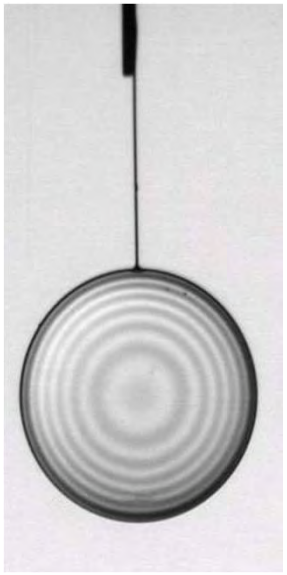
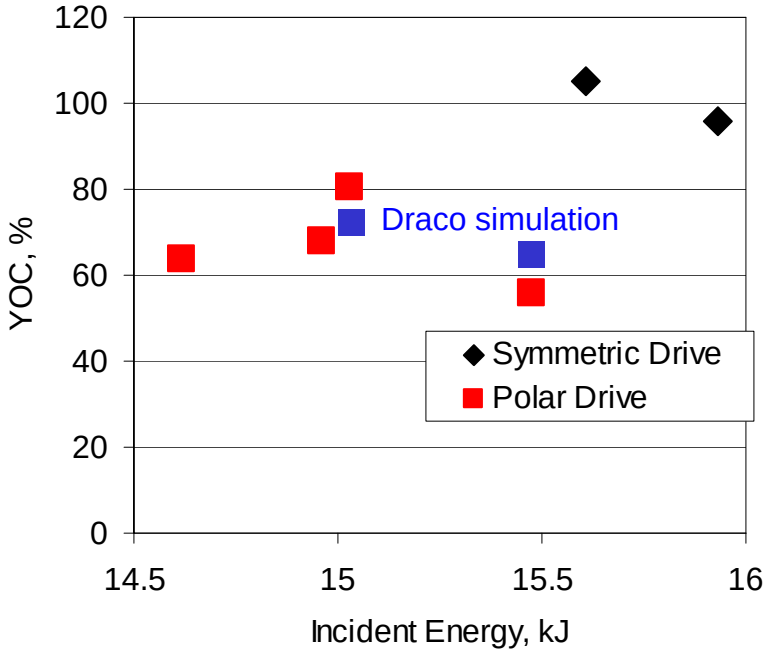
Modeling of OMEGA Polar-Drive Exploding Pusher Experiments

Exploding pusher target at TCC



DT fill, ramp laser pulse



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International Workshop
on ICF Shock Ignition
Rochester, NY
8-10 March 2010

Summary

OMEGA experiments have demonstrated that Polar-Drive exploding pusher implosions provide a reliable source of fusion products for the NIF

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- **Polar-Drive (PD) implosions obtained 60%-70% of 1D yield.**
- **Implosions were performed to study the effects of single beam smoothing and target quality.**
- **DRACO 2-D simulations correctly predict the onset and magnitude of neutron production.**
- **There is qualitative agreement in the size and shape of x-ray images at later times when the incoming glass shell interacts with the outgoing shock wave.**

9 exploding pusher targets have been shot on the NIF

Collaborators

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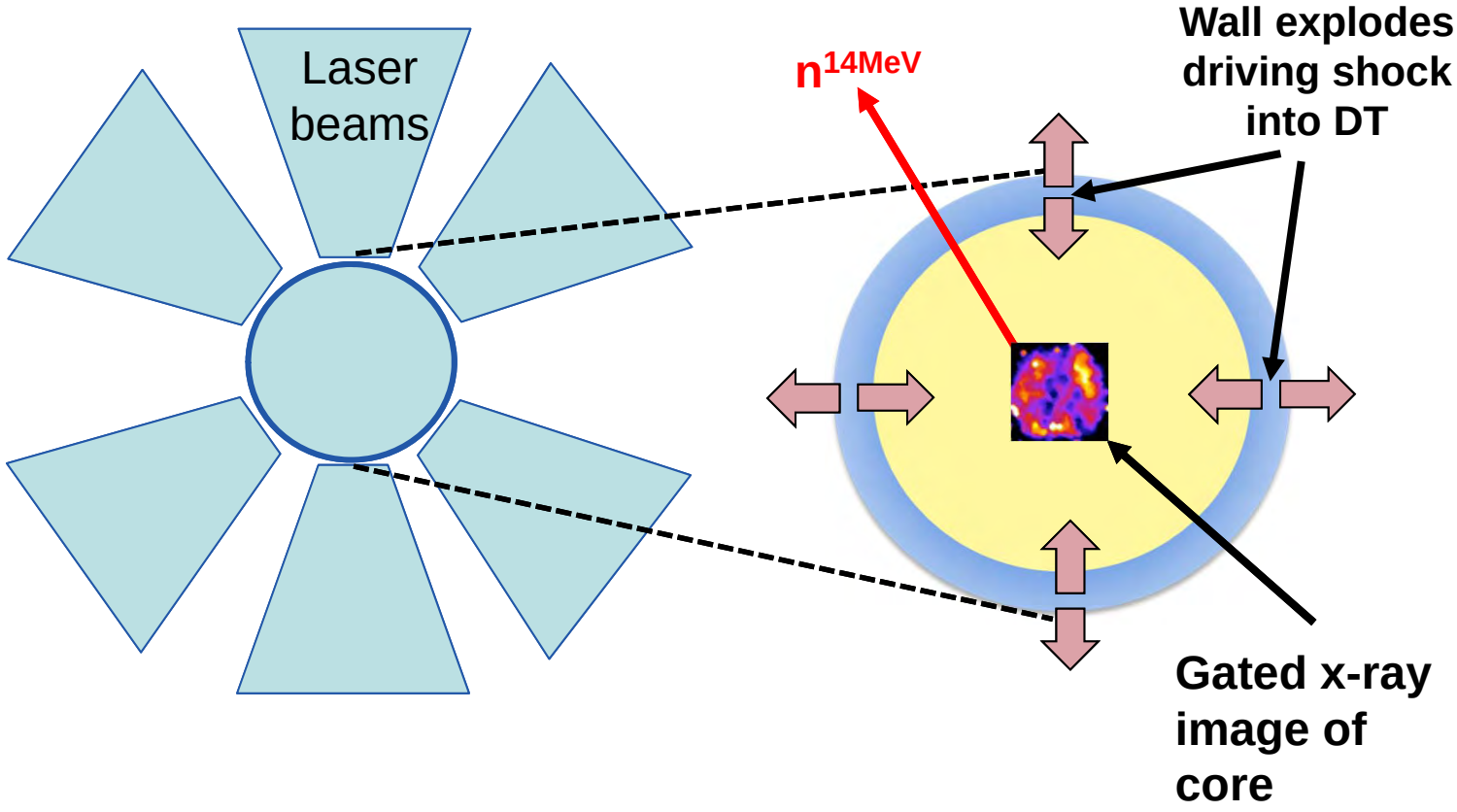
Exploding pushers use polar drive to heat thin, glass-walled targets which drive strong shocks to produce MeV neutrons



Controllable Y_n - up to $1x10^{16}$, low ρr ~ 10's mg/cm^2 , isotropic Y, easy fielding

NIF PD commissioning platform was validated on OMEGA using repointed and de-focused laser beams

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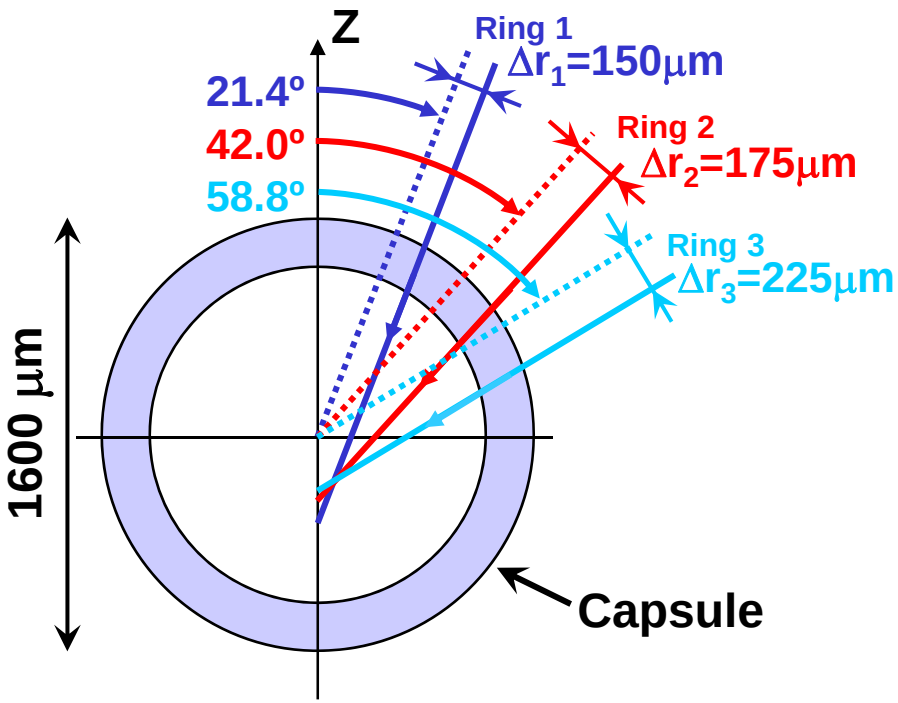
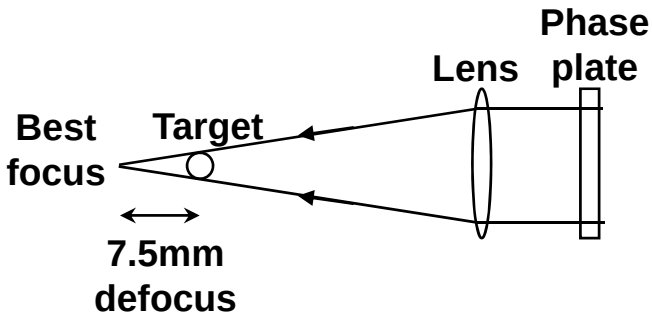
PD beam-repointing configuration

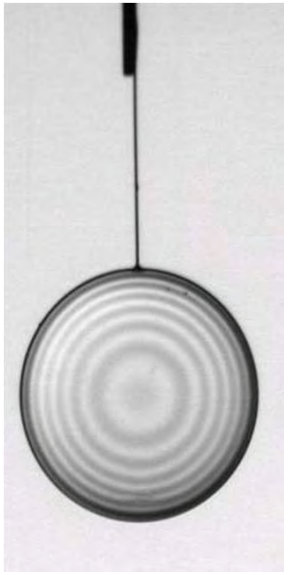


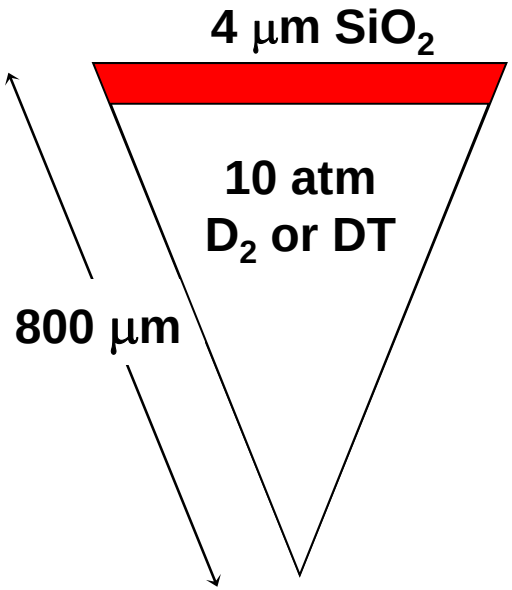
Use de-focus to fill the NIF-sized target on OMEGA

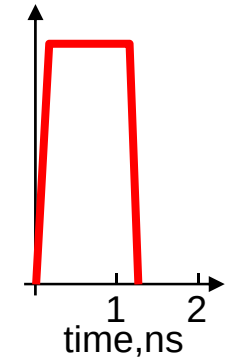


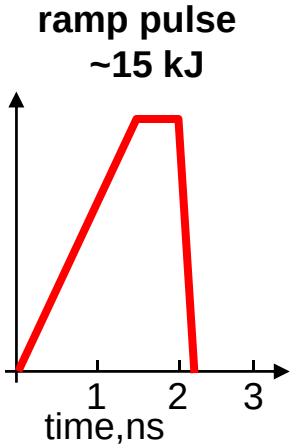
OMEGA experiments used the same thin-wall glass targets as deployed on the NIF

Target image at TCC



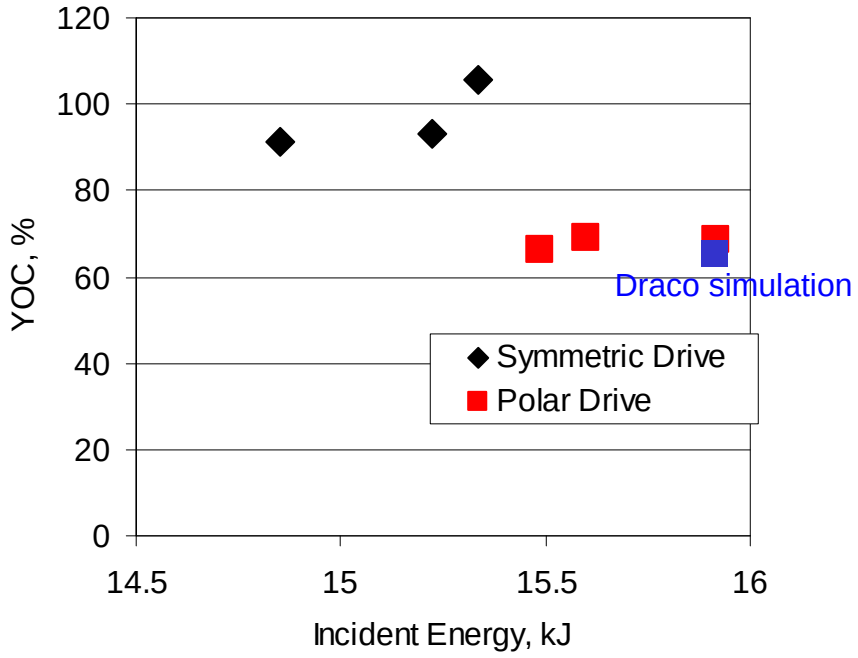




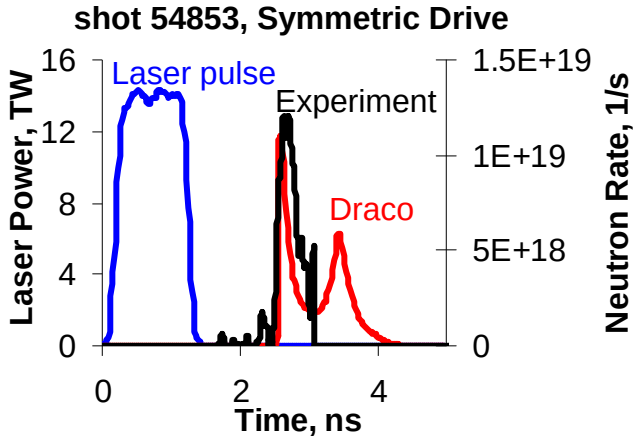


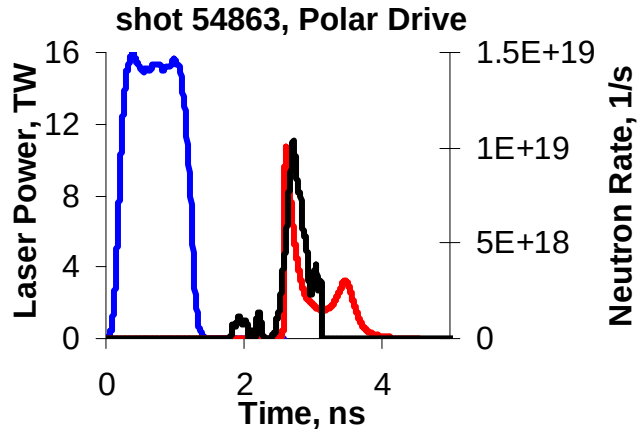
- Ramp pulse was developed to avoid blow by on the NIF

Initial D_2 PD experiments emulating NIF commissioning shots have demonstrated yields of 60%-70% of 1D predictions and good agreement with neutron production



Average symmetric experimental yield =4.6e9

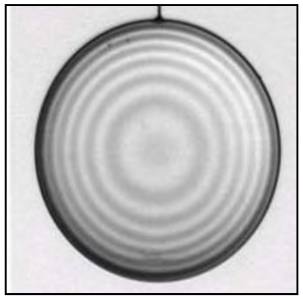


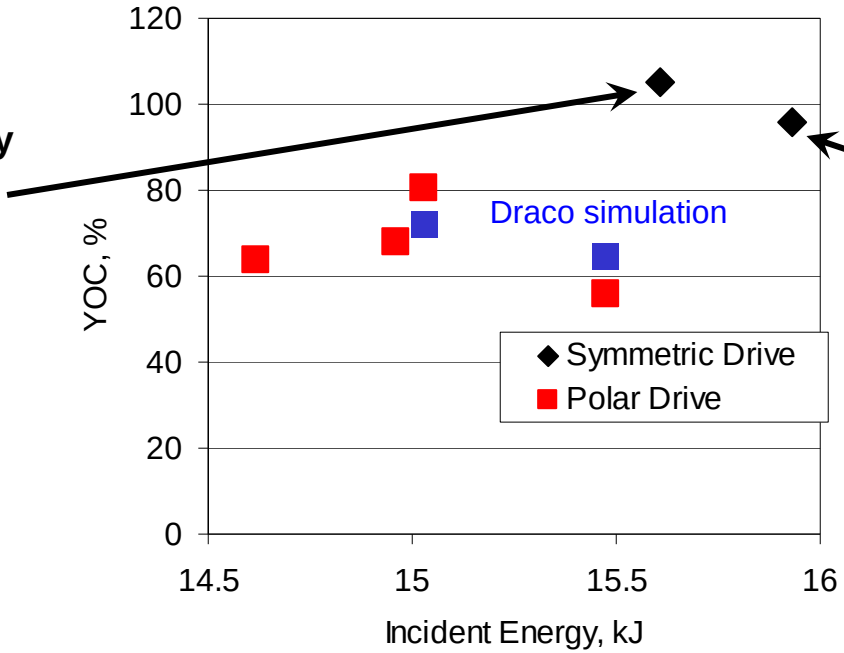


DT implosions have determined that performance is insensitive to target quality and SSD

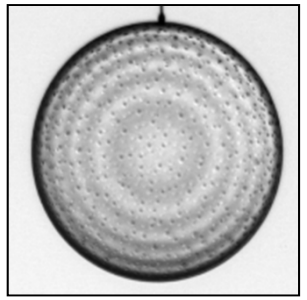
- Goals of DT experiments: DT fill, ramp pulse, no SSD, target quality

Good target quality



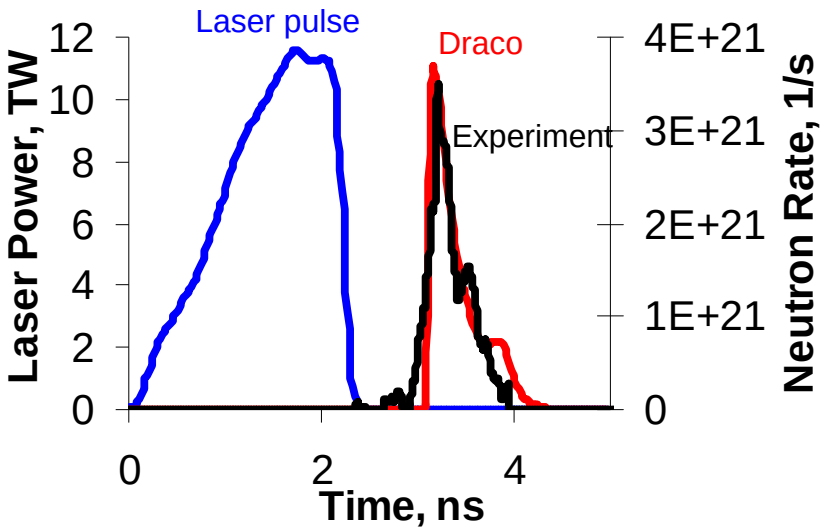


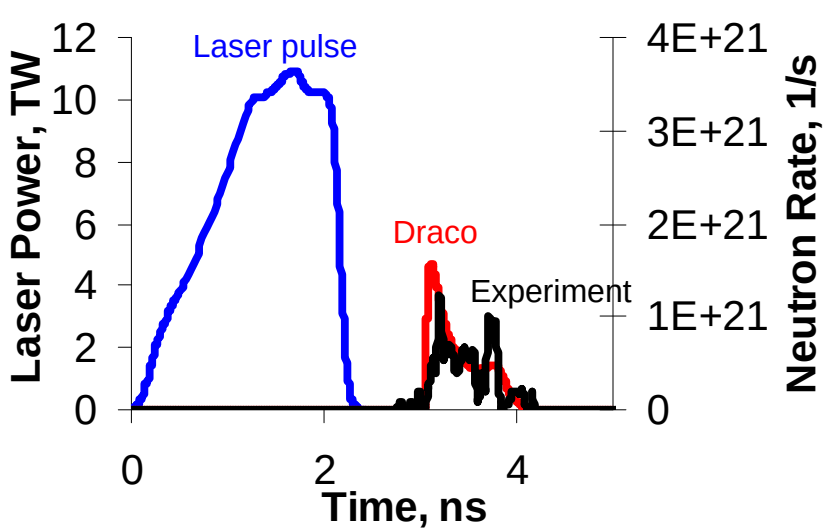
Poor target quality



Average symmetric experimental yield = 1.4e12

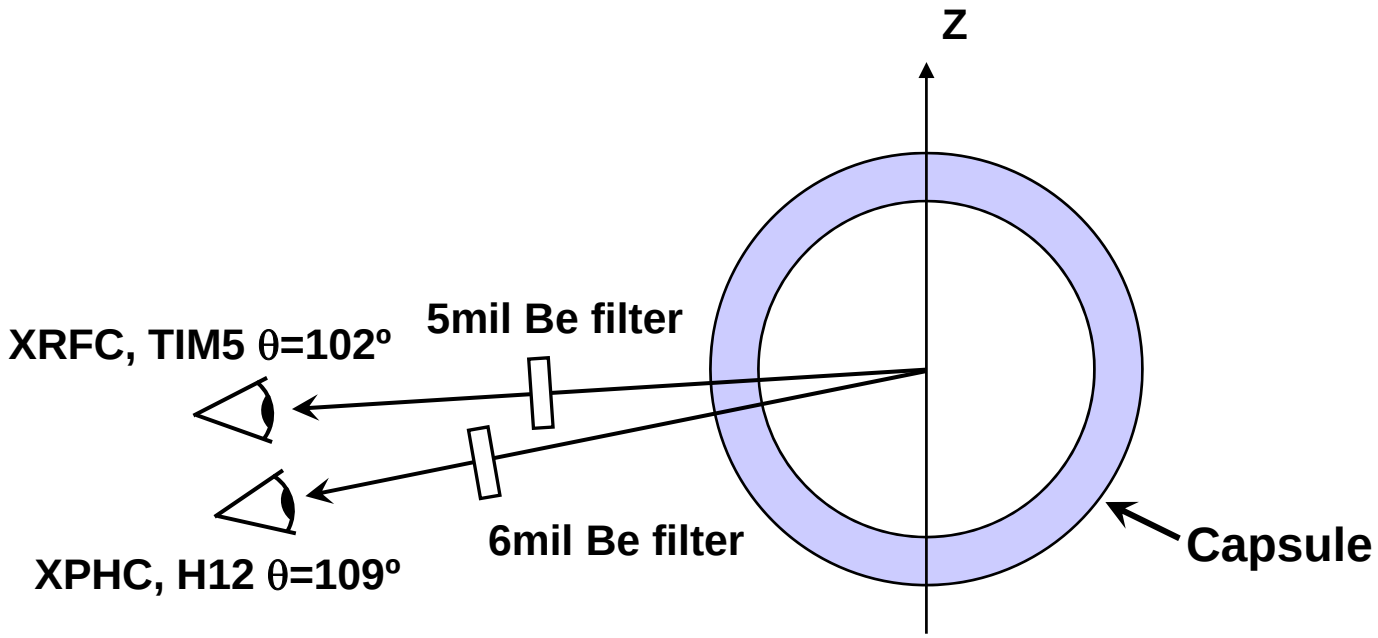
Draco 2-D simulations reproduce the onset and magnitude of measured NTD neutron production of PD DT implosions





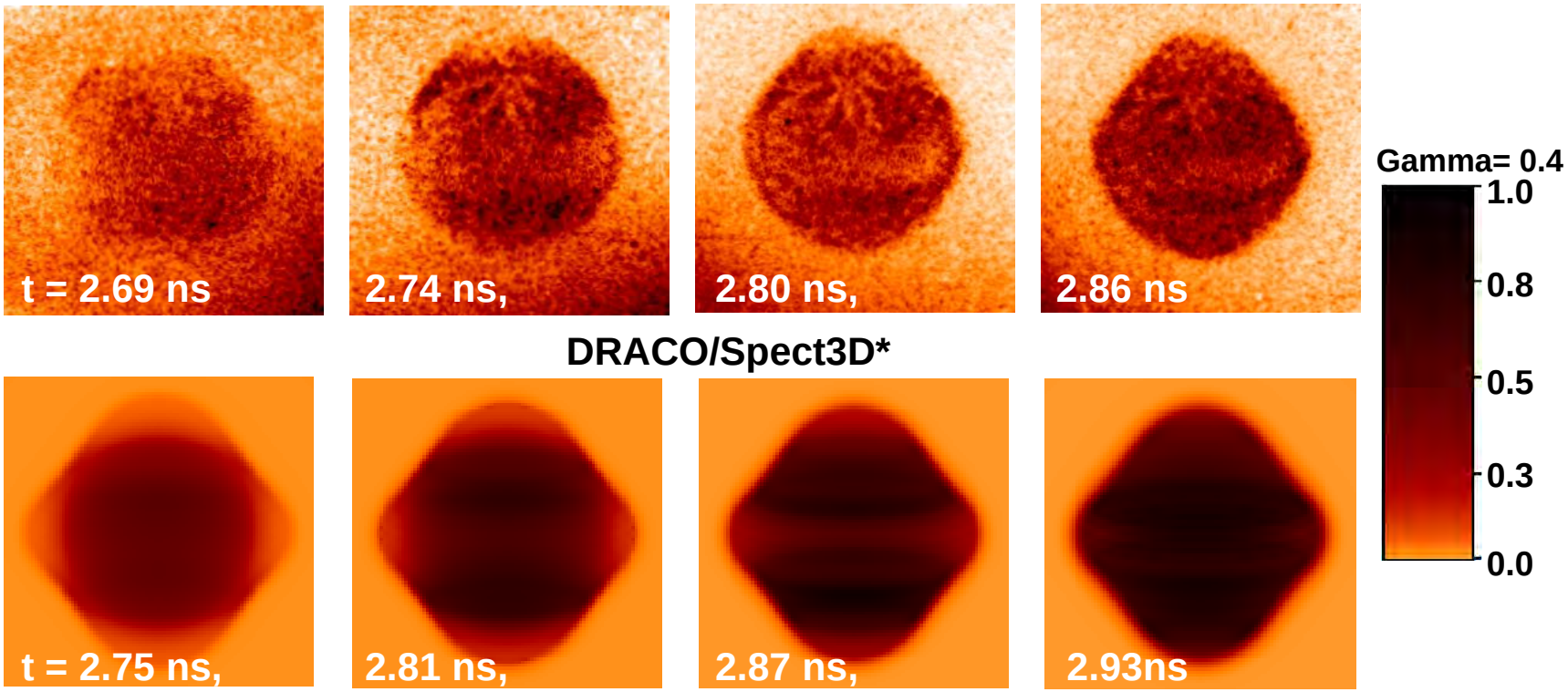
X-ray framing camera (XRFC) and X-ray pin hole camera (XPHC) were used to study the implosion symmetry

- The XRFC and XPHC lines of sight are slightly below the equator



Self-emission images of D_2 implosions obtained with XRFC agree with Draco/Spect3D simulations

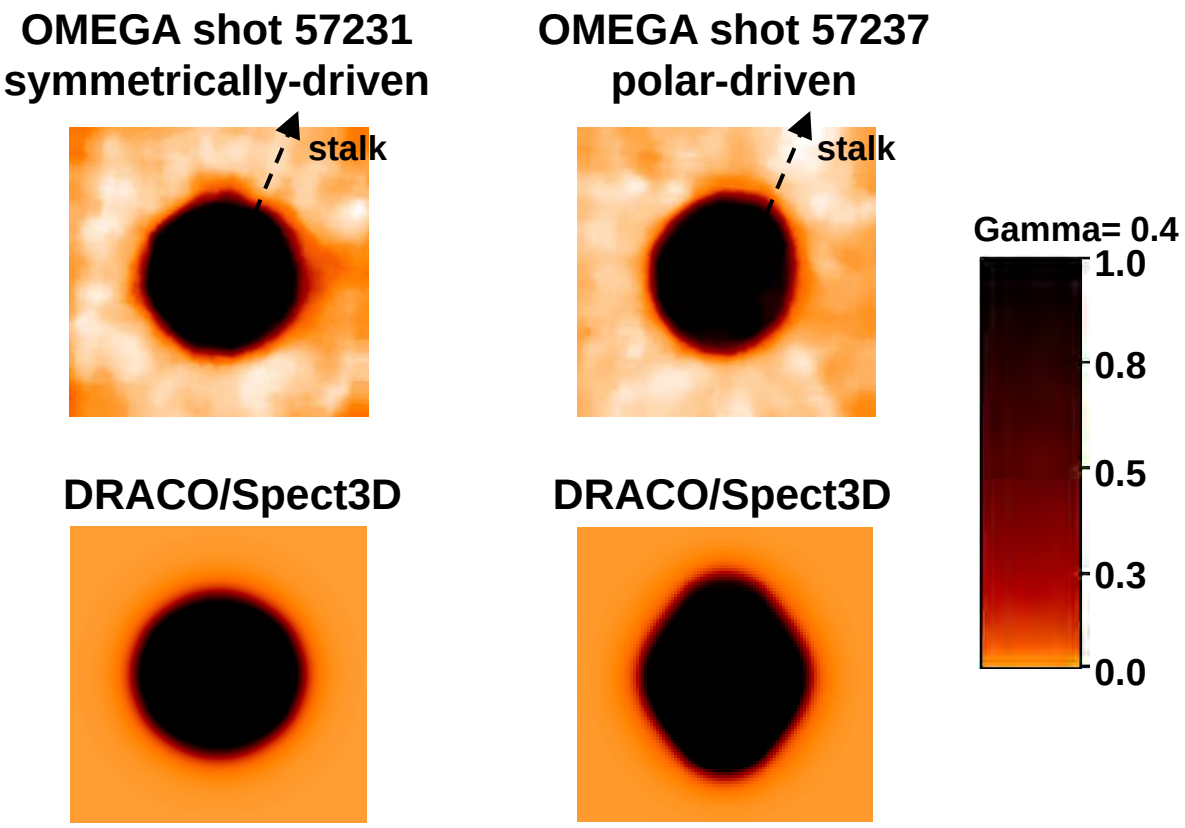
PD D_2 shot 54863, XRFC, TIM5 $\theta = 101°$



600 x 600 μm regions
intensity of x-ray emission

*Spect3D: Prism Computational Sciences, Inc., Madison, WI

Pin-hole camera images of DT implosions show fair agreement with Draco/Spect3D simulations



XPHC CID x-ray images, 6 mils Be filter

600 x 600 μm regions

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