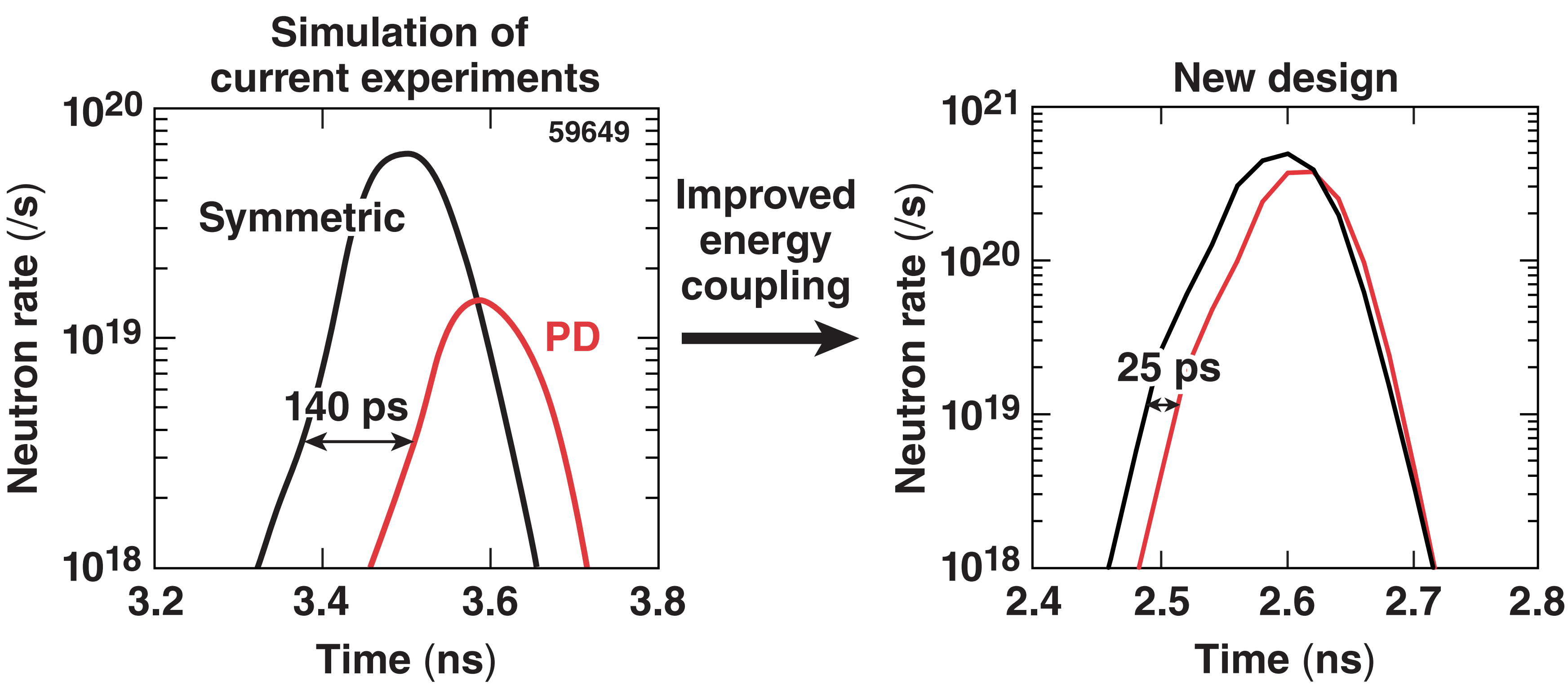
Polar-Drive Designs for OMEGA



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Summary

Improved target performance in OMEGA polar drive (PD) experiments can be obtained with custom beam profiles

- Current triple-picket low-adiabat, high-convergence PD OMEGA implosions result in a 29±10% yield and a bang time delayed by ~140 ps relative to symmetric drive
- This reduction in target performance is primarily due to reduced implosion velocity in PD relative to symmetric drive
- Optimized phase plate designs can increase implosion velocity, improving the yield relative to symmetric drive to 75% and reduce the delay in bang time to ~25 ps

Collaborators

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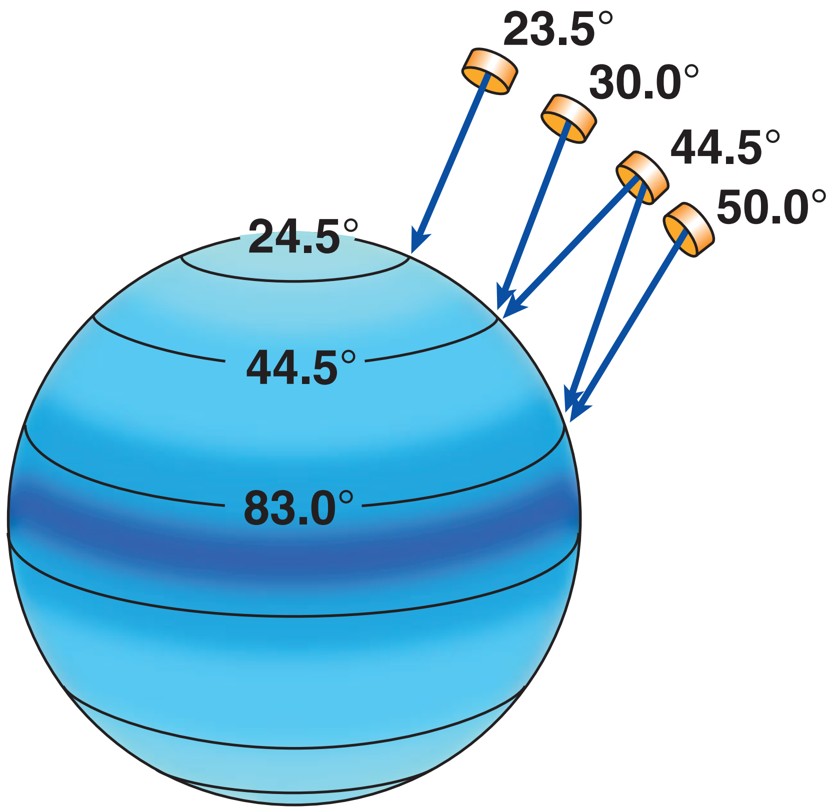
Polar drive* enables direct-drive experiments in the x-ray-drive configuration

Repointing for NIF PD†



- Oblique irradiation near the equator is at lower densities ($n = n_{crit} \times \cos^2\theta_{inc}$)
  - nonradial beams
  - reduced absorption
  - reduced hydro efficiency
  - lateral heat flow

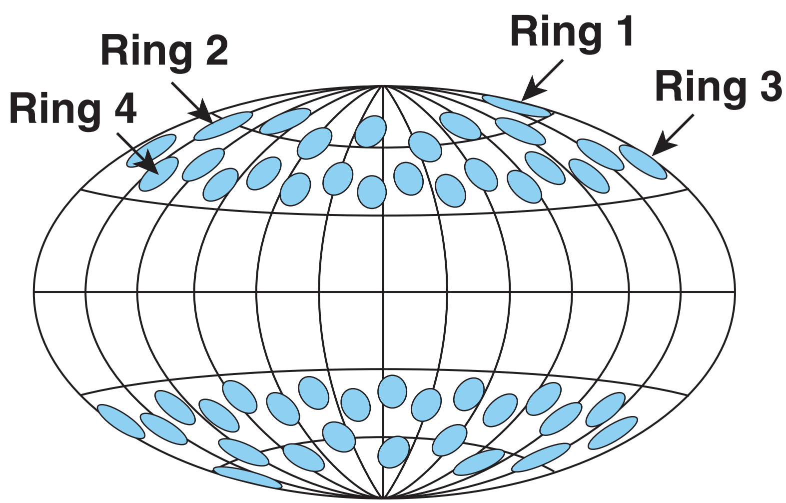
Uniform target drive with PD irradiation requires increased intensity at the equator to compensate for the oblique irradiation.

*S. Skupsky *et al.*, Phys. Plasmas 11, 2763 (2004).
†T. Collins, KI3.00002, this conference

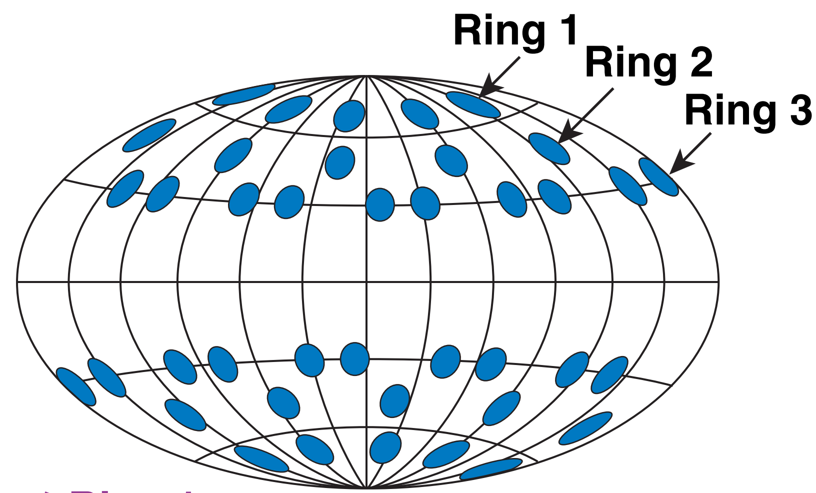
TC9532e

40 OMEGA beams emulate the 48-quad (192-beam) NIF configuration

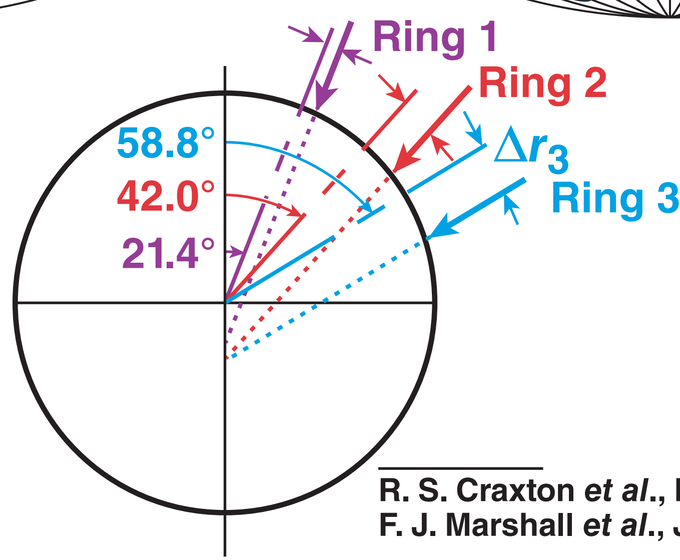
NIF configuration



OMEGA PD configuration



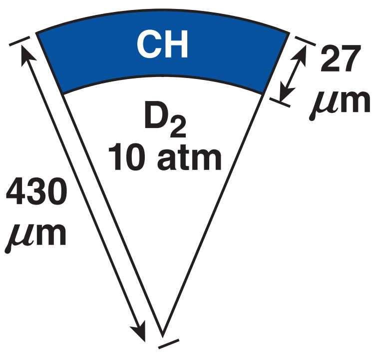
- **The remaining beams are used to backlight the shell**

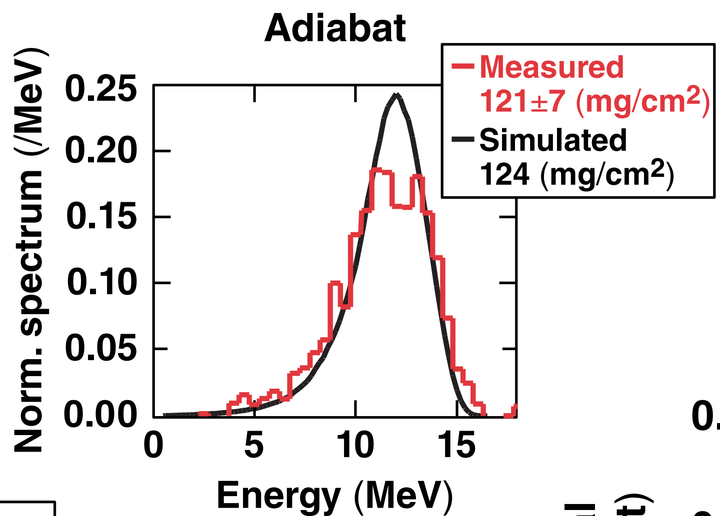


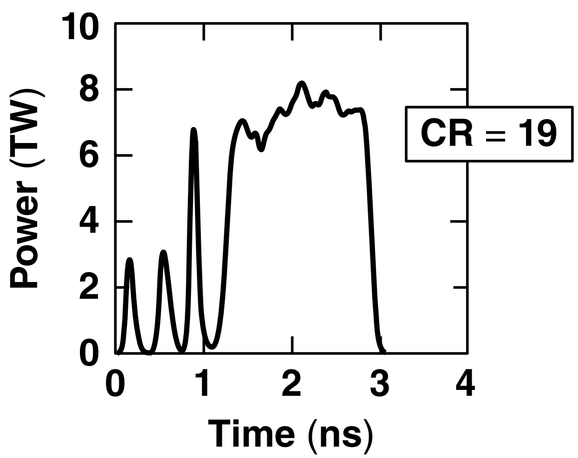
R. S. Craxton *et al.*, Phys. Plasmas 12, 056304 (2005).
F. J. Marshall *et al.*, J. Phys. IV France 133, 153 (2006).

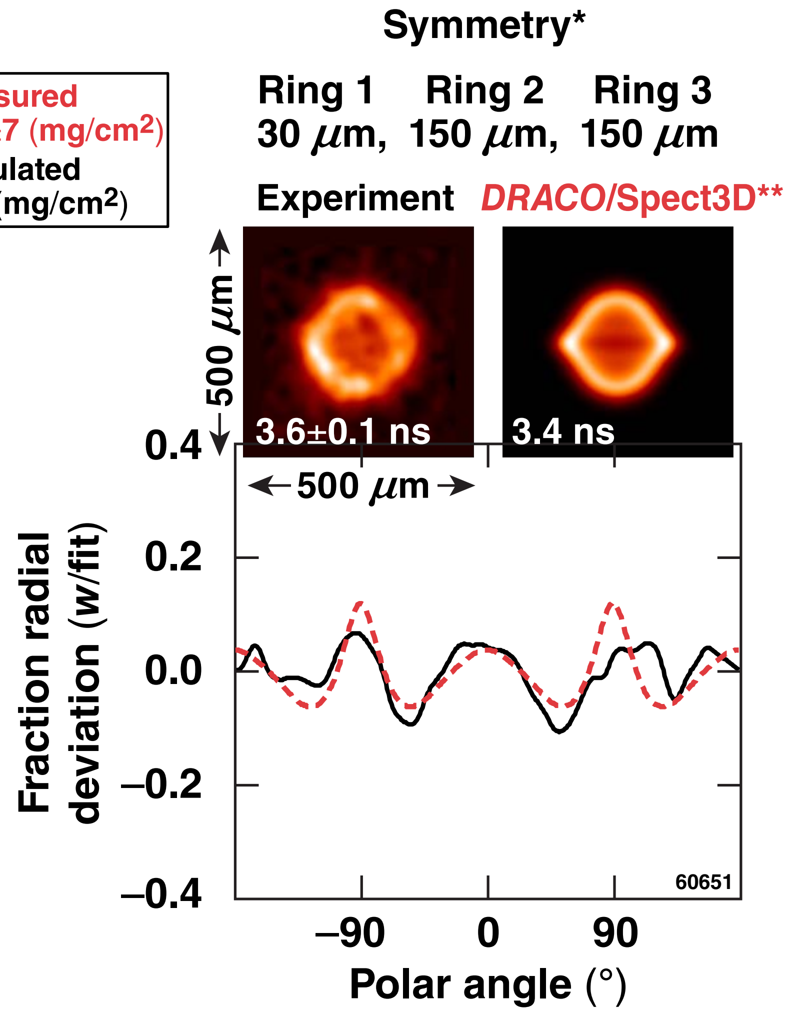
TC7194d

A high-convergence, triple-picket design is used to study PD-related physics









*F. J. Marshall, PO8.00007, this conference.
**Spect3D – J. J. MacFarlane *et al.*, High Energy Density Phys. 3, 181 (2007).

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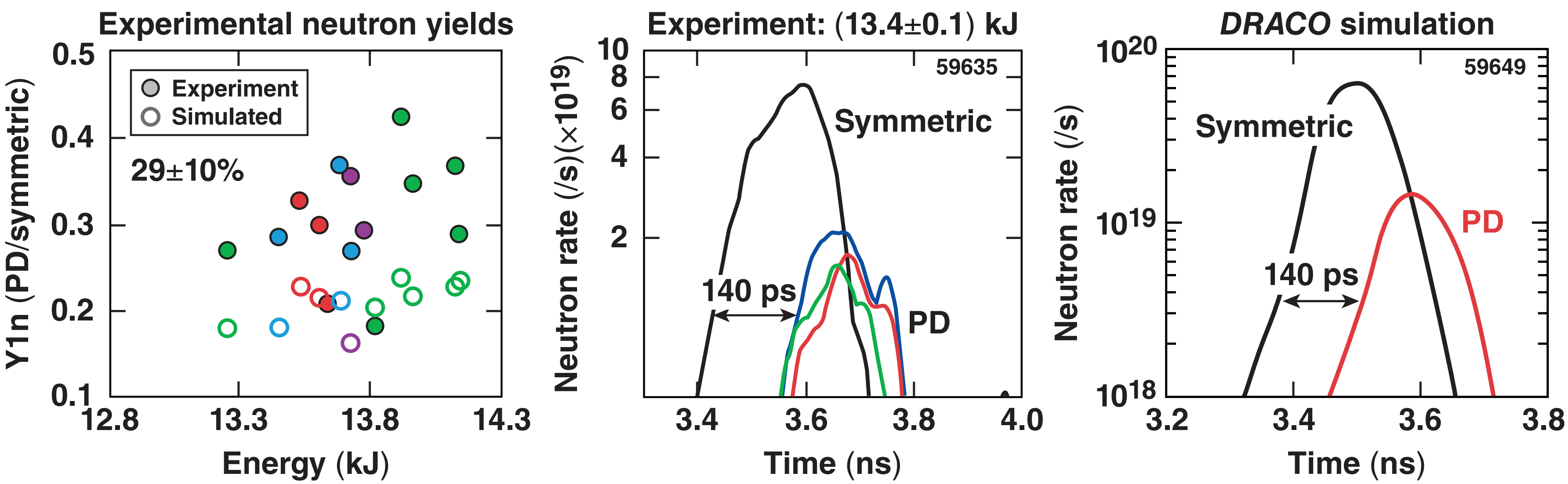
Yield reduction is primarily caused by reduced implosion velocity



Colors represent different pointing schemes

- Delay in PD bang time is due to reduced coupling and hydro efficiency
- Bang time provides a measure of implosion velocity
- $\frac{\delta V_{imp}}{V_{imp}} \sim \frac{\delta t_{bang}}{T_{laser}} \sim \frac{140 \text{ ps}}{1600 \text{ ps}} \sim 9\%$
- $Y_{1\text{-D}} \sim \langle T_i \rangle^{4.7} \sim V_{imp}^{5.9}$
- A 10% increase in V_{imp} increases $Y_{1\text{-D}}$ by nearly a factor of two

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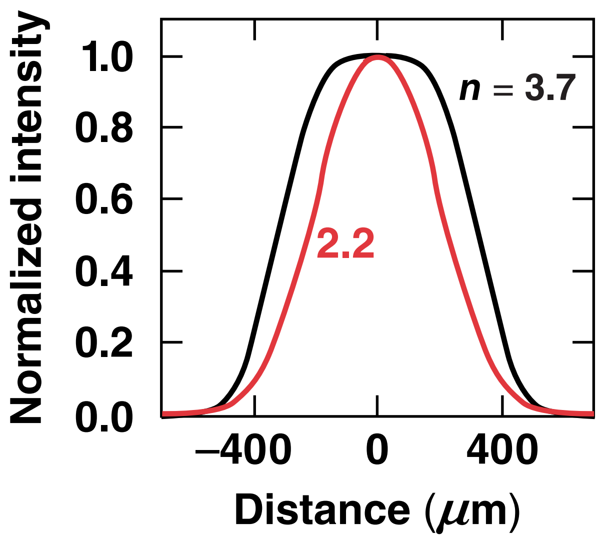
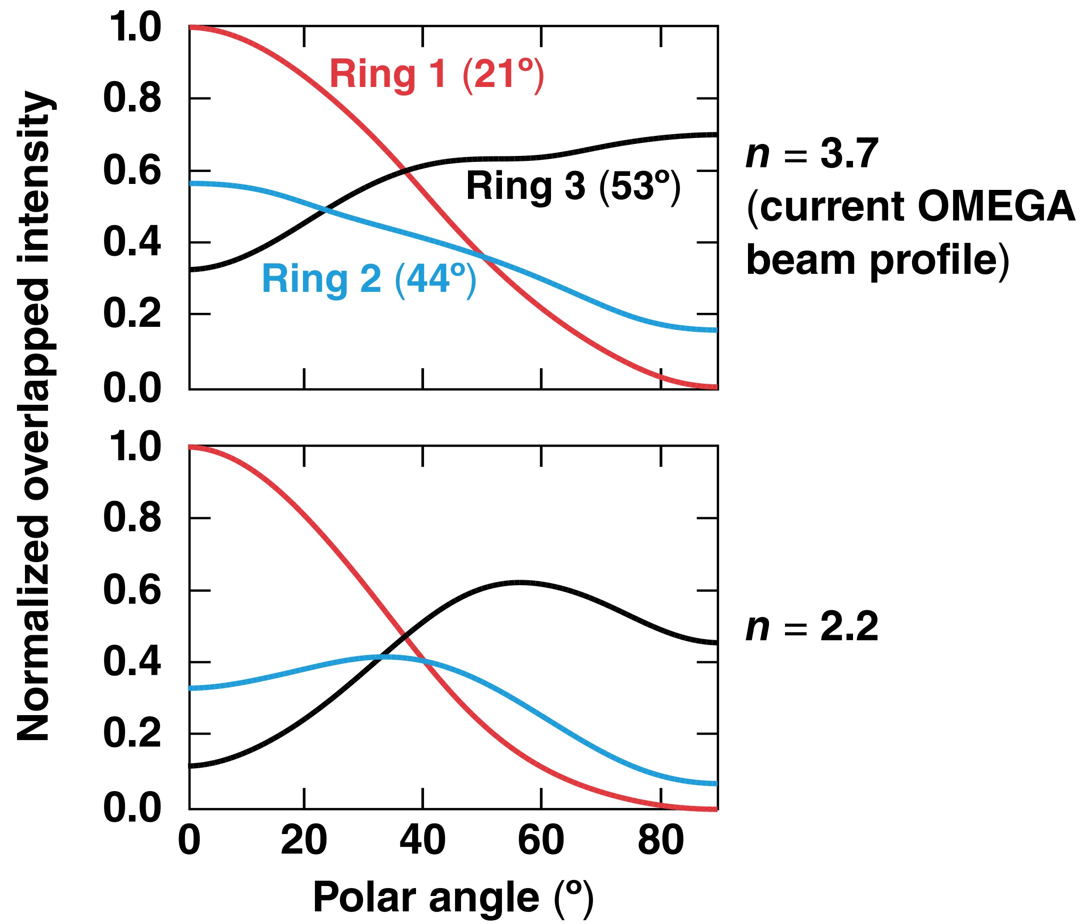
A lower super Gaussian order beam profile is necessary for localized control over energy deposited on target

Beam profile is described by:

$$I(r) = I_0 e^{-(r/\delta)^n}$$



Overlapped beam intensity for individual OMEGA rings (normalized to maximum of Ring 1)



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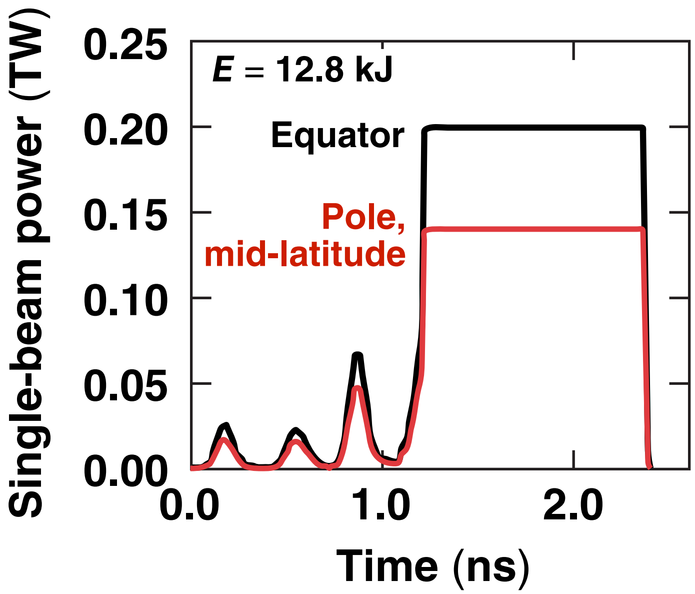
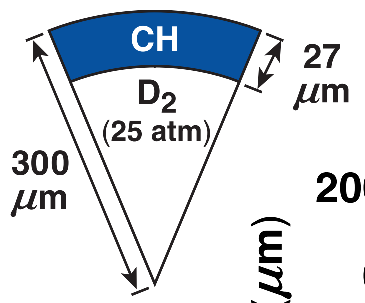
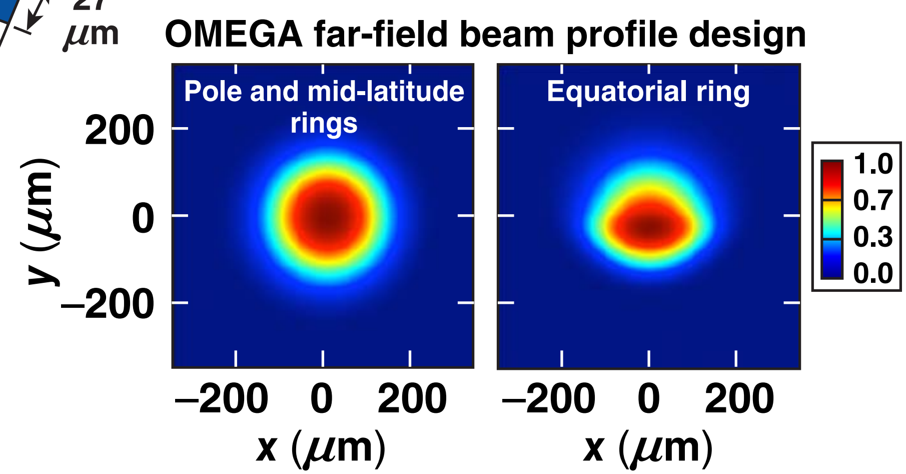
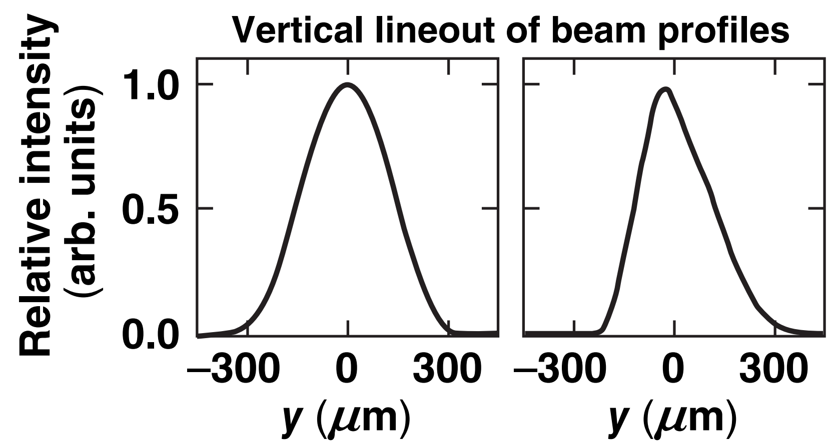
An OMEGA target design that uses similar beam profiles has been designed









- The NIF ignition design* uses similar beam profiles

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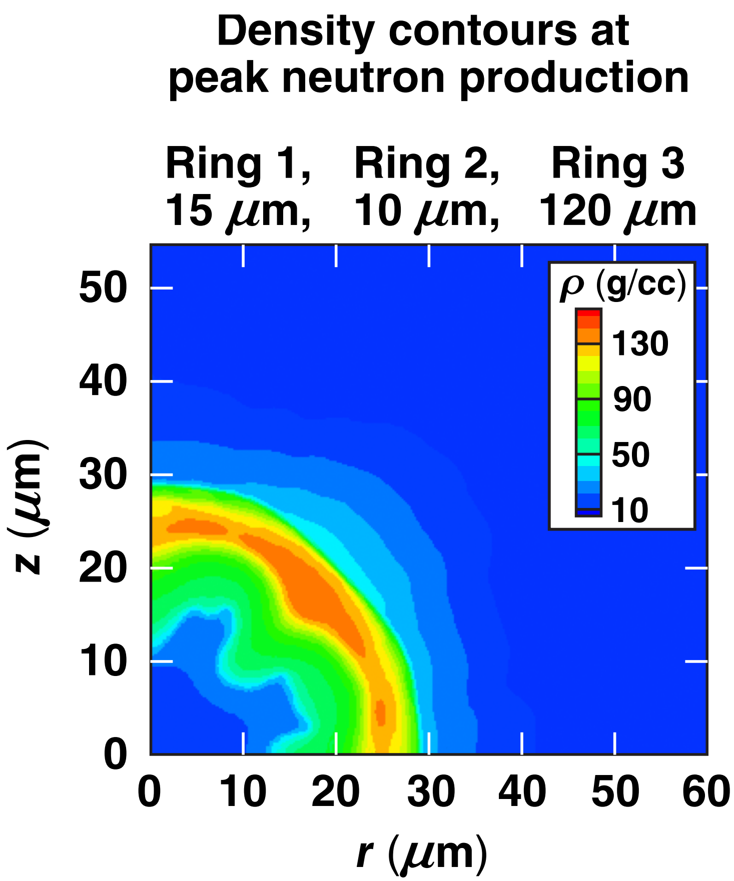
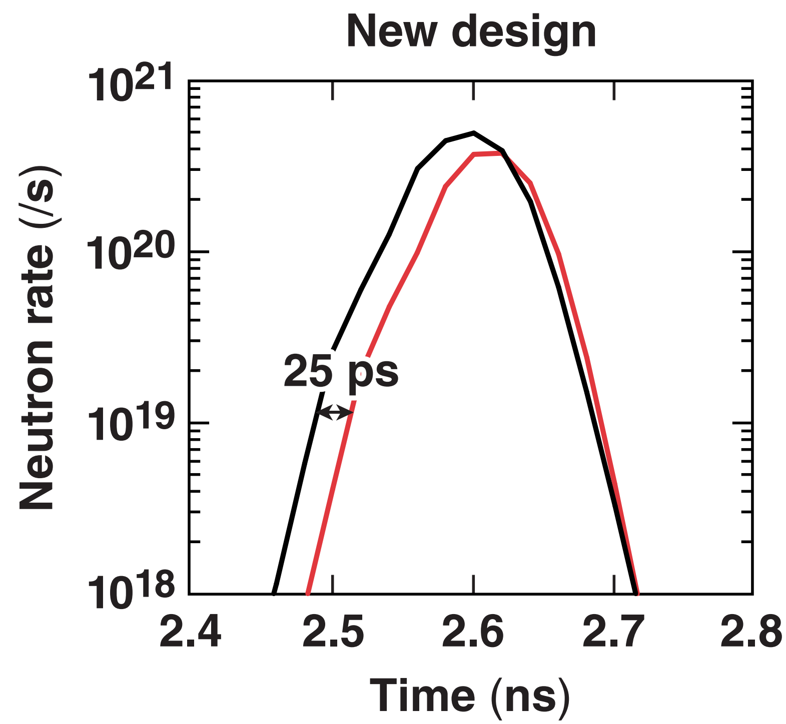
*T. Collins, KI3.00002, this conference

Better laser energy coupling (and adequate symmetry) can be achieved with custom beam profiles



Yield ratio (PD/symmetric) = 75%



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Summary/Conclusions

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