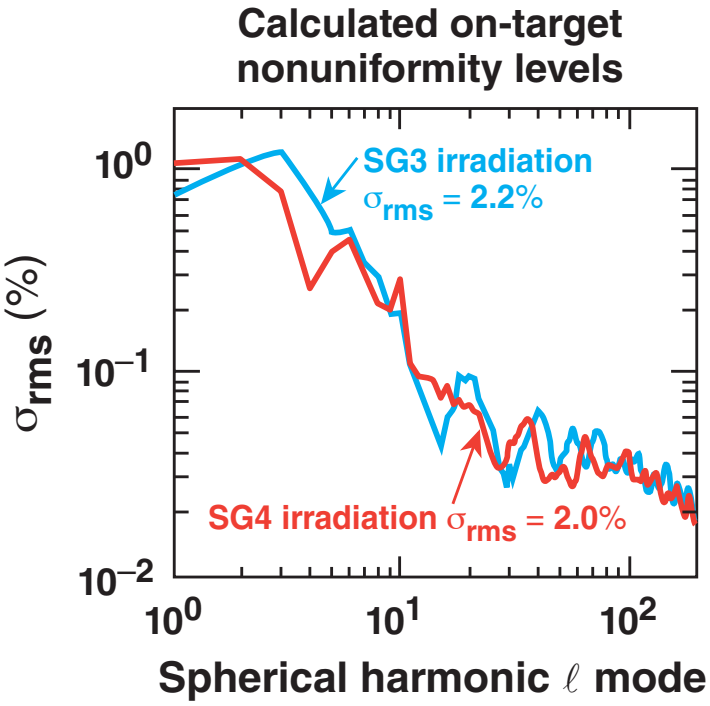
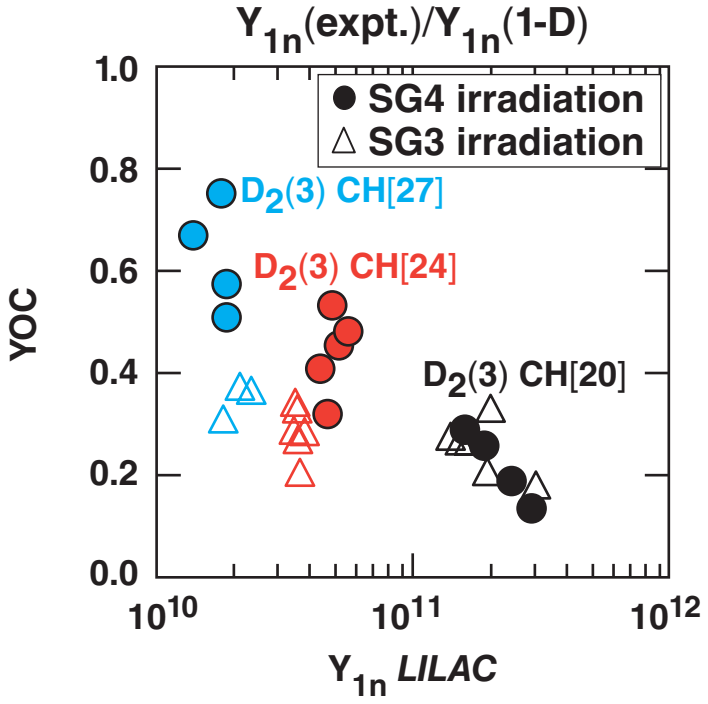
Experimental Investigation of the Effects of Irradiation Nonuniformities on the Performance of Direct Drive Spherical Implosions





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46th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Savannah, GA
15–19 November 2004

Summary

OMEGA implosion performance improved with reduced laser irradiation nonuniformities

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- The on-target laser irradiation nonuniformities were reduced using a new phase plate design.
- High-adiabat implosions of D_2-filled plastic shells with predicted convergence ratios (CR) from 10 to 40 were investigated.
- Primary neutron yield for higher convergence implosions of thicker shell targets that are less susceptible to laser imprint from high ℓ-modes nearly doubled as compared to 1-D predictions.

Collaborators

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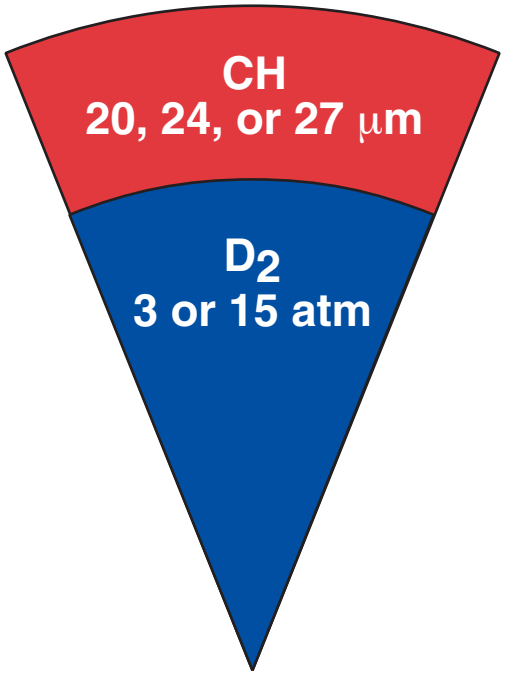
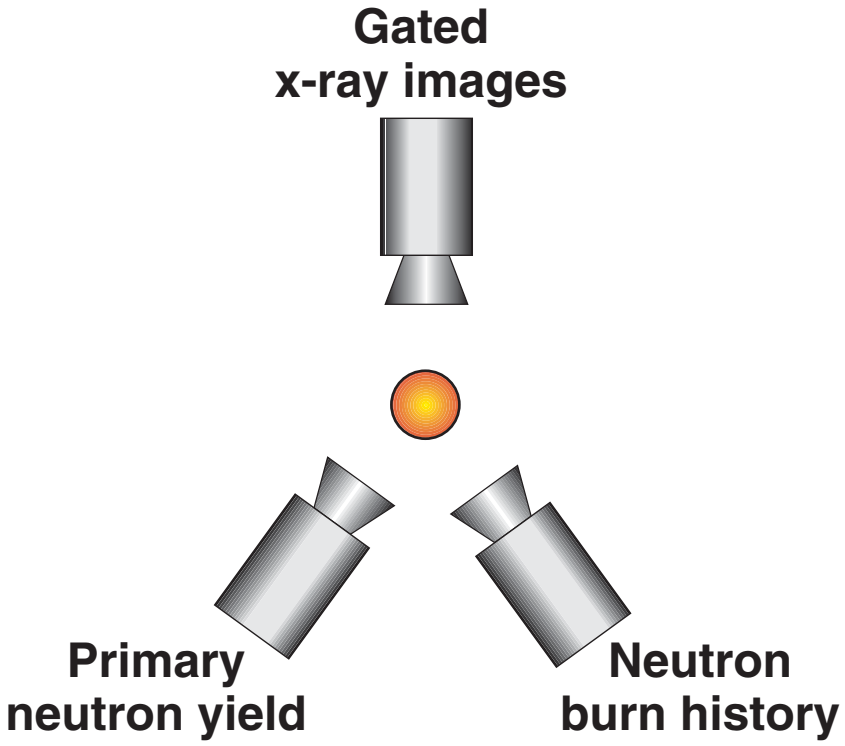
The performance of high-α, D_2-filled plastic–shell implosions was investigated on OMEGA

$$\alpha \cong 5 \equiv \frac{\text{Pressure in the shell}}{\text{Fermi degenerate pressure}}$$





Predicted convergence ratio: 15 to 40

- **Laser irradiation with 23 kJ, 1-ns square laser pulse with 1 THz 2-D SSD and PS**

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The new SG4 phase plate reduces the laser irradiation nonuniformities on OMEGA

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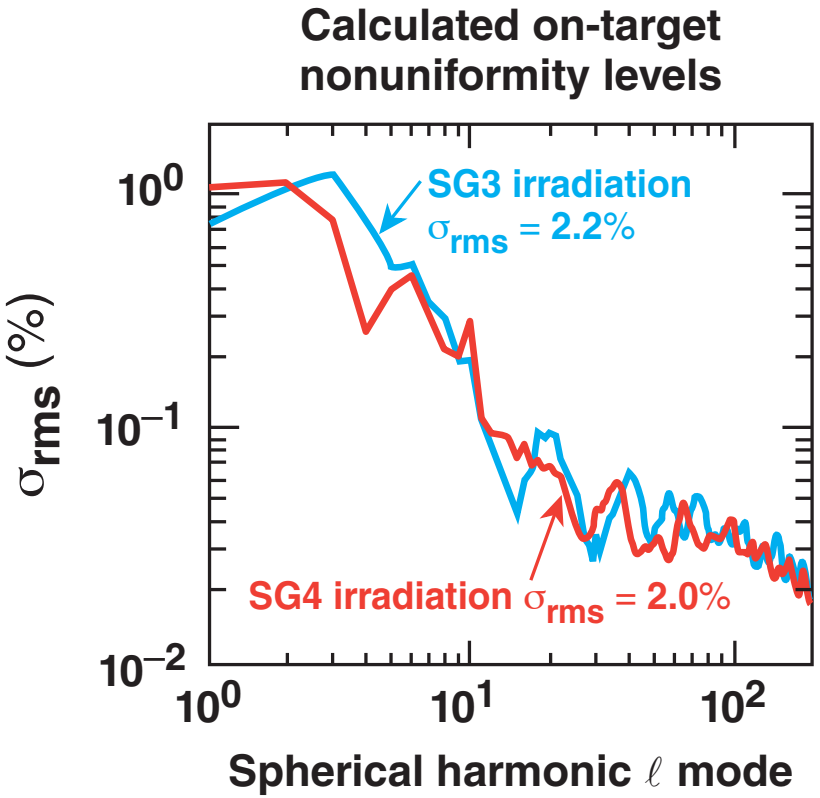

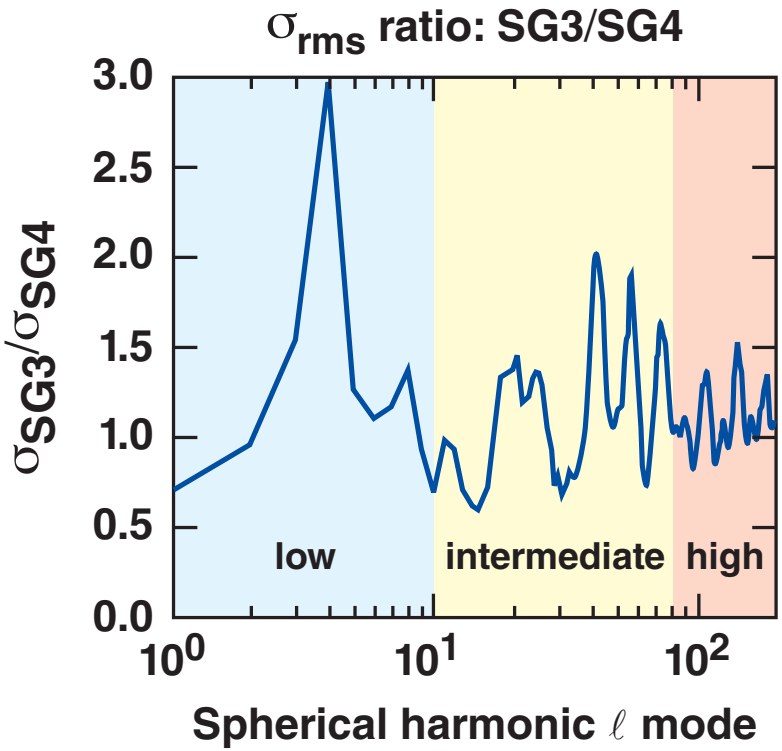

$$I(r) \propto \exp\left[-(r/\delta)^n\right]$$

- New DPP n = 4.1 (SG4)
- Old DPP n = 2.2 (SG3)
- Target diameter: 930 μm to 860 μm

Sources of Nonuniformities

Single-beam nonuniformity
Mispointing (20 μm rms)
Energy imbalance (2.6% rms)
Target offset (2 μm)

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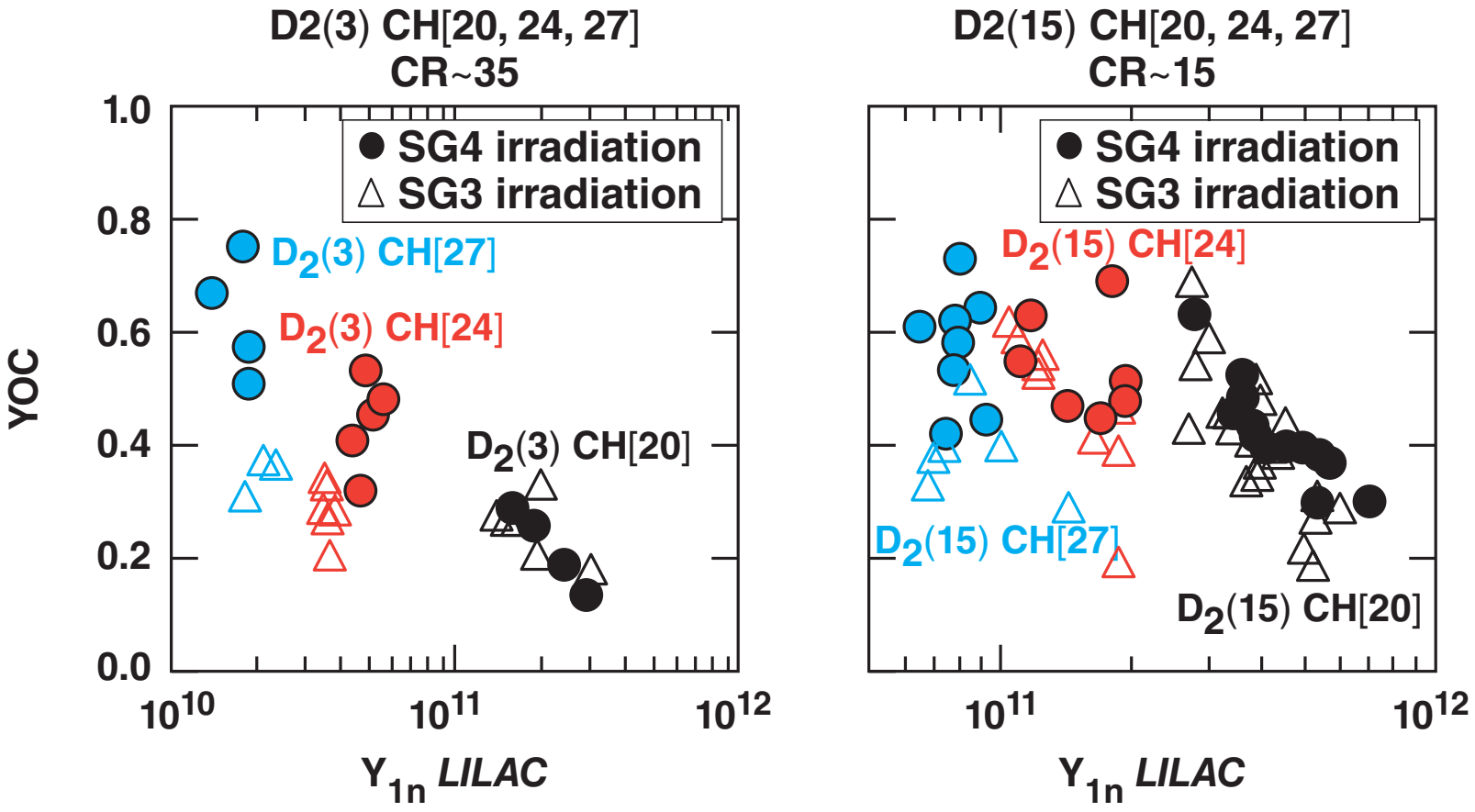
The ratio of measured primary neutron yield to the 1-D prediction increases for thicker targets with SG4 irradiation



- YOC improvements are more pronounced for implosions with higher convergence ratios.

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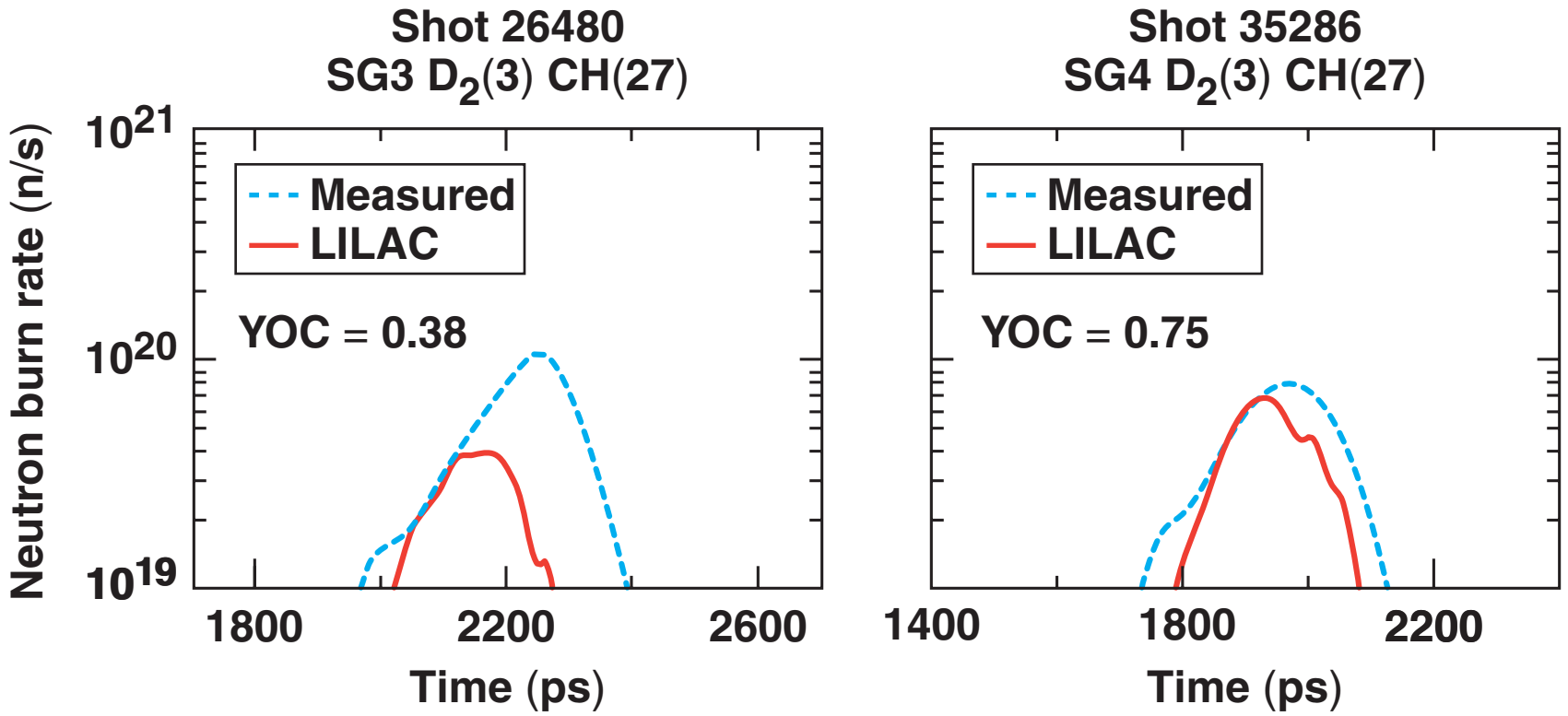
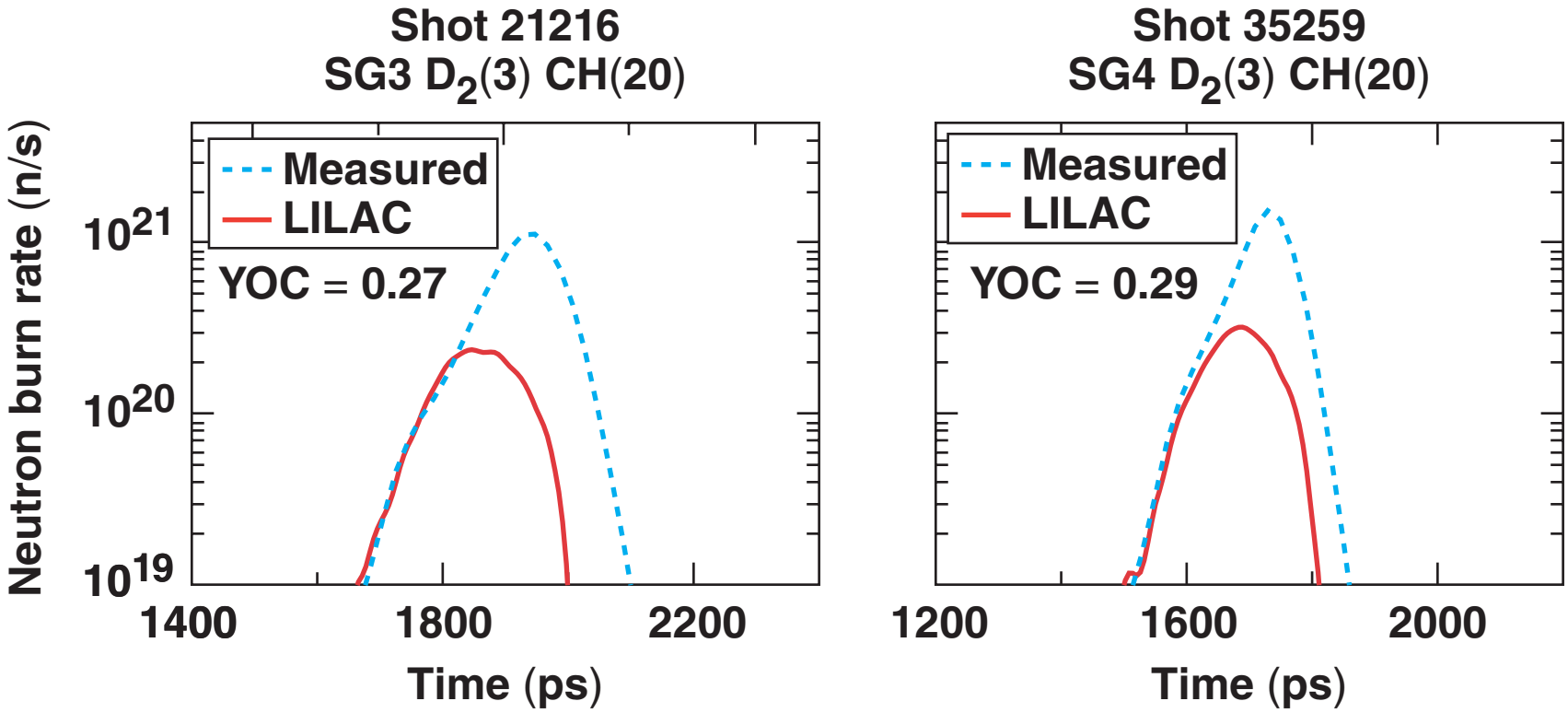
The peak measured neutron burn rate is higher for D_2(3) CH(27) with SG4 irradiation



- 2-D simulations show that the performance of these implosions is dominated by low and intermediate ℓ-modes.*

*P. B. Radha BI2.004

The measured neutron burn rates are comparable for D_2(3) CH(20) with SG3 and SG4 irradiation



- 2-D simulations show that these implosions are dominated by high ℓ-modes which cause shell break up during the acceleration phase.*

*P. B. Radha BI2.004

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X-ray images gated at the time of peak neutron production show near 1-D compression for the D_2(3) CH(27) implosions

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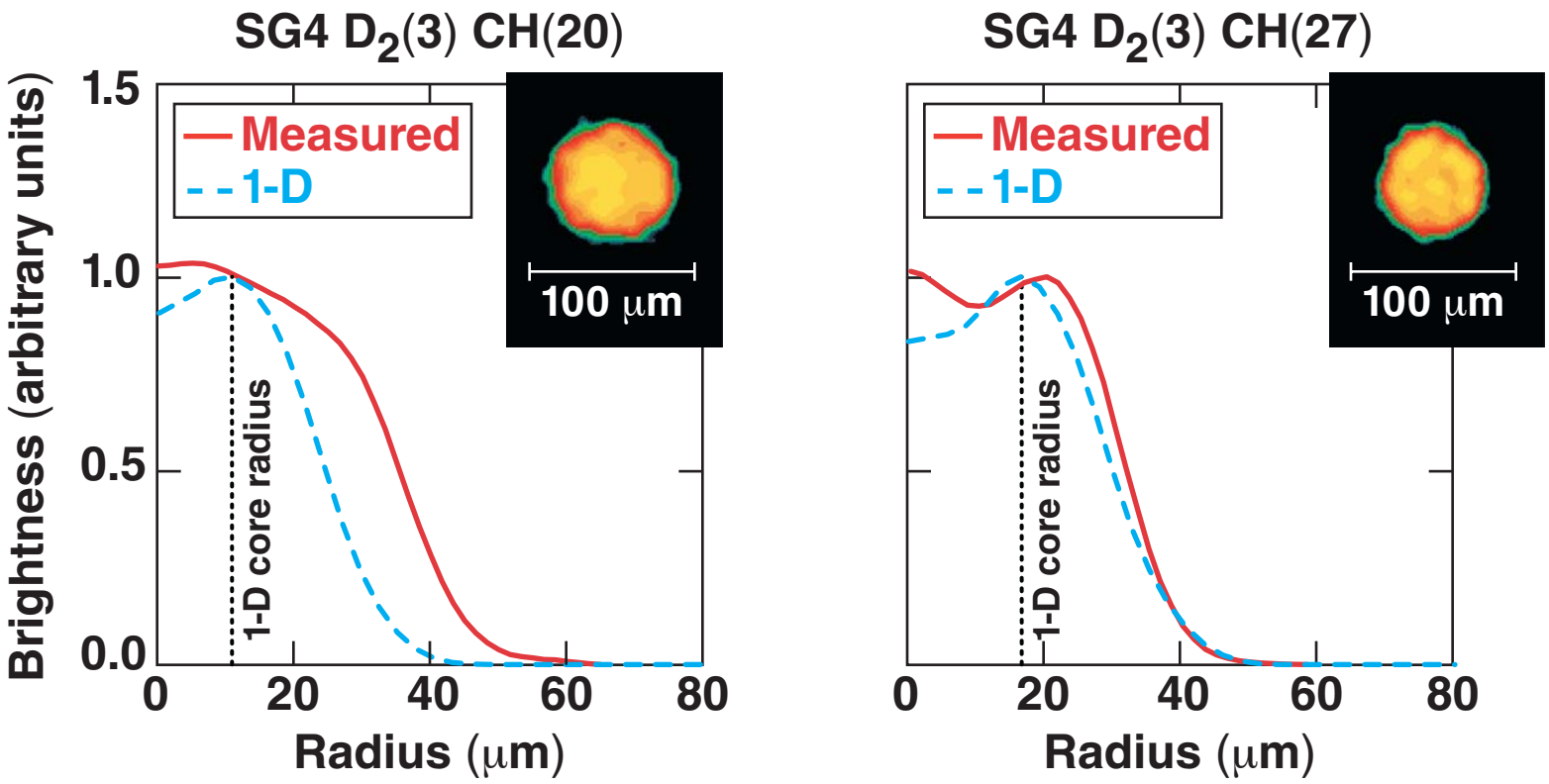
$E_{h\upsilon}$ ~ 4.5 keV



- Less than 1-D compression is realized with D_2(3) CH(20) implosions because the high ℓ-mode nonuniformities cause the thinner shell to break up during the acceleration phase.*

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Summary/Conclusions

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