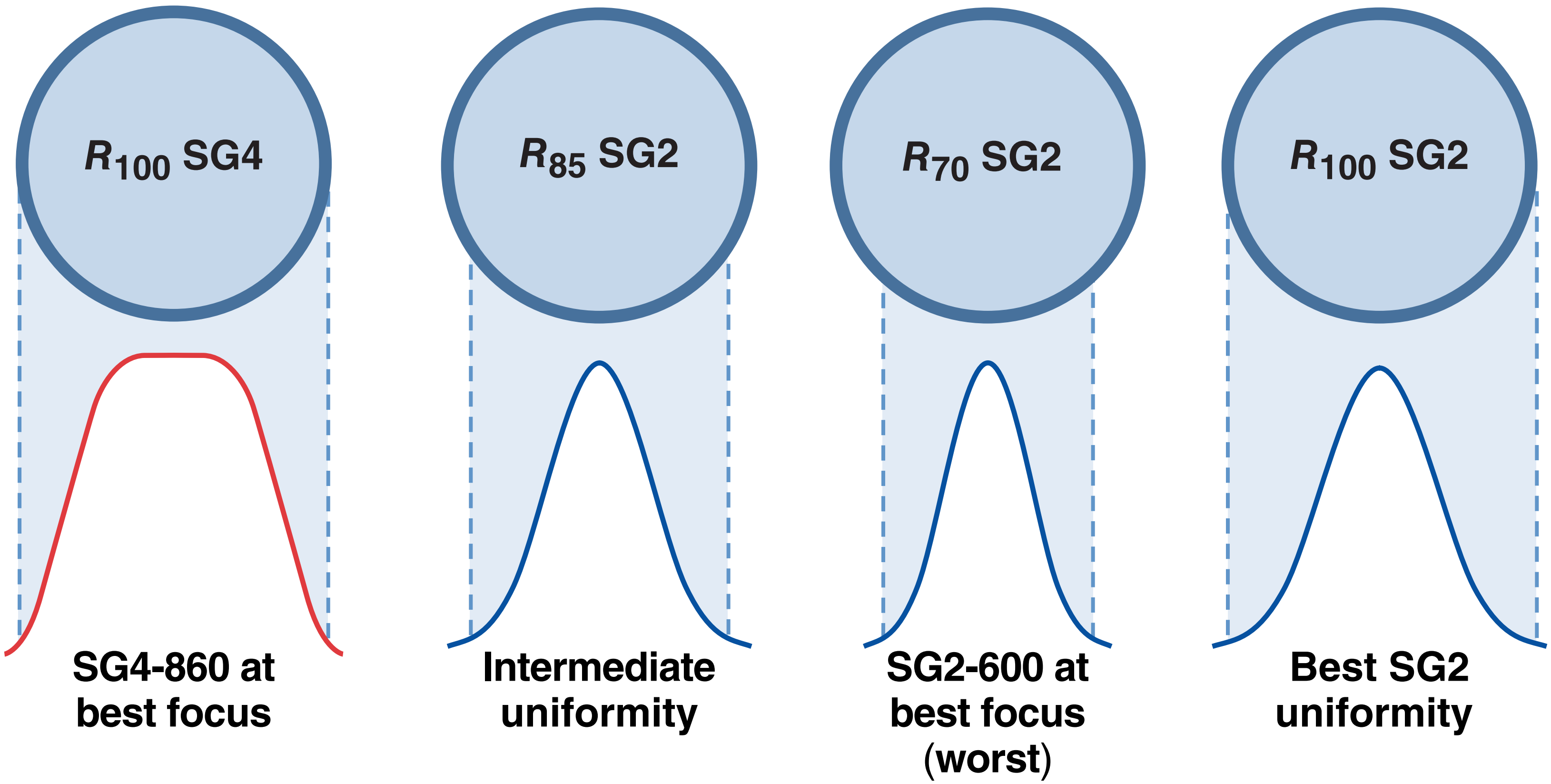
Status of Ignition Hydro-Equivalent Implosion Performance on OMEGA



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55th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Denver, CO
11–15 November 2013

Summary

Ignition hydro-equivalent performance on OMEGA is a key goal for the polar-drive–ignition campaign

- Mitigation of cross-beam energy transfer (CBET) and hydro-instability seeds will be required to demonstrate ignition hydro-equivalence on OMEGA*
- The primary CBET mitigation strategies on OMEGA involve reducing the amount of light going around the target**
- The expected performance improvement with CBET mitigation ($R_{beam}/R_{target} \sim 0.85$) was overwhelmed by the time zero nonuniformity
- The next set of DT implosions will test the R_{85} strategy using the SG2-600 phase plates at best focus on a 710-μm-diam DT target

*V. N. Goncharov, GI3.00001, this conference (invited).
**D. H. Froula *et al.*, CO7.00002, this conference.

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Collaborators

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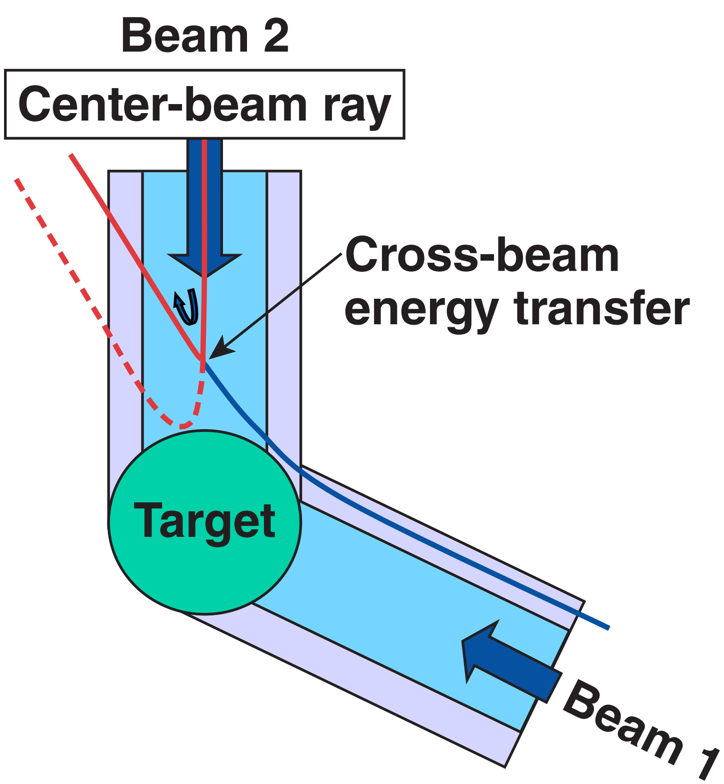
There are a number of options* for mitigating CBET



1) Reduce the number of crossing rays**
   a) $R_{beam}/R_{target} < 1$ (OMEGA only)
   b) Zooming ($R_{beam}/R_{target} \sim 1$ at T_0)

2) Reduce the plasma volume for stimulated Brillouin scattering (SBS) resonance formation
   a) steepen the density gradient and raise T_e using mid-Z ablators
   b) different beam colors [National Ignition Facility (NIF) only]
   c) technology (e.g., STUD pulses)†

*D. H. Froula *et al*., CO7.00002, this conference.
**I. V. Igumenshchev *et al*., Phys. Rev. Lett. 110, 145001 (2013).
†B. Afeyan, GI3.00004, this conference (invited).

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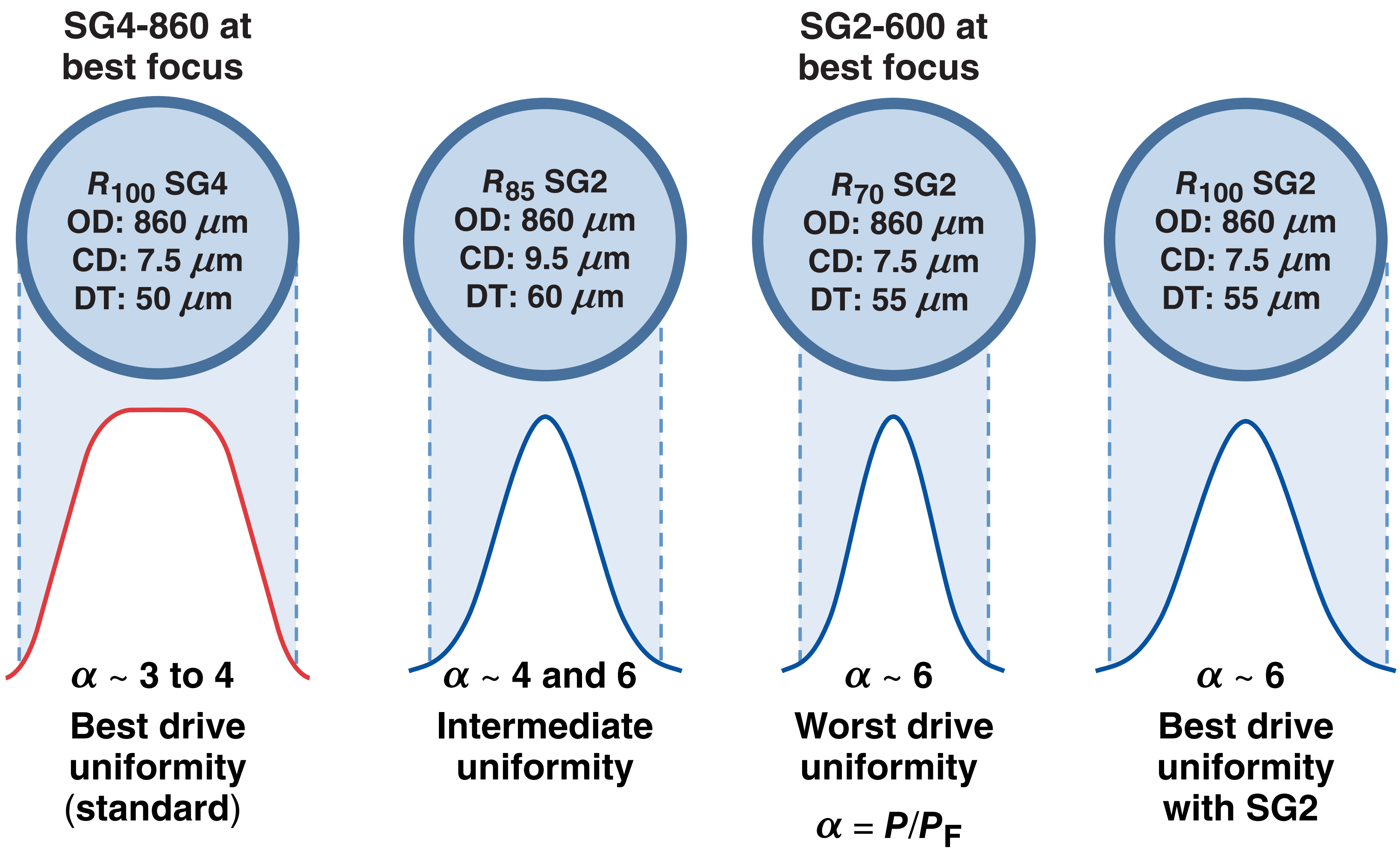
Experiments were performed with R_{70}, R_{85}, and R_{100} configurations using the SG2-600 phase plates



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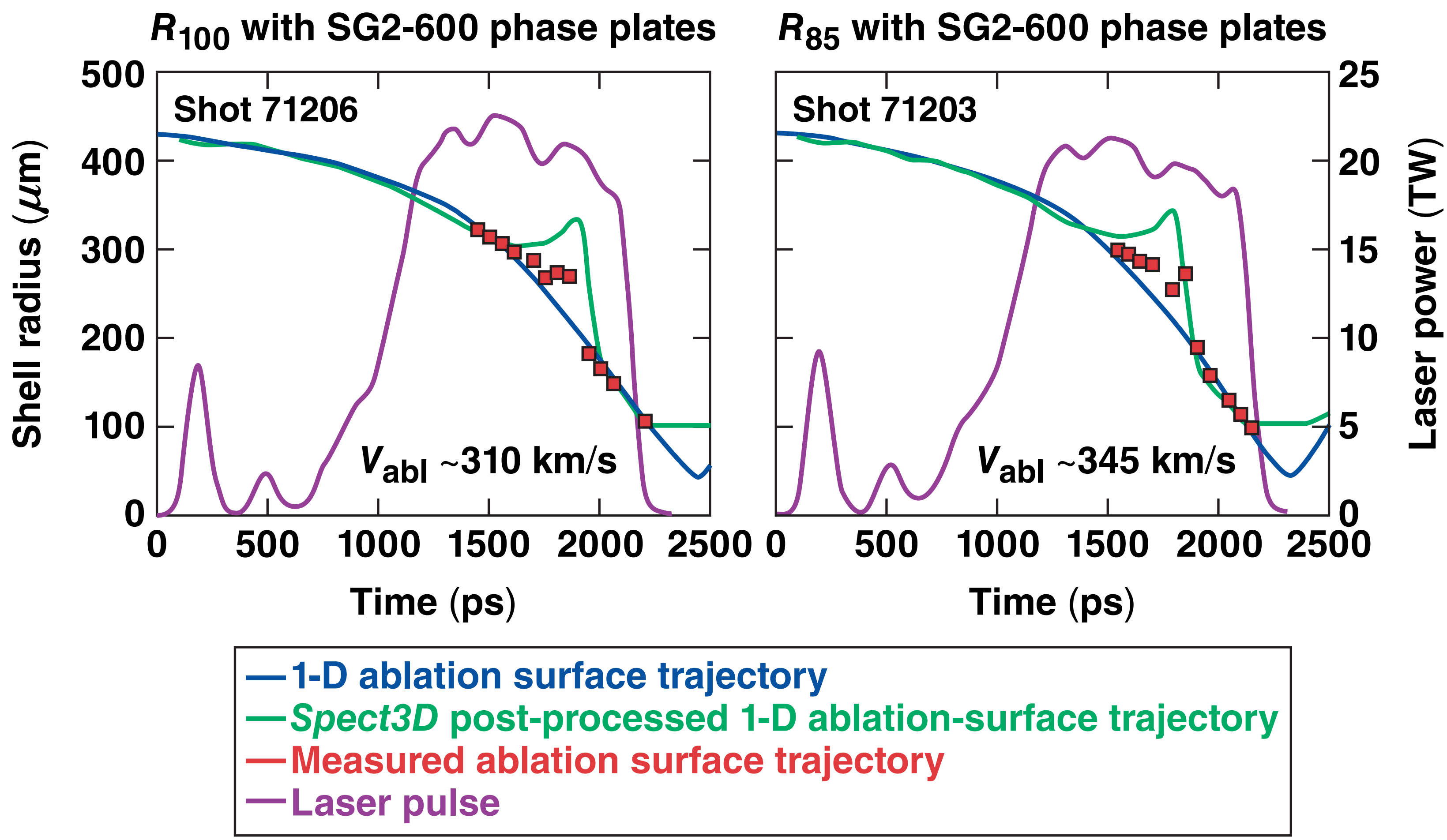
The measured shell trajectories agree with 1-D predictions for the R_{85} and R_{100} configurations



1-D *LILAC* (CBET and nonlocal) predicts the difference in shell trajectories for the two different drive configurations.

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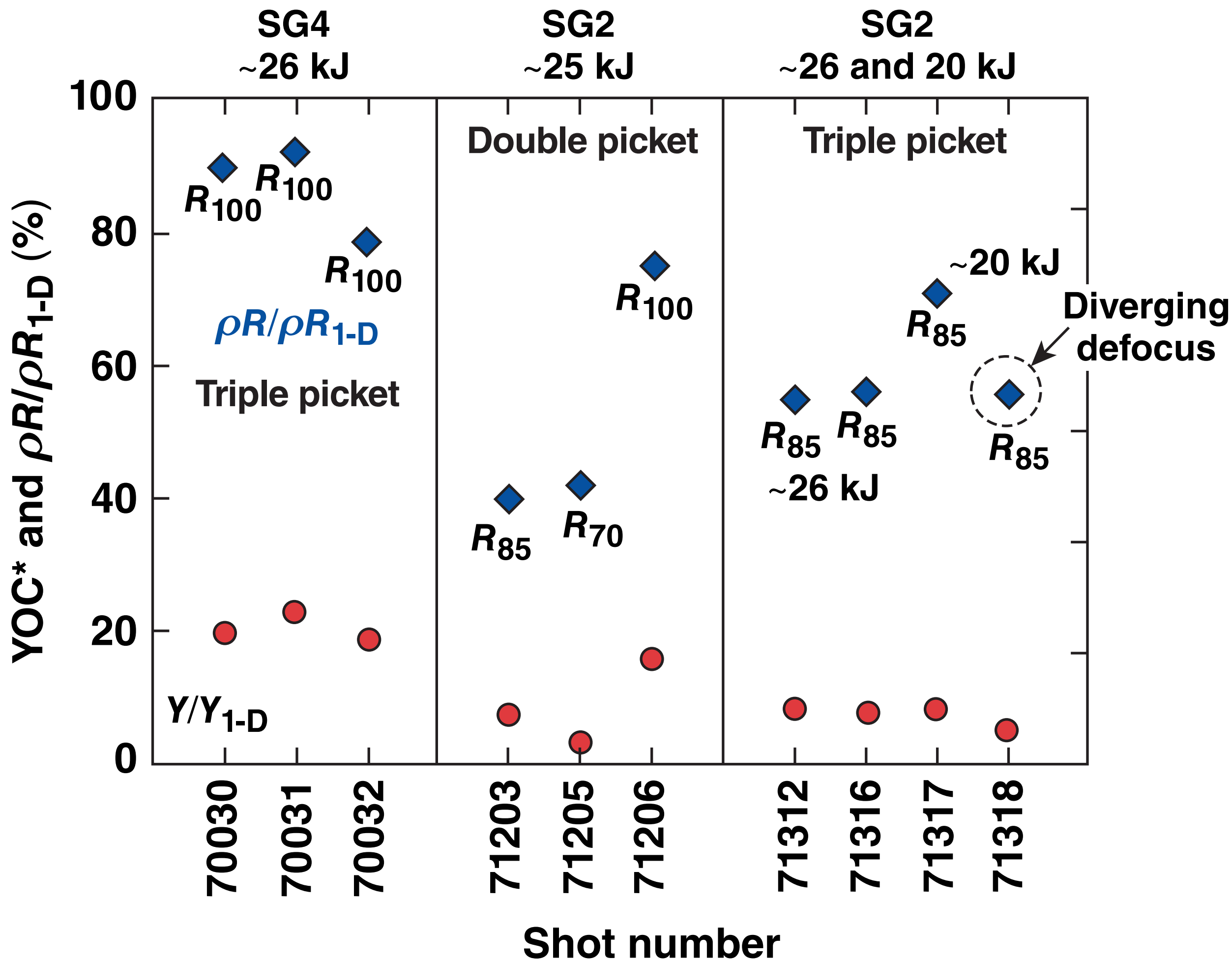
The best performance with the SG2-600 phase plates was the R_{100} configuration



This indicates that nonuniformity at time zero leads to reduced performance with the defocused phase plates.

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*Yield-over-clean

The SG2 experiments exposed a fixed spatial pattern in the picket-energy variation that imprints mid-mode nonuniformity

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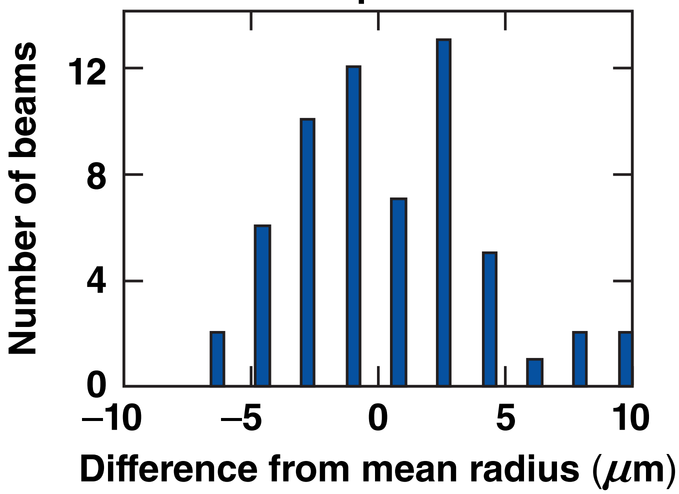
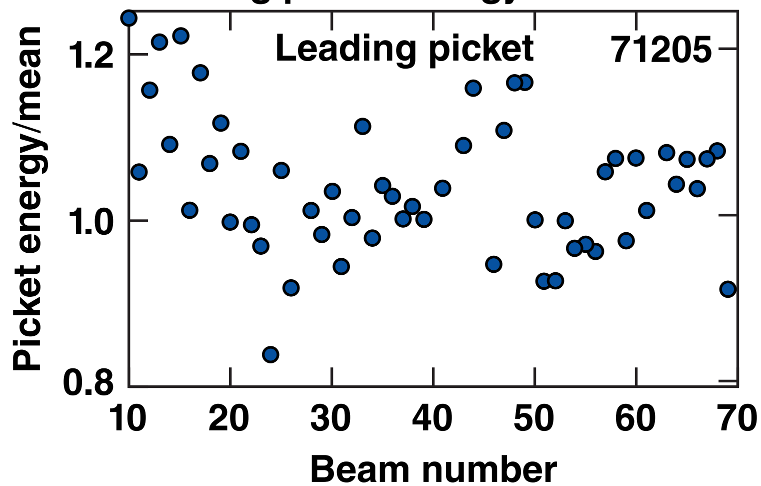
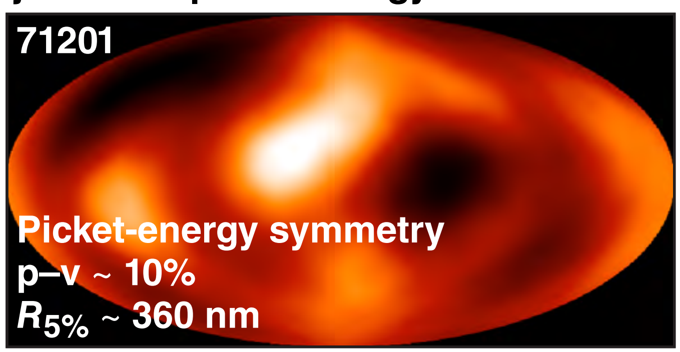
Measured beam spot-size distribution



Leading picket-energy distribution



Hard-sphere projection of picket-energy variation using beam profiles



The impact of this fixed pattern imprint is not as apparent with the SG4 phase plates at best focus.

Summary/Conclusions

Ignition hydro-equivalent performance on OMEGA is a key goal for the polar-drive–ignition campaign

- Mitigation of cross-beam energy transfer (CBET) and hydro-instability seeds will be required to demonstrate ignition hydro-equivalence on OMEGA*
- The primary CBET mitigation strategies on OMEGA involve reducing the amount of light going around the target**
- The expected performance improvement with CBET mitigation ($R_{beam}/R_{target} \sim 0.85$) was overwhelmed by the time zero nonuniformity
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Different CBET mitigation strategies are required for polar (NIF) and symmetric drive (OMEGA)

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Strategy	OMEGA (symmetric)	NIF (polar drive)
Smaller laser spots (R_{beam}/R_{target} < 1.0)	Reduced-edge rays Illumination uniformity	Reduced-edge rays Symmetry control
Two-state zooming $R_{picket} = R_{target}$, $R_{drive} < R_{target}$	Reduced-edge rays (drive) Power spectrum	Reduced-edge rays (drive) Symmetry control
Mid-Z ablators Be, Si, CH(Si), HDC	Increased T_e at $n_{cr}/4$ X-ray preheat	Increased T_e at $n_{cr}/4$ X-ray preheat
Wavelength shifts Cone-to-cone	Mitigate CBET $\Delta\lambda$ > 0.7 nm (UV)	Mitigate CBET $\Delta\lambda$ > 0.7 nm (UV)

Recent layered DT implosions tested the trade-off between drive uniformity and CBET mitigation with the R_{85} configuration.

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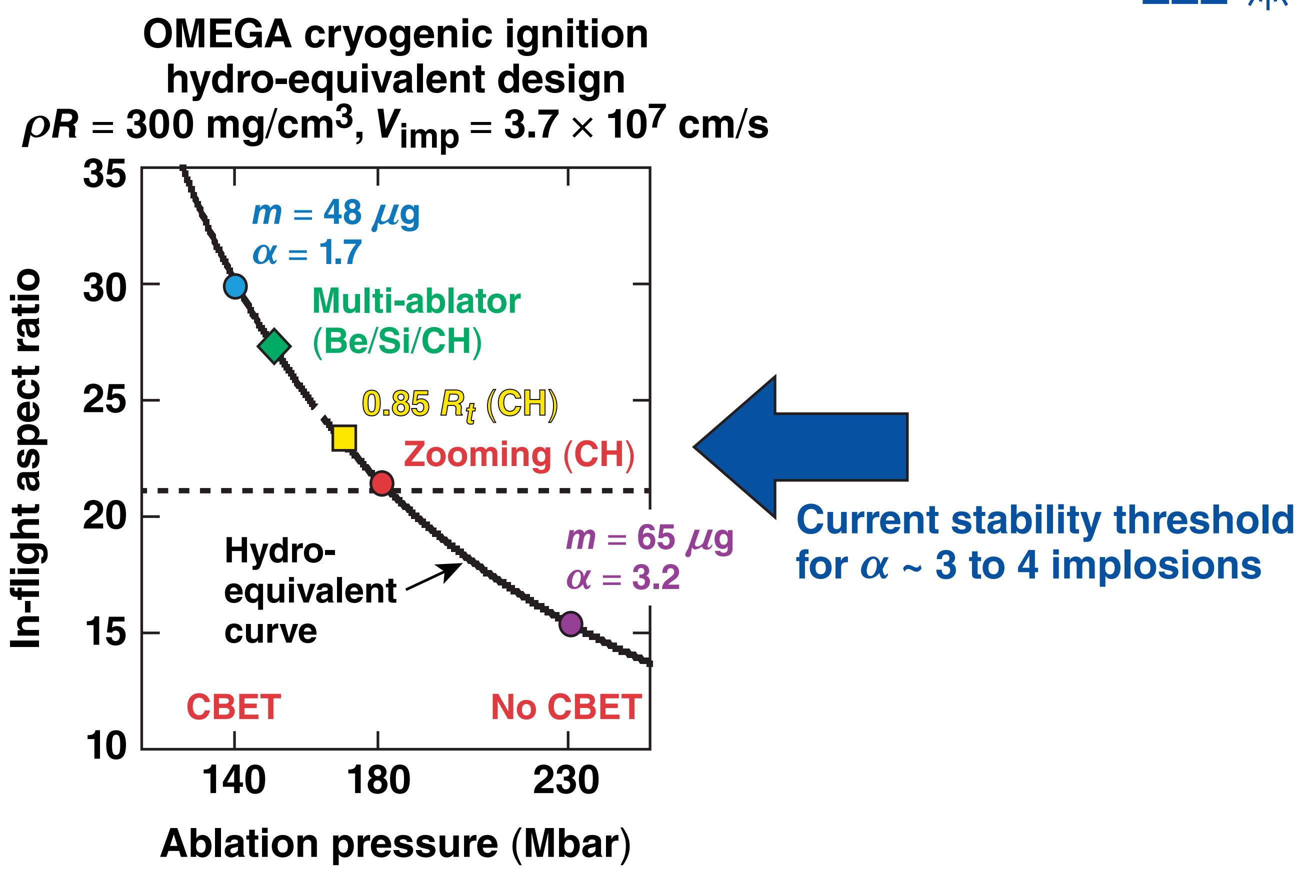
Mitigating CBET* is required to achieve ignition hydro-equivalent performance on OMEGA



Effort continues to identify and mitigate hydro-instability seeds to further increase the stability threshold.**

*D. H. Froula *et al.*, CO7.00002, this conference.
**T. C. Sangster *et al.*, Phys. Plasmas 20, 056317 (2013).

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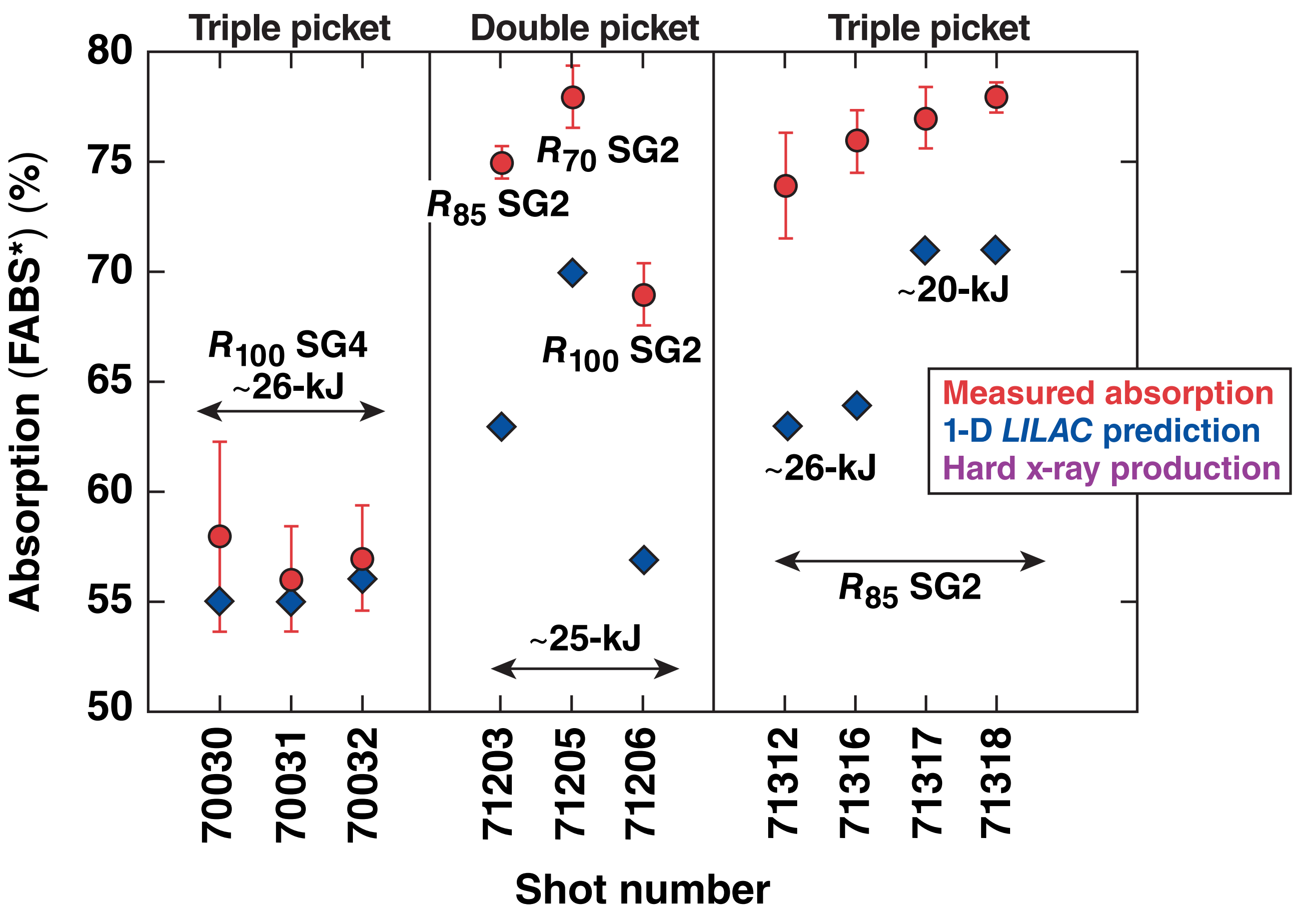
The energy absorbed increased as expected with the R_{85} configuration but the magnitude is not predicted by *LILAC*



Hard x-ray measurements suggest that excitation of the TPD instability may explain some of the discrepancy.

*Full-aperature backscatter station

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