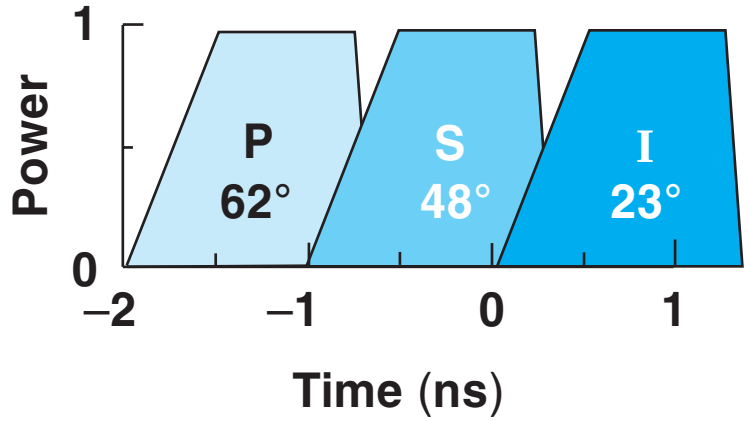
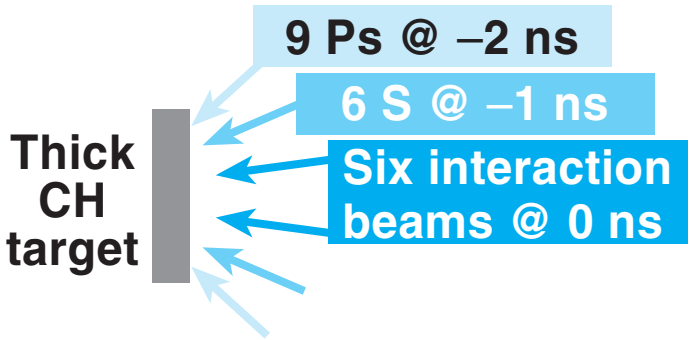
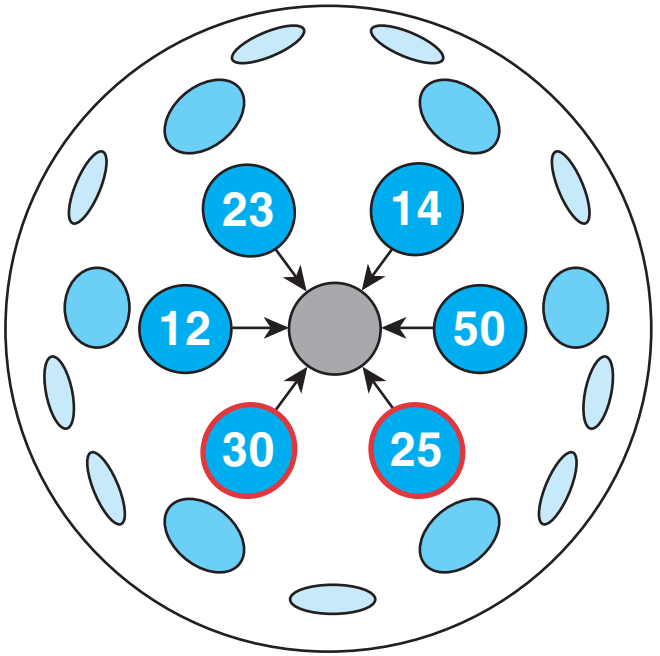
Multibeam SBS Interaction Experiments in OMEGA Long-Scale-Length Plasmas







W. Seka *et al.*
Laboratory for Laser Energetics
University of Rochester

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Collaborators

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LLE: S. P. Regan
D. D. Meyerhofer
B. Yaakobi
C. Stoeckl
R. S. Craxton
R. E. Bahr

LLNL: H. Baldis

LULI (France): J. Fuchs, C. LaBaune

Summary

Various multiple-beam SBS effects are clearly evident in experiments with six interaction beams

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- Experiments on OMEGA at 351 nm with full beam smoothing were carried out in plasmas relevant to NIF direct-drive implosions.
- Multiple-beam effects are dominated by seeded SBS
- Evidence was found for the existence of common (central) ion waves.
- SBS power reflectivities appear to saturate around a few percent.
- Under plasma conditions corresponding to NIF direct-drive ignition experiments, SBS power and energy reflectivities remain well below 1%.

Outline

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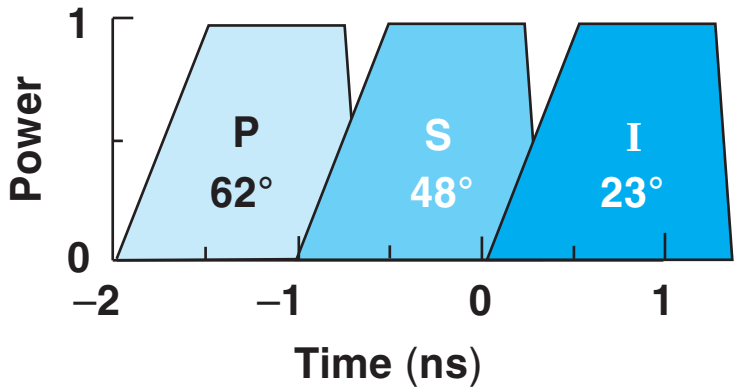
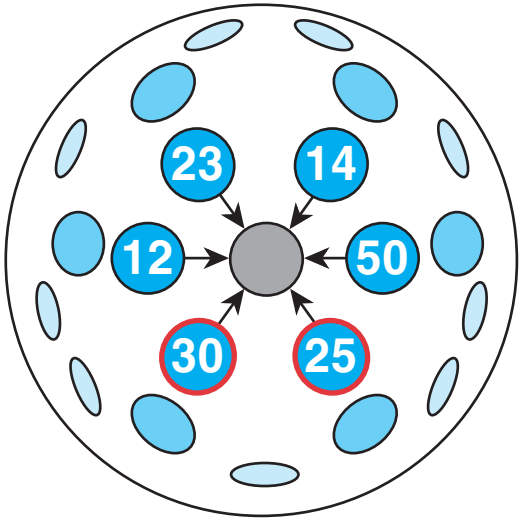
- **Multiple-beam interaction experiments**
  - **Motivation**
  - **Experimental details**
  - **Time-resolved and time-integrated SBS data**
  - **Conclusions**

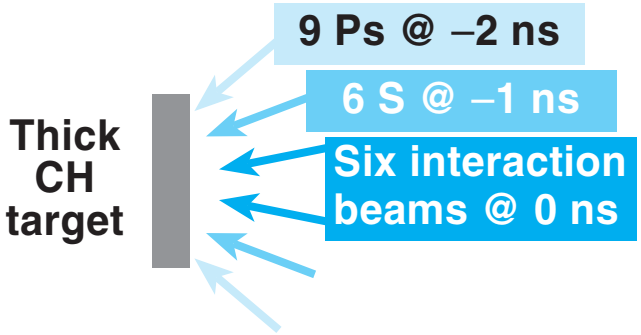
Multiple-beam SBS interaction experiments used three sets of delayed beams, six of them interaction beams



BL	25	30	12	23	14	50
I_{14}	4	16	4	8	16	8

(W/cm^2)





Intensities are varied with phase plates; energies are kept constant.

- Plasma density scale lengths and T_e roughly correspond to NIF direct-drive conditions.
- Full-beam smoothing (1-THz 2-D SSD and polarization smoothing)
- SBS and SRS with and without time resolution in two beams

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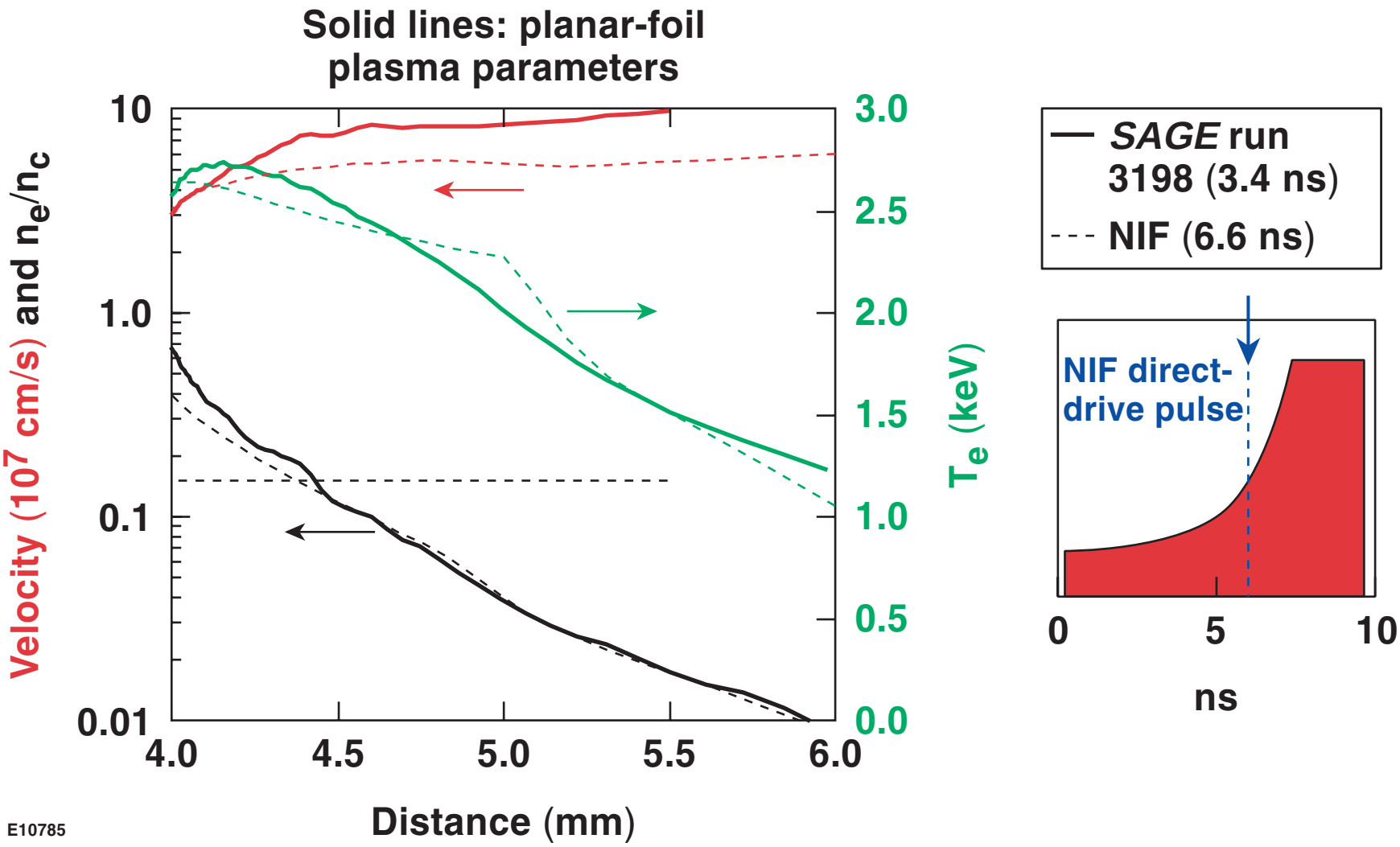
A 2-D simulation of OMEGA planar-foil plasma resembles direct-drive NIF conditions at ~ 6 ns into the laser pulse



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Multiple-beam experiments are dominated by seeded SBS backscattering

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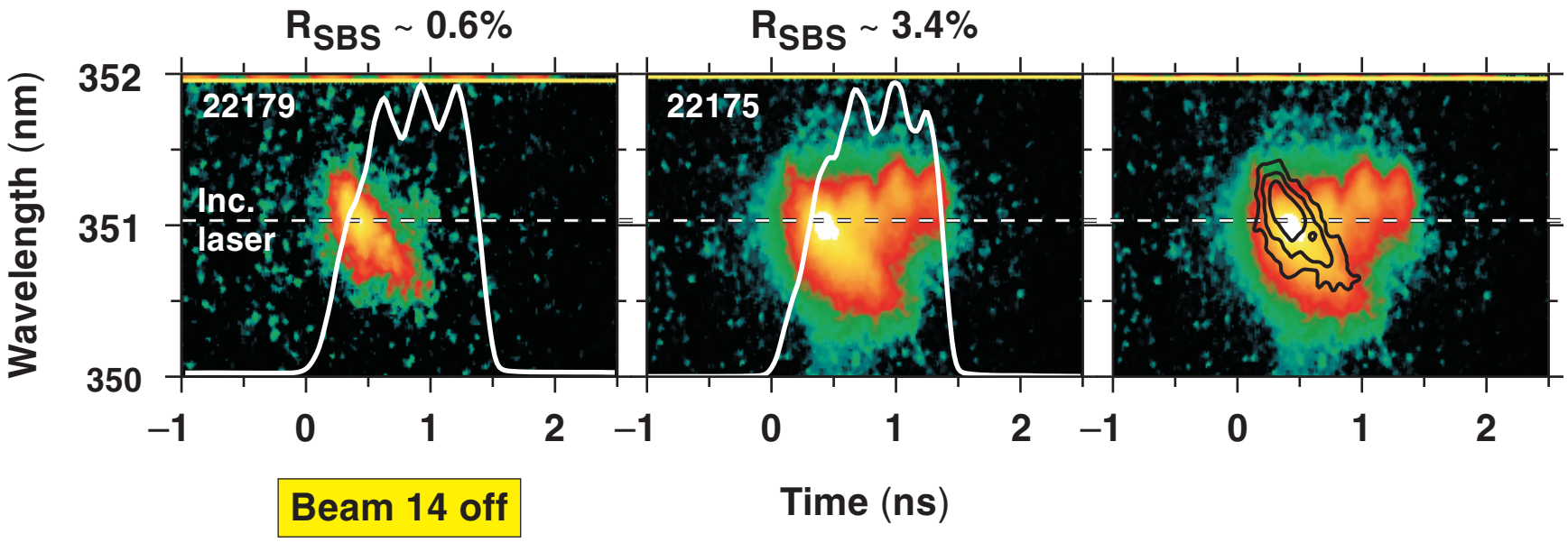
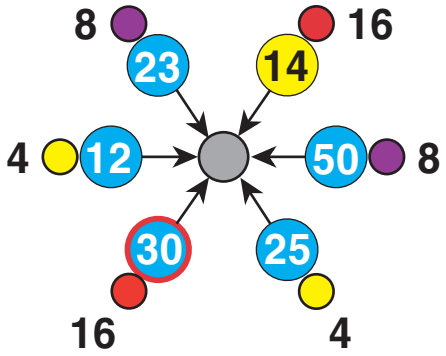
$I_{30} = 1.6 \times 10^{15}$ W/cm^2, SSD at 1-THz and PS





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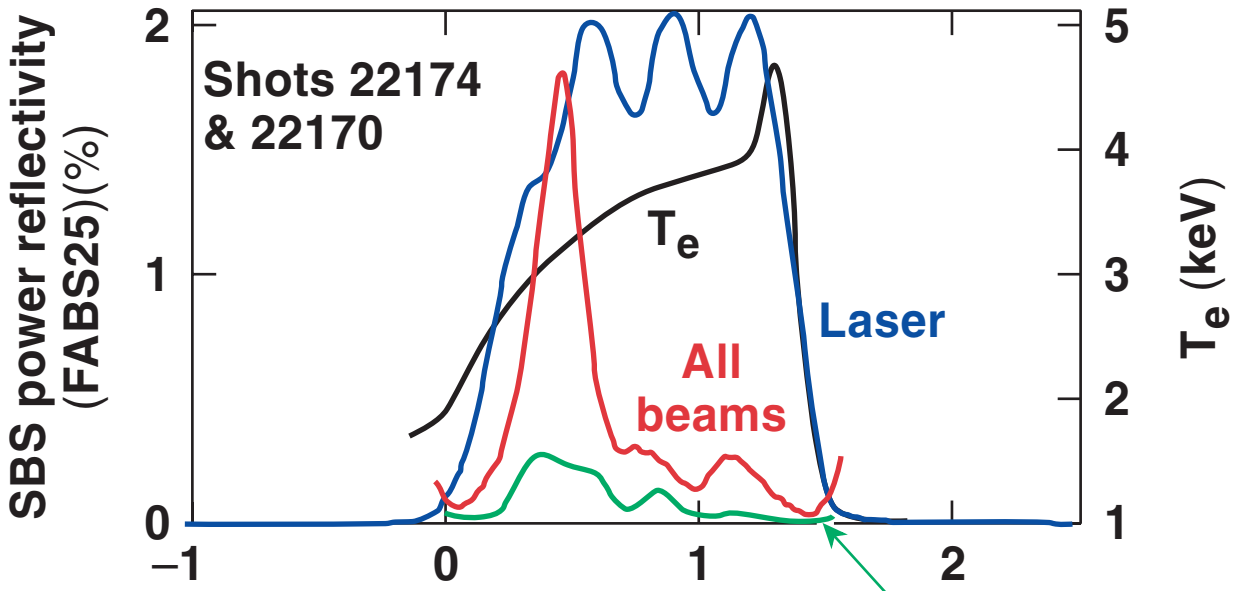
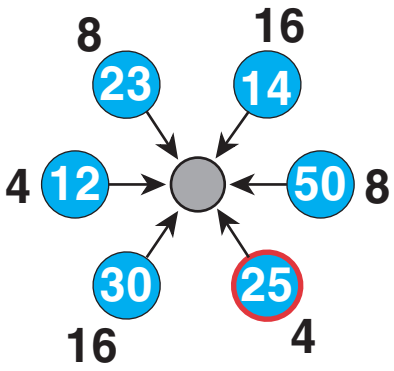
The multibeam SBS signals are dominated by amplification of specularly reflected light

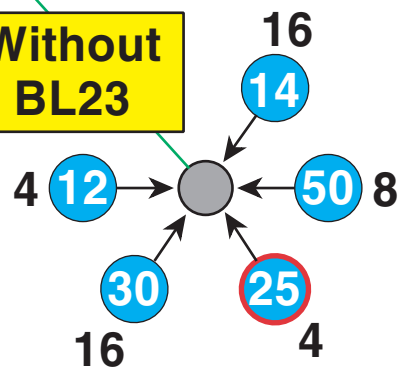




$I_{25} \sim 4 \times 10^{14}$ W/cm^2

$I_{23} \sim 8 \times 10^{14}$ W/cm^2

Without BL23



Note: The specularly reflected light is expected to increase with time due to heating of the plasma

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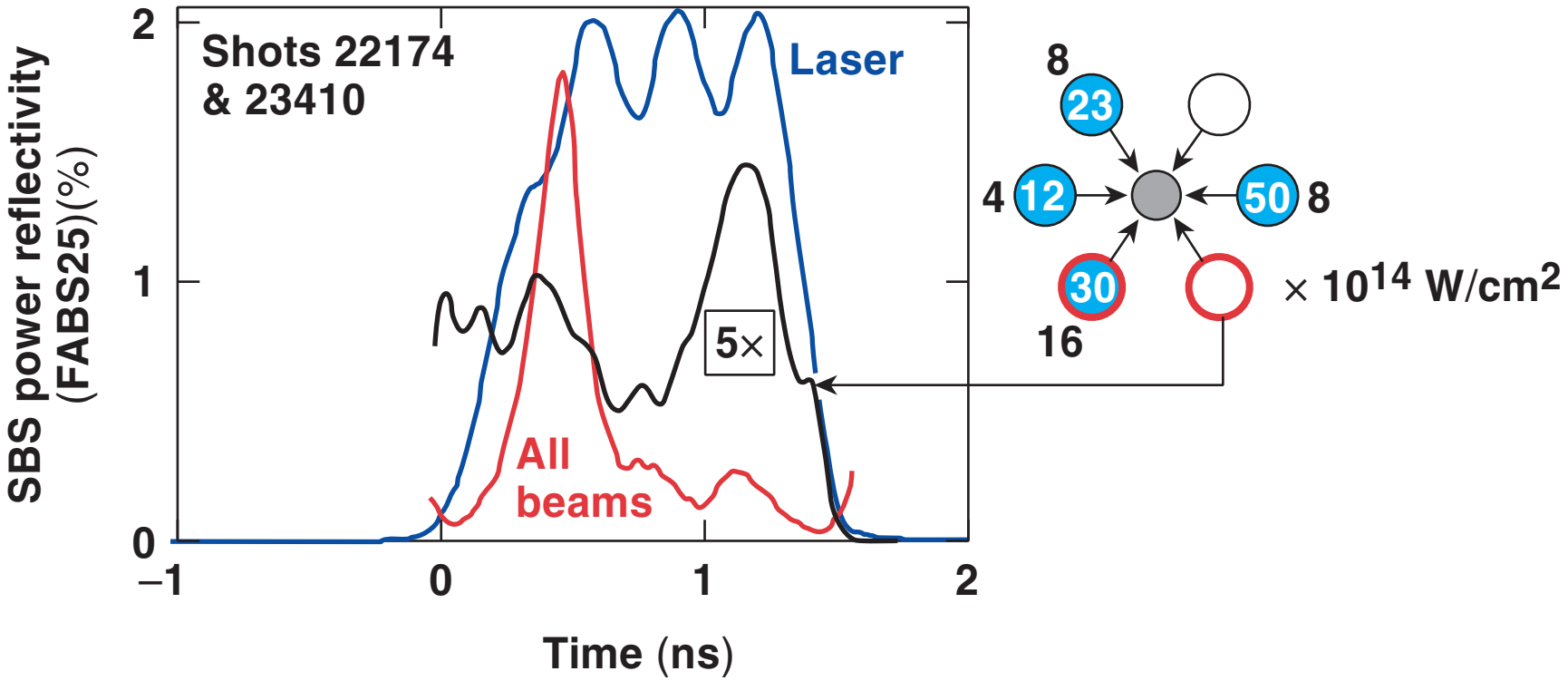
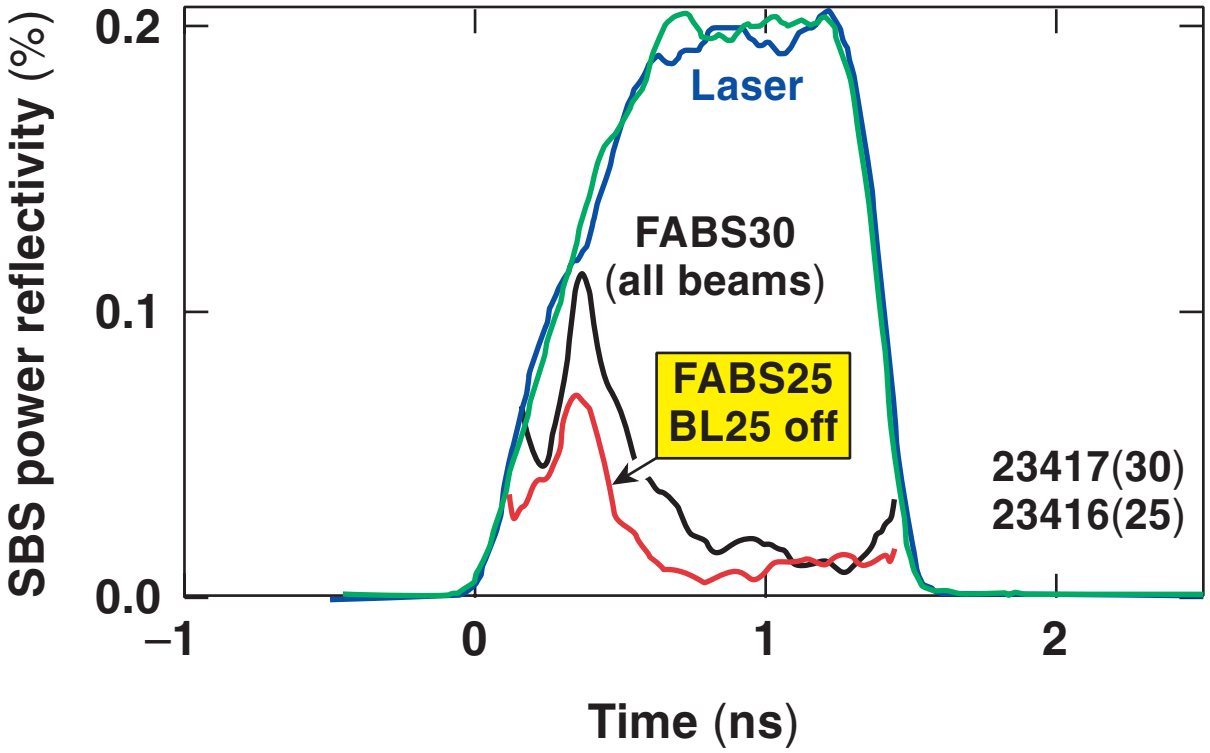
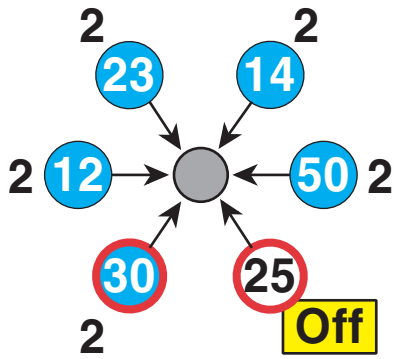
Without beams 25 and 14, FABS25 primarily records specularly reflected light from beam 23



Note: The specularly reflected light increases with time due to heating of the plasma

At low intensities common SBS ion waves contribute to Thomson scattering signal of BL23 without BL25

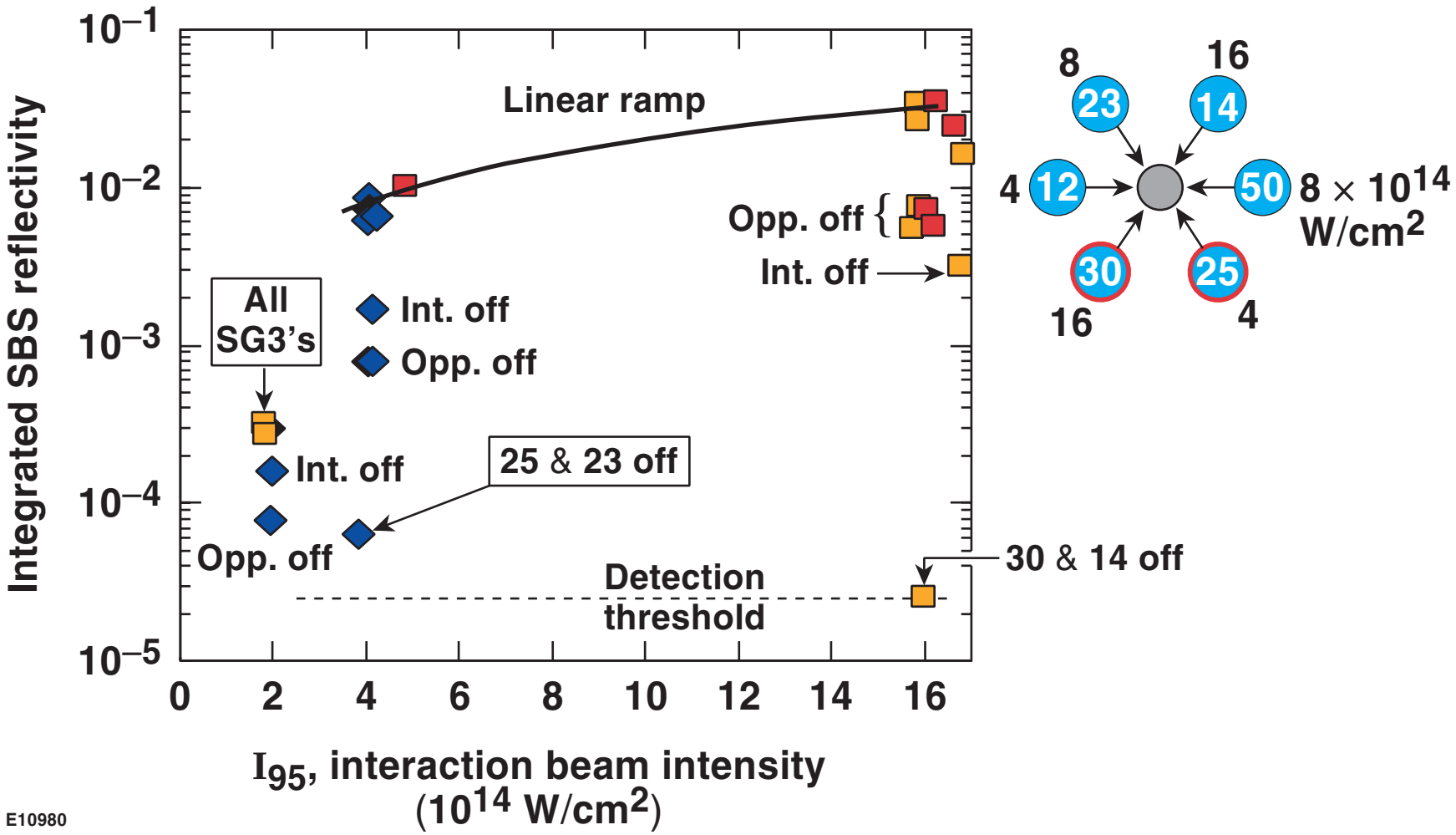




All
interaction beams
~ 2×10^{14} W/cm^2

E10979

The integrated SBS reflectivities confirm strong seeding from "opposing" beams along with reduced seeding from other beams



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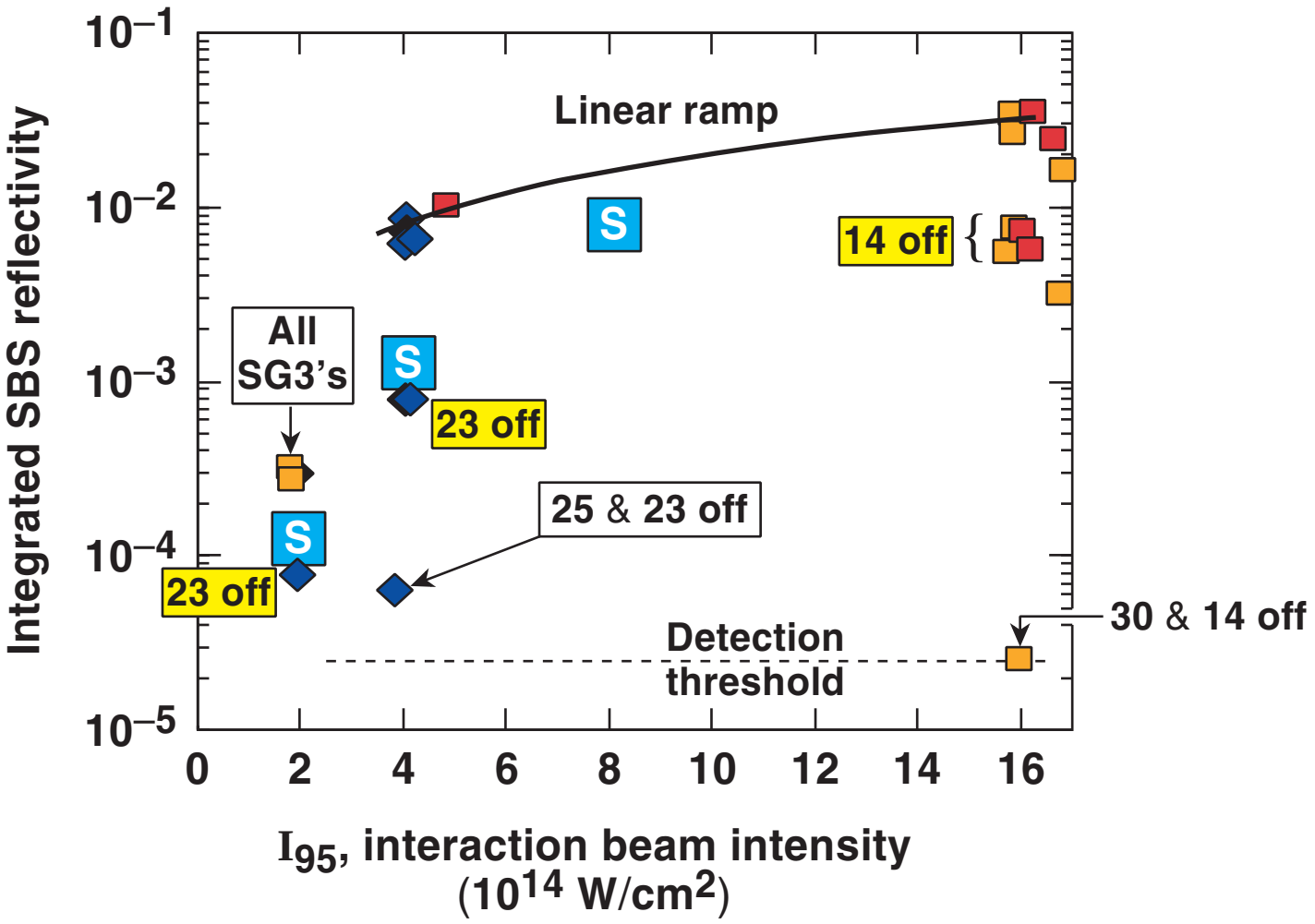
Present single-beam SBS data are consistent with older data



E10981

Multiple-beam experiments in planar geometry are only a rough approximation for spherical experiments

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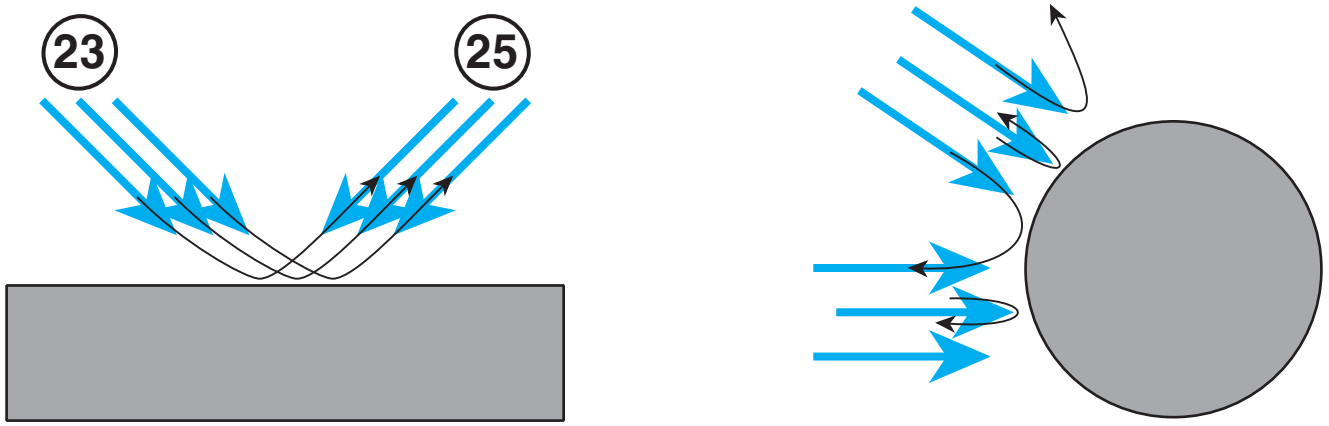

- Overlapping beams in planar targets are not exactly equivalent to overlapping beams in spherical geometry.
  - → Energetically, seeding in planar geometry is much more efficient.
- The present experiments have approximately the right density scale lengths but the velocity scale lengths are too short.
- Single-beam interaction experiments at perpendicular incidence have reduced SBS seeds due to increased absorption near the critical density

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