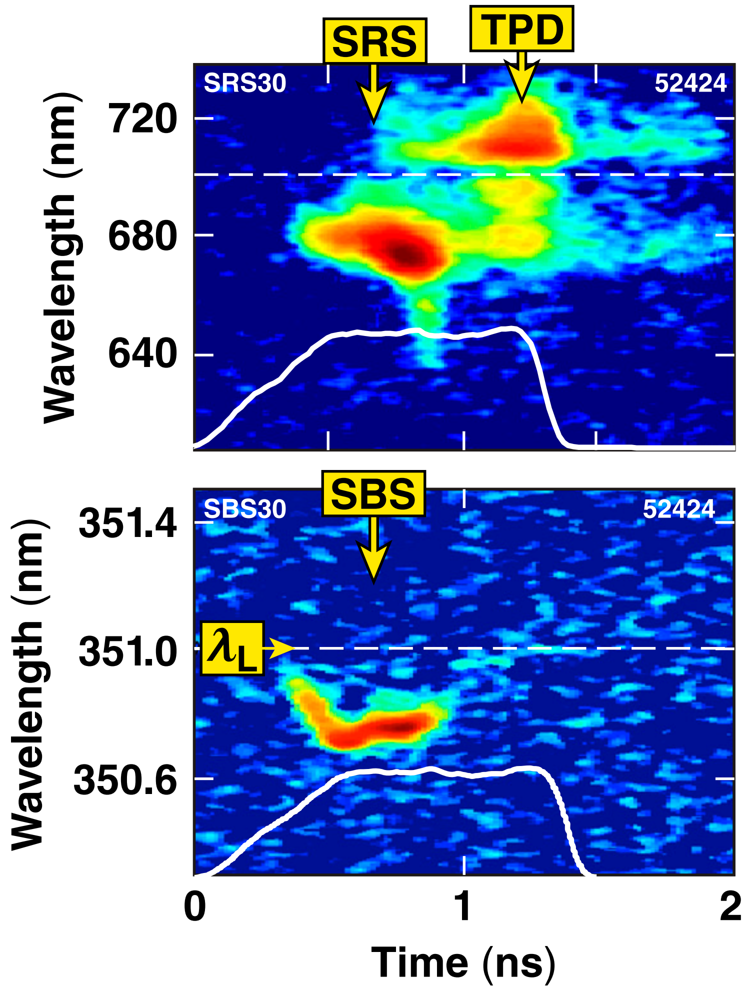
SBS, SRS, and TPD in Planar-Target Experiments Relevant to Direct-Drive ICF



TPD at $n_e/n_c \sim 0.2$ to 0.25

SRS at $n_e/n_c = 0.23$

SBS at $n_e/n_c = 0.25$

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Summary

SBS appears to suppress TPD when both are above threshold at $n_c/4$

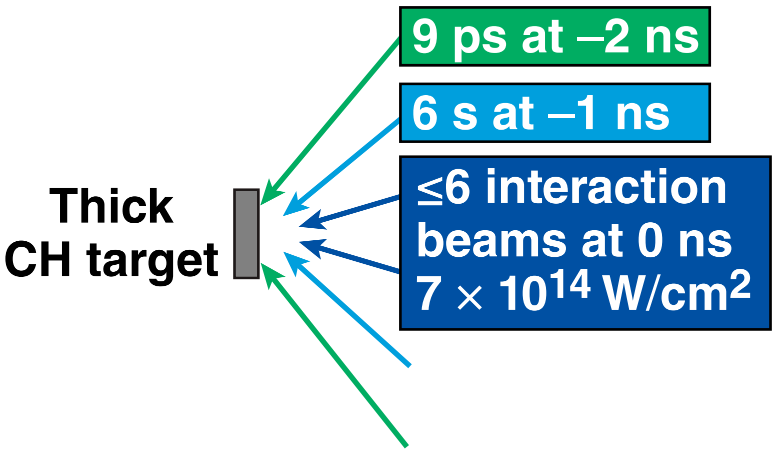
- Multiple-beam, flat–target interaction experiments have been arranged to have SBS, SRS, and TPD go above threshold at the same time in about the same region of space.
- 2-D hydrodynamic simulations along with estimates of SBS gain factors show that SBS goes above threshold at $n_c/4$ at the same time that the TPD instability is significantly above threshold.
- The TPD instability is suppressed as long as SBS is present near $n_c/4$.
- The SRS instability is observed at $n_e/n_c \sim 0.23$. Its behavior is unaffected by SBS, which occurs at higher densities.

Collaborators

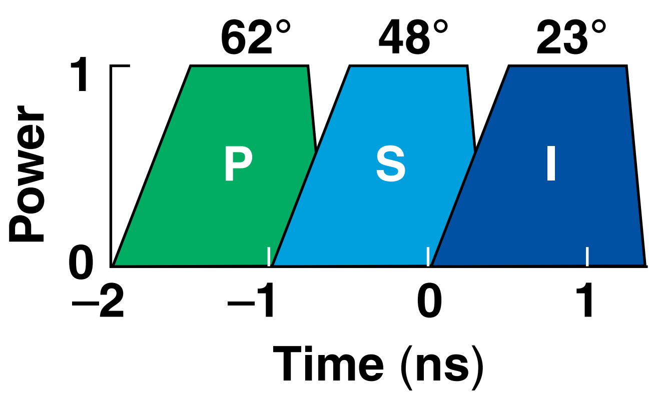
D. H. Edgell, J. F. Myatt, R. S. Craxton,
A. V. Maximov, and R. W. Short

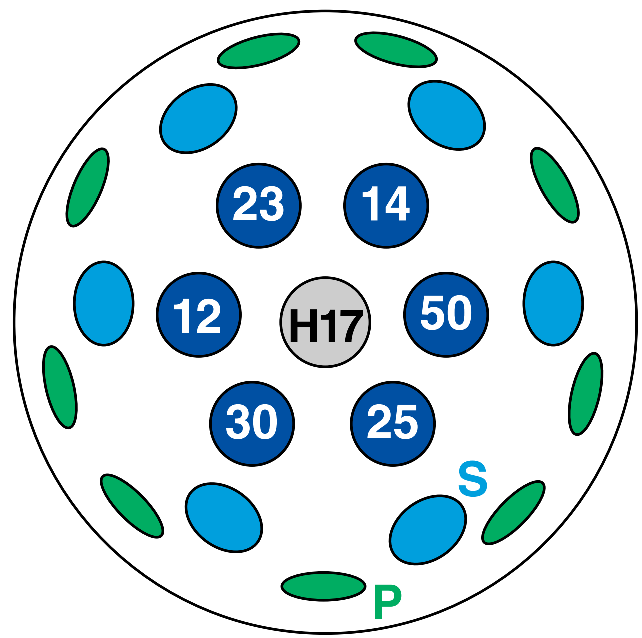
Laboratory for Laser Energetics
University of Rochester

Planar–target experiments are carried out with three delayed sets of beams



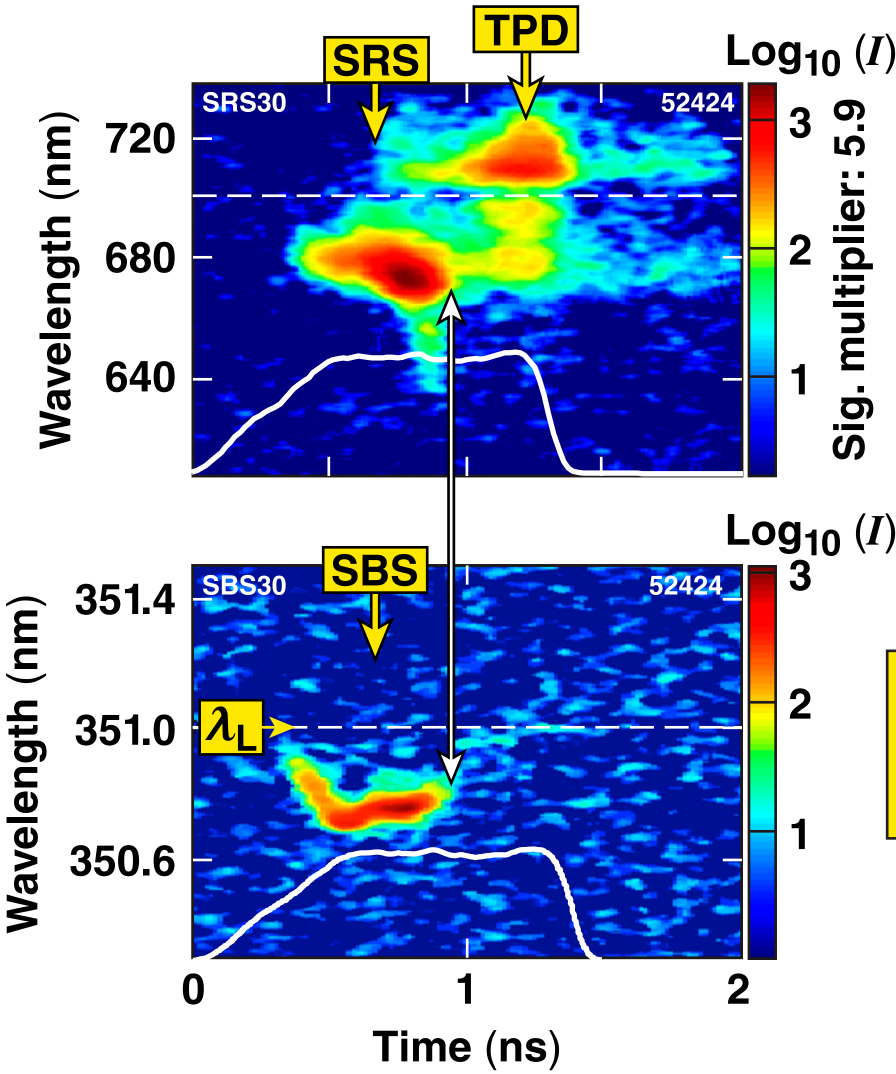
The target normal points in the direction of the symmetry axis of the six interaction beams





E19025

The striking observation in these experiments is the almost simultaneous onset and termination of SBS and SRS followed by the onset of two-plasmon-decay instability

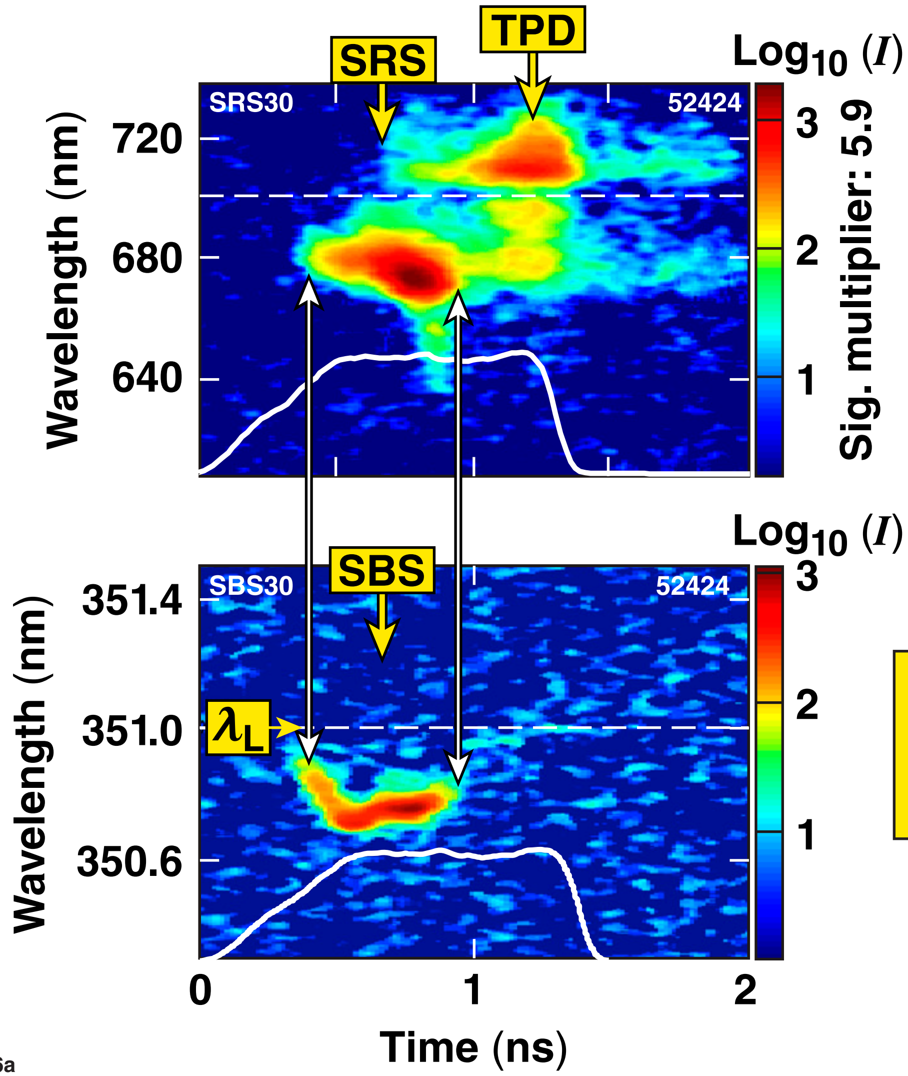


These observations suggest some interaction between these instabilities.

E19026

The striking observation in these experiments is the almost simultaneous onset and termination of SBS and SRS followed by the onset of two-plasmon-decay instability

UR LLE



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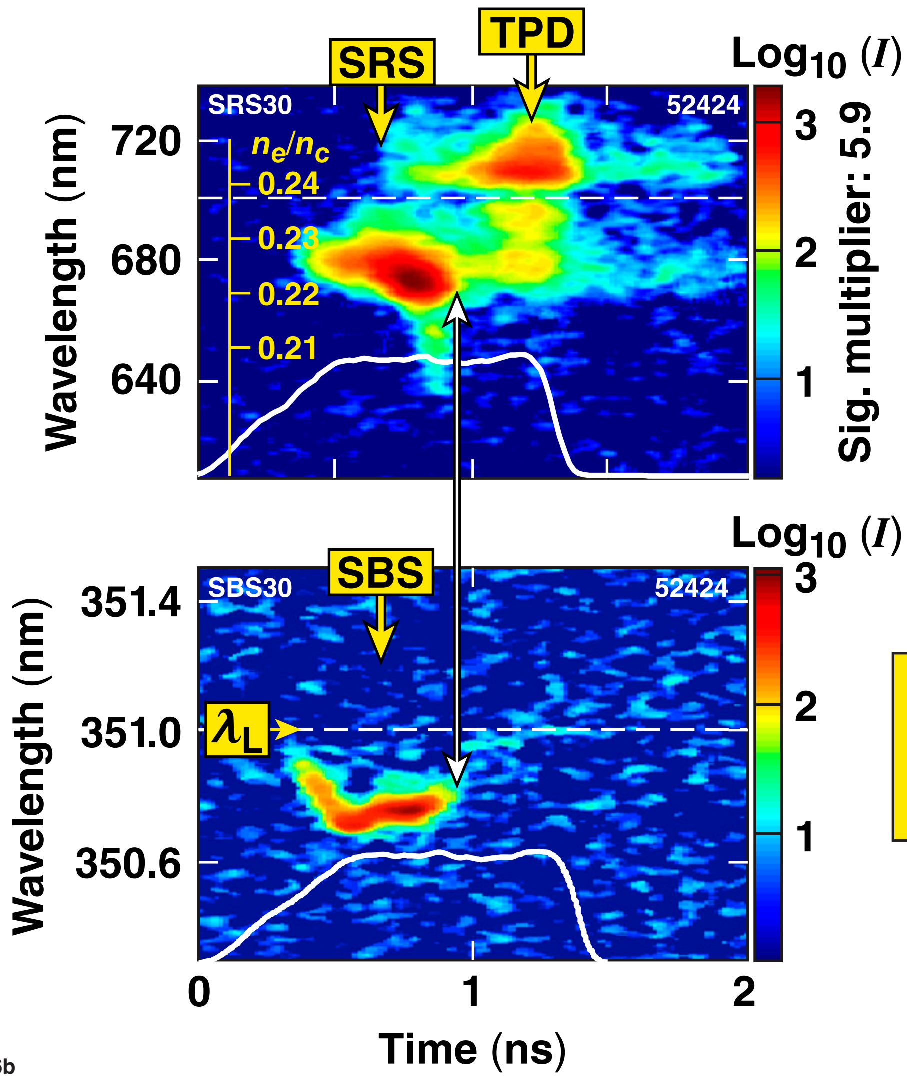
E19026a

The striking observation in these experiments is the almost simultaneous onset and termination of SBS and SRS followed by the onset of two-plasmon-decay instability

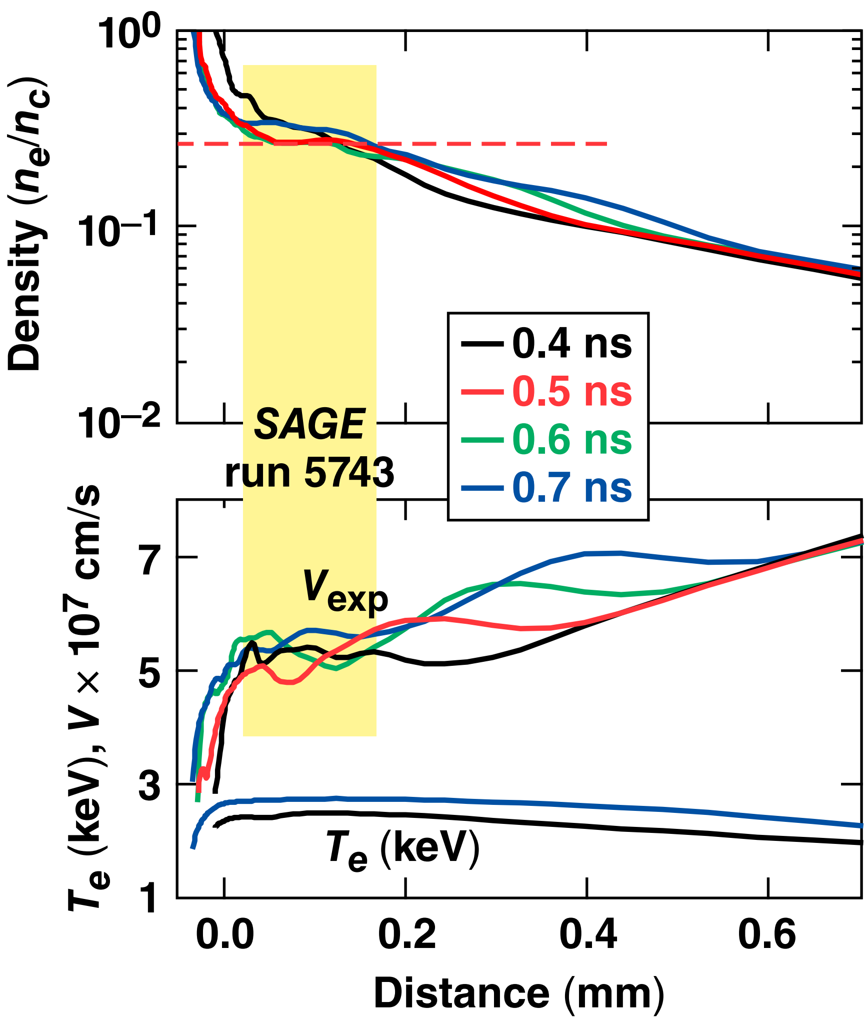


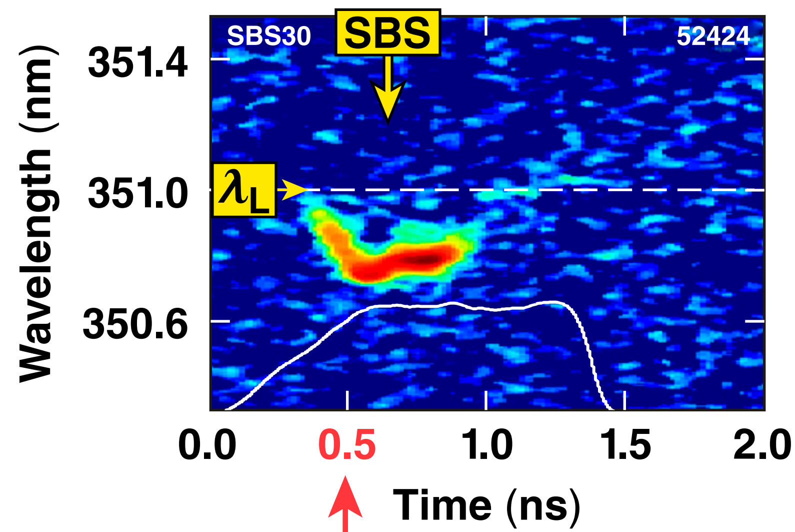
SRS density range obtained from dispersion relation

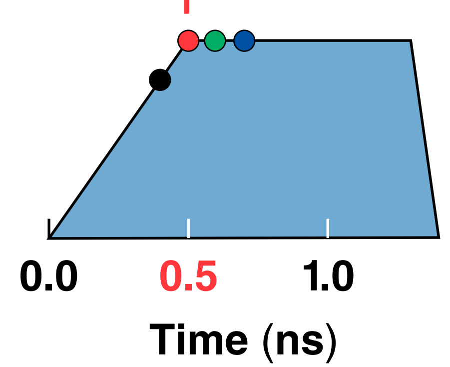
These observations suggest some interaction between these instabilities.

E19026b

Two-dimensional *SAGE* simulations show velocity gradients and densities are ideal for SBS near quarter critical when the peak of the pulse is reached

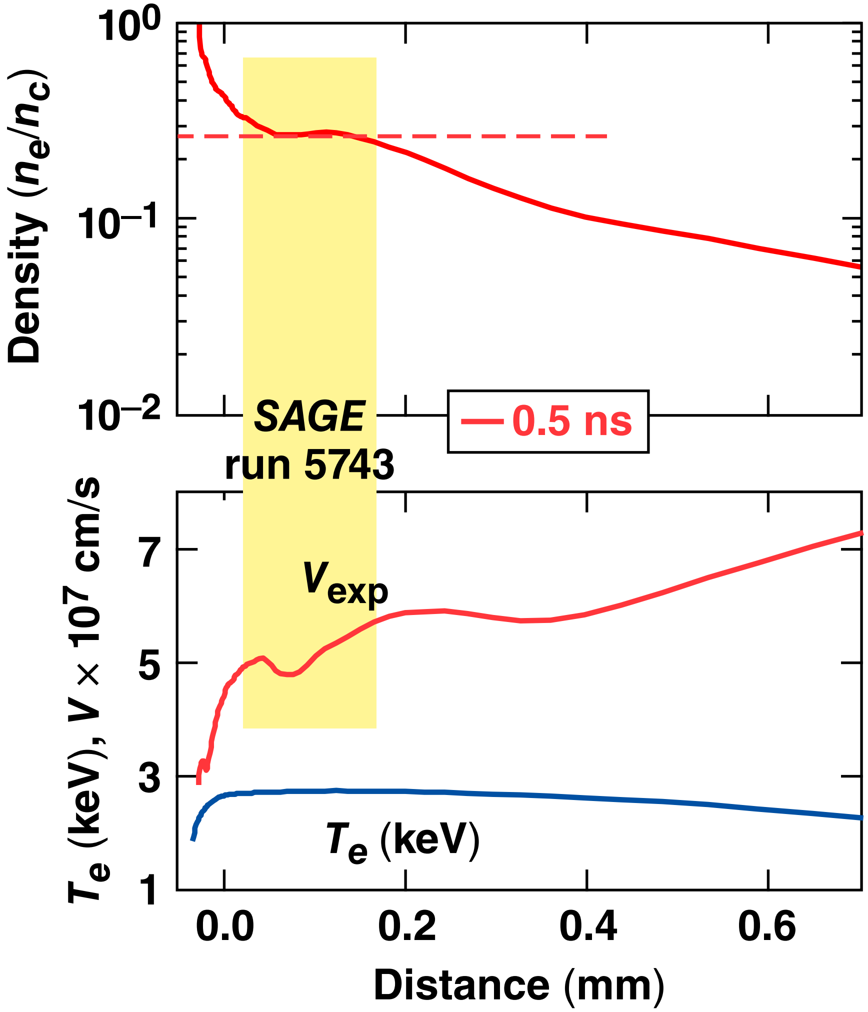


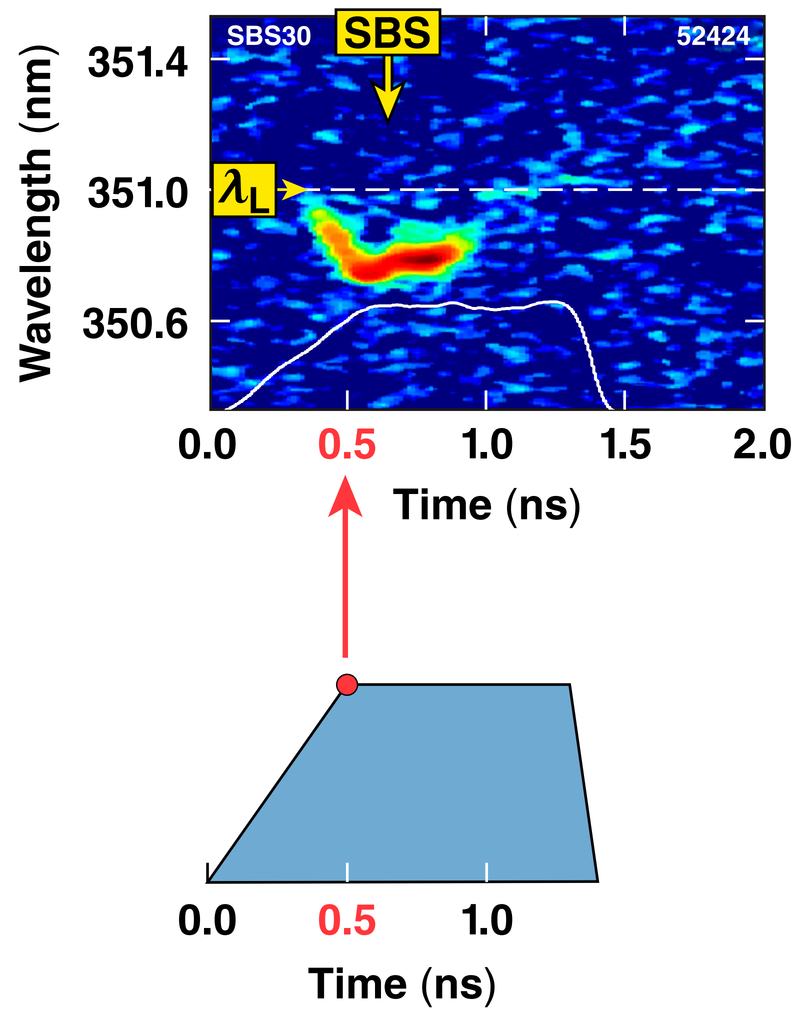




E19027

Two-dimensional *SAGE* simulations show velocity gradients and densities are ideal for SBS near quarter critical when the peak of the pulse is reached



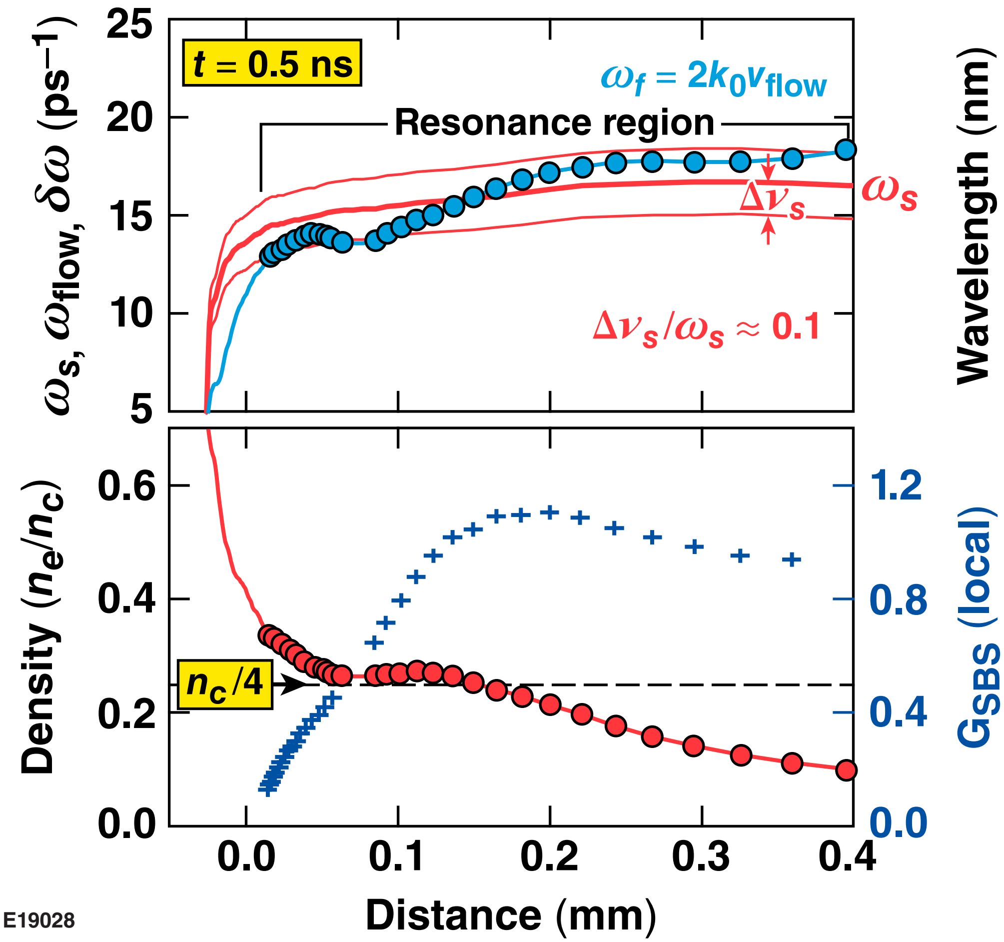


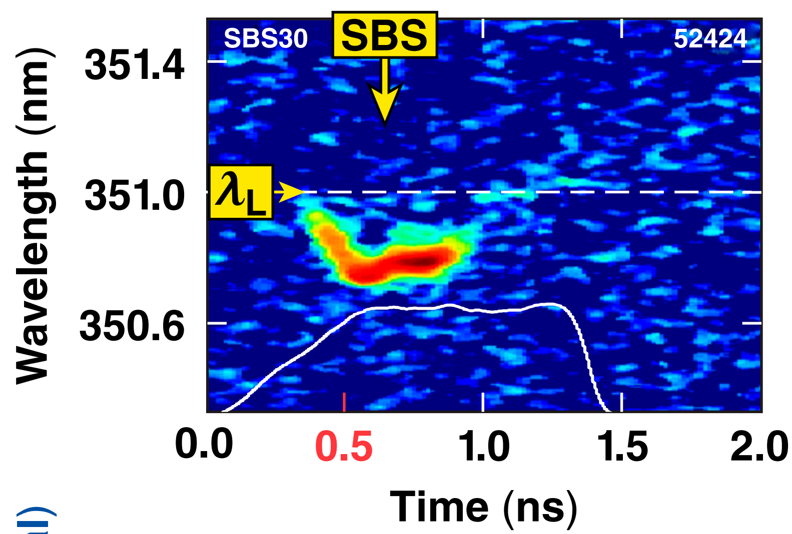
E19027a

The convective SBS gain factor is estimated by integrating the spatial growth rate over the gain length determined by damping the ion waves

UR LLE

$$G_0(\ell)^{(1)} = 2.9 \times 10^{-2} \int \frac{(n_e/n_c)(I_{14}\lambda^2)(1/\lambda_0)}{T_e(1+\tau_i)(\nu_s/\omega_s)(1-n_e/n_c)^{1/2}} d\ell$$





Total SBS intensity gain = 20

E19028

J. Myatt *et al.*, Phys. Plasmas 11, 3394 (2004).

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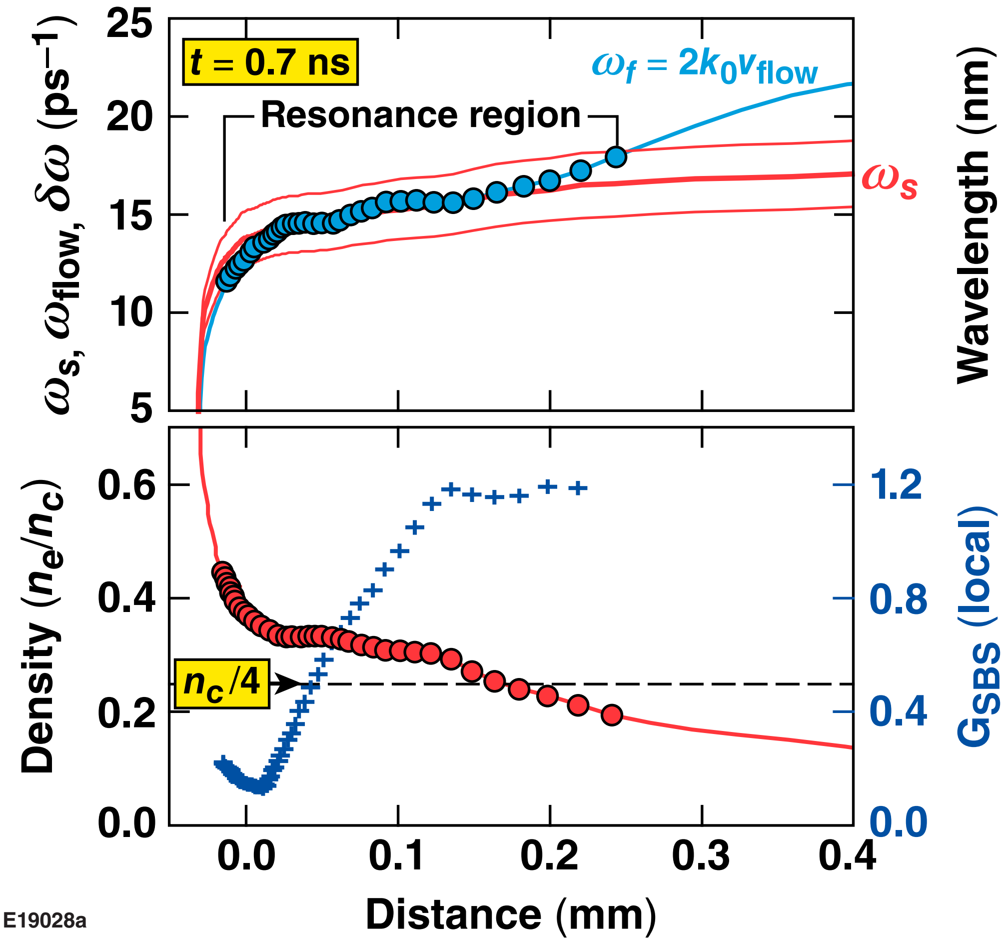
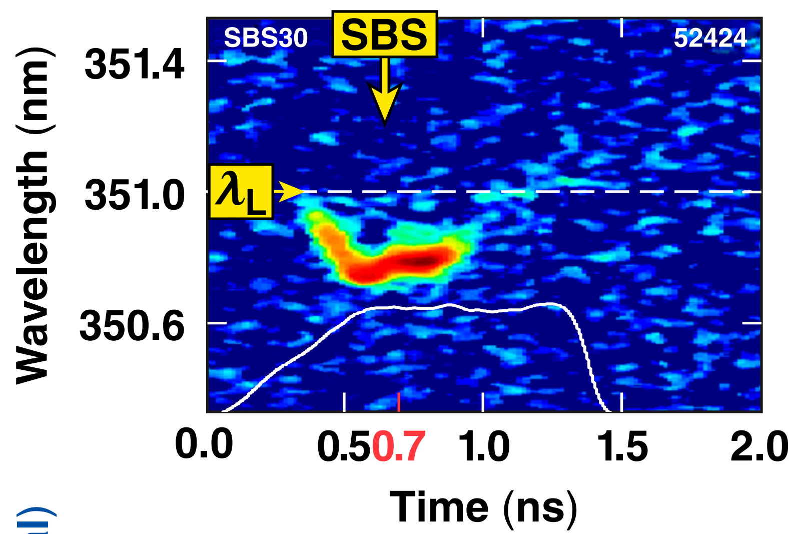
UR LLE



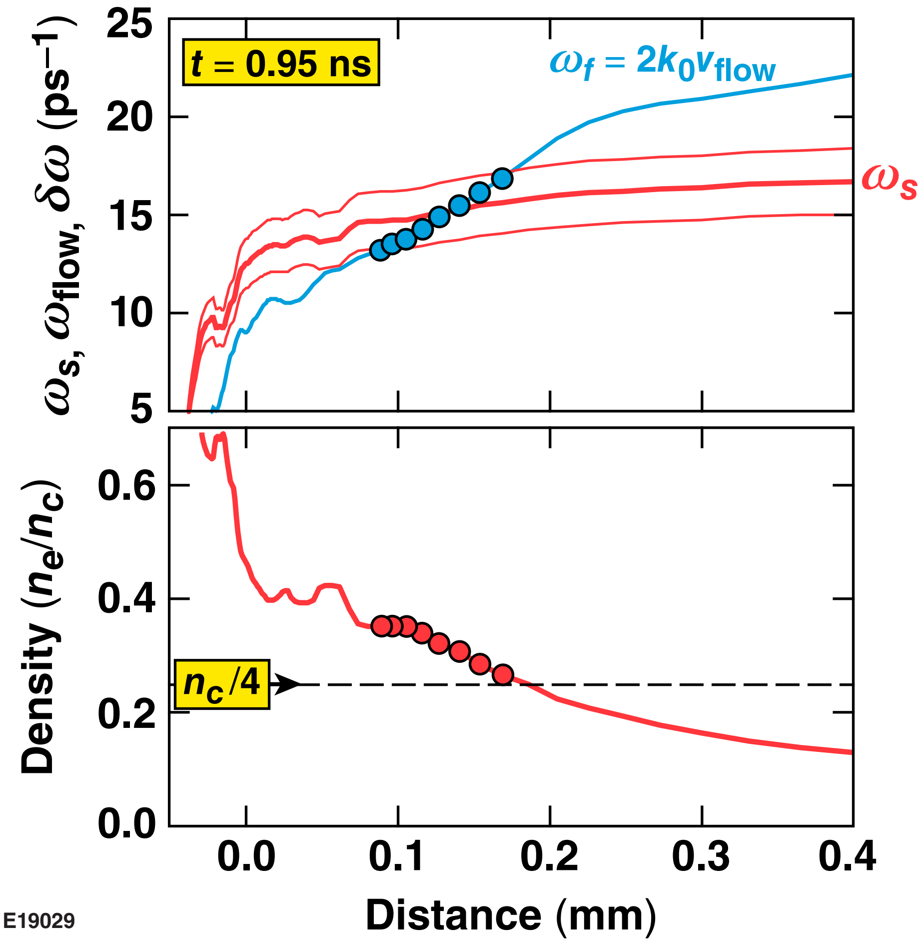


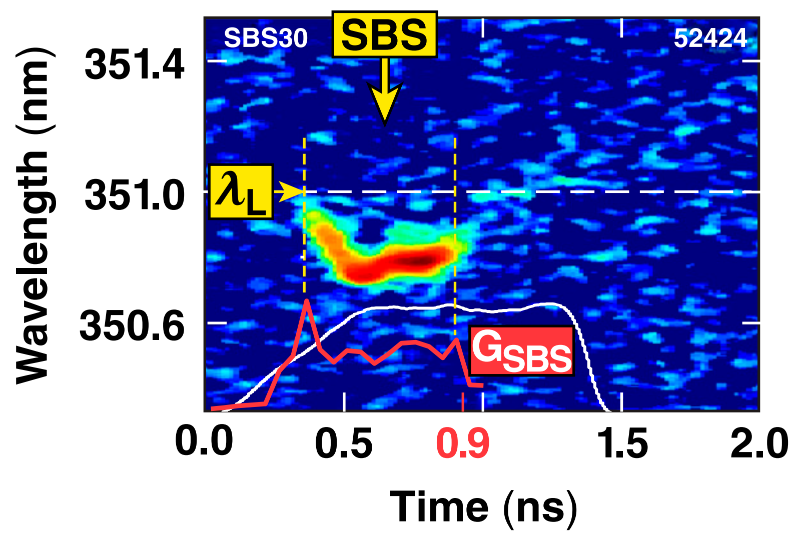
Total SBS intensity gain = 24

Mean mach # = 1.27
2.7 Å blue shift

E19028a

At 0.95 ns the SBS resonance region has shrunk and the gain factor is neglible

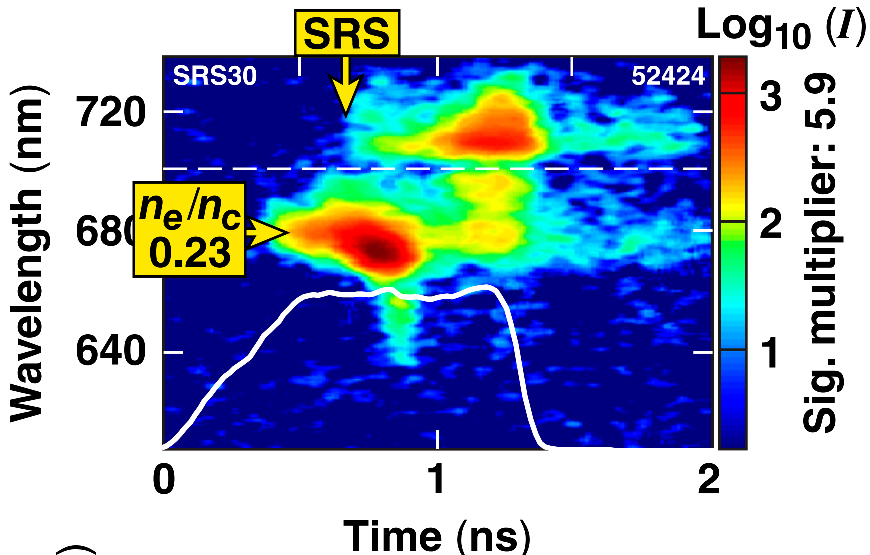


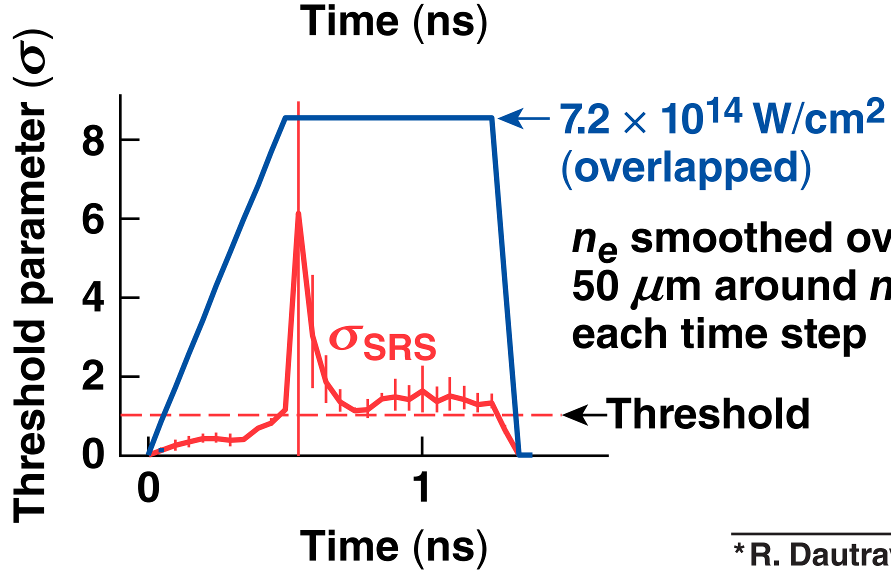


Total SBS intensity gain = 9

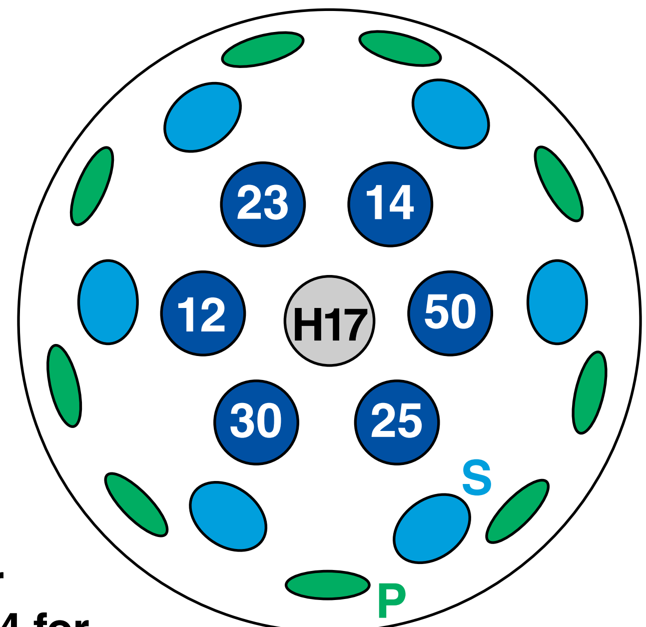
E19029

The SRS sidescatter threshold* is compatible with driving a shared plasma wave that points toward H17





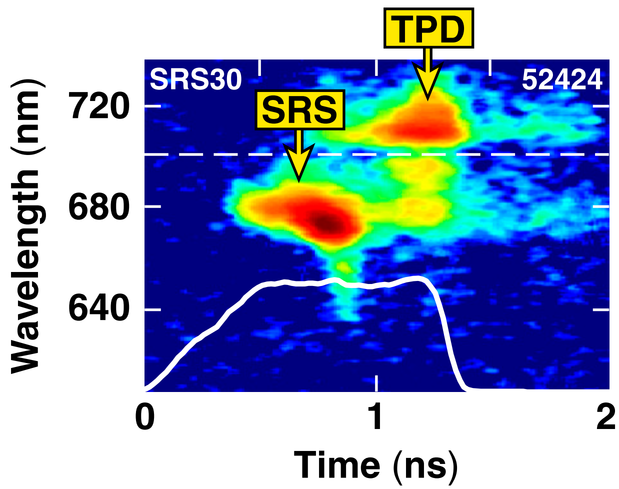
n_e smoothed over 50 μm around $n_c/4$ for each time step

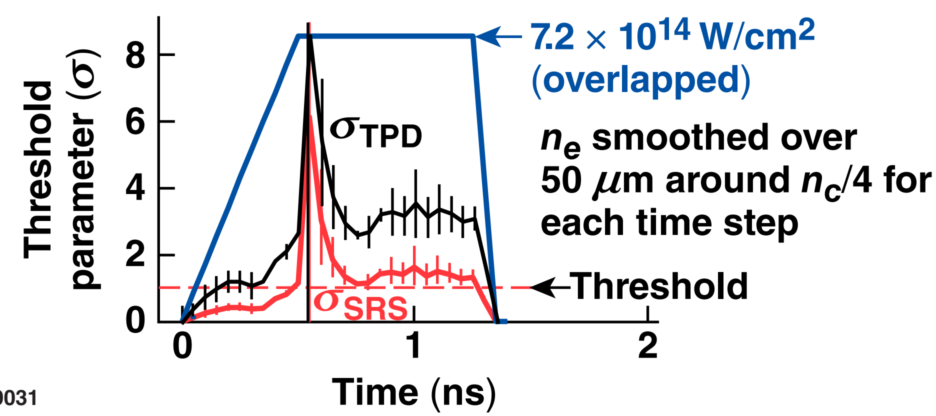


E19030

*R. Dautray and J.-P. Watteau, in *La Fusion Thermonucléaire Inertielle par Laser* (Eyrolles, Paris, 2010), Vol. 1, p. 495.

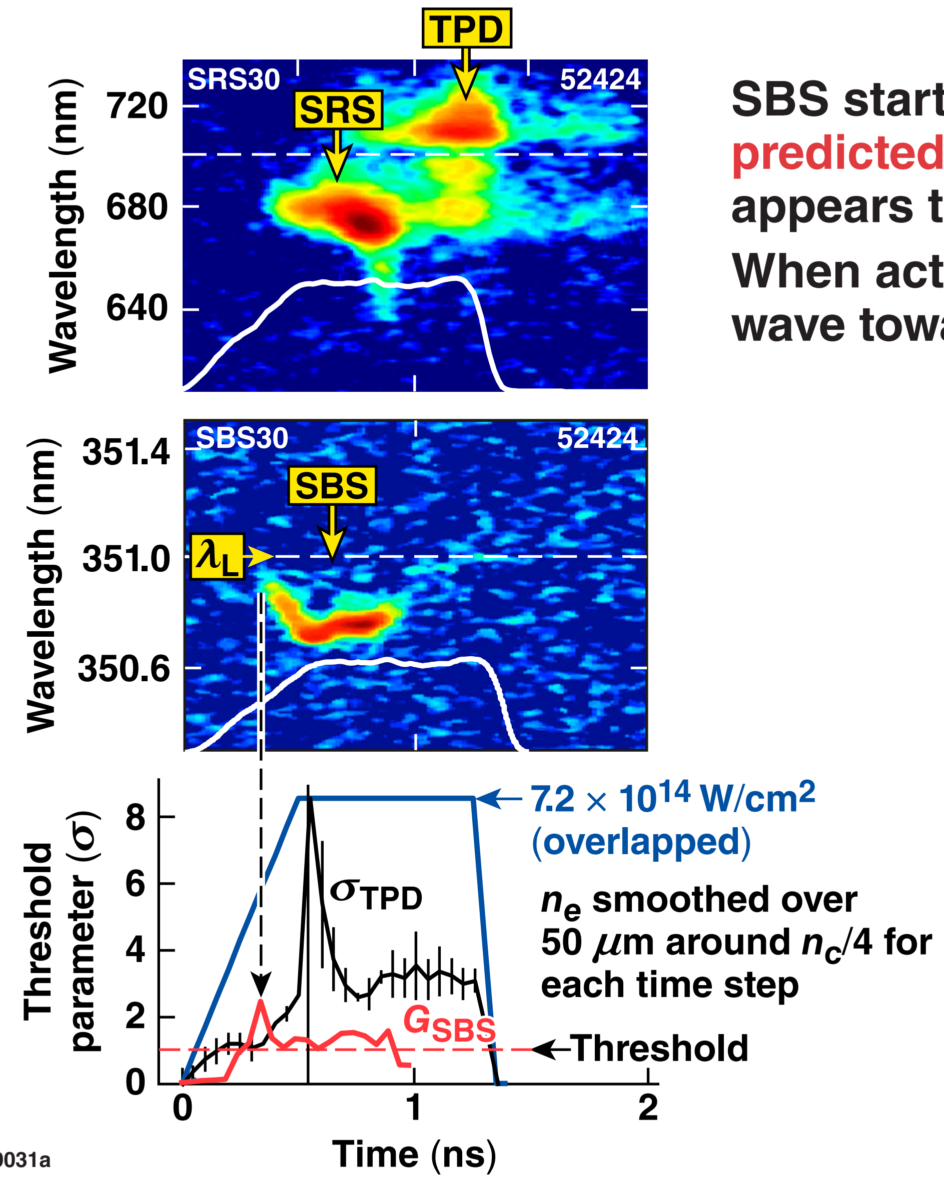
The calculated TPD threshold peaks early like the SRS threshold but is NOT observed experimentally until much later





E19031

The calculated TPD threshold peaks early like the SRS threshold but is NOT observed experimentally until much later



SBS starts at 0.35 ns. At 0.5 ns it is predicted to be active right at $n_c/4$ and appears to suppress the TPD instability.

When active above $n_c/4$ it still sheds ion wave toward $n_c/4$ via supersonic flow.

E19031a

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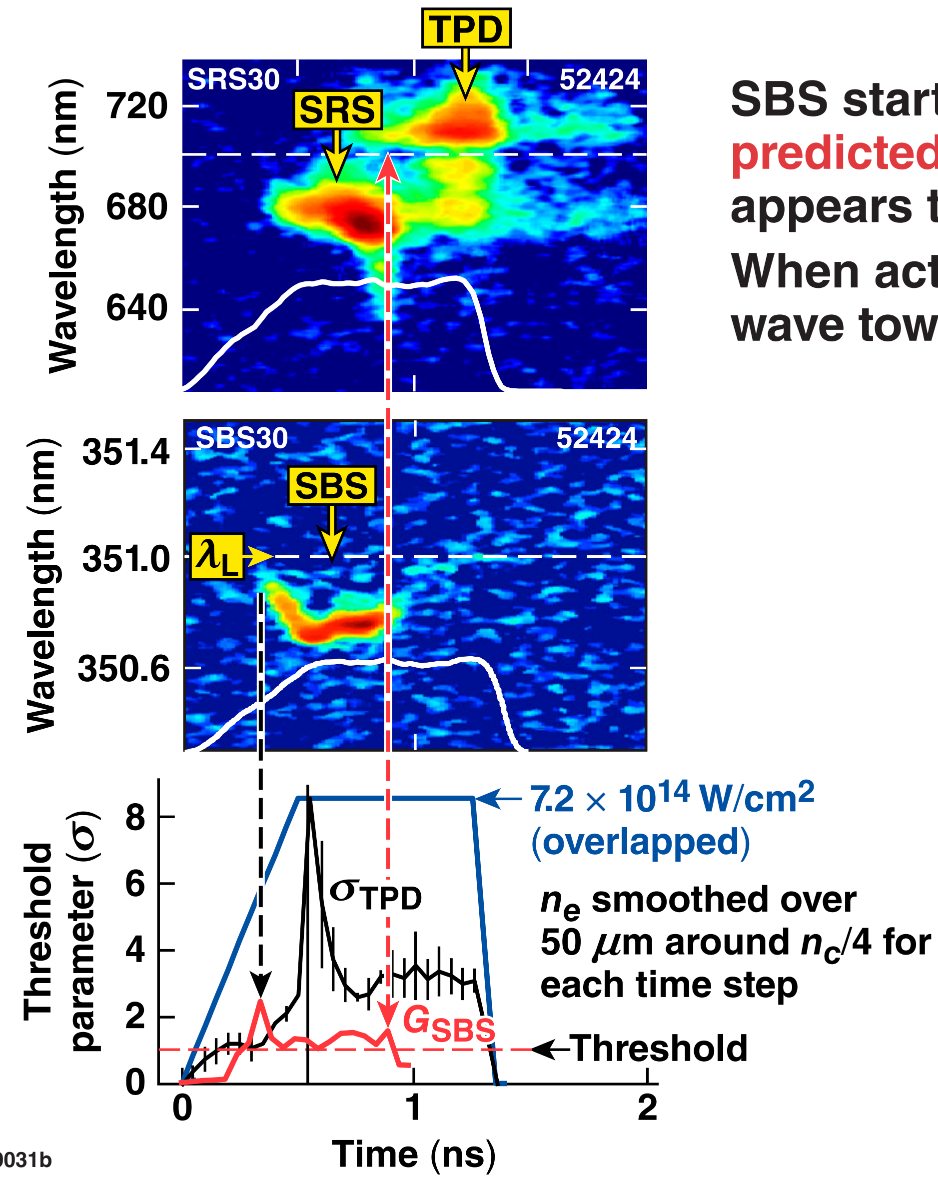

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E19031b

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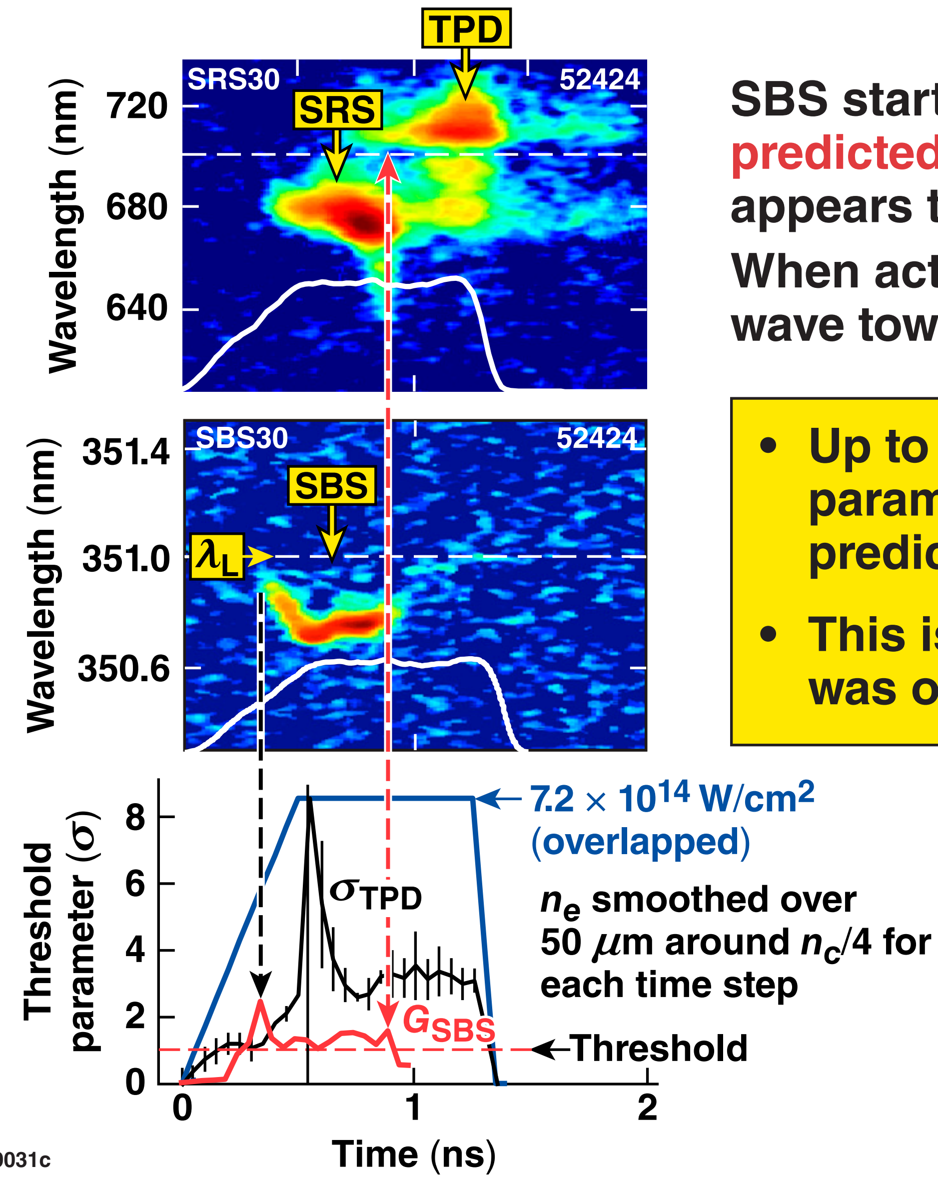

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- Up to now the TPD threshold parameter has been an excellent predictor for the TPD instability.
- This is the first time that SBS was observed near $n_c/4$.

E19031c

Summary/Conclusions

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