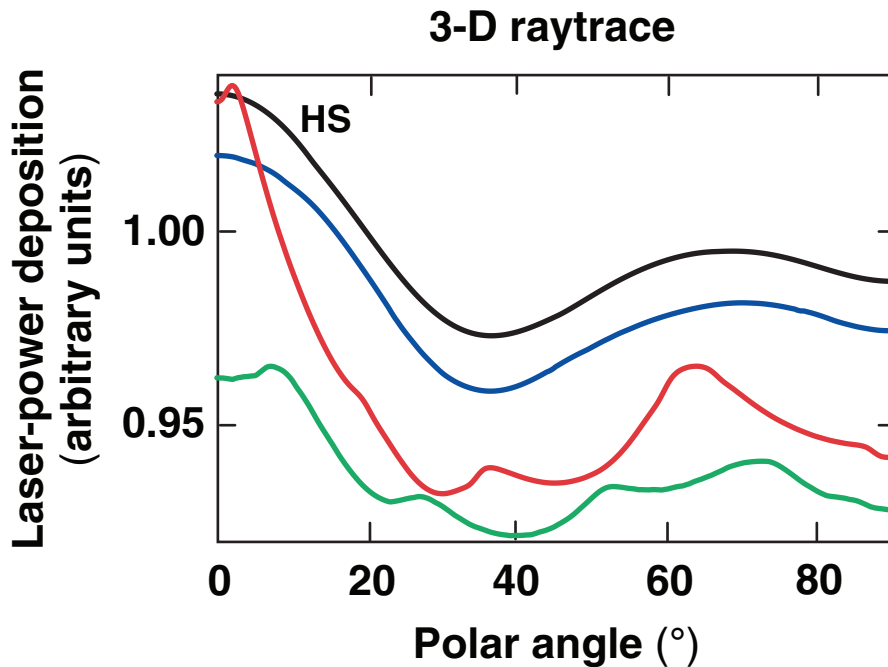
*see, e.g., W. L. Kruer, *The Physics of Laser-Plasma Interactions* (Addison-Wesley, Redwood City, CA, 1988).

The slab model explains nonuniformities obtained in 3-D raytrace

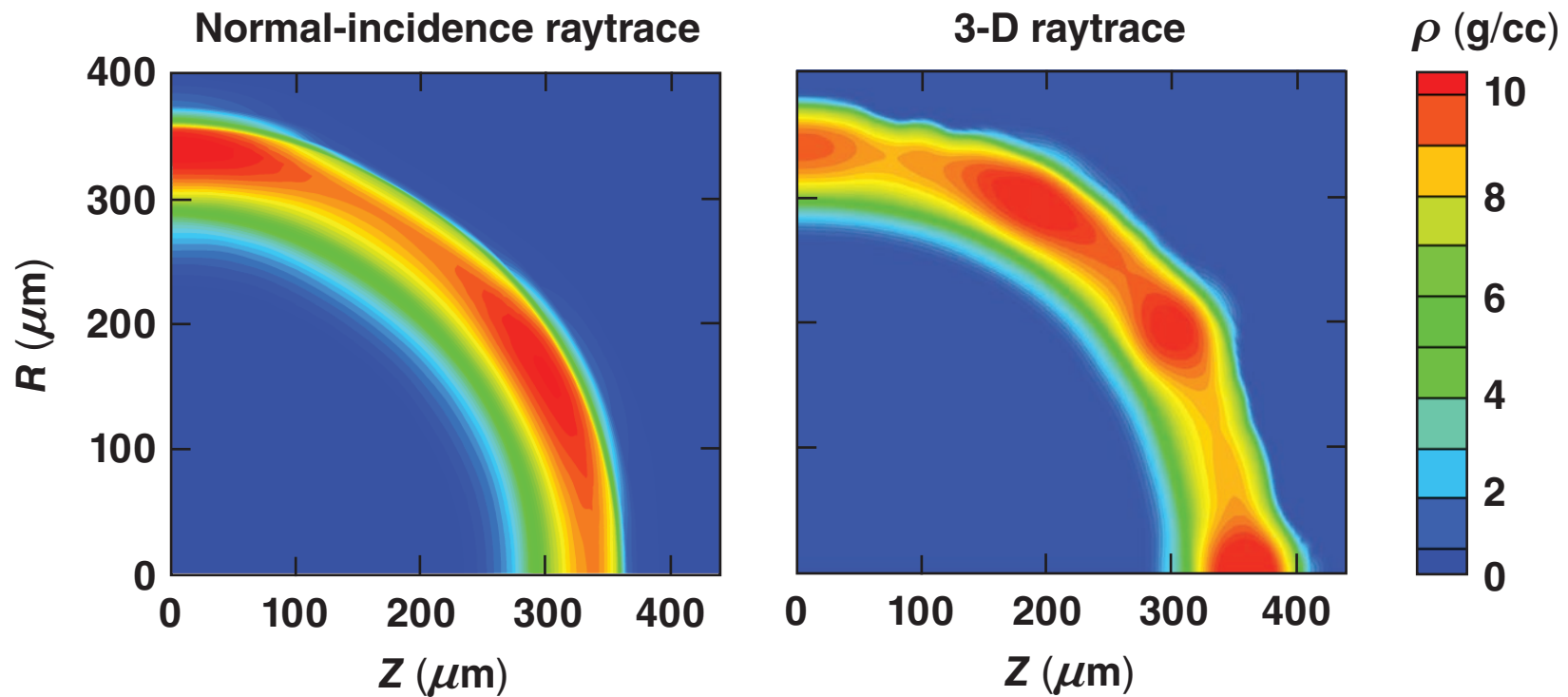
- Combining ray-energy absorption by the plasma slab with the hard-sphere illumination qualitatively reproduces laser-absorption nonuniformities obtained with 3-D raytrace.



Spectral analysis of actual deposition exhibits the higher spectral content



Deposition nonuniformities caused by sharp density gradients do not affect shell integrity during the implosion



Near 1-D target performance is preserved

Summary/Conclusions

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