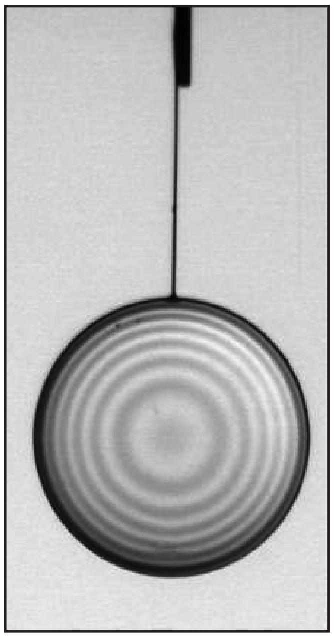
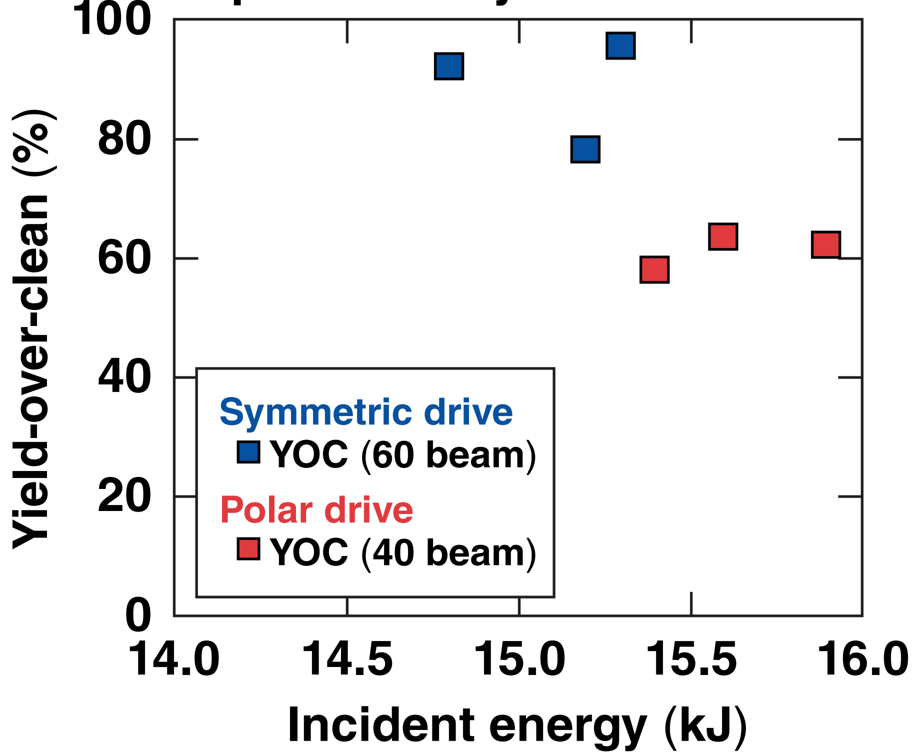
Design of High-Neutron-Yield, Polar-Drive Targets for Diagnostic Activation Experiments on the NIF



Target image at TCC

Average symmetric D_2 experimental yield = 4.6×10^9



P. W. McKenty
University of Rochester
Laboratory for Laser Energetics

51st Annual Meeting of the
American Physical Society
Division of Plasma Physics
Atlanta, GA
2–6 November 2009

Summary

Polar-drive (PD) designs will meet the neutron-diagnostic-development requirements for the NIF

- High neutron yields are obtained from simple, room-temperature, glass microballoon targets
- Uniform PD illumination is possible using existing NIF phase plates
  - defocus the beams
  - repoint the beams
  - spread the beams within certain quads
- OMEGA experiments using NIF targets and PD illumination are producing ~60% of the predicted 1-D yields.
- Yields approaching 10^{16} are expected for 1 MJ of incident light on the NIF

Collaborators

R. S. Craxton, J. A. Marozas, A. M. Cok, M. Bonino,
D. R. Harding, D. D. Meyerhofer, and R. L. McCrory

University of Rochester
Laboratory for Laser Energetics

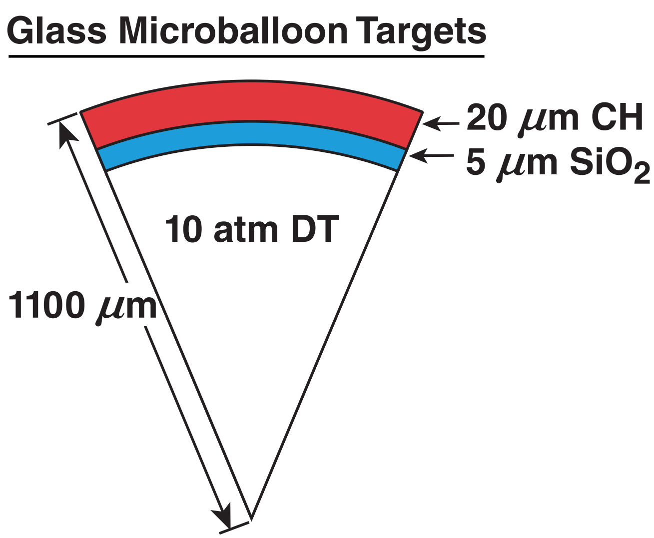
J. D. Kilkenny, A. Nikroo, J. Fooks, and M. L. Hoppe

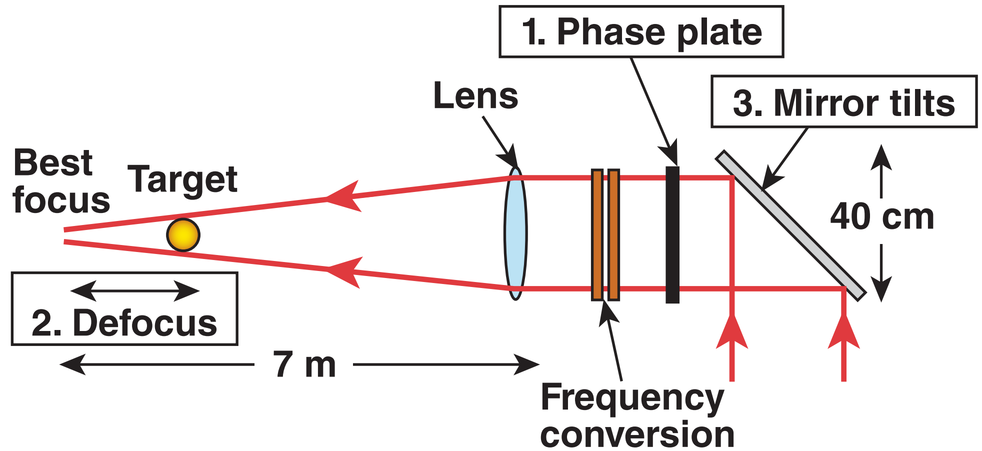
General Atomics Corporation
LaJolla, CA

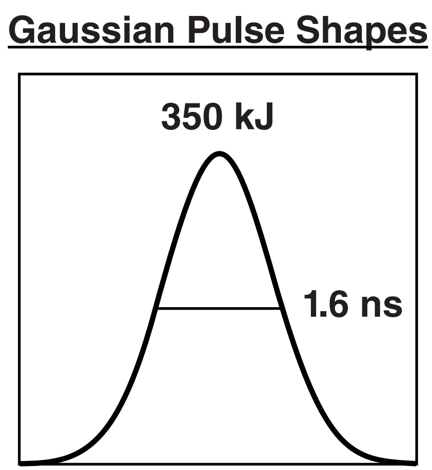
J. M. Edwards, A. J. MacKinnon, D. H. Munro, and R. Wallace

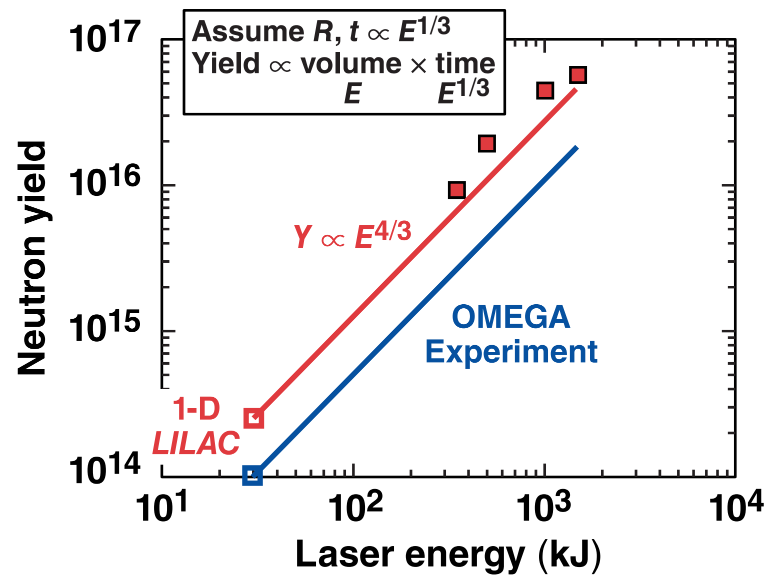
Lawrence Livermore National Laboratory
Livermore, CA

Original polar-drive designs employed existing NIF ID phase plates to access a wide range of diagnostic yields





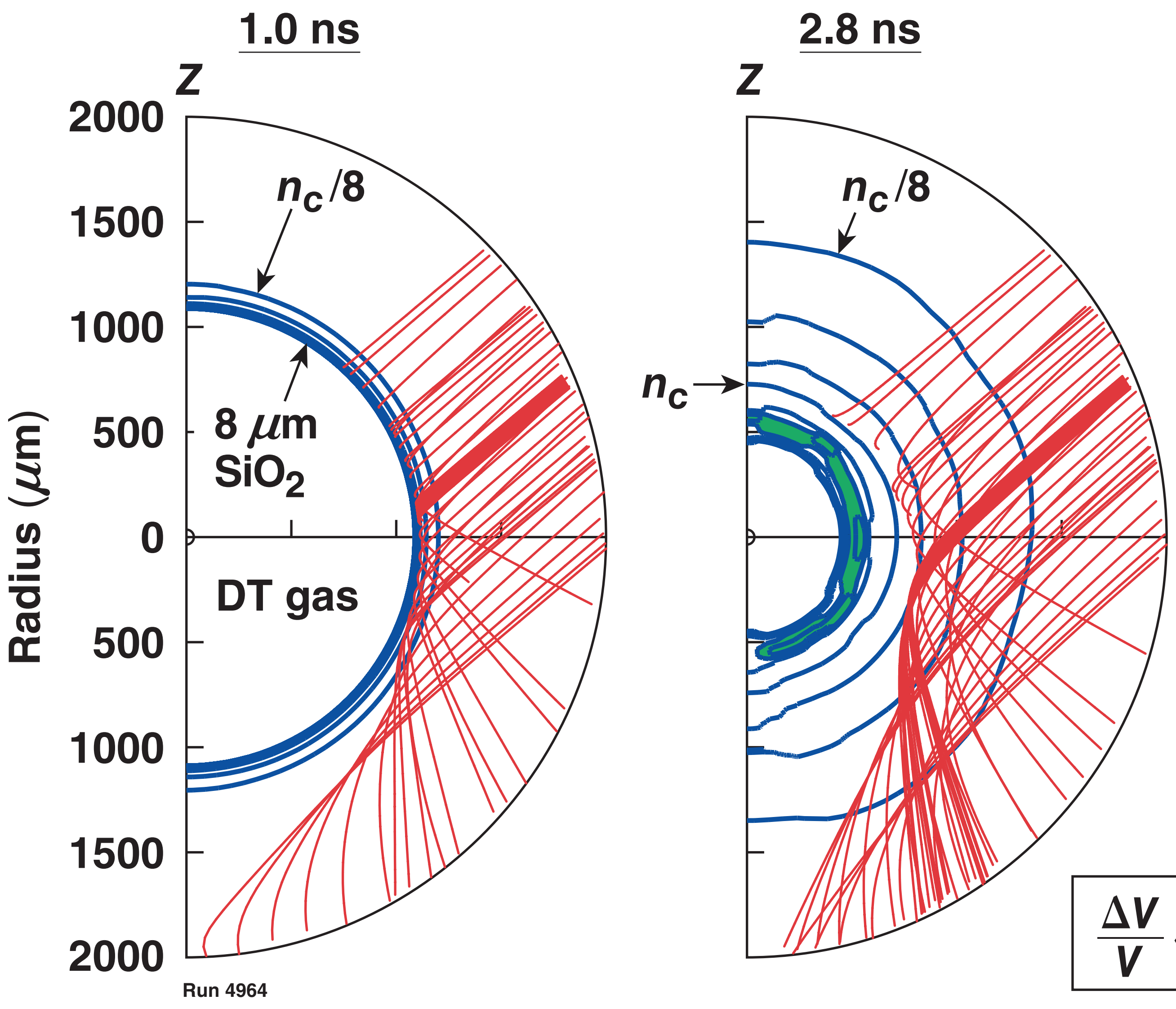




I1844b

*A. M. Cok, R. S. Craxton, and P. W. McKenty, Phys. Plasmas 15, 082705 (2008).

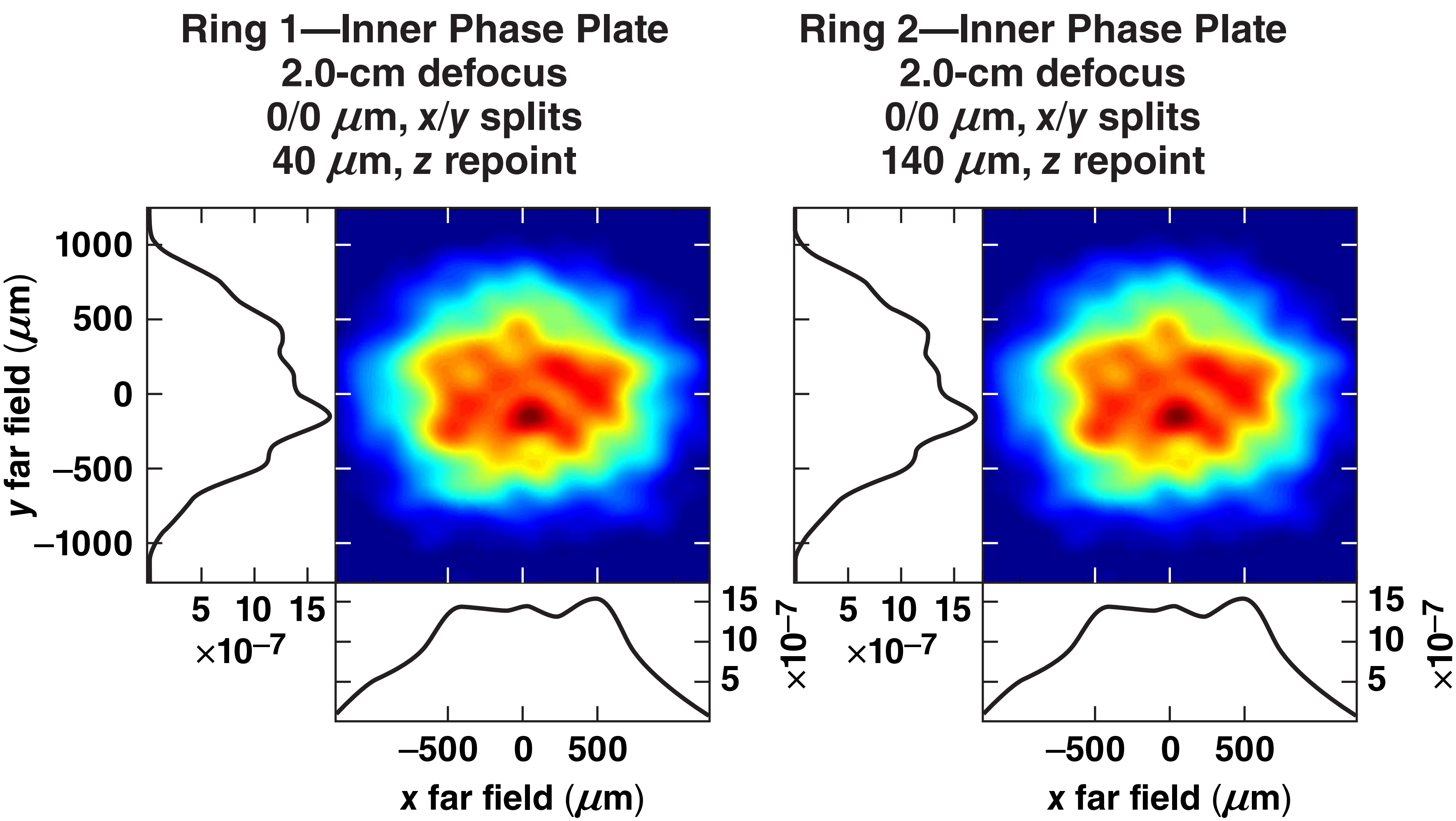
SAGE 3-D PD ray trace is employed to demonstrate that the shell implodes with a high degree of uniformity



$$\frac{\Delta V}{V} \sim 1.7\%$$

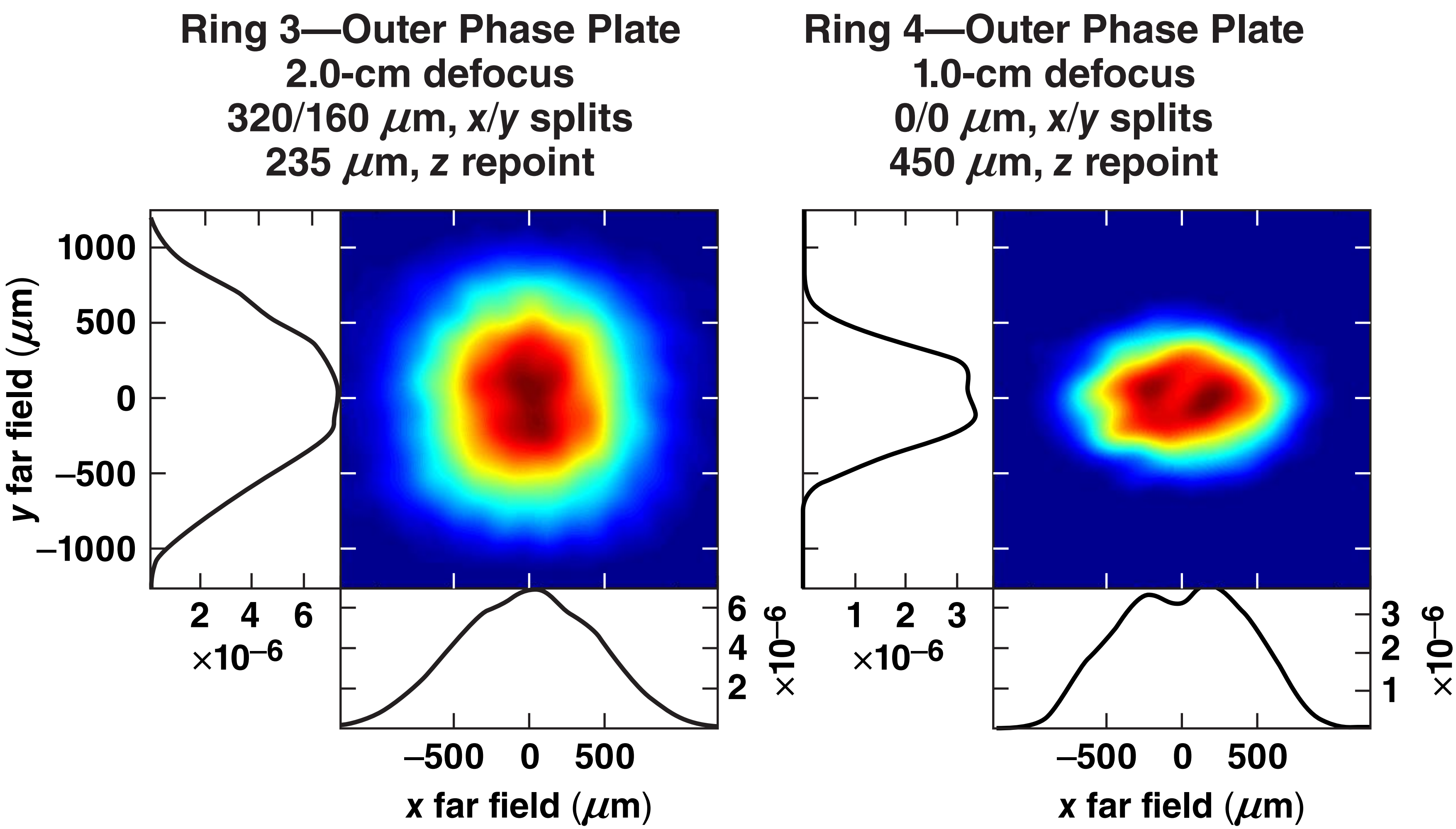
TC7885a

The two polar NIF beam rings employ inner-cone phase plates with 2-cm defocus and slight repointing



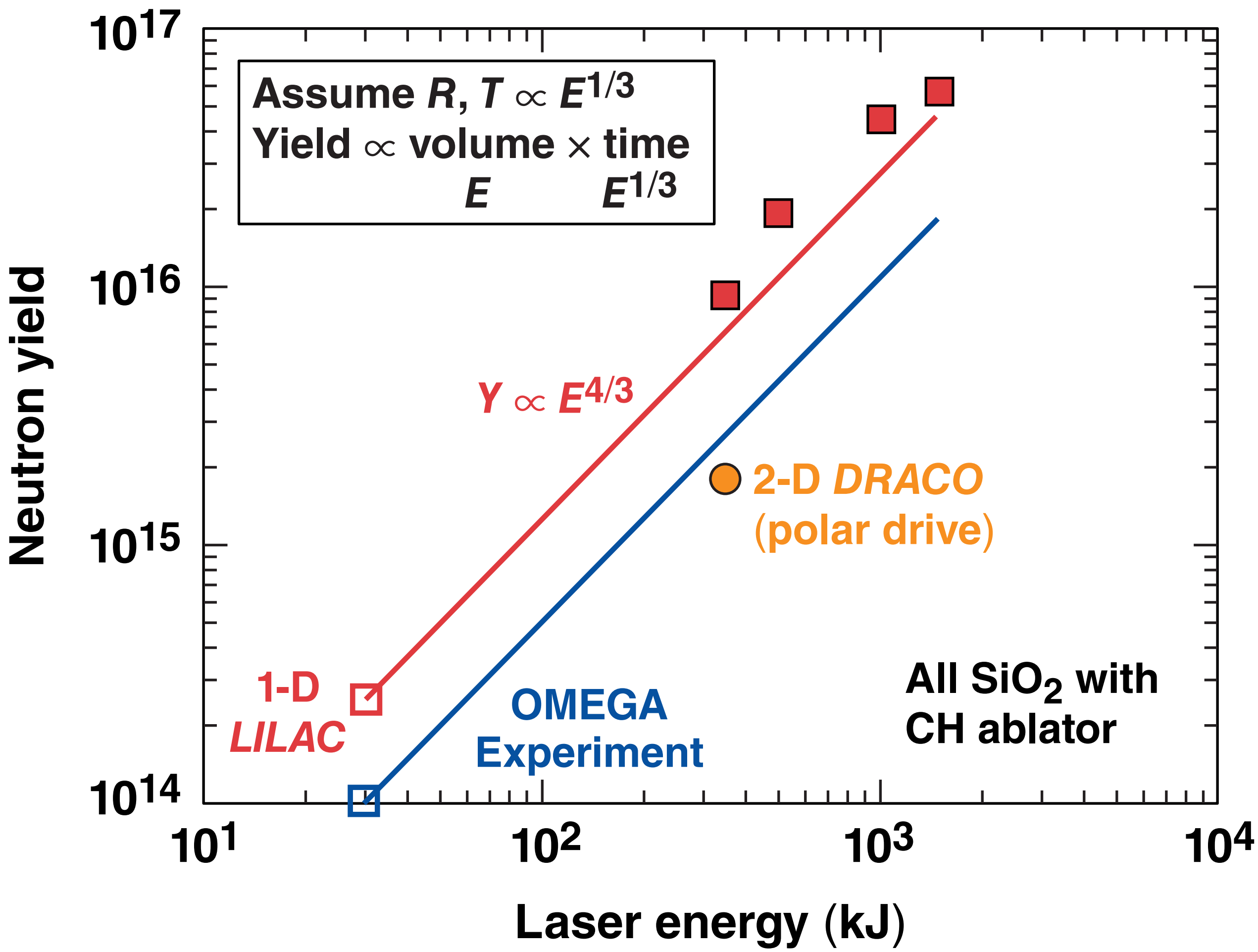
TC8525

The remaining two NIF beam rings employ outer cone phase plates with various defocus and *x*/*y* splits coupled with more significant repointing



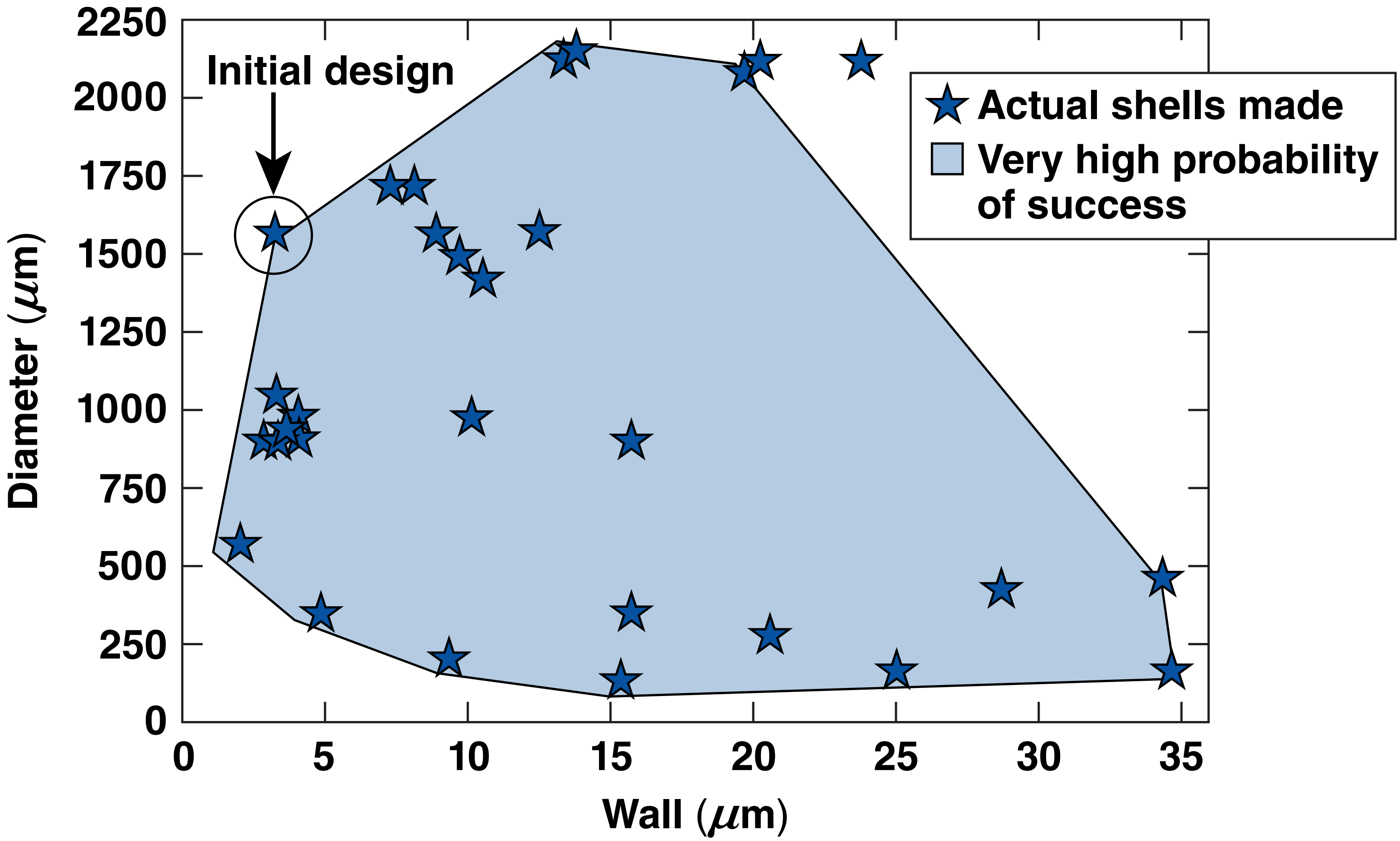
TC8526

The anticipated yields are consistent with OMEGA results and a very simple scaling model



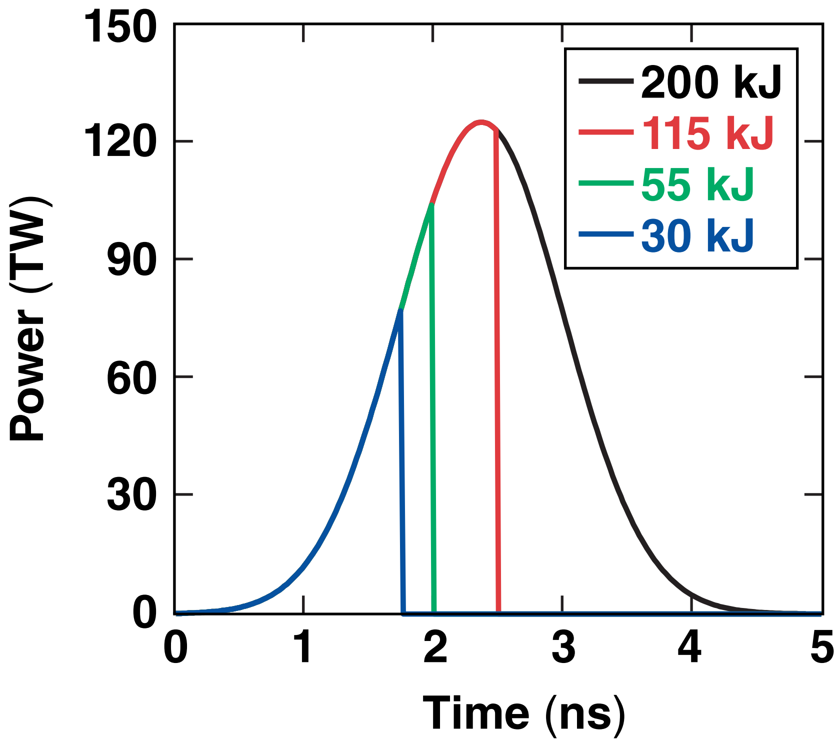
TC8162

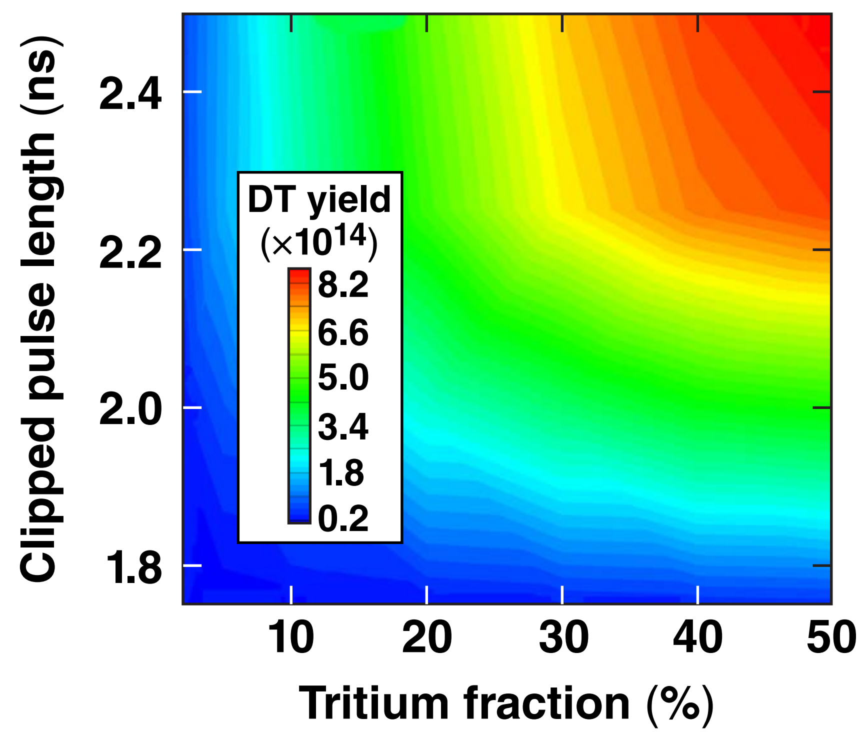
Current target-fabrication capabilities limit 4-μm-wall glass shells to ~1500-μm OD



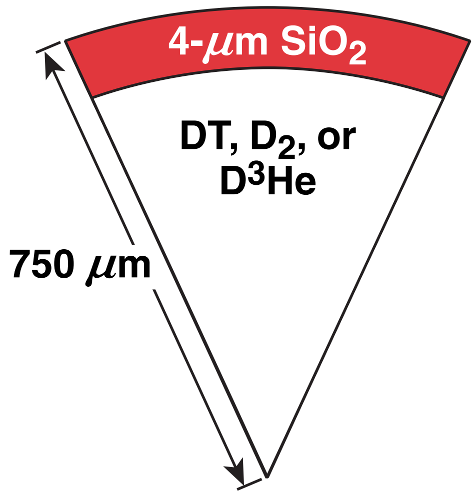
TC8524a

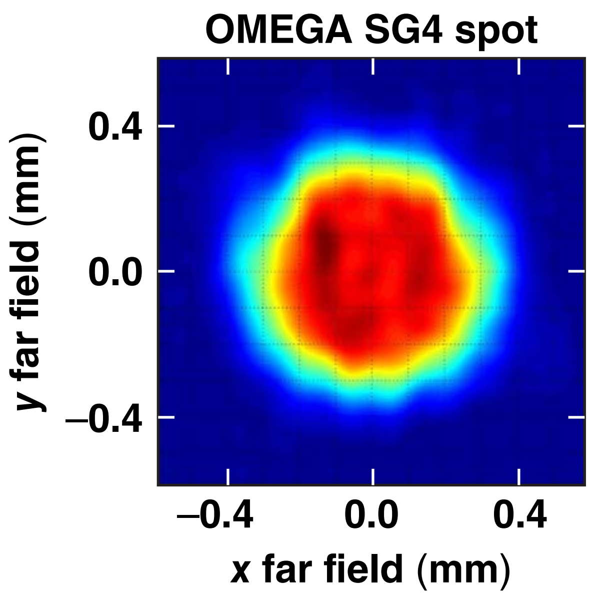
Pulse clipping and variable tritium fill ratios provide simple levers to achieve desired neutron yields for NIF commissioning shots

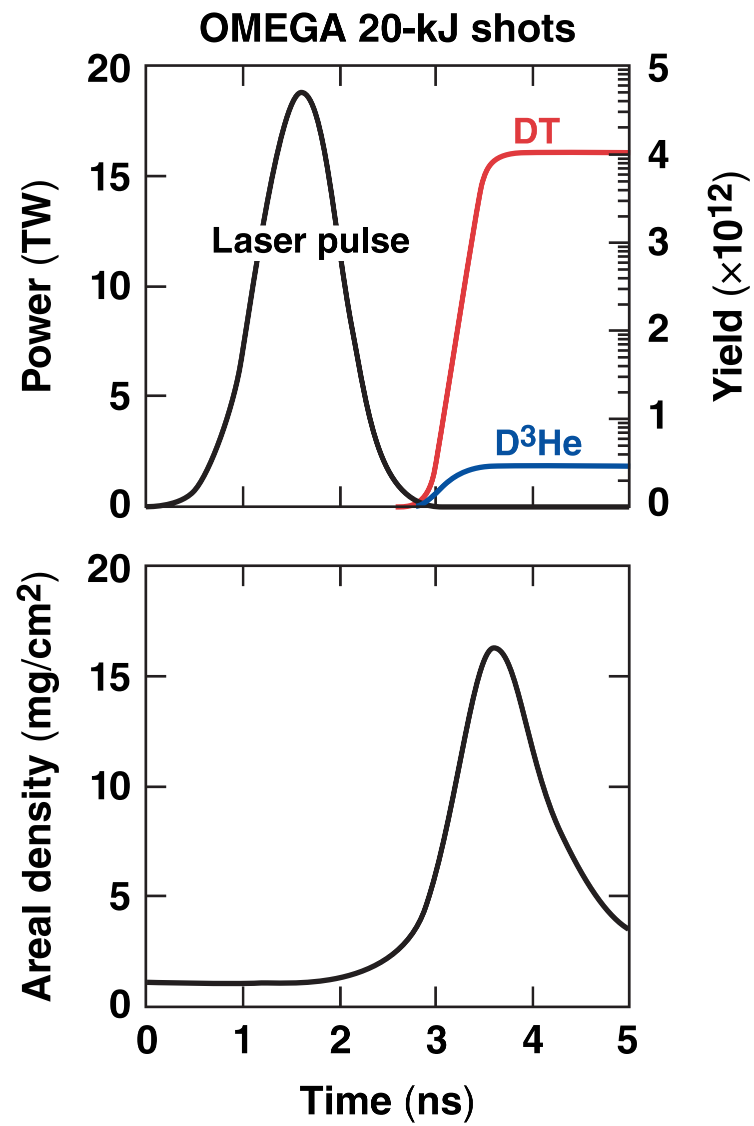




OMEGA shots are underway to test the overall PD defocusing scheme using an actual NIF target

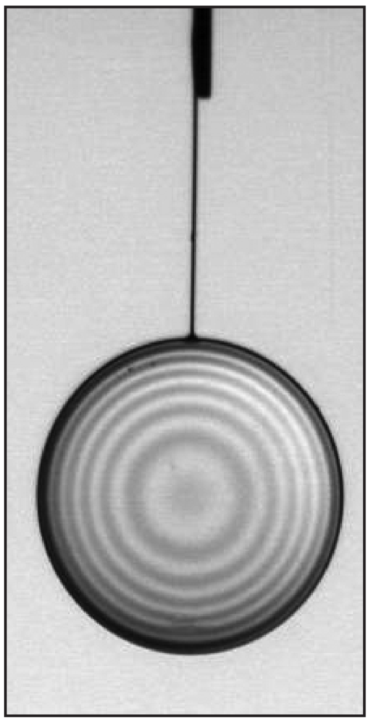




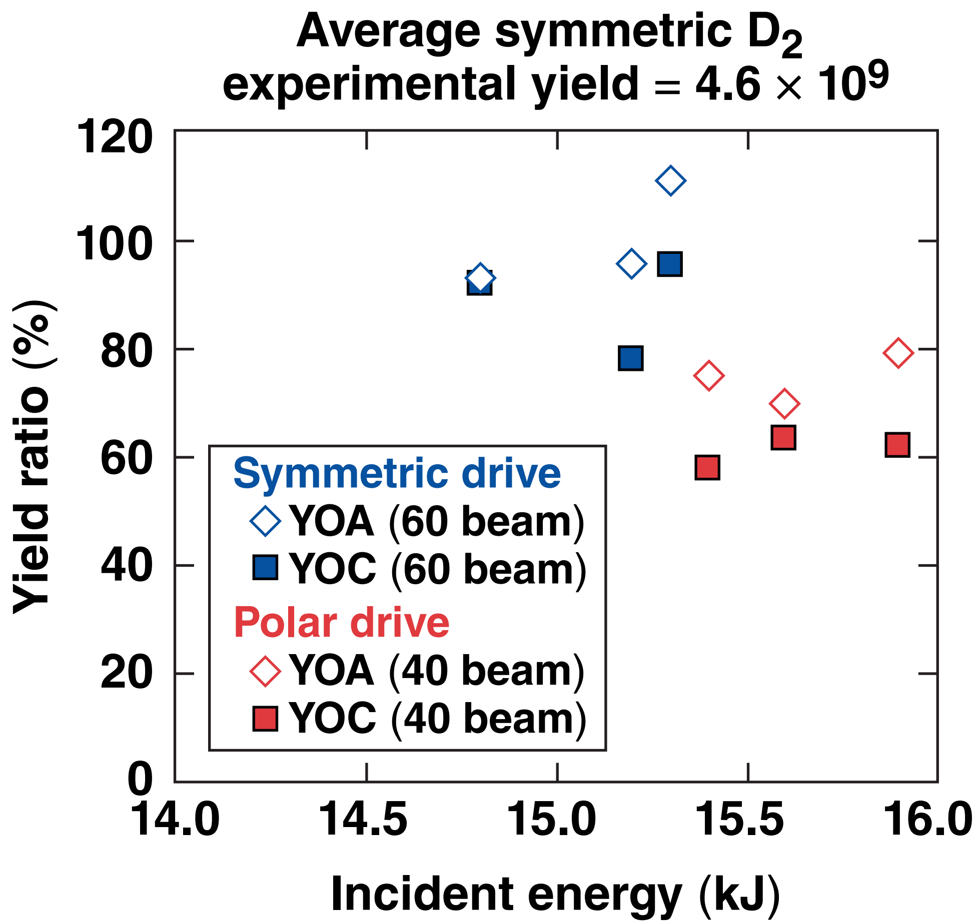


TC8529

OMEGA experiments, utilizing a NIF-size target, have demonstrated PD yields of ~60% of 1-D predictions

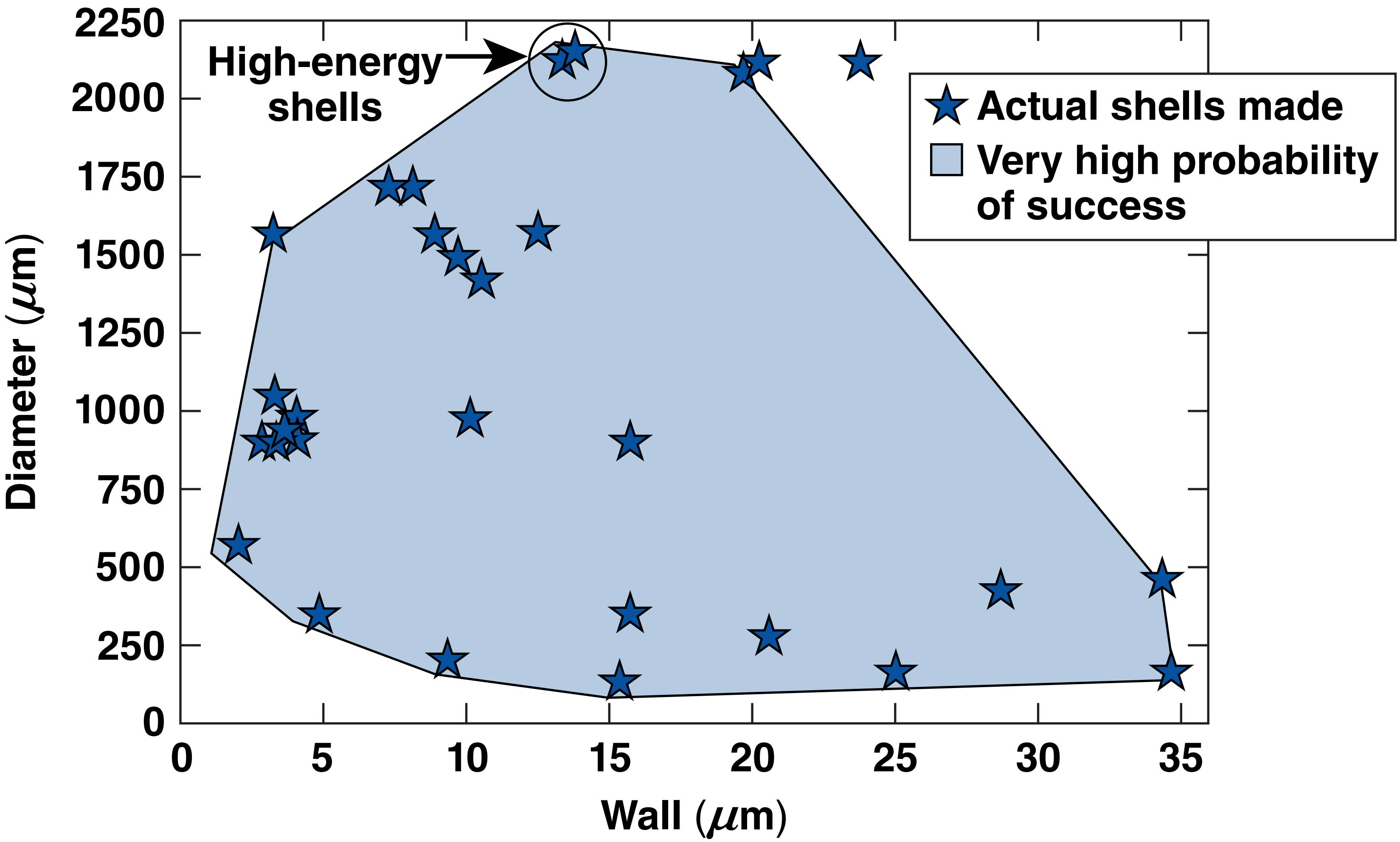


Target image at TCC



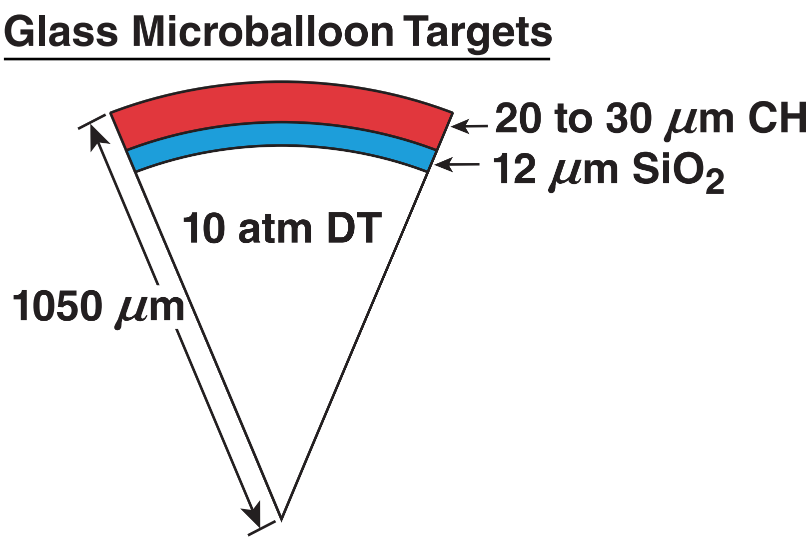
TC8530a

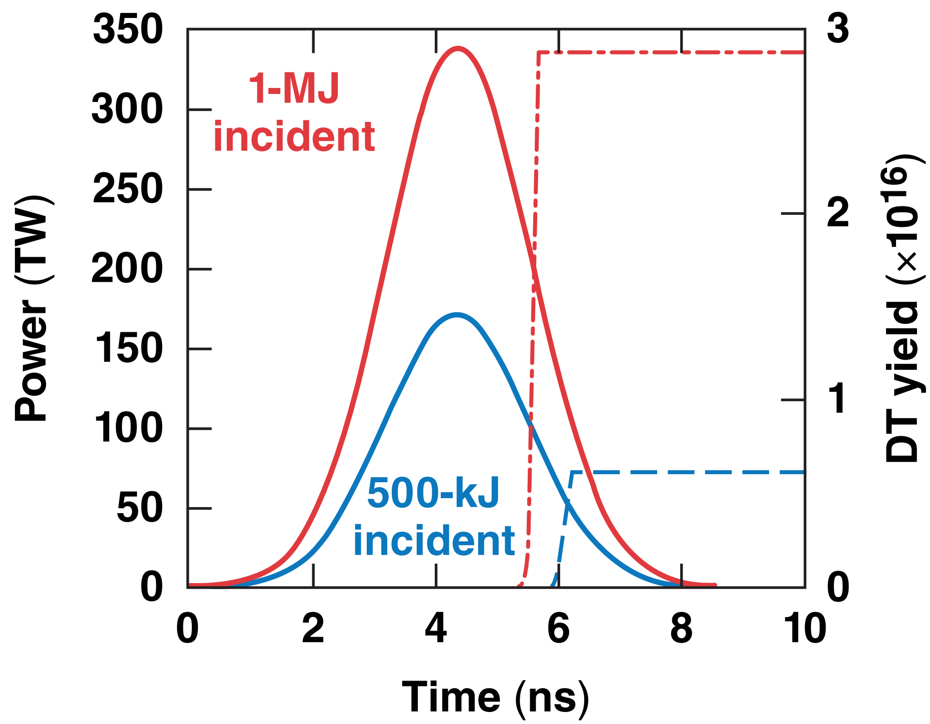
Neutron yields approaching 10^{16} will require the largest Hoppe shells manufactured to date



TC8524b

Simple PD designs employing accessible Hoppe targets can deliver high neutron yields in May 2010





TC8641

Summary/Conclusions

Polar-drive (PD) designs will meet the neutron-diagnostic-development requirements for the NIF

UR LLE

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