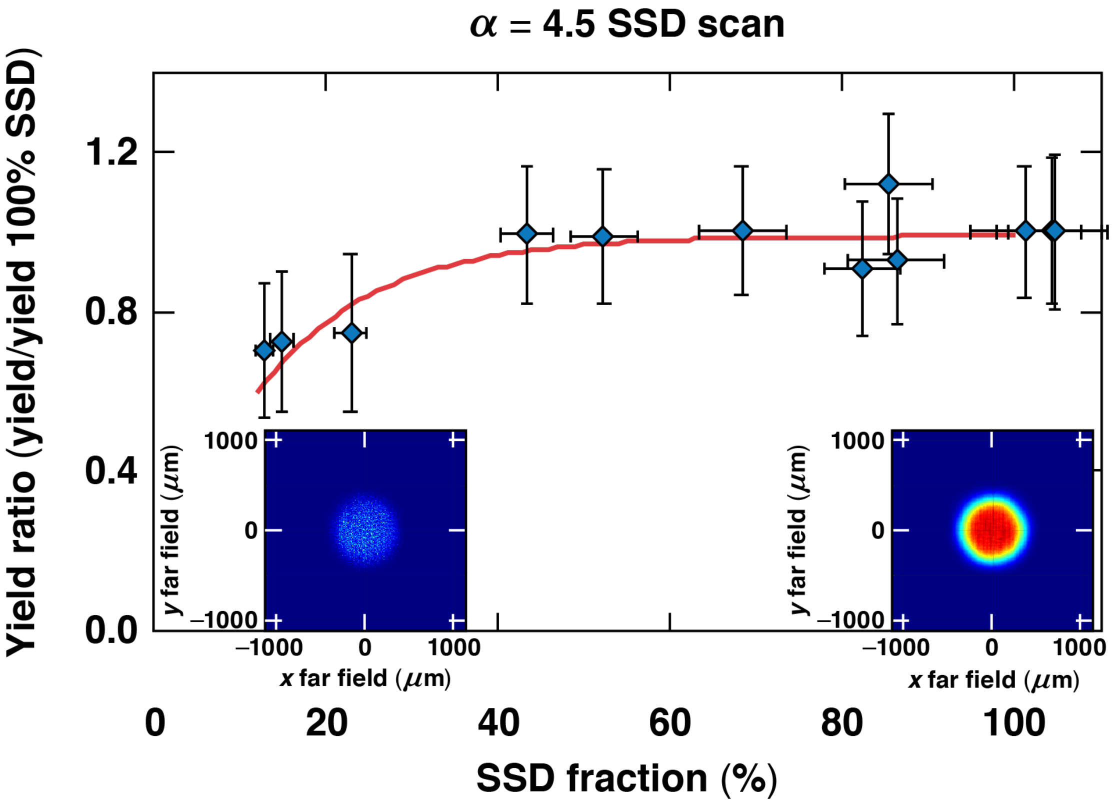
A Systematic Study of Laser Imprint for Direct Drive—from Seeds to Integrated Implosions



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Summary

Performance of α = 4.5 and 3.5, cryogenic implosions on OMEGA is not limited by beam imprint

- Illumination σ_{total} from calculation was fitted with a single parameter function to determine Illumination σ_{total} for all smoothing by spectral dispersion (SSD) bandwidth scan shots
- All implosion metrics improve as SSD bandwidth increases and then plateau
  - the plateau region for high-adiabat implosions starts at σ_{total} ~ 4.5% for both yield and ρR
  - the plateau region for low-adiabat implosions starts at σ_{total} ~ 3.5% for both yield and ρR and is less pronounced
  - burnwidth data show the same trends for low-and high-adiabat implosions with a reduced plateau at σ_{total} ~ 3%

Collaborators

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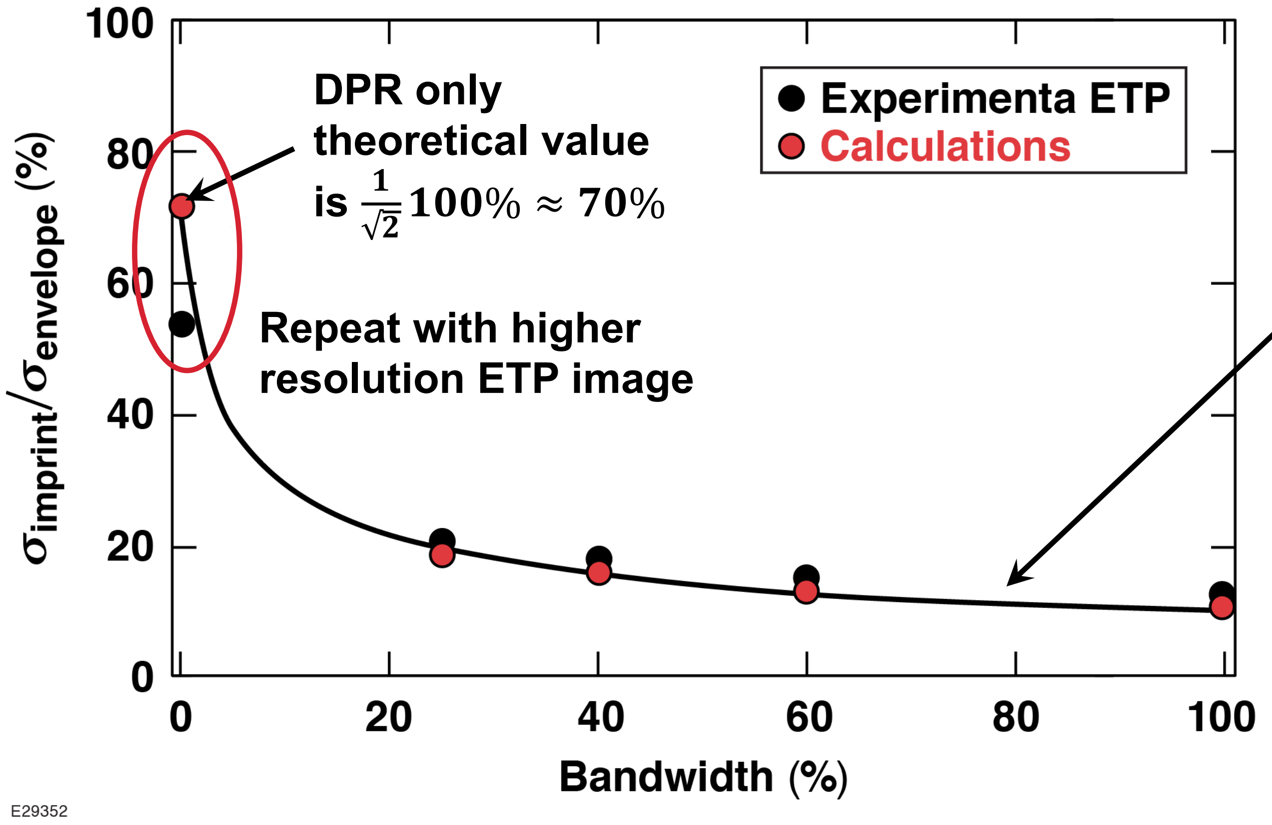
The calculated magnitude of single-beam imprint modes versus SSD bandwidth (using 100-ps FWHM Gaussian picket) qualitatively agree with ETP measurement



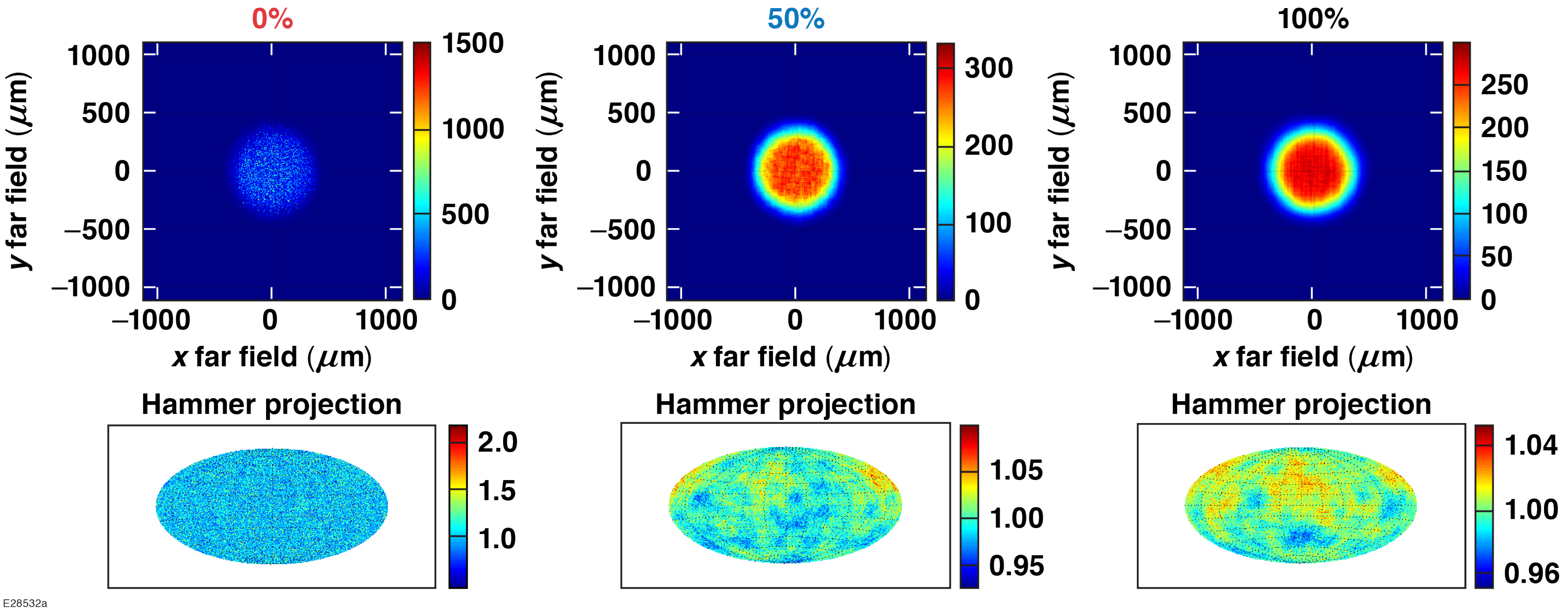
$$\sim \frac{\sigma_0}{\sqrt{t_p \text{ bandwidth} + 1}} \; *$$

$$\sim \frac{\sigma_0}{\sqrt{\frac{\Delta t_p}{\tau_c} + 1}} \qquad \tau_c \sim \frac{1}{\text{bandwidth}}$$

FWHM = full width at half maximum
ETP = equivalent target plane
DPR= distributed polarization rotator

* LLE Review Quarterly Report 114, 73 (2008).

Single-beam and overlapped far-field intensities versus bandwidth were calculated for SG5-850 phase plates and a target diameter of 900 μm



SSD modeling done by A. Shvydky
Single-beam far fields are calculated by convolving the DPP far field with the SSD kernel
A "hard-sphere" model is used to calculate the overlap intensity

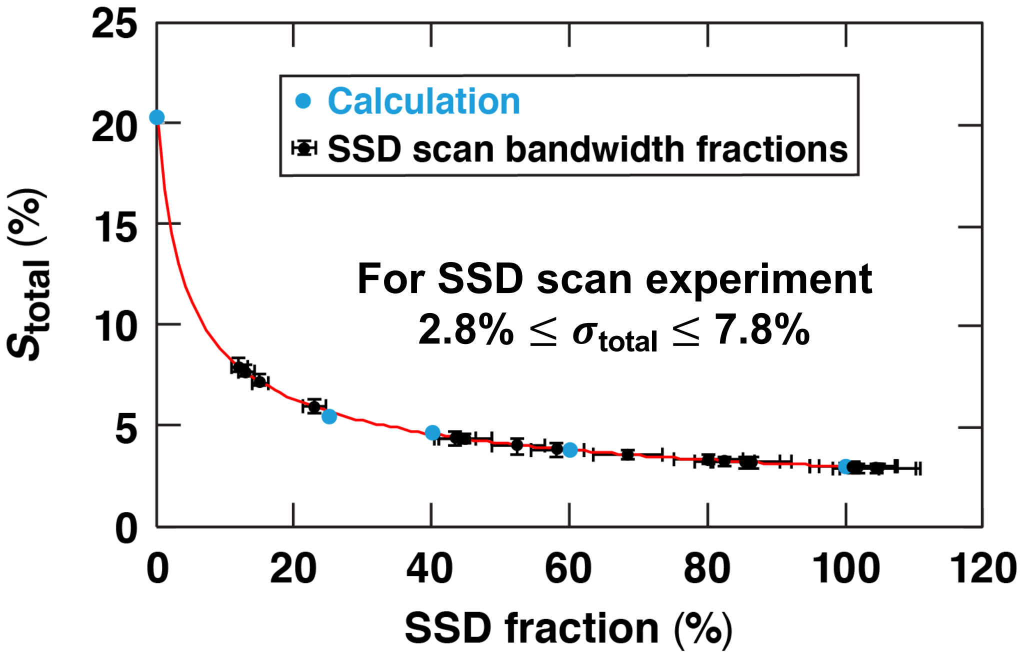
DPP: distributed phase plate

Illumination σ_{total} calculated was fitted with a single parameter function

$$\sigma_{\text{total}} = \frac{\sigma_{\text{SSD}=0}}{\sqrt{A \bullet \text{SSD}_{\text{fraction}} + 1}}$$

Bandwidth (%)	σ_{total} (%)
0	20.3
25	5.4
40	4.6
60	3.73
100	2.92

A = 47.50±0.55



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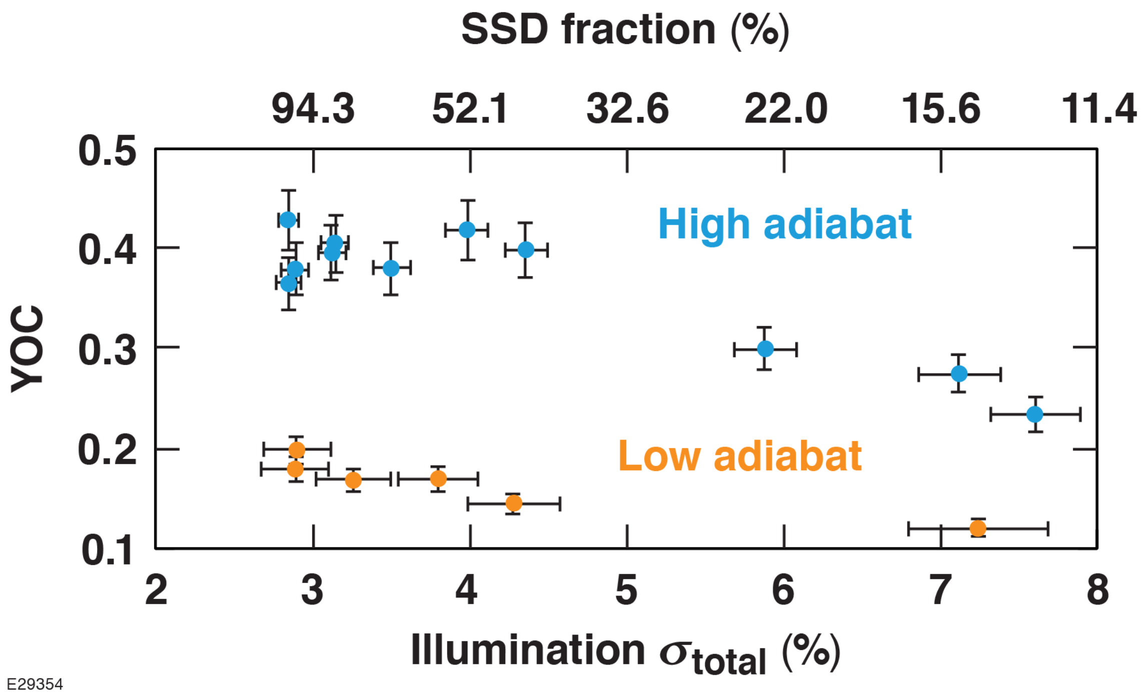
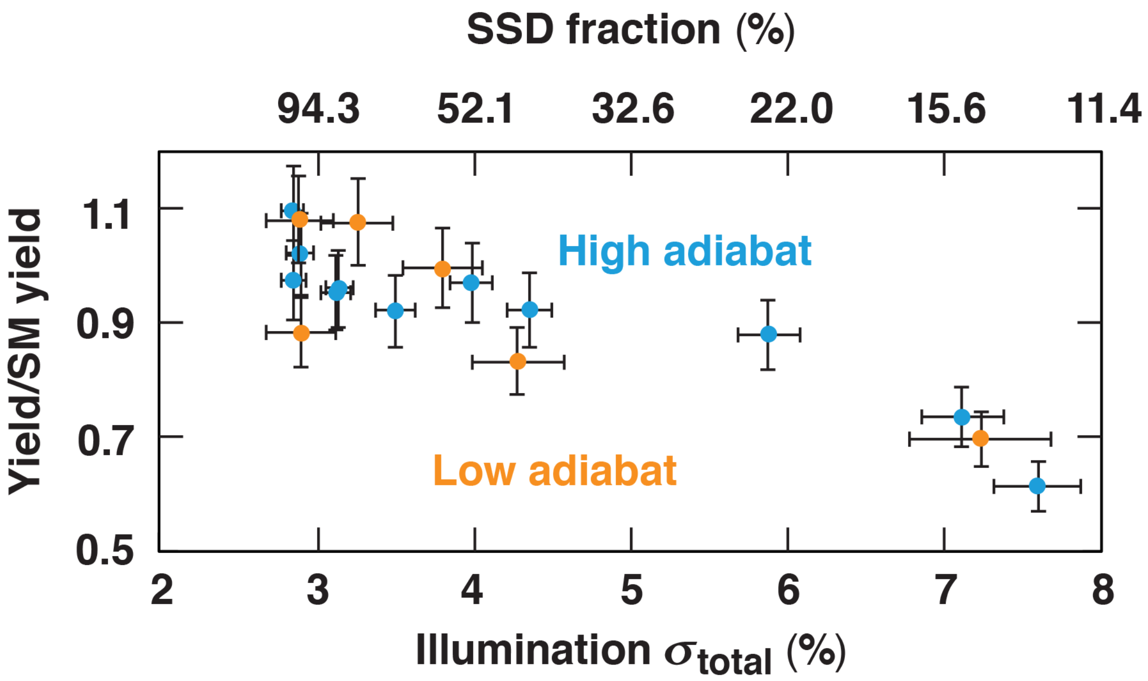
$$\sigma_{\text{total}} = \frac{20.3\%}{\sqrt{47.50 \bullet \text{SSD}_{\text{fraction}} + 1}}$$

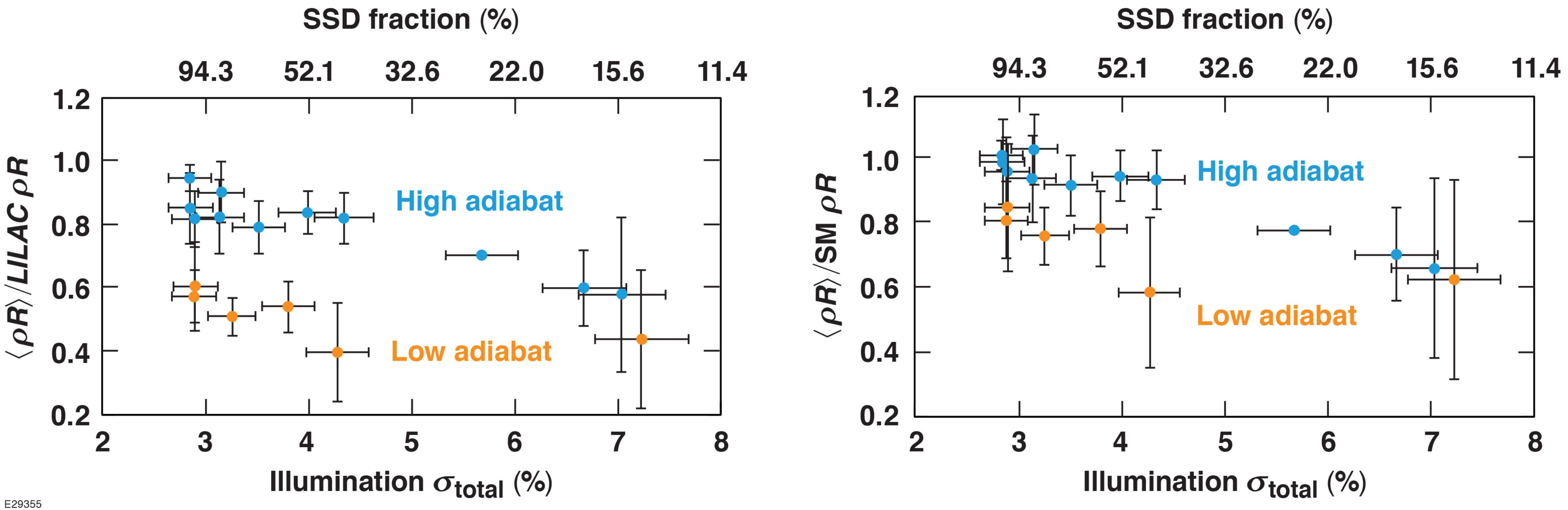
Neutron yield normalized to either *LILAC* 1-D yield (YOC) or statistical model (SM) yield plateaus for low-adiabat implosions





YOC: yield over clean

$\langle \rho R \rangle$ normalized to either *LILAC* 1-D ρR or statistical model ρR plateaus like the normalized yield



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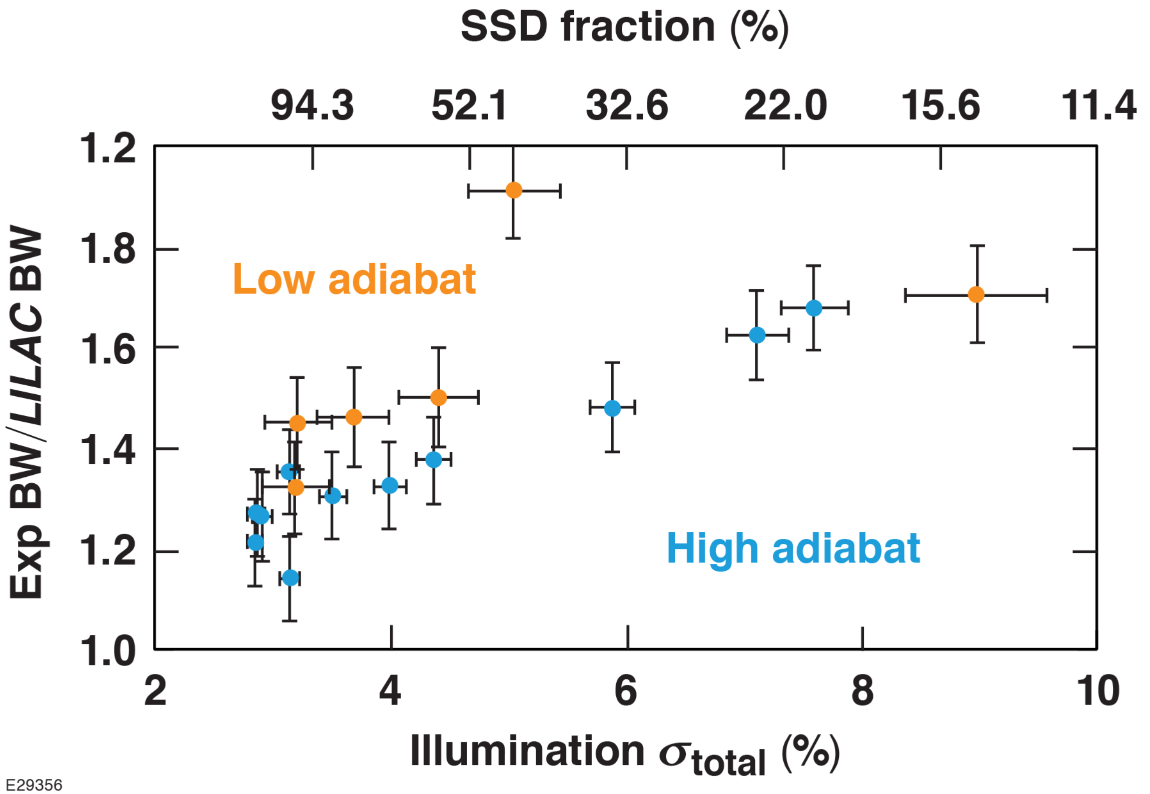
Neutron temporal diagnostic (NTD) burnwidth normalized to *LILAC* 1-D burnwidth also plateaus but over a reduced range



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