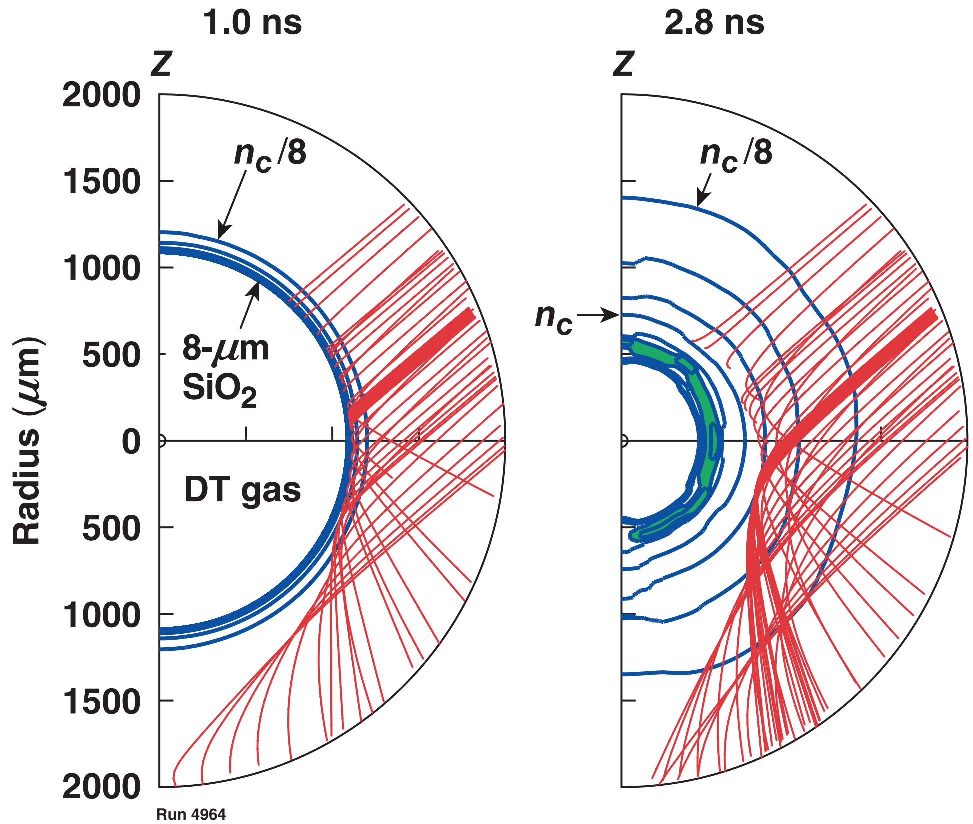
Initial Polar-Drive Designs to Optimize Neutron Yields on the NIF



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Summary

Polar drive can be used with indirect-drive phase plates to generate highly uniform implosions for neutron diagnostic development

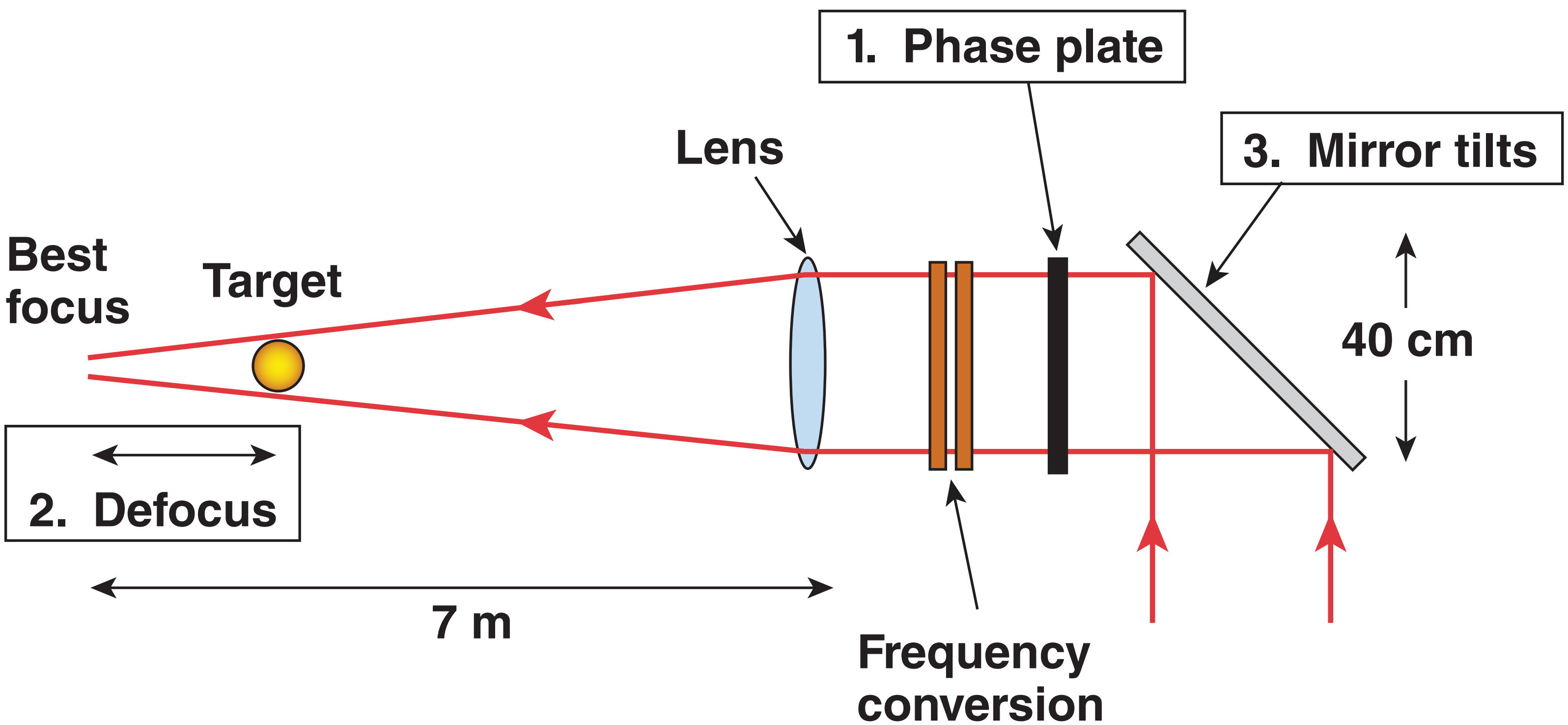
- Uniformity is obtained through three means
  - defocusing the beams
  - repointing the beams
  - spreading the beams within a quad
- Designs are available from 350 kJ to 1.5 MJ
  - expect ~2×10^{15} to ~10^{16} neutrons
- The targets (thin-walled SiO_2 shells filled with DT) implode with a velocity nonuniformity of a few percent

TC7945

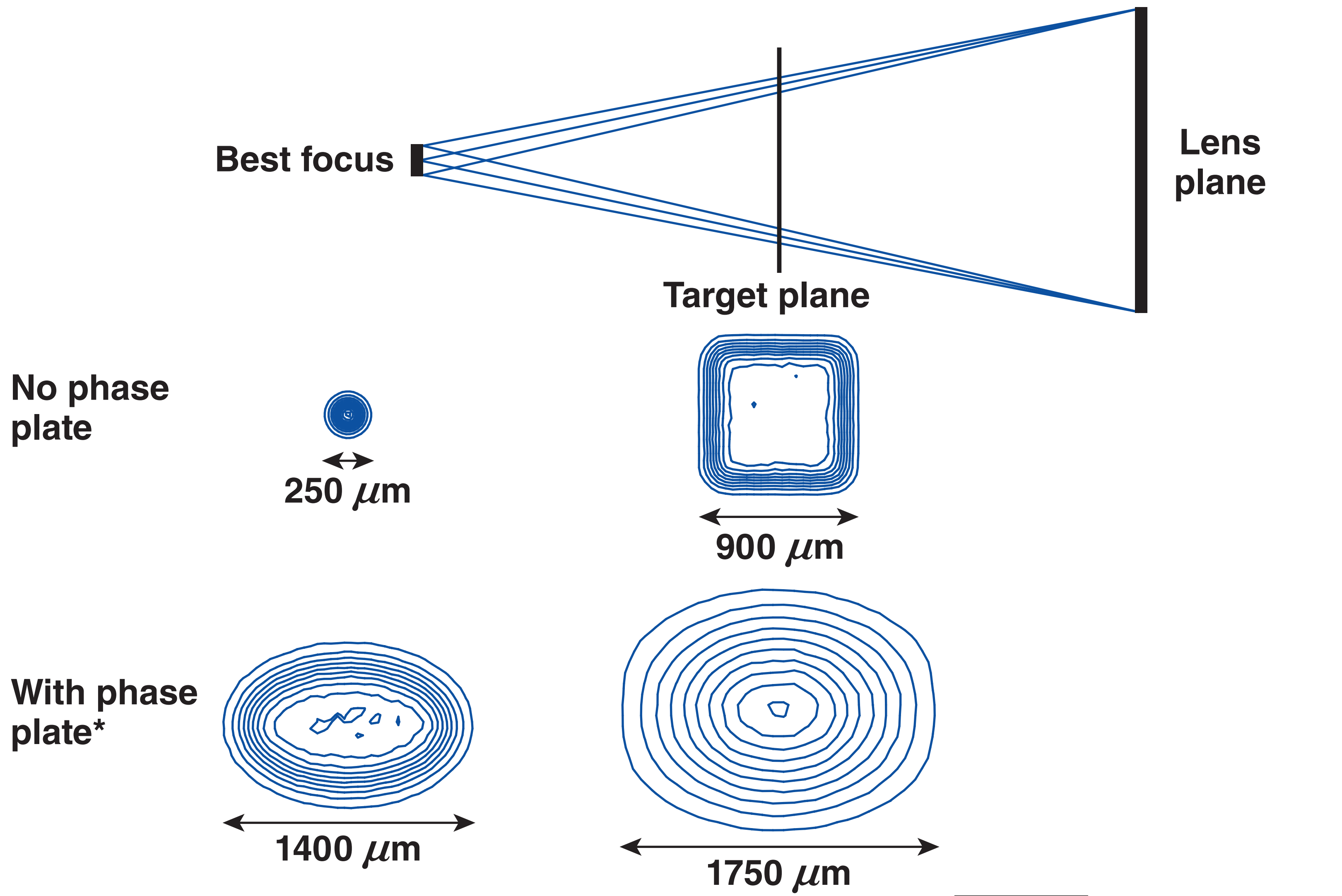
Outline

- Parameters available for optimization
- Design at 350 kJ
- Scaled designs for 350 kJ to 1.5 MJ

The polar-drive designs use only readily available capabilities on the NIF



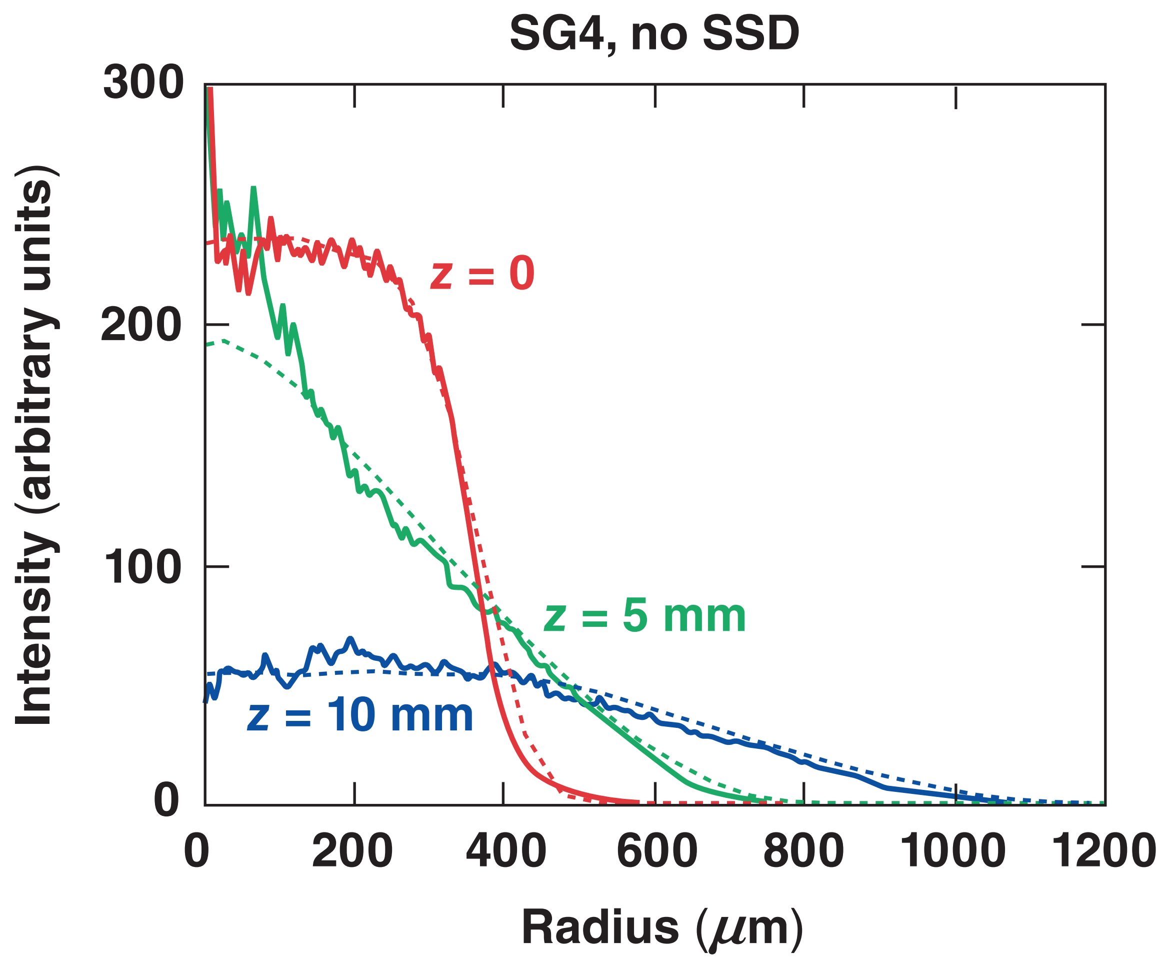
Focal distributions are calculated using a simple geometrical-optics model



*D. Munro parameterization

TC7884

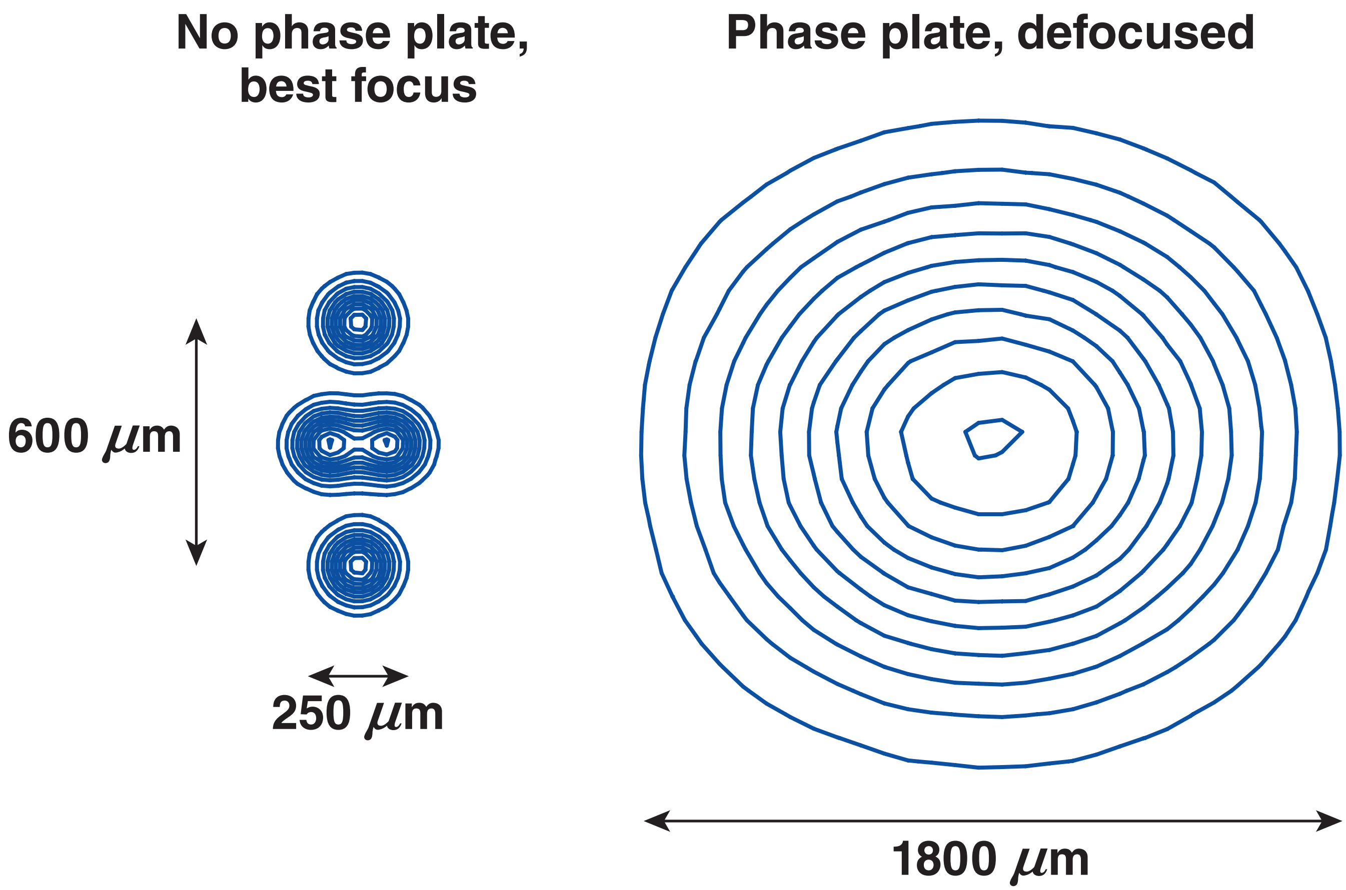
The geometrical optics model has been checked using OMEGA data*



E14638

*T. J. Kessler

More-spatially-broadened target-plane profiles can be obtained using split-quad focusing*



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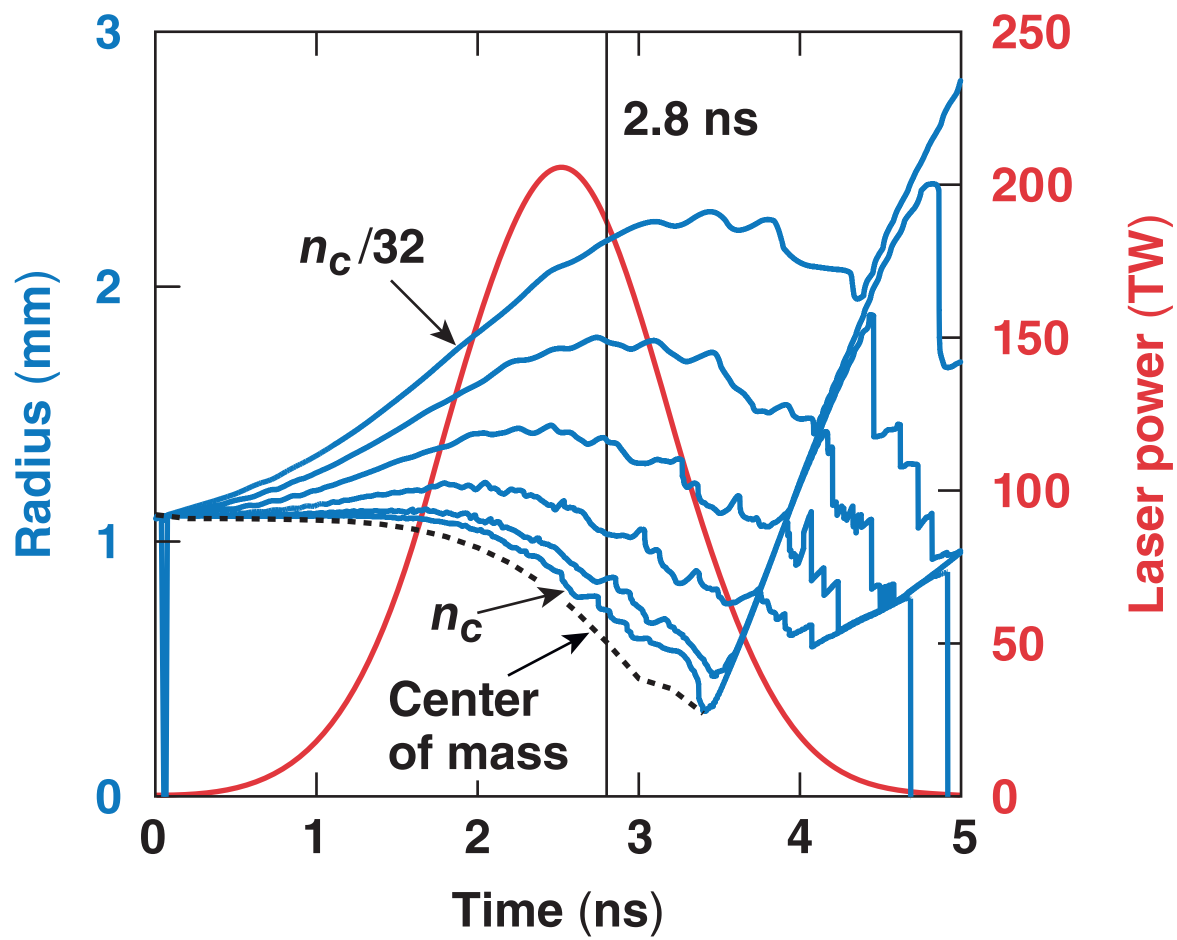
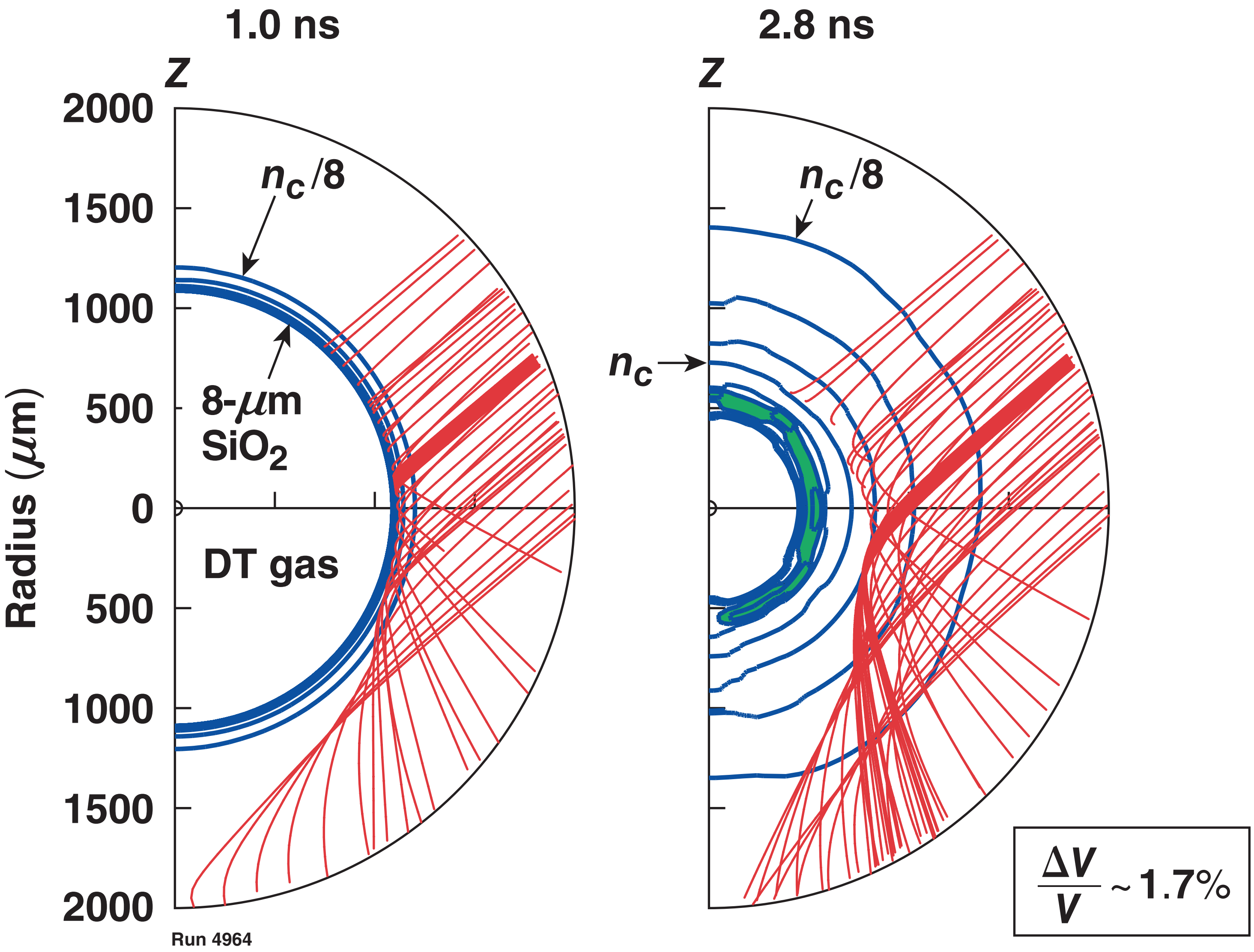
*Suggested by E. Moses

The 350-kJ design is diagnosed at 2.8 ns, just before peak neutron production



E15384

At 2.8 ns the shell is imploding with a high degree of uniformity



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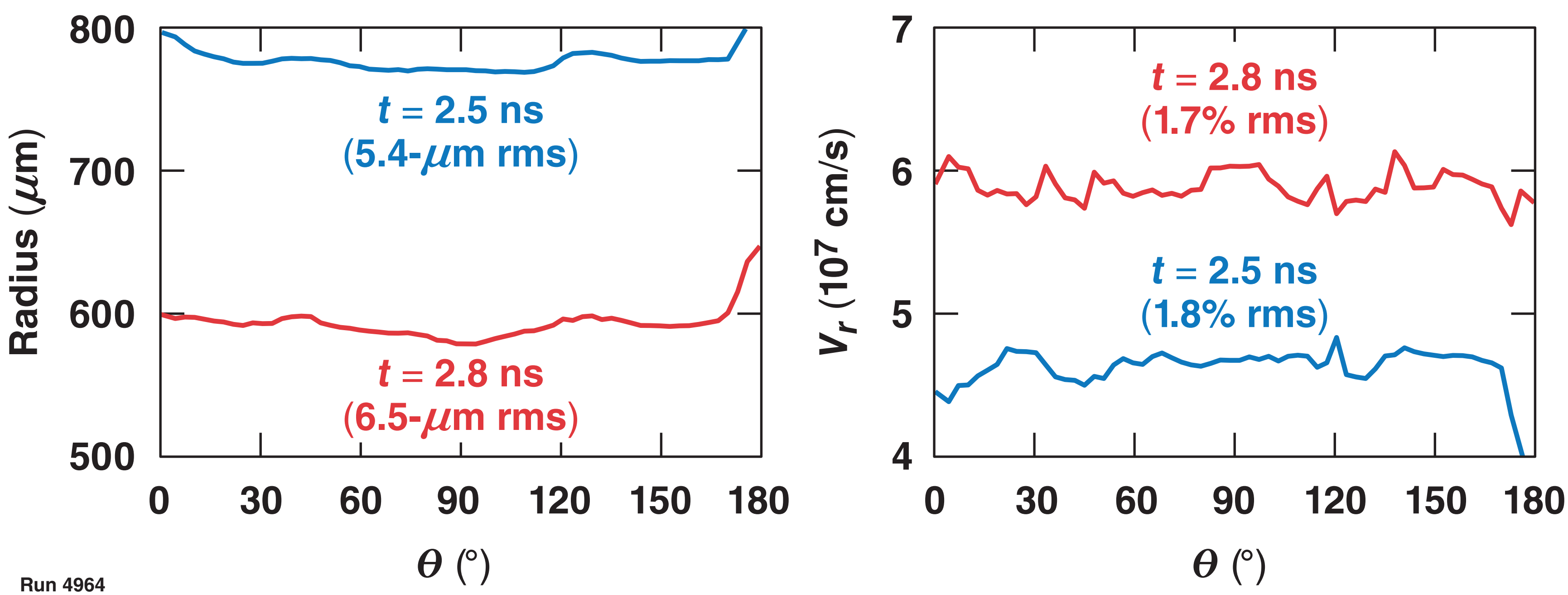
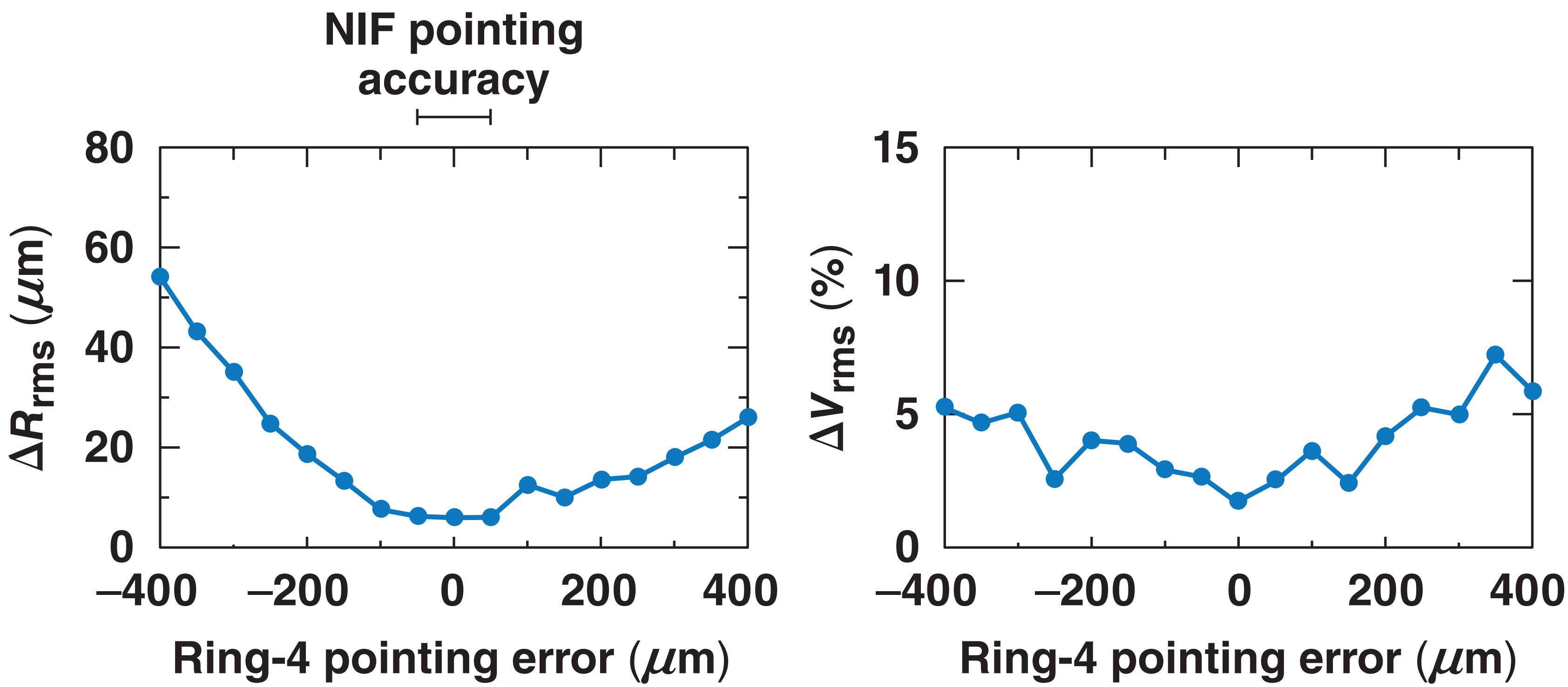
At 2.8 ns the center-of-mass radius is 600±6.5 μm and its velocity is 6×10^7 cm/s ±1.7%



Run 4964

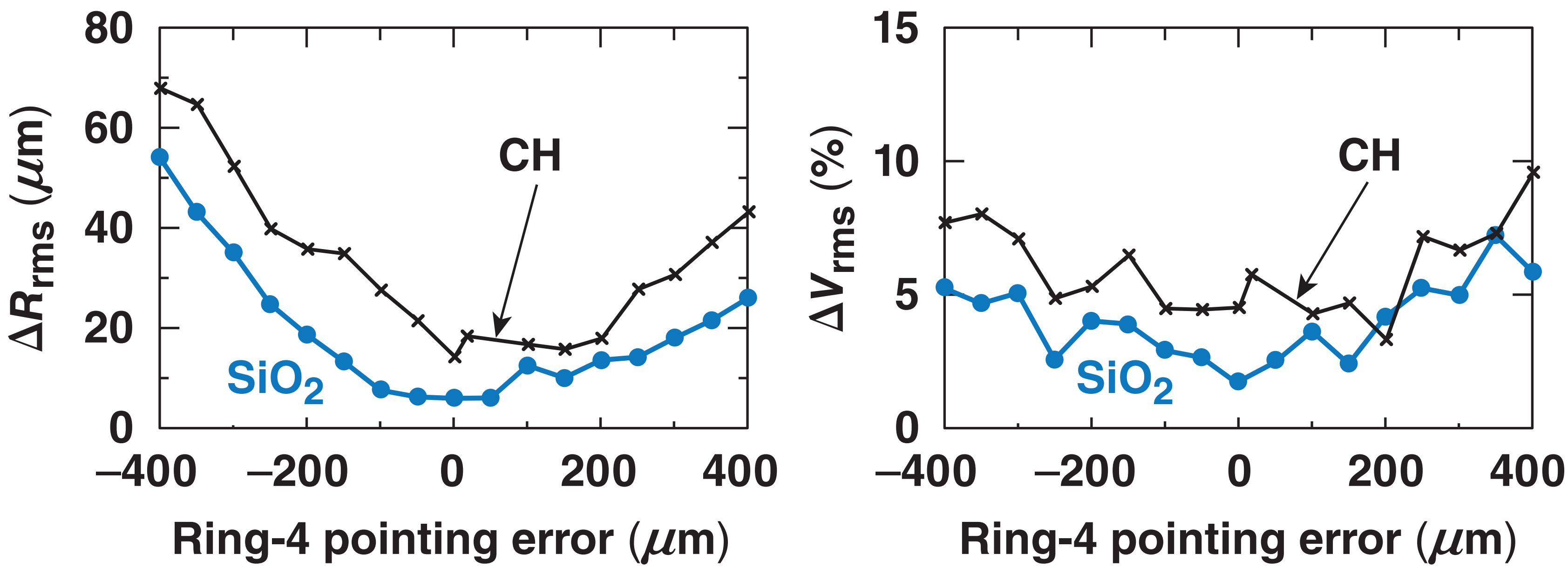
TC7886

The NIF pointing accuracy of ±50 μm is easily adequate



TC7887b

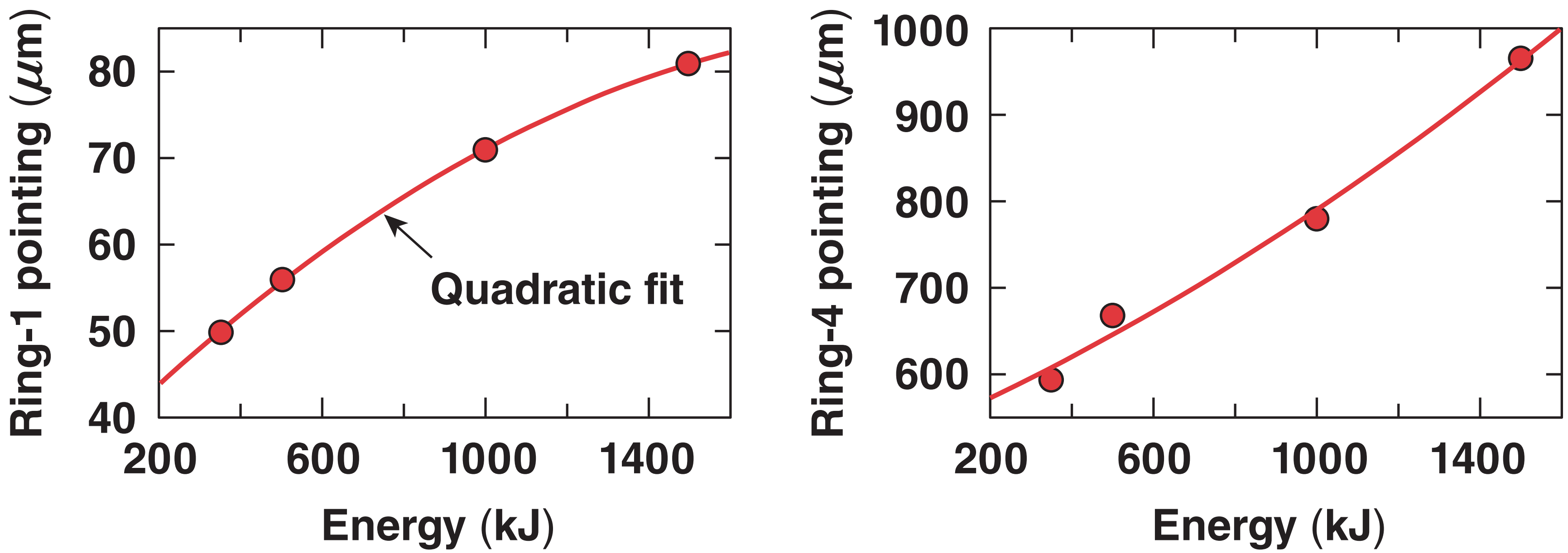
The optimum pointing for SiO_2 appears to be not quite optimum for CH



- Re-optimization for the actual target design is required.

TC7887a

Optimum designs were identified at four different energies, allowing designs for other energies to be obtained by interpolation



- Targets were scaled with $T \propto E^{1/3}$, R $\propto E^{1/3}$

TC7888

Summary/Conclusions

Polar drive can be used with indirect-drive phase plates to generate highly uniform implosions for neutron diagnostic development

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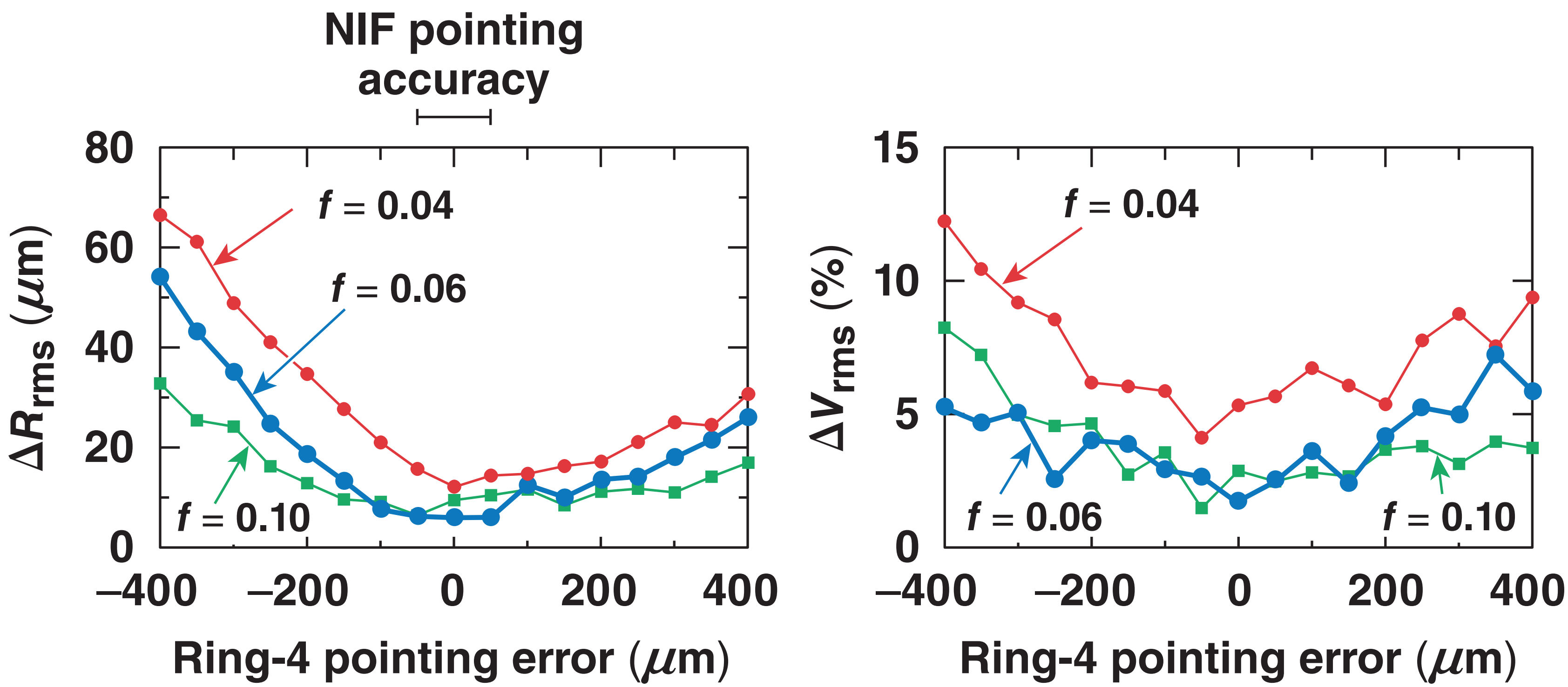
These targets can also provide initial tests of polar drive on the NIF.

TC7945a

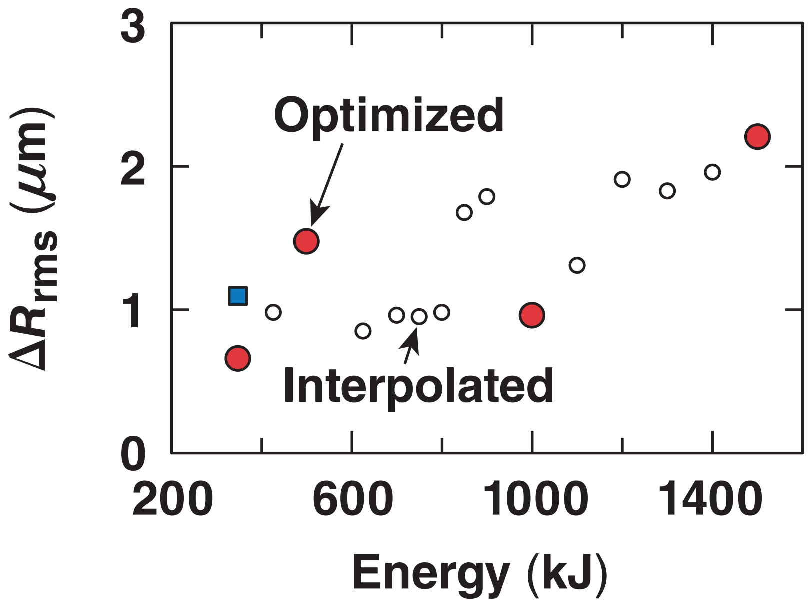
The optimum pointing is not strongly dependent on the flux limiter

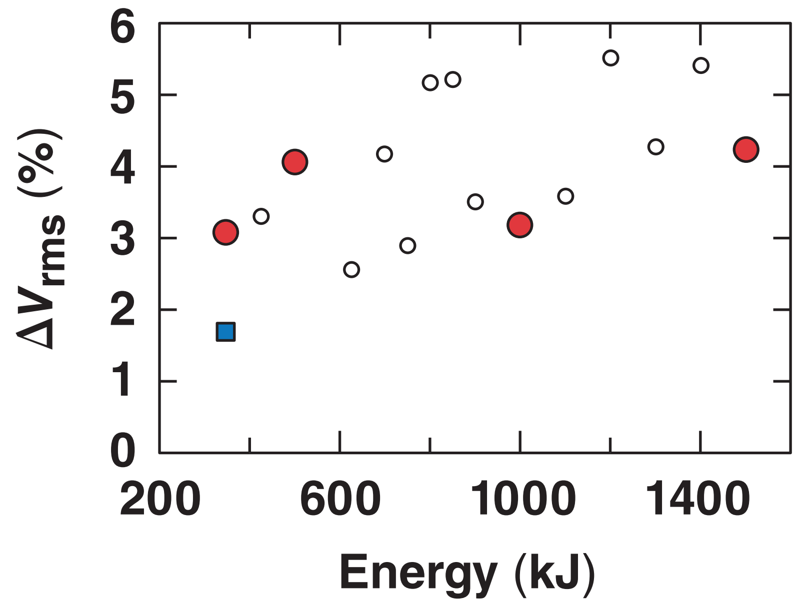


- The NIF pointing accuracy is easily adequate.

TC7887

The uniformities obtained from interpolated designs are consistent with those from the four optimized designs





TC7889