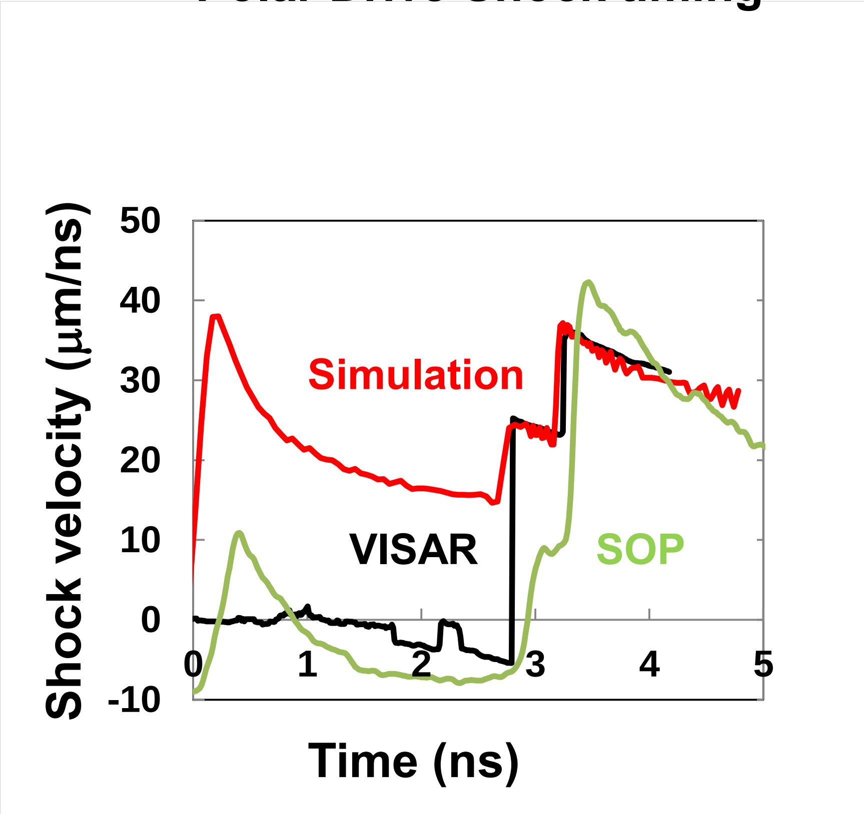
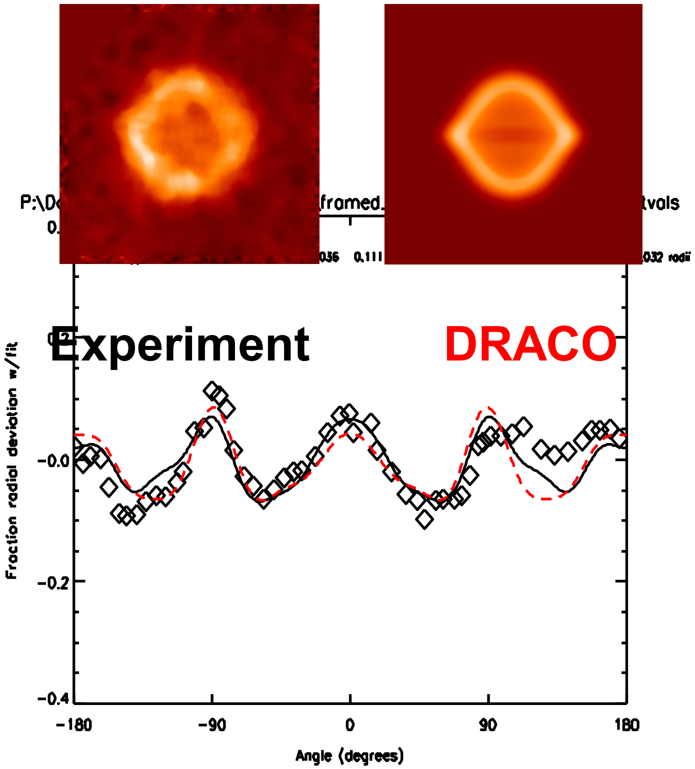
Results from Polar Drive OMEGA Experiments

Polar Drive Shock timing



Symmetry



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International Workshop on
Shock Ignition 2011
Rochester, NY

Collaborators

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Summary

Polar Drive OMEGA experiments are being used to validate/improve relevant physics models

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- Low adiabat (α~3.5) implosions with convergence ratio ~18 are irradiated with triple pickets on OMEGA in Polar Drive (PD) configuration

- Separate polar drive shock timing experiments indicate that shock velocities are adequately modeled

- Overall target performance has been studied for several repointed PD configurations
  - delayed observed bang times relative to simulations indicate loss of drive
  - near-1D areal densities are obtained
  - near-predicted symmetry is obtained with differently repointed beams
  - yields are reduced by ~x5 relative to symmetric drive

- Implosions involving the systematic exploration of various knobs (target shimming, beam energies, phase plates etc.) are being designed and will be tested on OMEGA

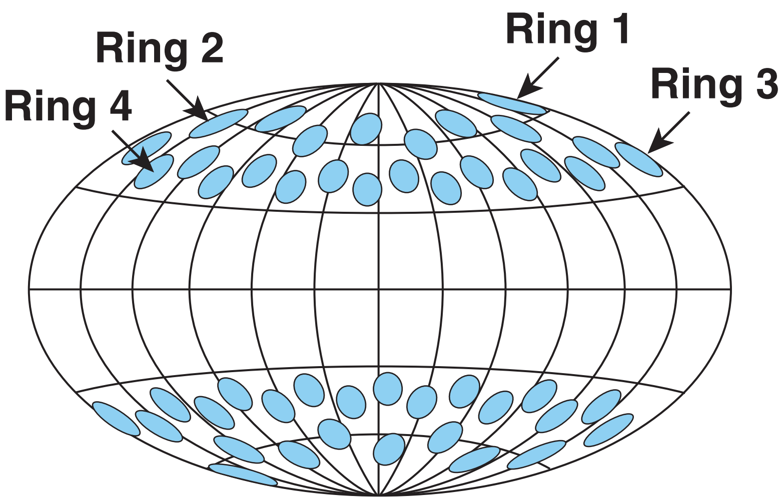
OMEGA experiments will address some of the basic questions relating to polar drive (PD)

The goal is to validate/improve models relating to laser deposition, heat conduction, and nonuniformity growth

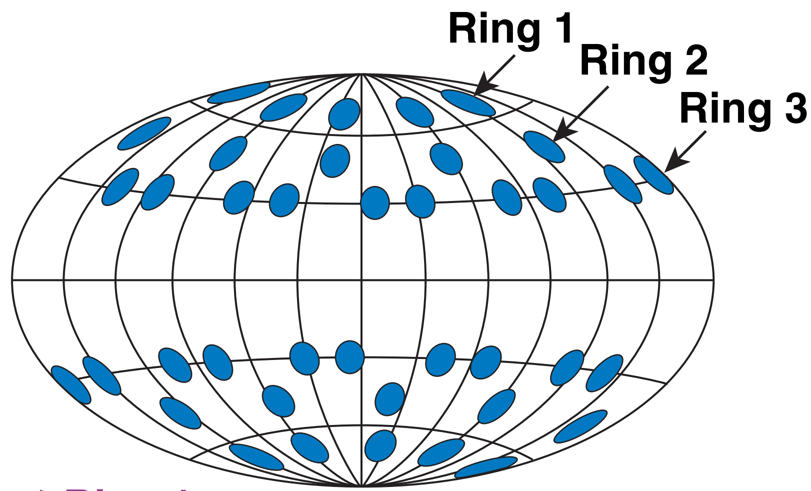
- **Can we model shock timing adequately in PD configuration?**
- **Can we tease-out information about drive for oblique angles of incidence?**
- **Can we predictably change shell nonuniformity?**
- **Can we improve the nonuniformity on target using knobs that we have – pointing, target shimming, energies, beam shapes etc?**
- **Can we couple more energy into the target by using a combination of the knobs?**

40 OMEGA beams are used to emulate the 192 beam (48 quad) NIF configuration

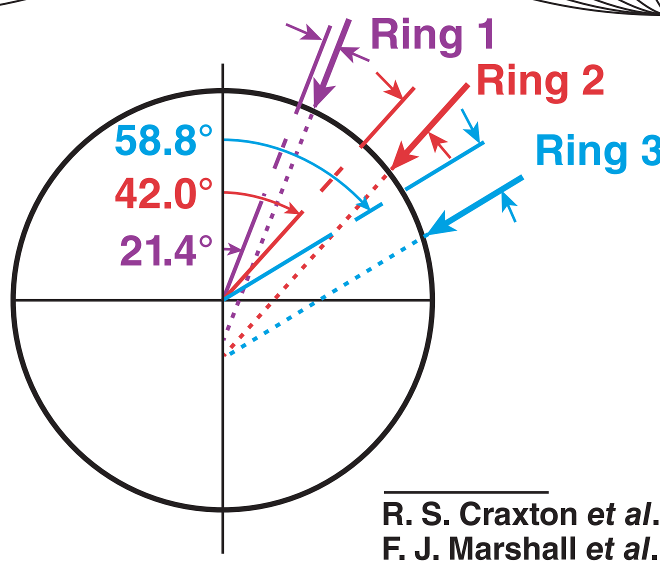
NIF configuration



OMEGA PD configuration

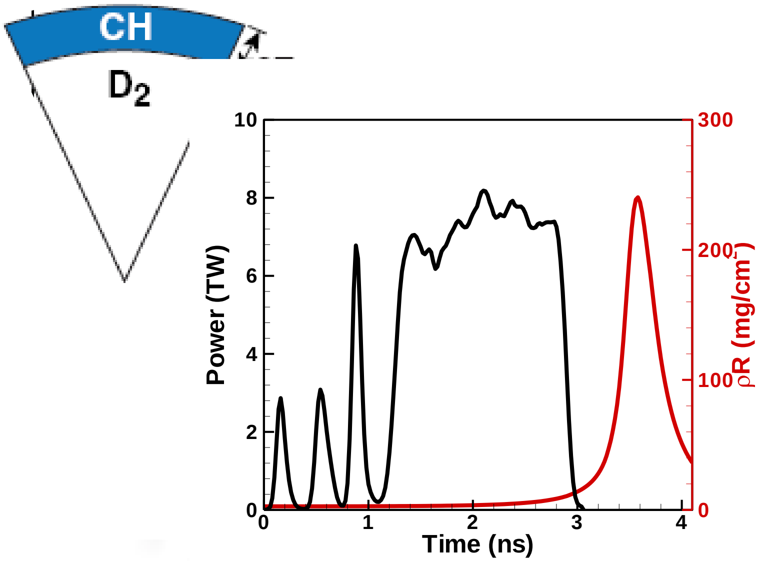


- **The remaining beams are used to backlight the shell.**

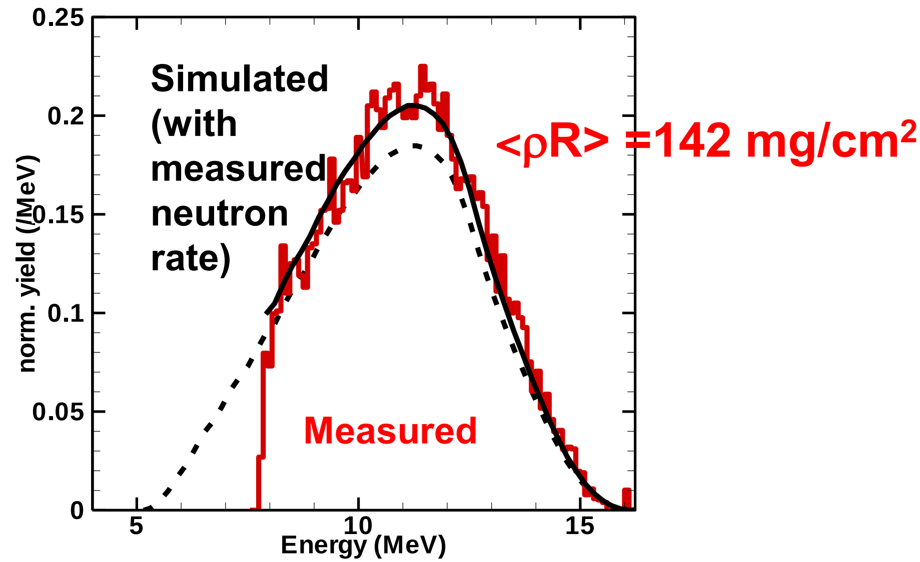


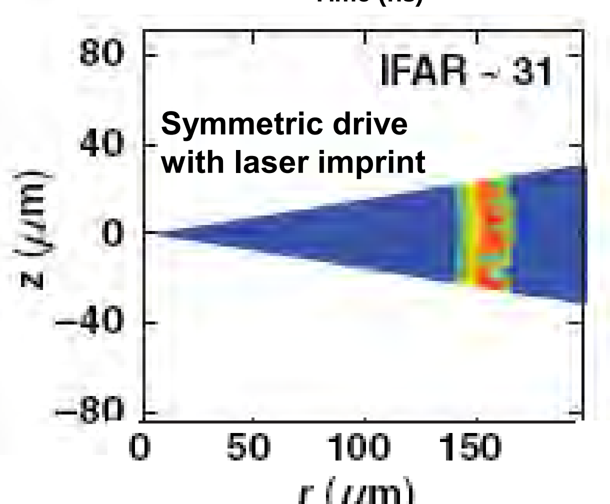
R. S. Craxton *et al.*, Phys. Plasmas 12, 056304 (2005).
F. J. Marshall *et al.*, J. Phys. IV France 133, 153 (2006).

A triple picket warm CH design* is currently used for PD studies



CR~18 (peak neutron production)
α~3.5
IFAR~31
E(laser)=13.5 kJ
<ρR> = 167 mg/cm² (147 mg/cm² with NTD)





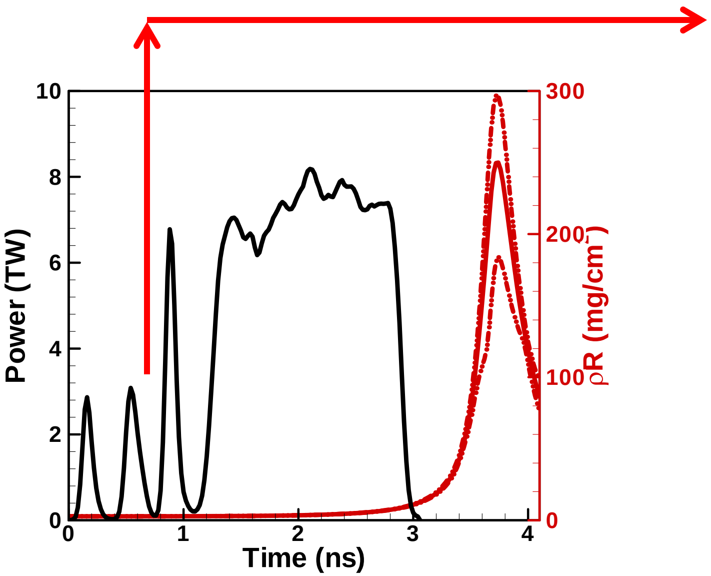
- Several re-pointed configurations have been studied thus far.

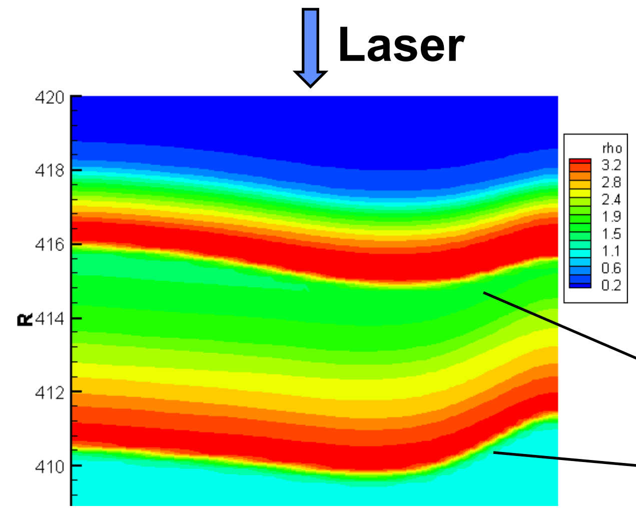
* P. B. Radha et al., Phys. Plasmas 18, 012705 (2011)

Shocks

In current OMEGA PD configurations, nonuniform shocks can distort the inner-shell significantly

(90 μm,150 μm, 150 μm)

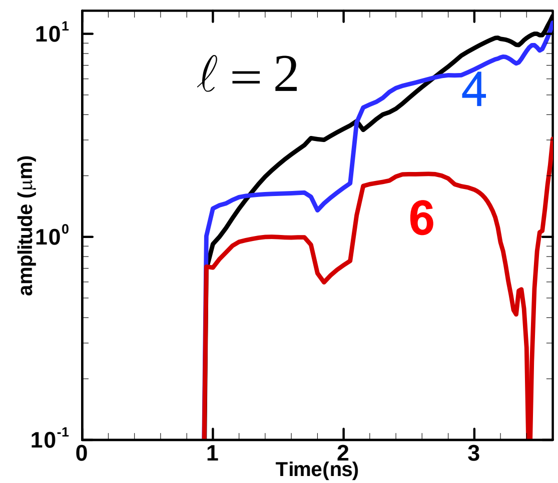




Density contours @650 ps

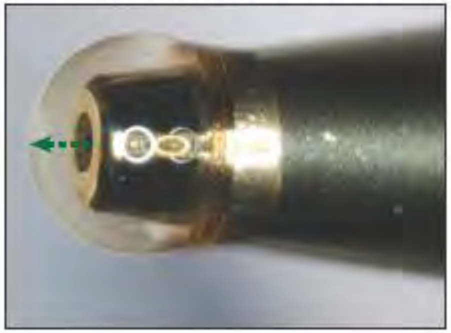
Second shock

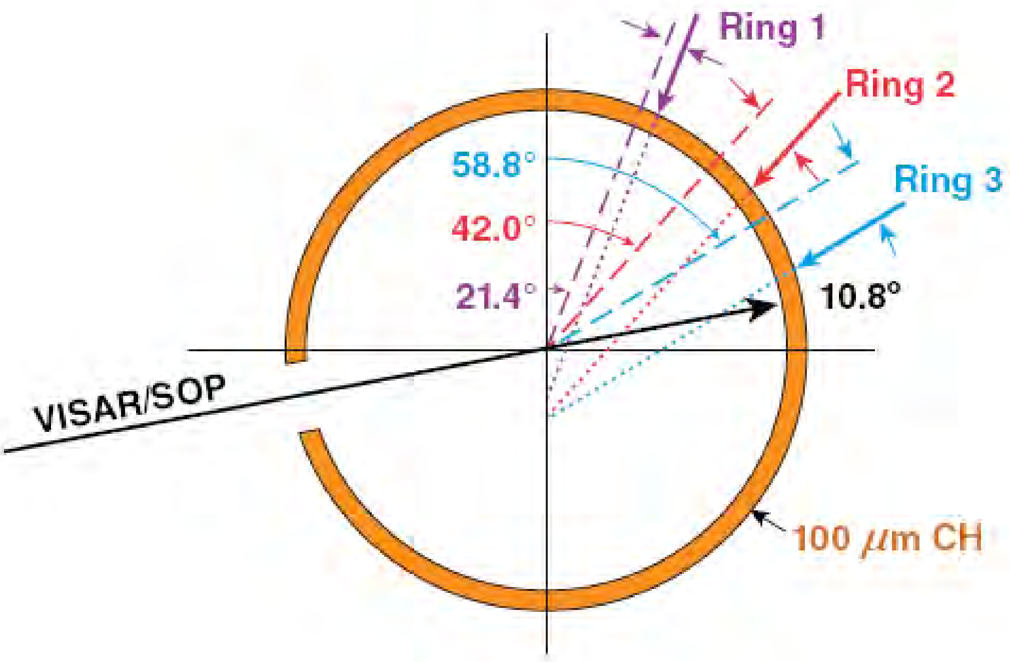
First shock



Amplitude at rear shell surface

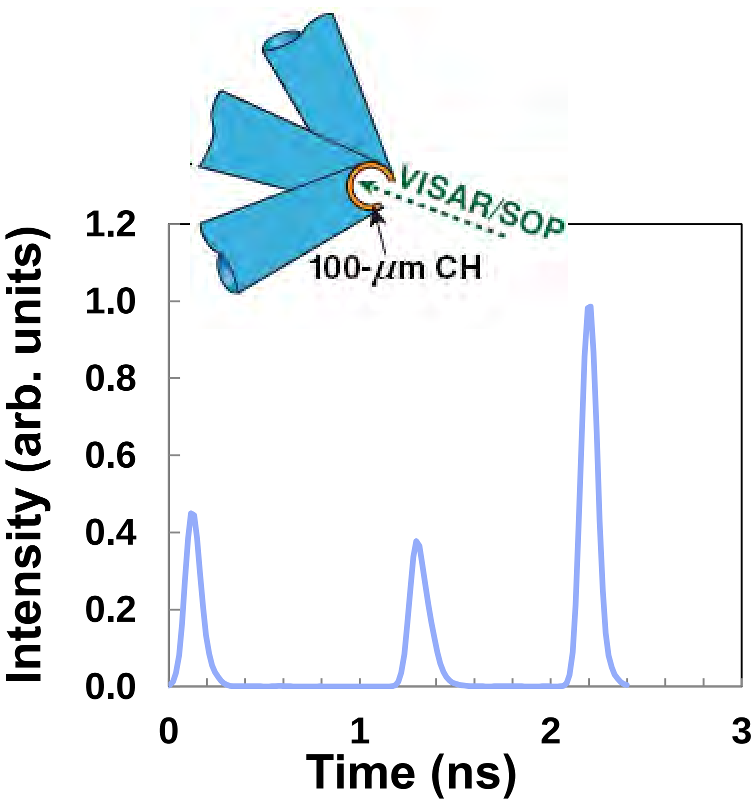
Shock velocities have been inferred close to the equator in PD configurations



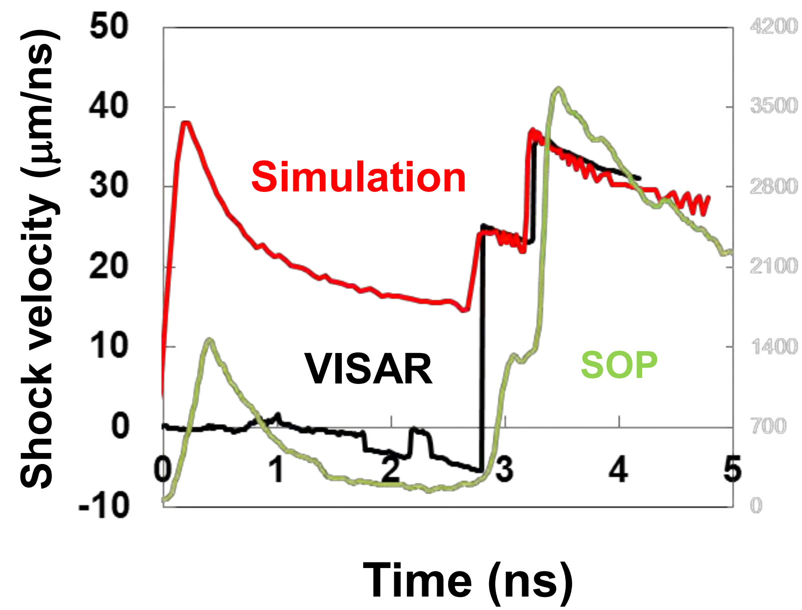


T. R. Boehly et al., Phys. Plasmas 16, 056302 (2009)

Good agreement is obtained between measurements and DRACO simulations for PD shock timing



Shot 60670
(90 μm,133 μm, 133 μm)



Thus far only repointed configurations have been explored with triple picket pulse shapes

- Energetics (Bang time, Scattered light?)
- Areal density (Charged particle energy loss)
- Symmetry (x-ray Backlighting)
- Neutron Yields

Energetics

Polar drive implosions (like symmetric implosions) indicate loss of drive

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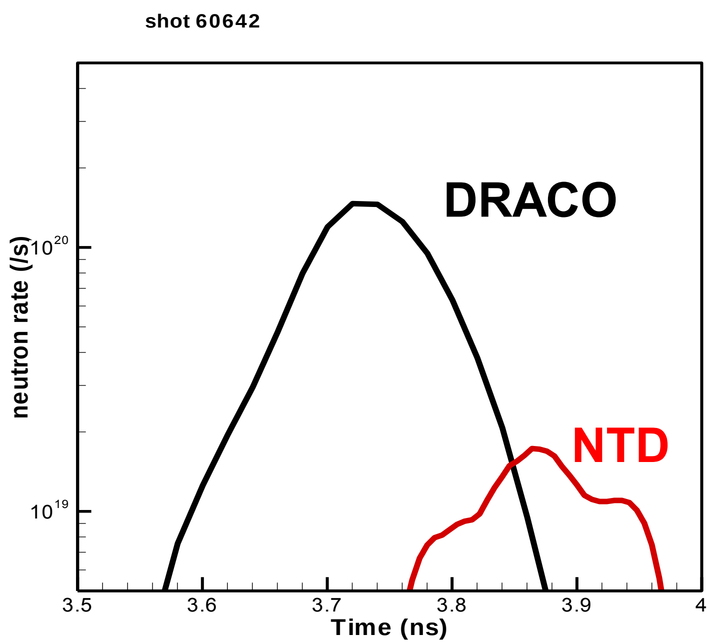
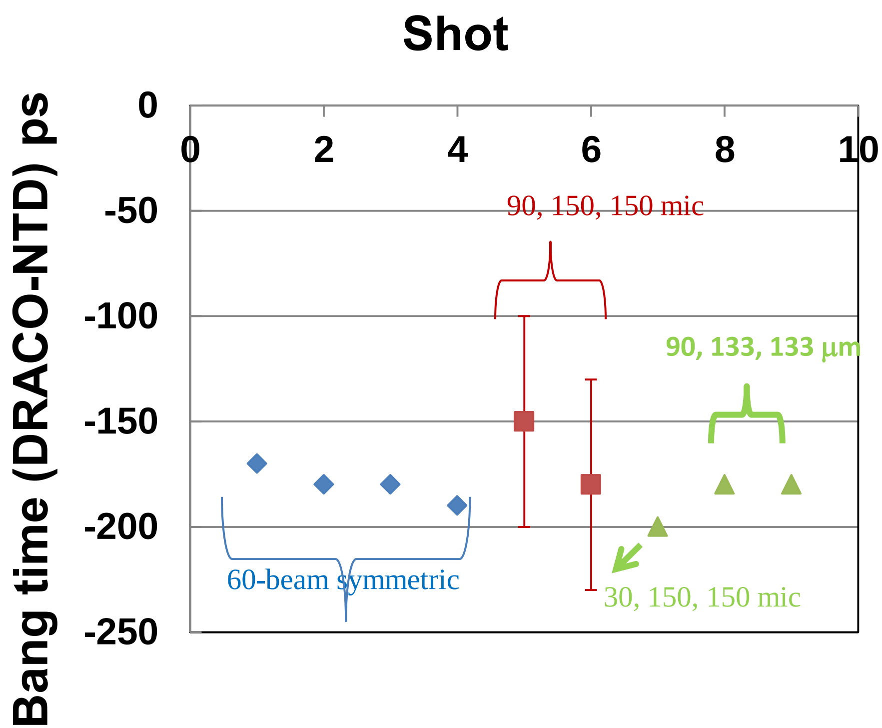
Neutron rate (PD implosion)

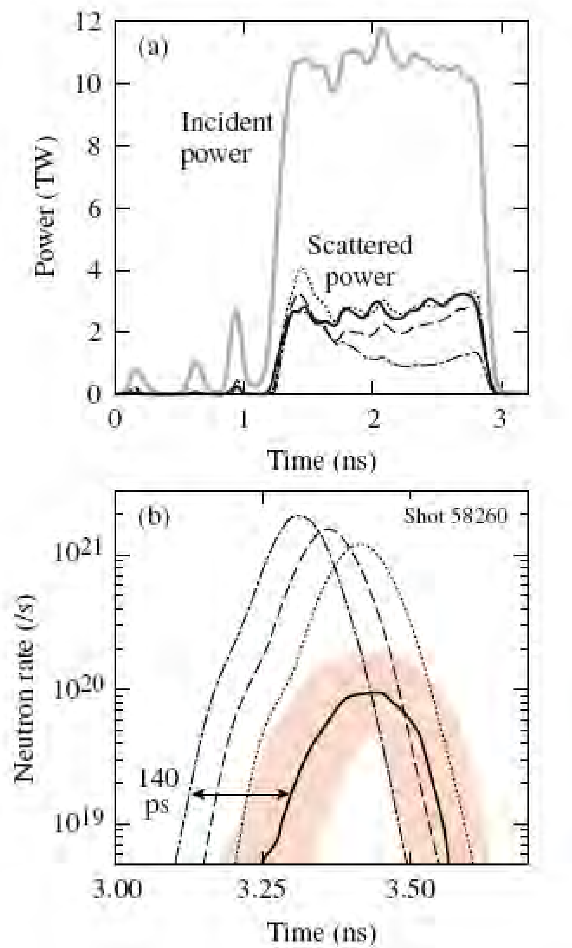




A similar delay in timing is inferred when comparing backlit images with simulations

This delay in bang time has been previously attributed* to cross-beam transfer induced by SBS

Symmetric drive



Measured

Inv. Bremsstrahlung

Cross-beam transfer model (x0.5)

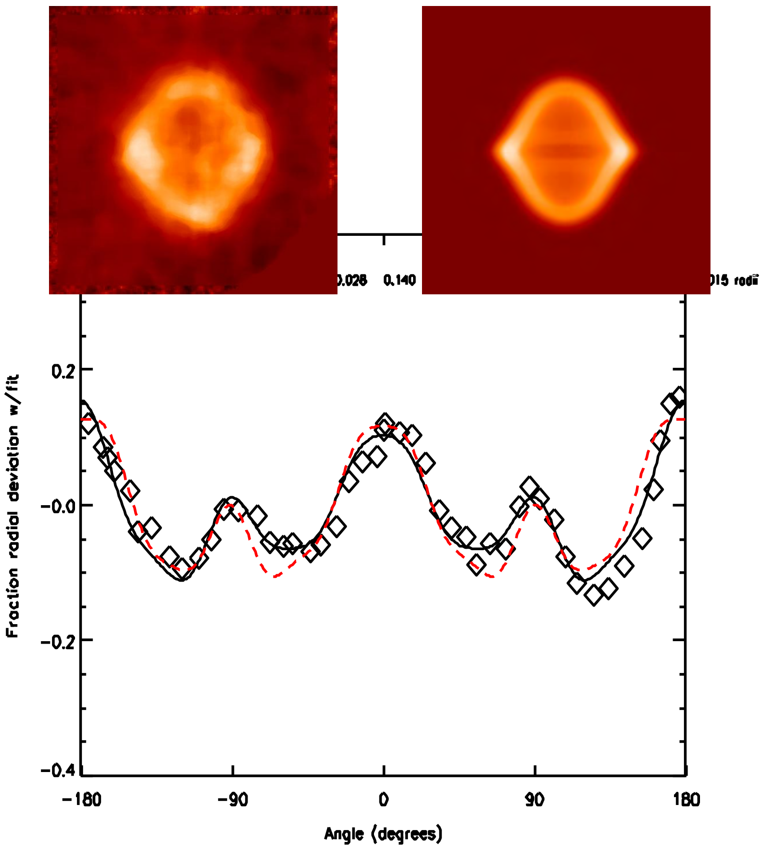
Cross-beam transfer model (x1.0)

*D. Edgell
I. Igumenshchev

Reasonable agreement in obtained in symmetry of compressed shell

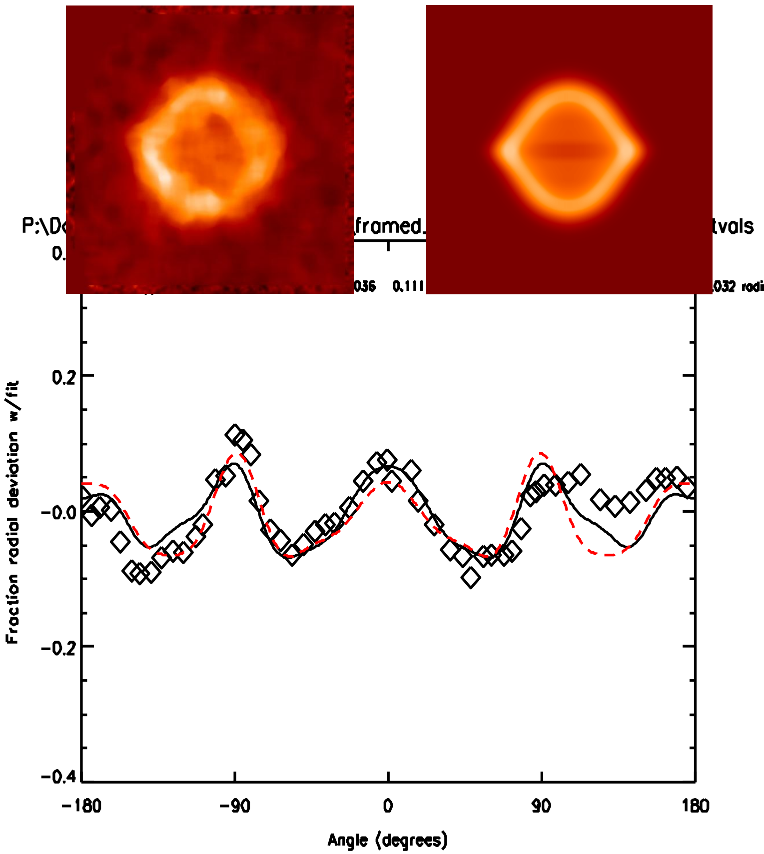
(90 μm,150 μm, 150 μm)

Experiment DRACO



(30 μm,150 μm, 150 μm)

Experiment DRACO



The residual $\ell = 4$ and $\ell = 8$ are characteristic of the SG4 phase plates on OMEGA .

Yields

Absolute yields are reduced by a factor of ~4-5 in the polar drive implosion relative to the symmetrically driven implosions

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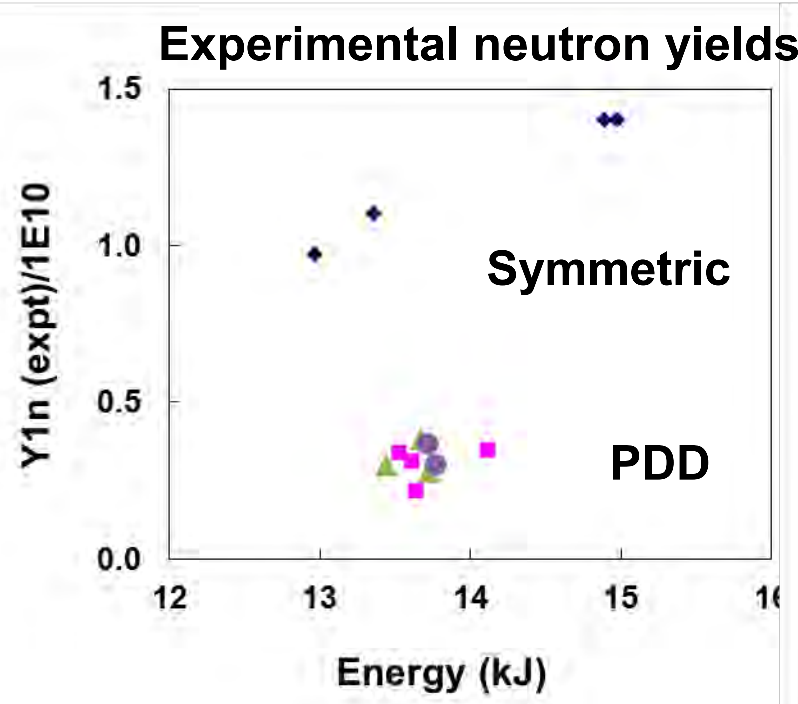

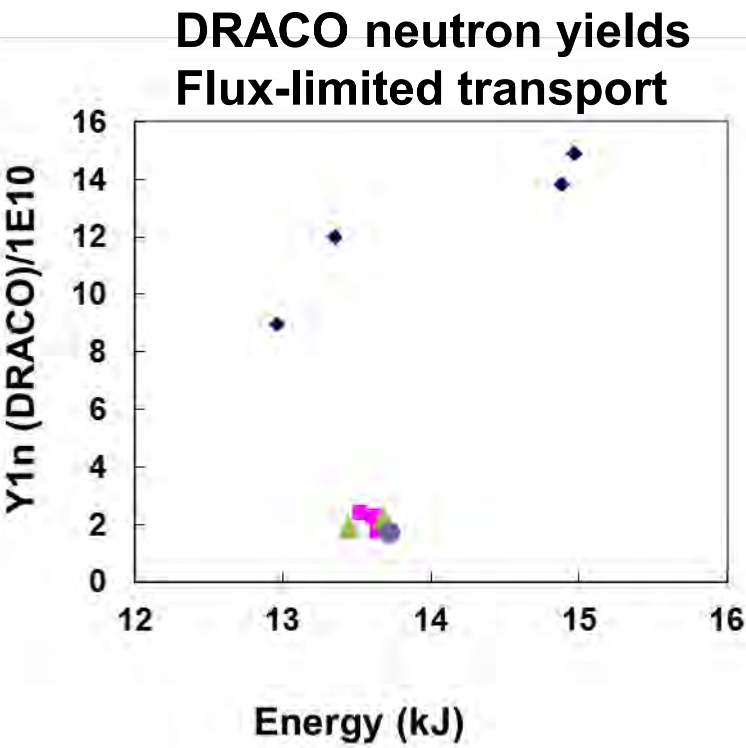

Design is ongoing to
- improve symmetry
- couple more energy into the target

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