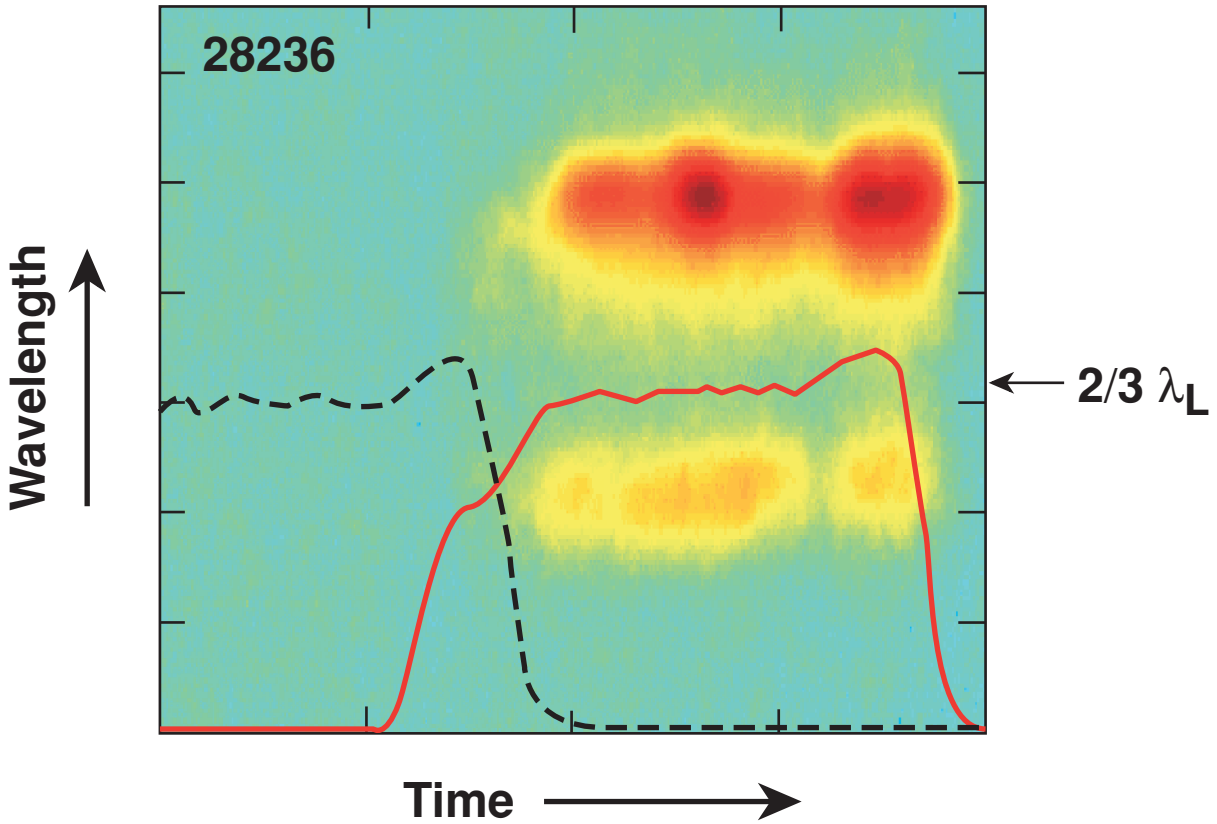
Investigation of the Two-Plasmon-Decay Instability Using Thomson Scattering

UR LLE



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33rd Anomalous
Absorption Conference
Lake Placid, NY
22–27 June 2003

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Summary

Thomson scattering off TPD plasmons shows TPD spectra indicative of convective instability

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- Thomson scattering shows strong signals below the Landau cutoff and strong Landau damping above.
- Rough estimates of the plasma-wave spectra suggest a convective instability and are inconsistent with absolute instability.
- Nonlinear hot-electron scaling with overlapped intensity is confirmed by similar scaling of plasma-wave amplitudes.
- OMEGA allows for a large variety of Thomson-scattering configurations.

Outline

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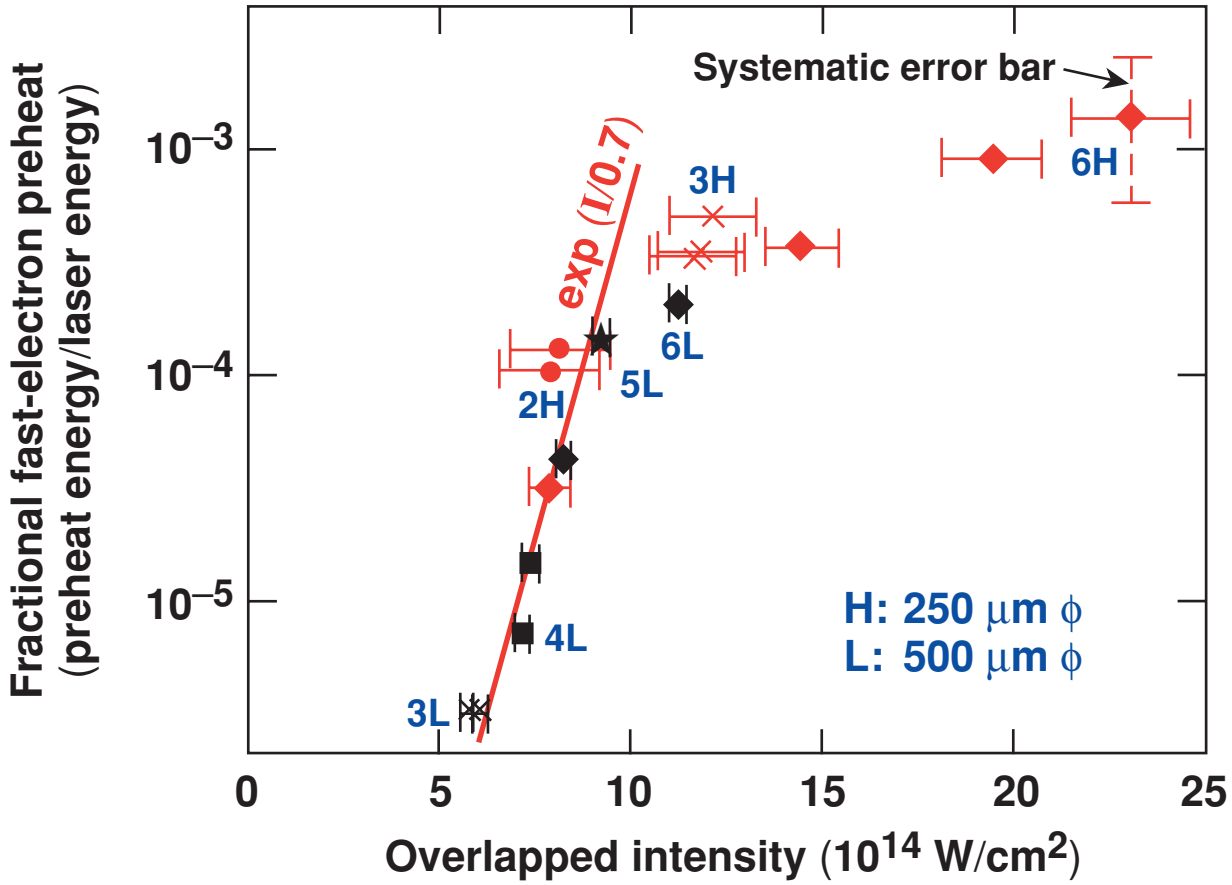
- Motivation
- Experimental arrangement
- Thomson-scattering results near the Landau cutoff
- Plasma-wave spectra

Motivation

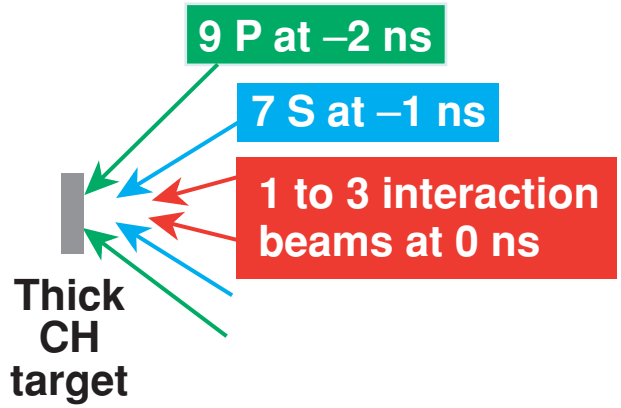
Recent TPD experiments have shown consistent fast-electron generation and sensitivity to overlapped beam intensities

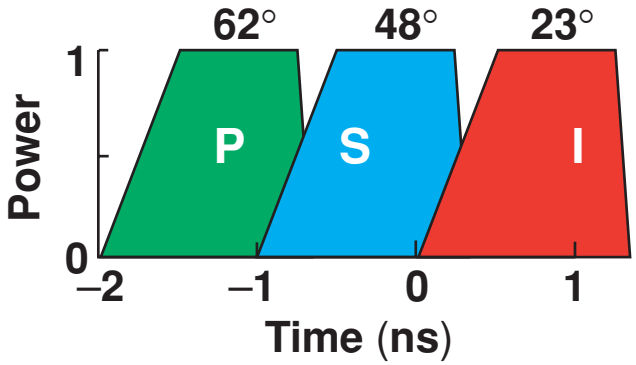


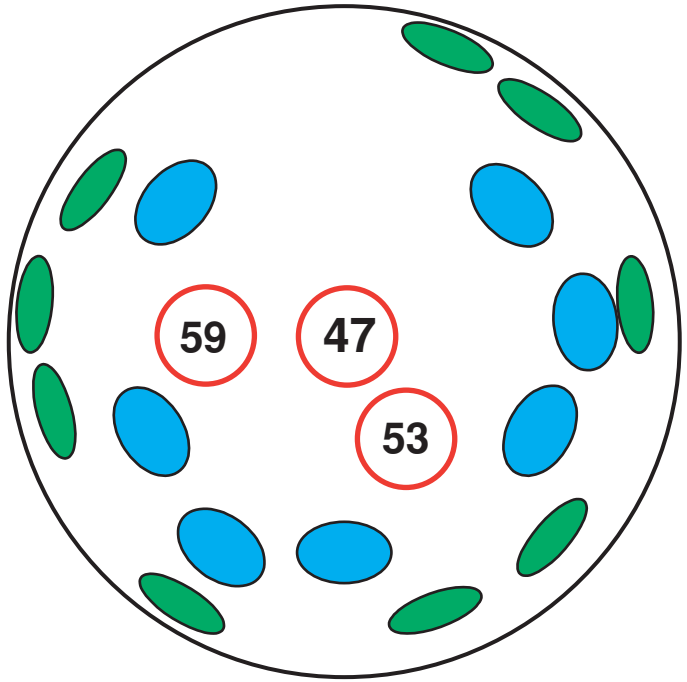
Targets: 100-μm-thick CH slabs; multibeam long-scale-length plasmas

E12304

Primary and secondary beams generate and heat the plasma prior to interaction beams and Thomson probe beam



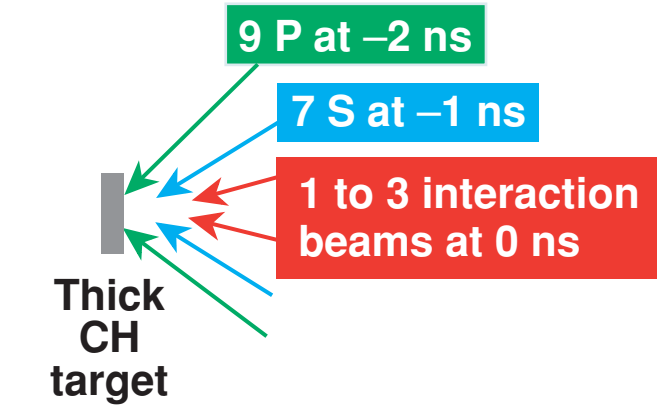


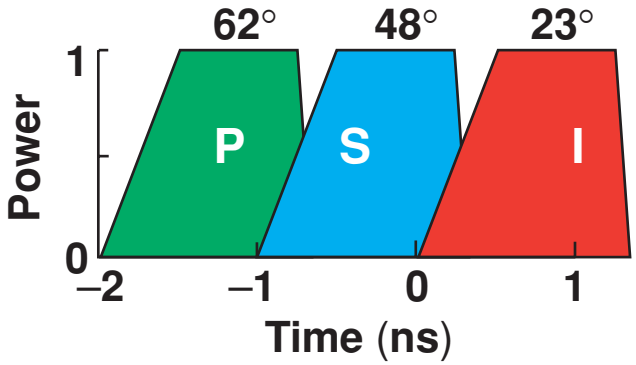


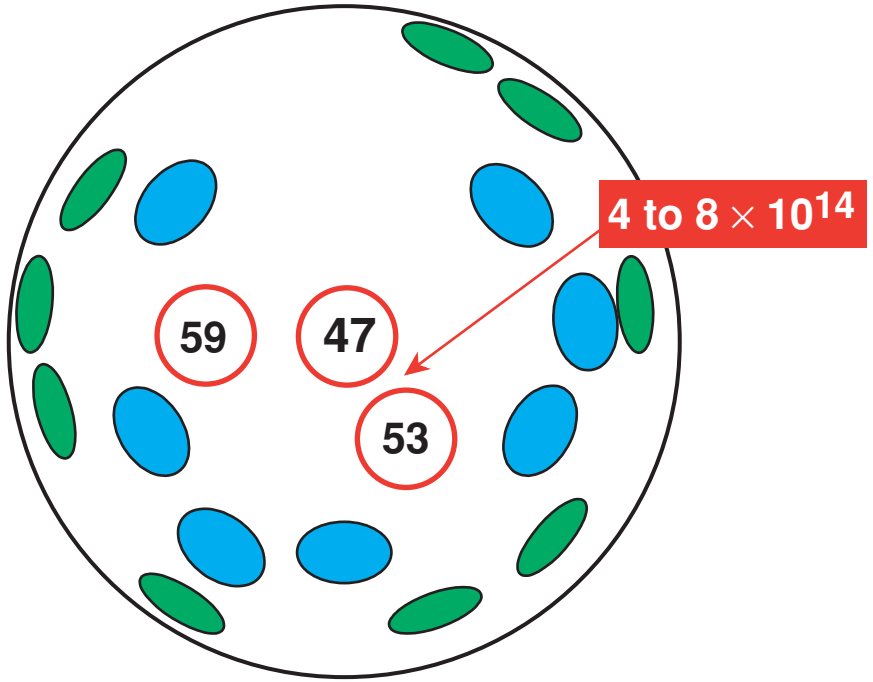
Targets perpendicular to 47

E12305

Primary and secondary beams generate and heat the plasma prior to interaction beams and Thomson probe beam







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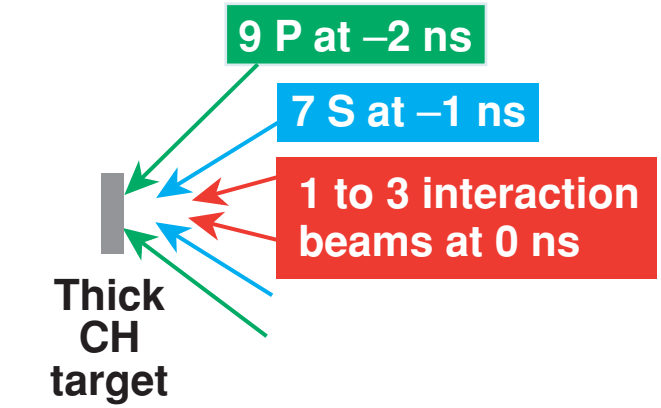

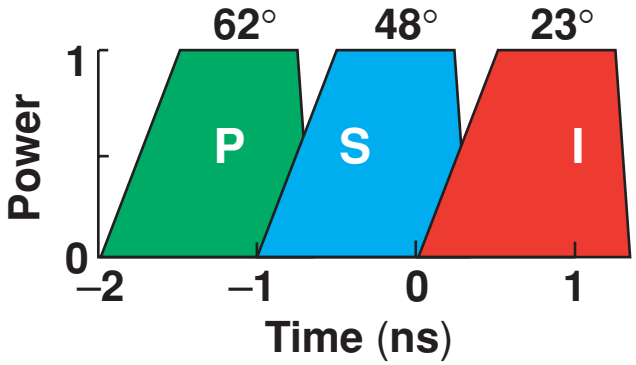

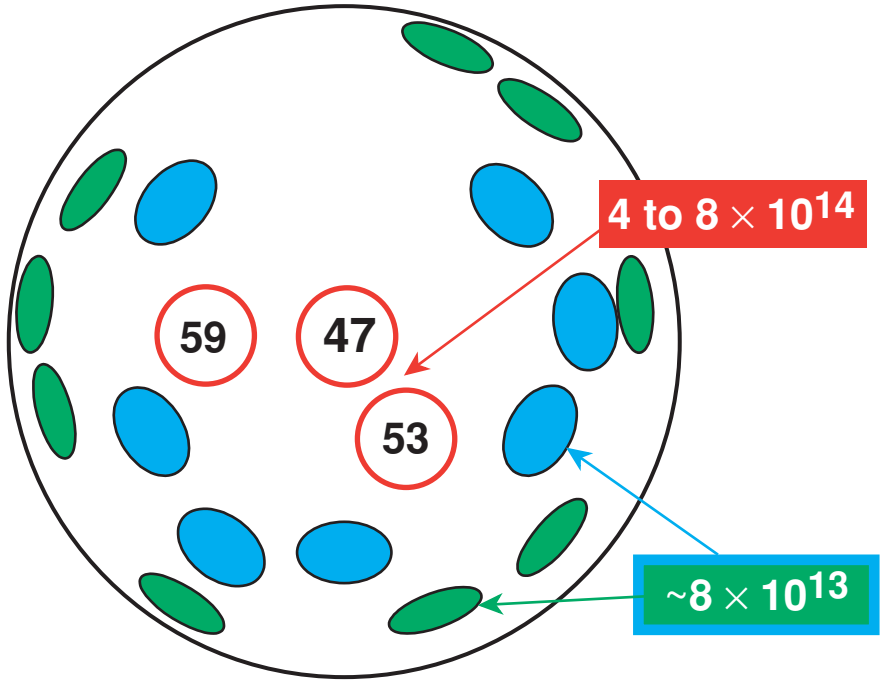

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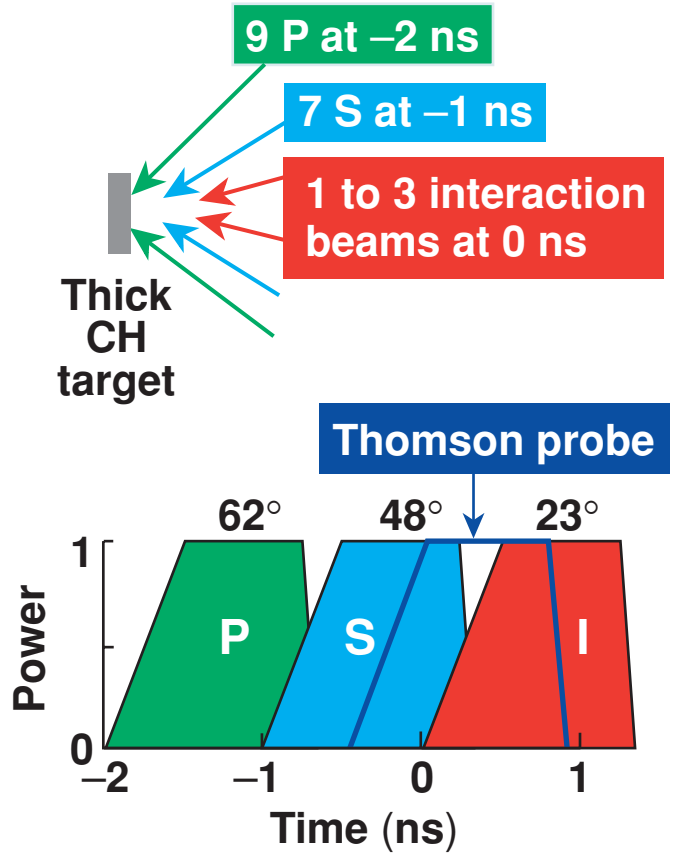

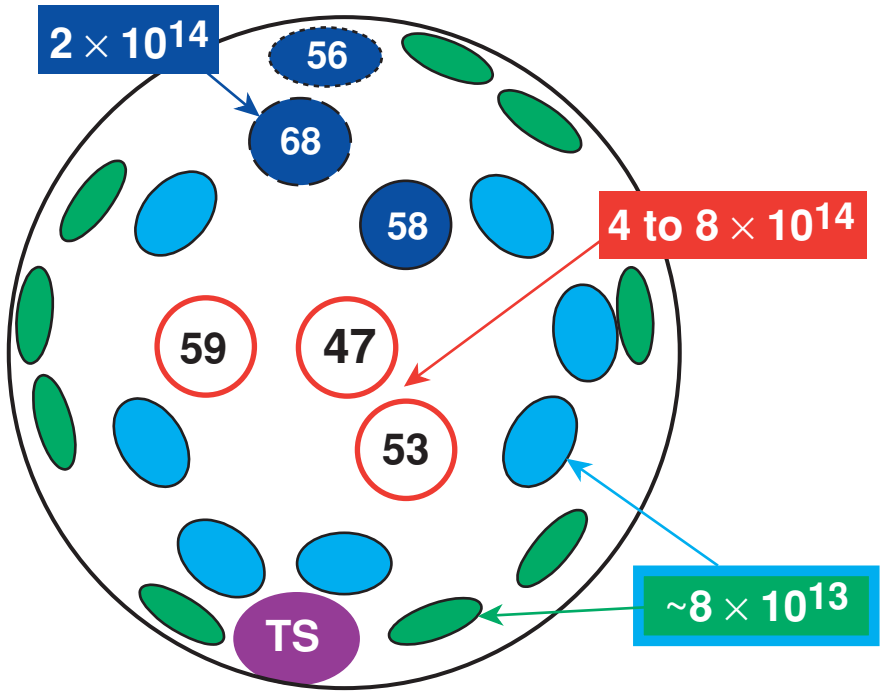

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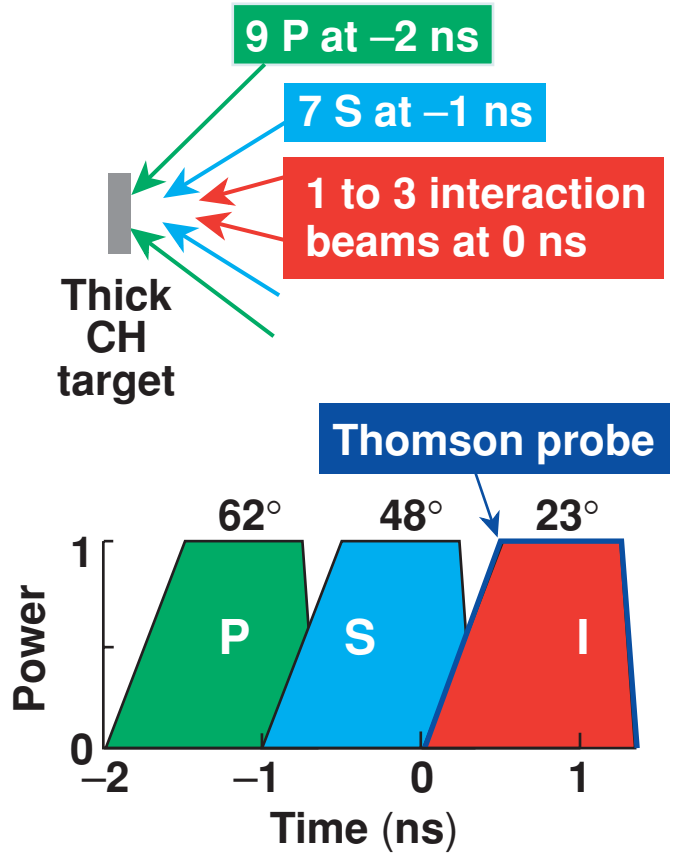

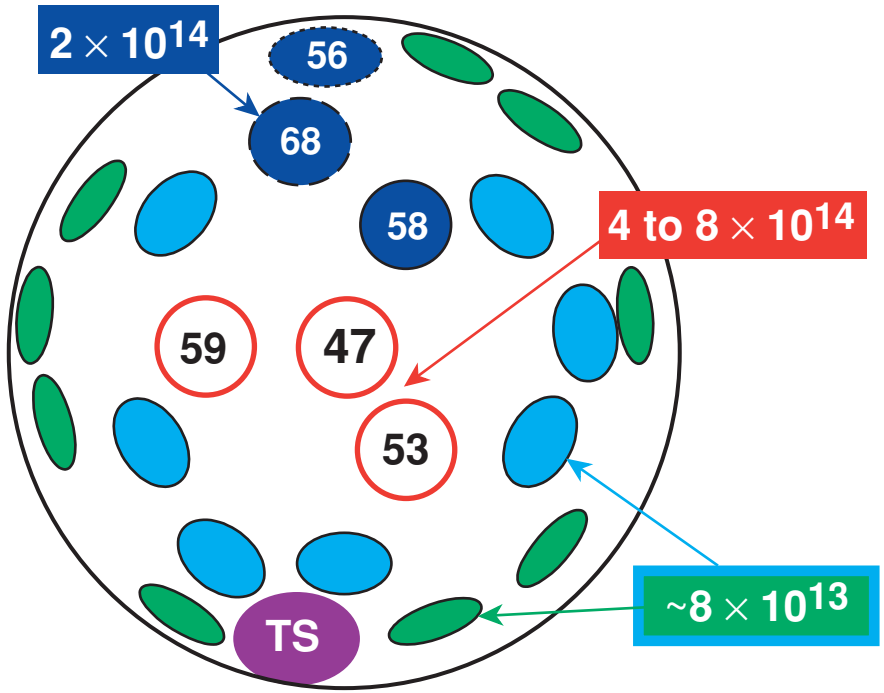

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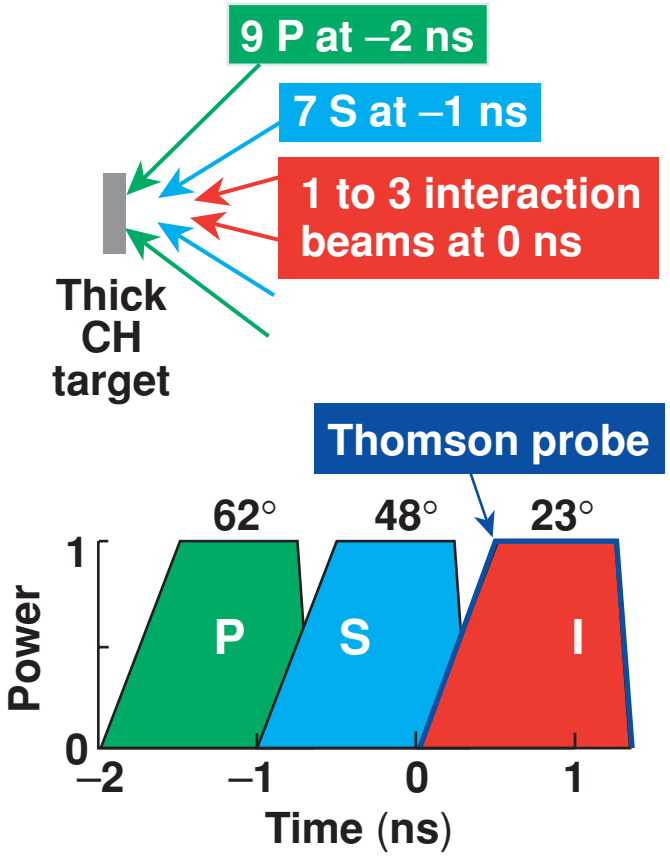
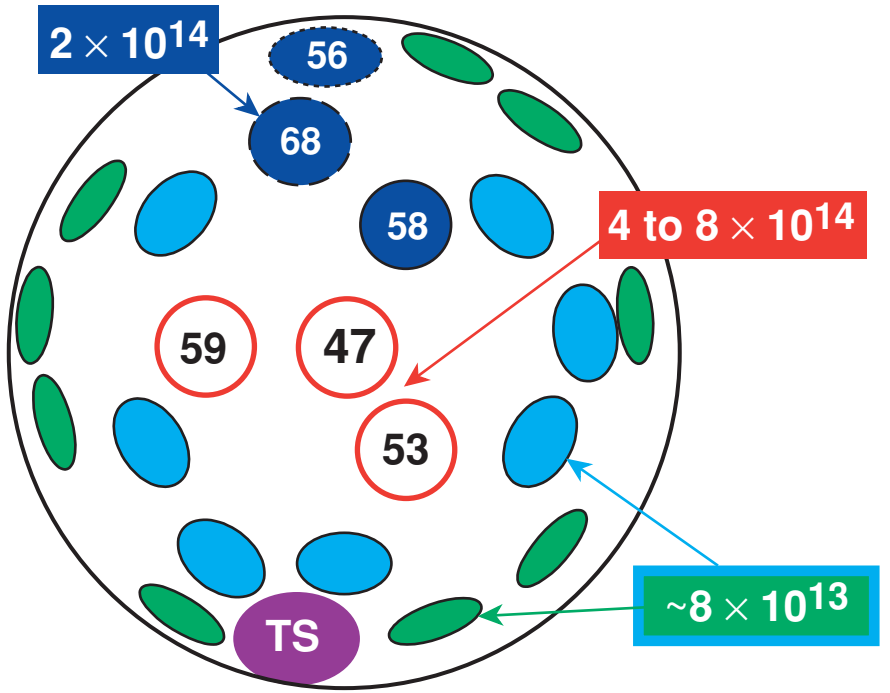




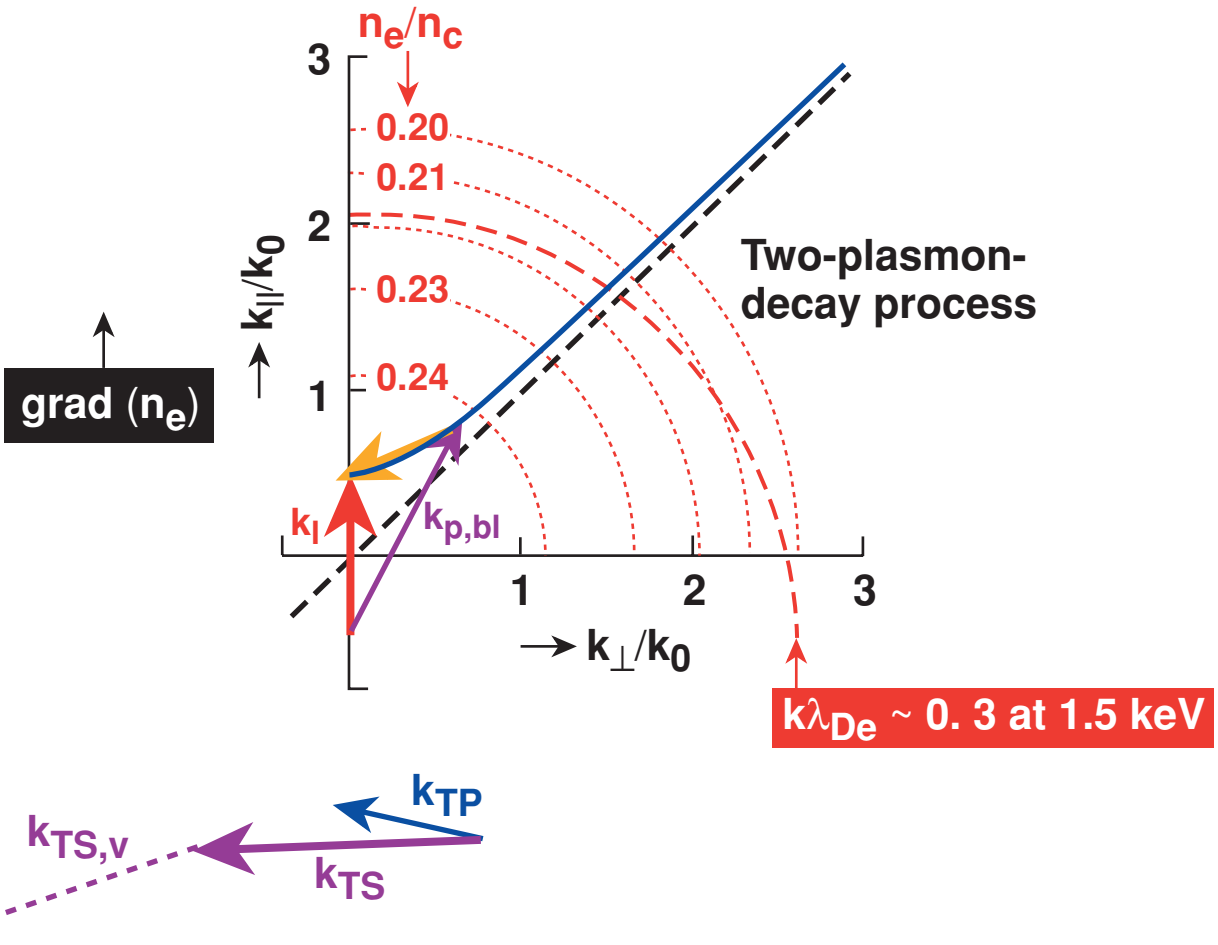
Targets perpendicular to 47

Interaction beams typically see

- density scale lengths of 0.3 to 0.5 mm near $n_c/4$ and
- T_e between 1.5 and 3.5 keV.

E12305

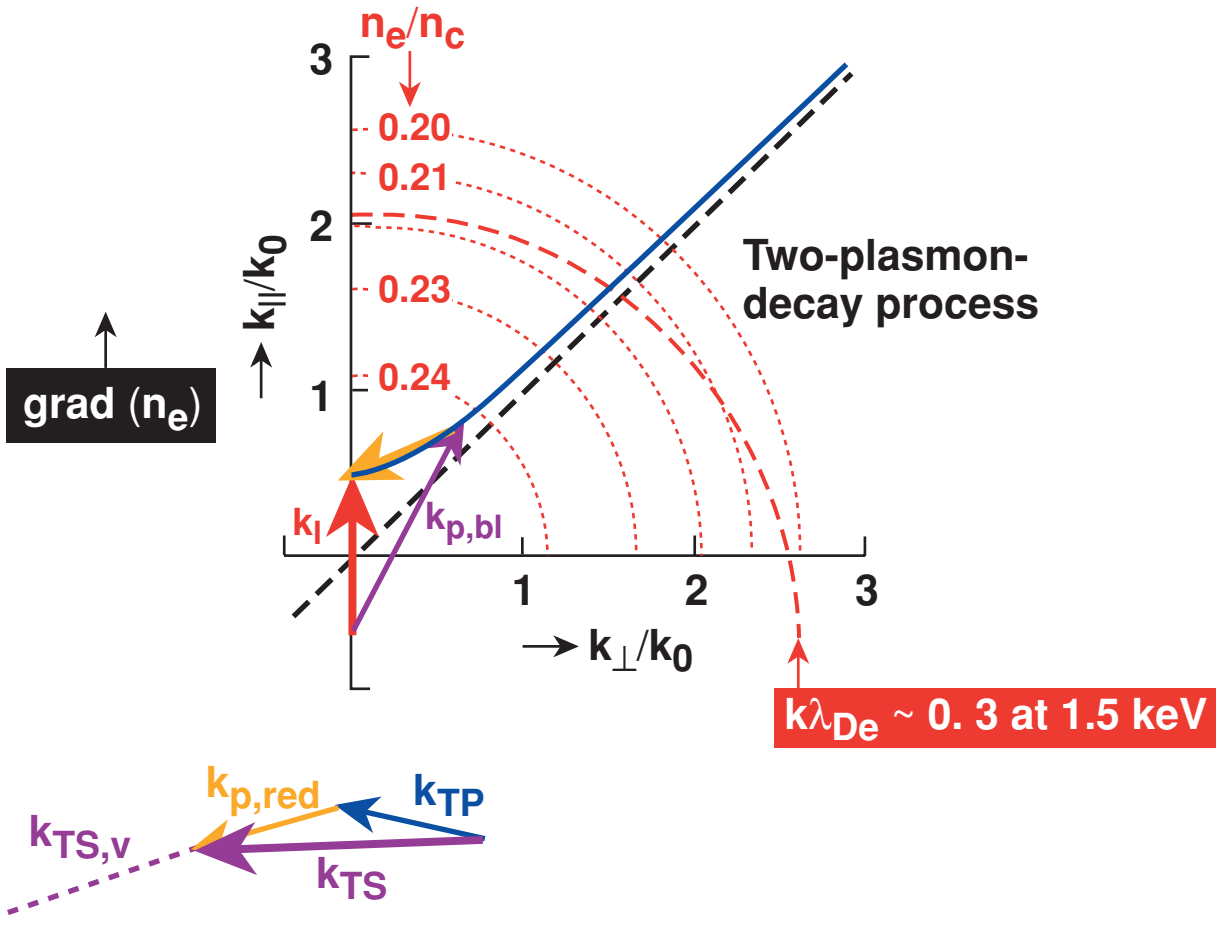
Thomson scattering for the shortest k_p's has $k\lambda_{De} \sim 0.13$ at $T_e = 1.5$ keV



For a given set of interaction beams, Thomson probe, and Thomson-scattering angles, there is a unique TPD decay that satisfies all phase-matching conditions.

E12306

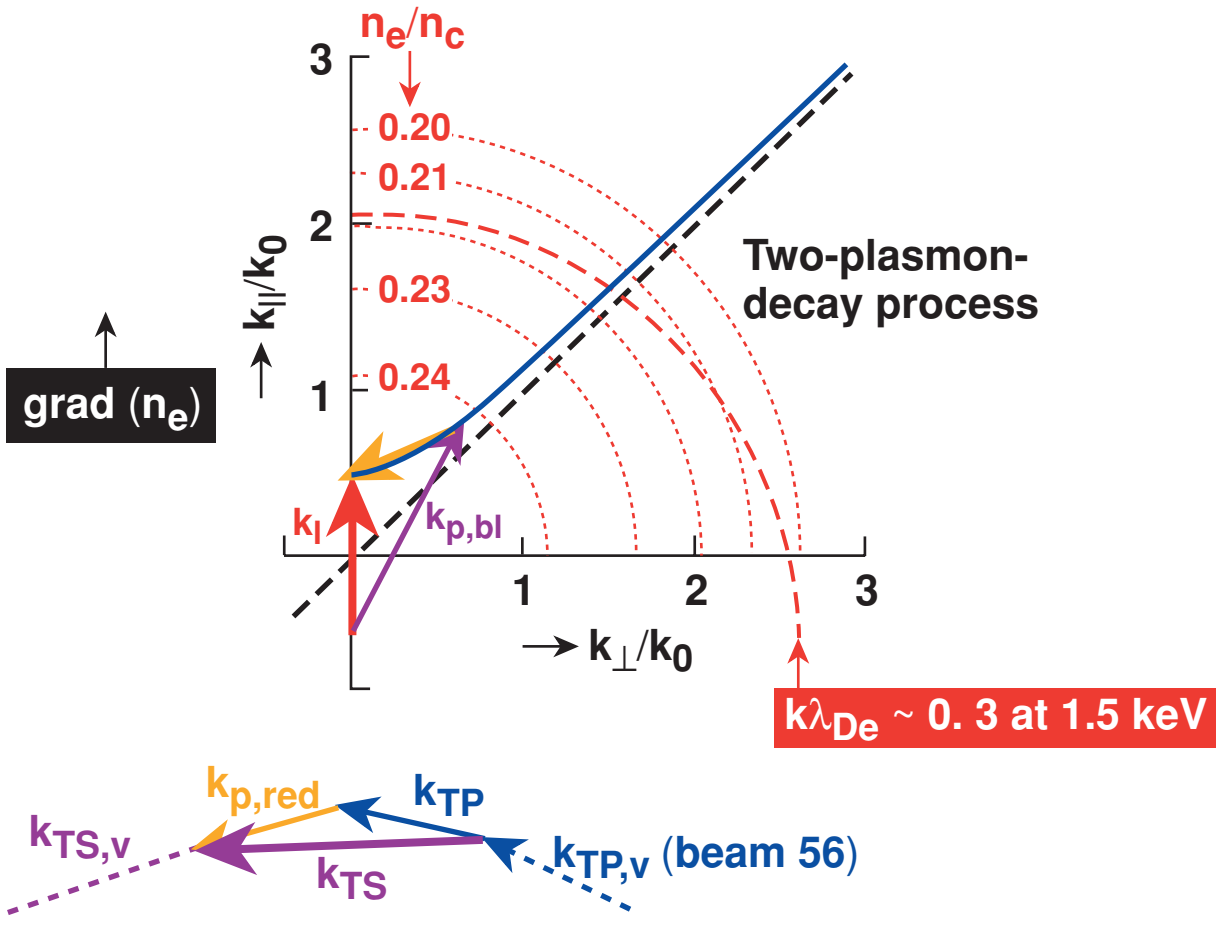
Thomson scattering for the shortest k_p's has $k\lambda_{De} \sim 0.13$ at $T_e = 1.5$ keV



For a given set of interaction beams, Thomson probe, and Thomson-scattering angles, there is a unique TPD decay that satisfies all phase-matching conditions.

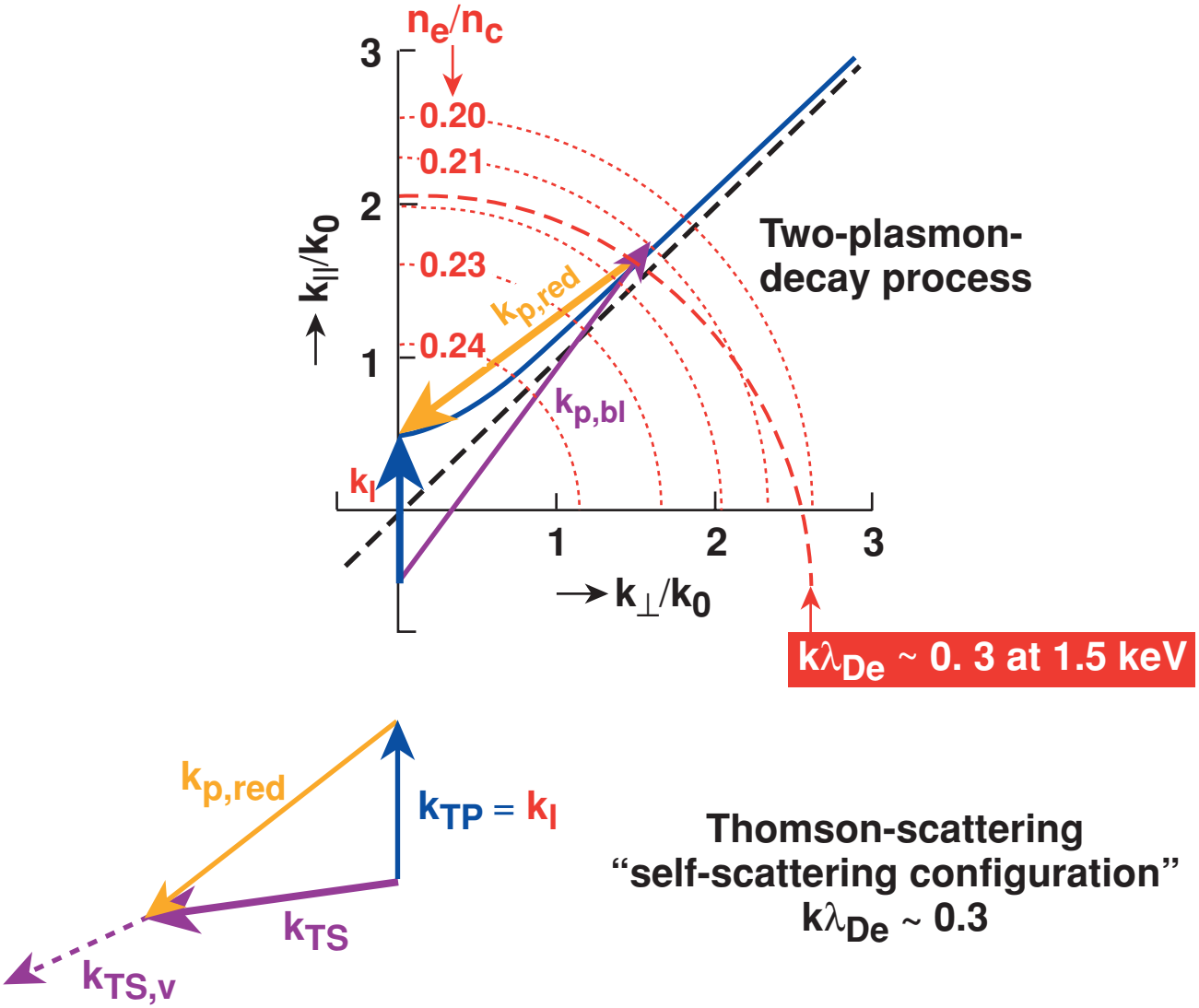
E12306

Thomson scattering for the shortest k_p's has $k\lambda_{De} \sim 0.13$ at $T_e = 1.5$ keV



For a given set of interaction beams, Thomson probe, and Thomson-scattering angles, there is a unique TPD decay that satisfies all phase-matching conditions.

"Self-Thomson scattering" probes the longest k_p's and is most sensitive to small changes in T_e



E12307

The present OMEGA Thomson-scattering experiments allow probing k_p's with $k\lambda_{De}$ ~ 0.13 to 0.35

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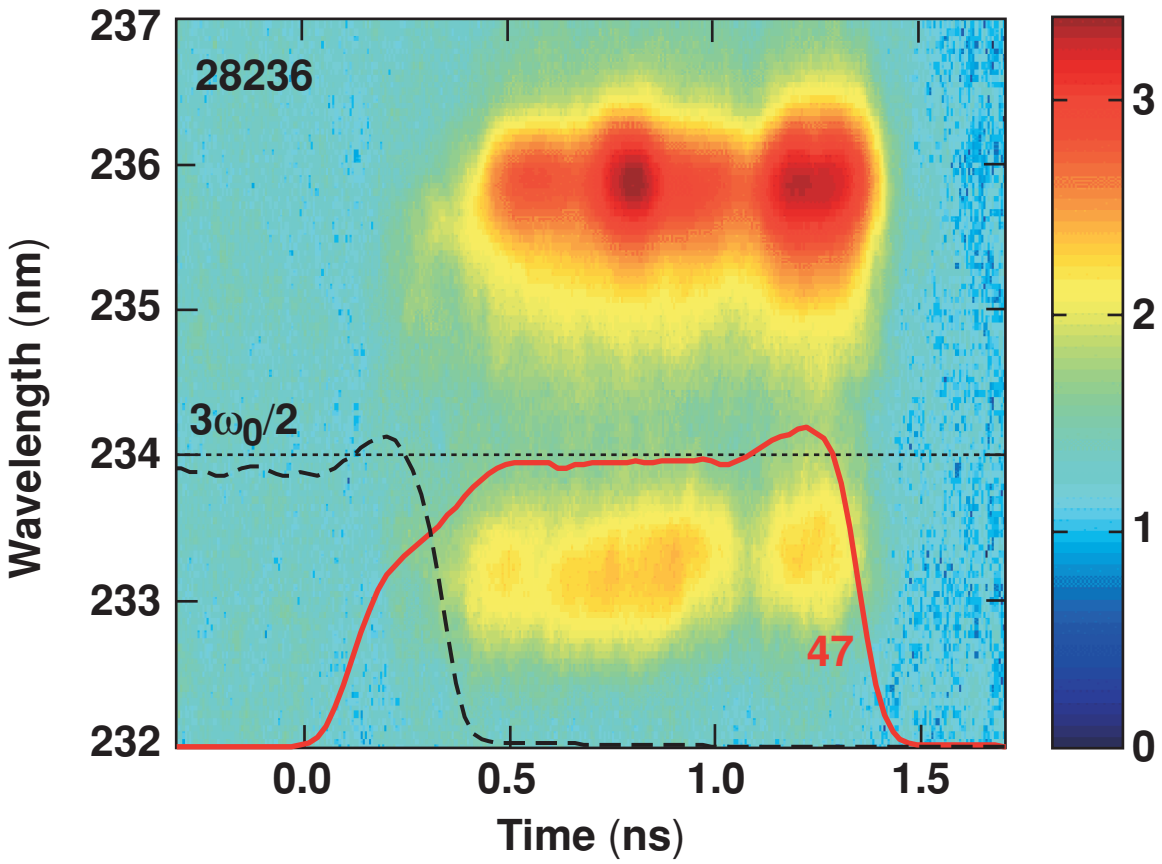
- Interaction beam: 47
- Thomson probe beams:

Thomson probe beams:	47	58	68	56
Probing $k\lambda_{De}$:	0.3	0.25	0.16	0.13
n_e/n_c:	0.21	0.22	0.23	0.20

at 1.5 keV

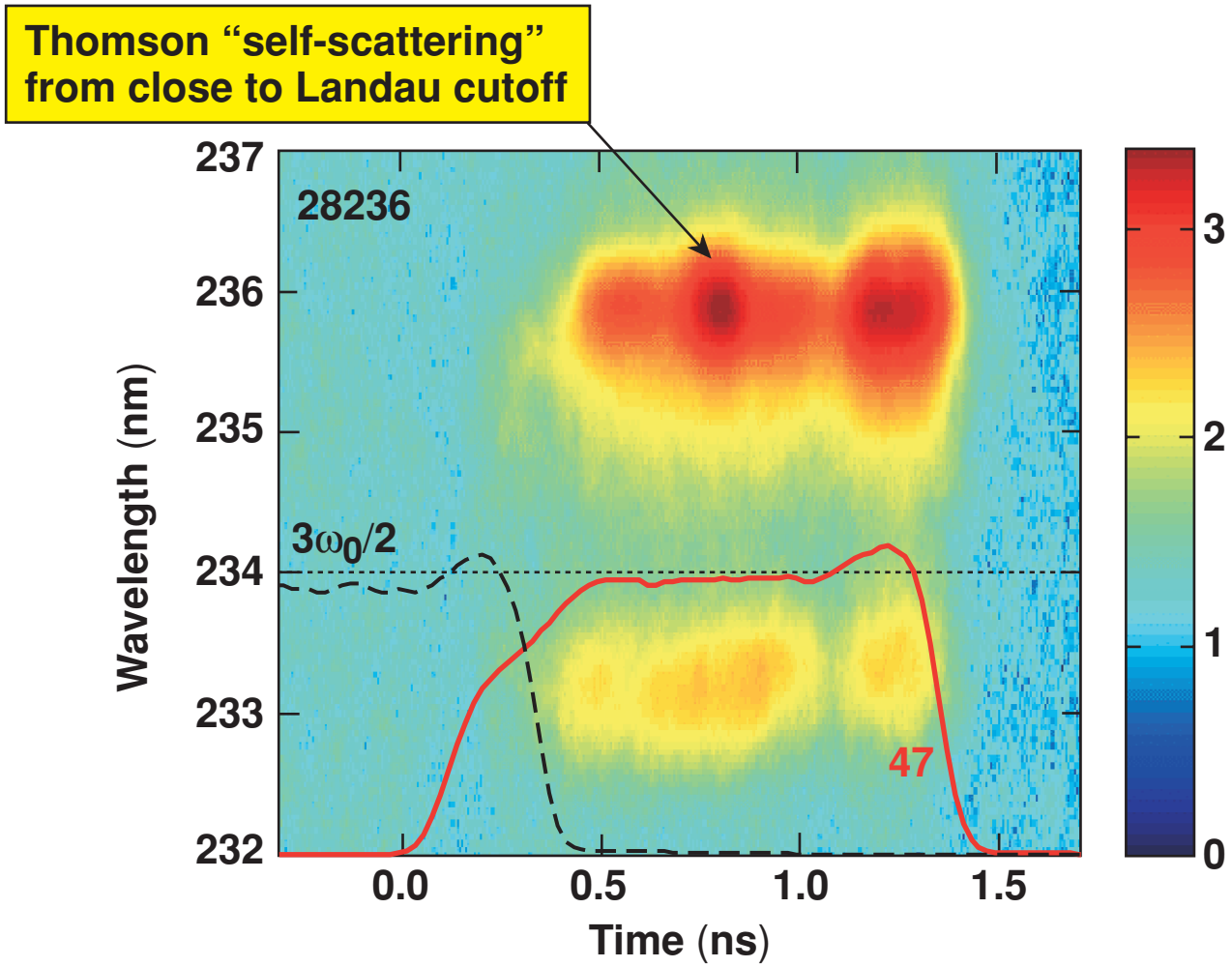
- T_e ~ 1.5 to 1.8 keV is typical for a single interaction beam.
- Additional beams (e.g., Thomson probe) can raise T_e.

"Self-scattering" occurs close to the Landau cutoff and is very temperature sensitive ($k_p\lambda_{De}$)



E12309

"Self-scattering" occurs close to the Landau cutoff and is very temperature sensitive ($k_p\lambda_{De}$)



E12309

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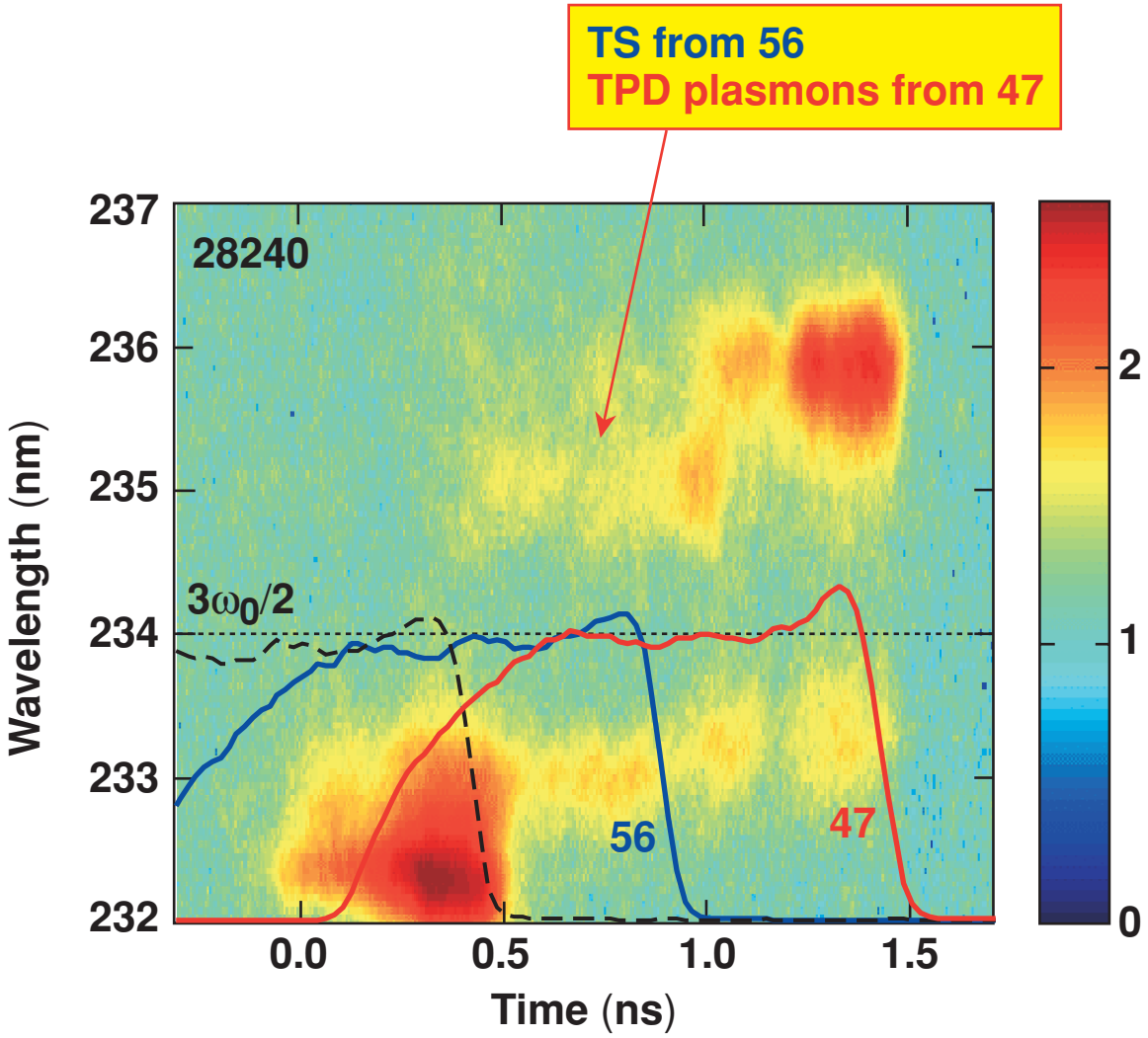
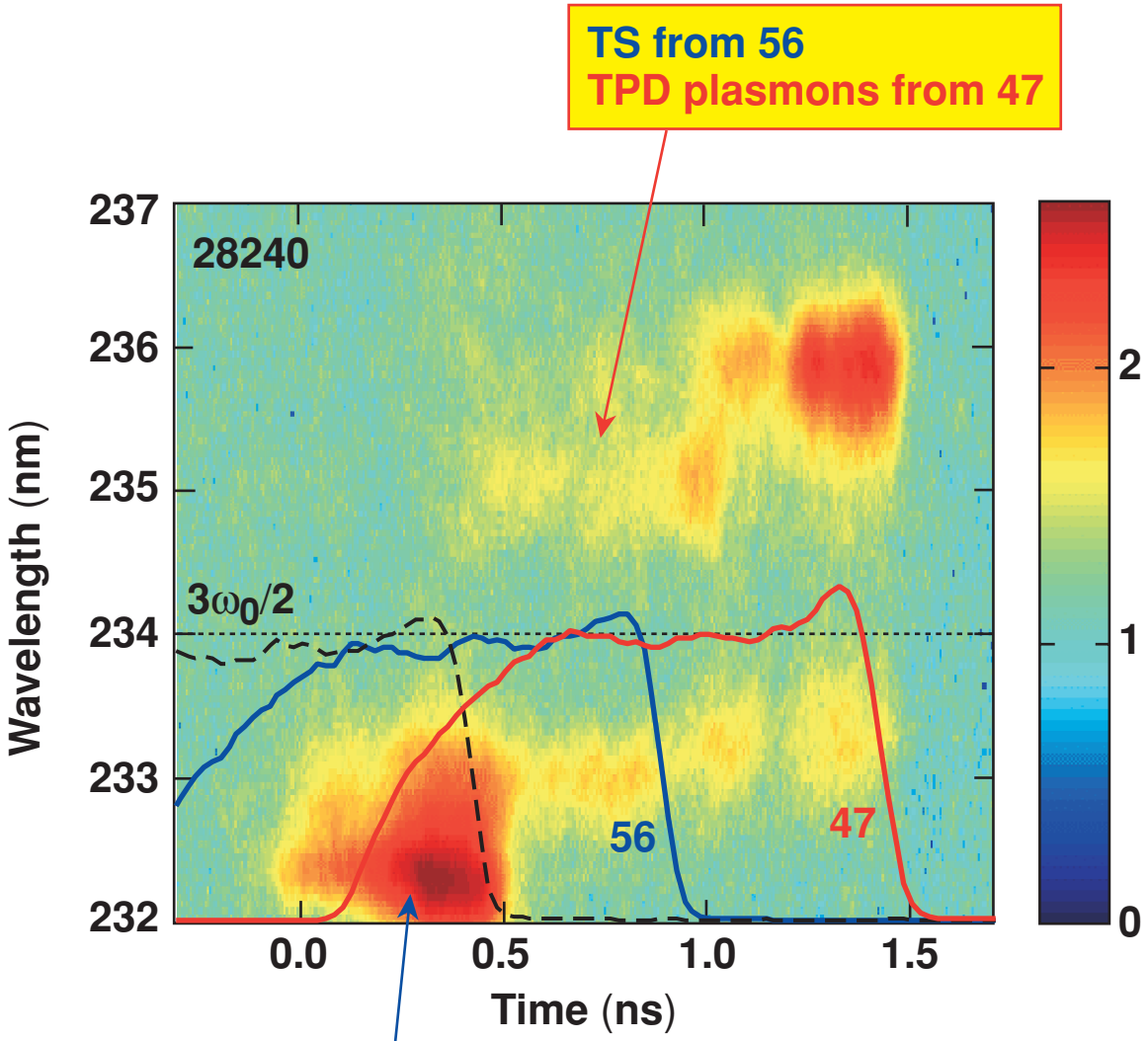


E12324

"Self-scattering" occurs close to the Landau cutoff and is very temperature sensitive ($k_p\lambda_{De}$)



Serendipitous Thomson signal from blue plasmons near Landau cutoff

E12324

"Self-scattering" occurs close to the Landau cutoff and is very temperature sensitive ($k_p\lambda_{De}$)

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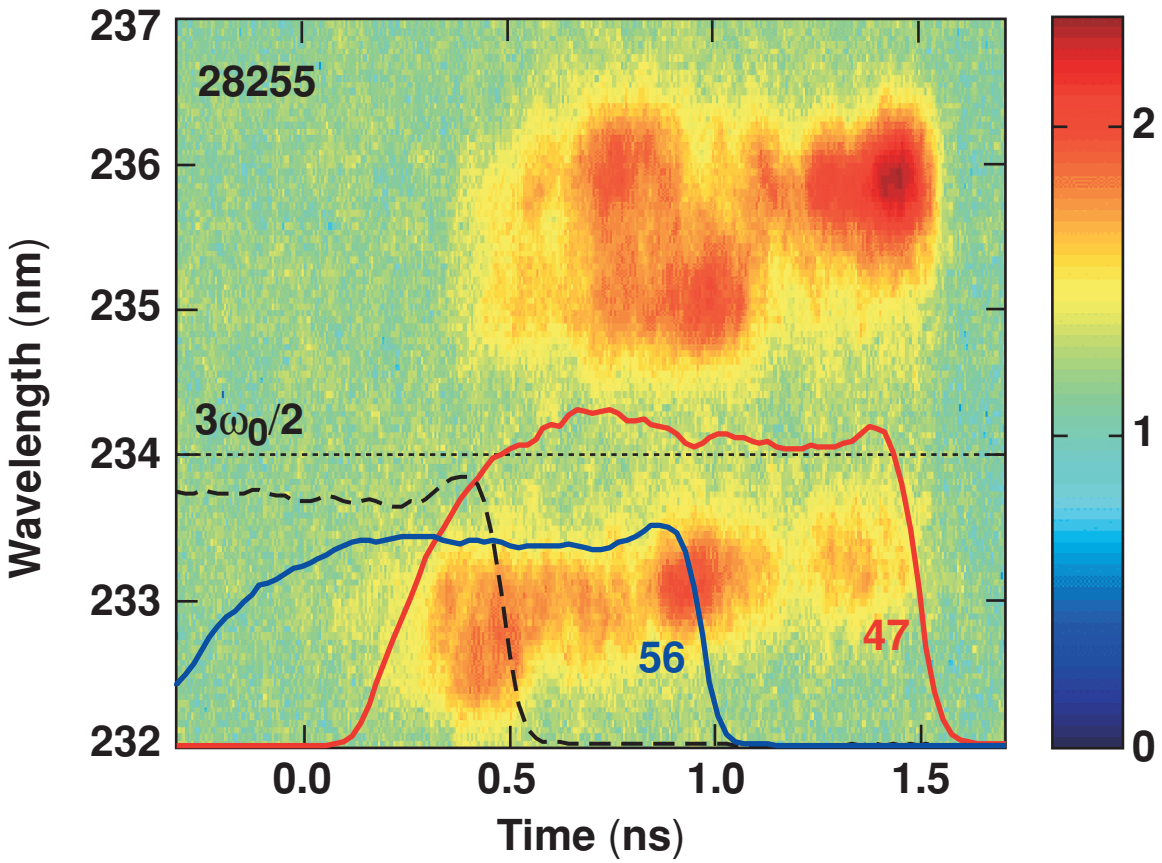
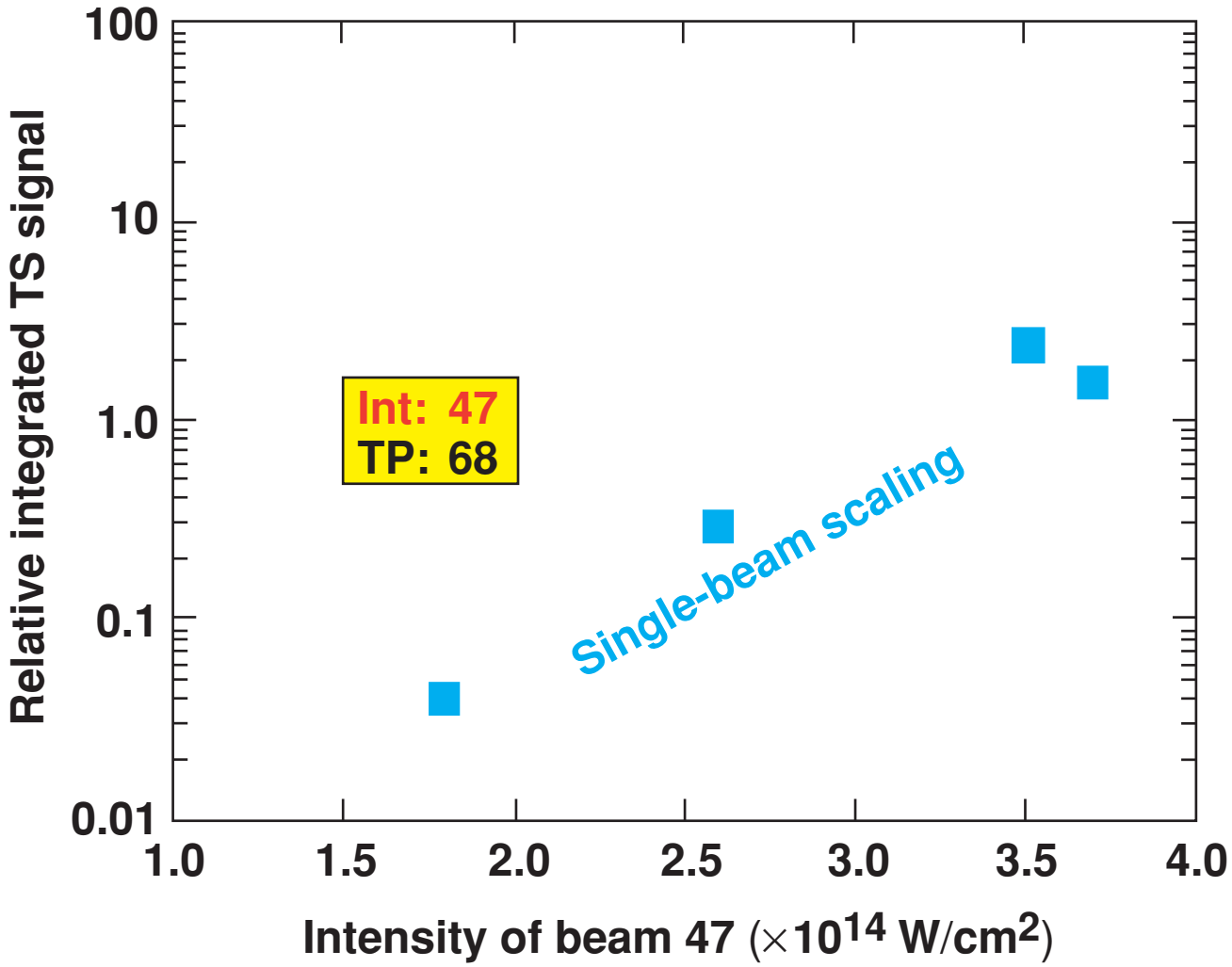
Thomson scattering from several probe beams can be seen with proper choice of beam intensities.



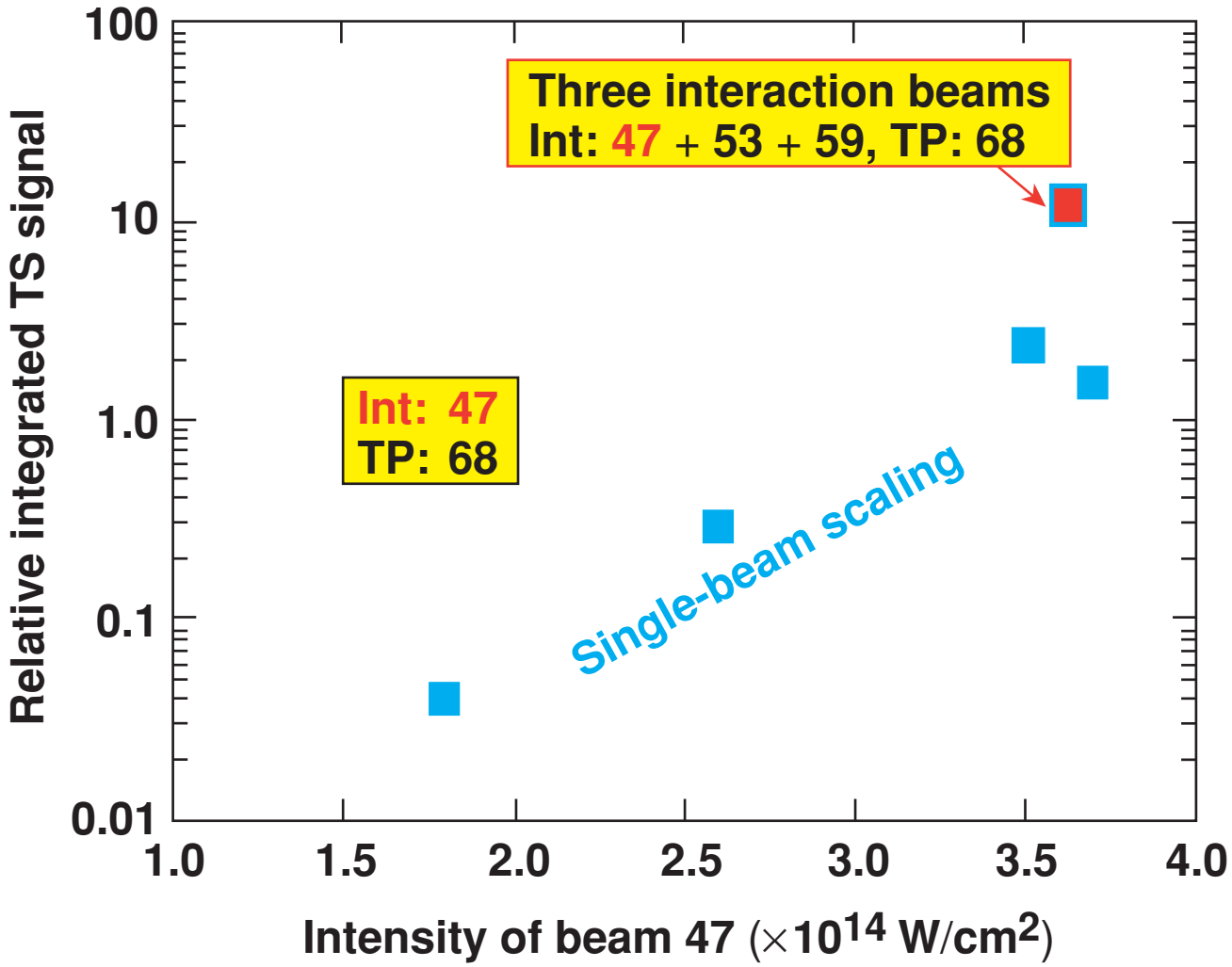
E12325

Exponential intensity scaling of TPD plasmons with $k\lambda_{De} \sim 0.16$ was observed with Thomson scattering



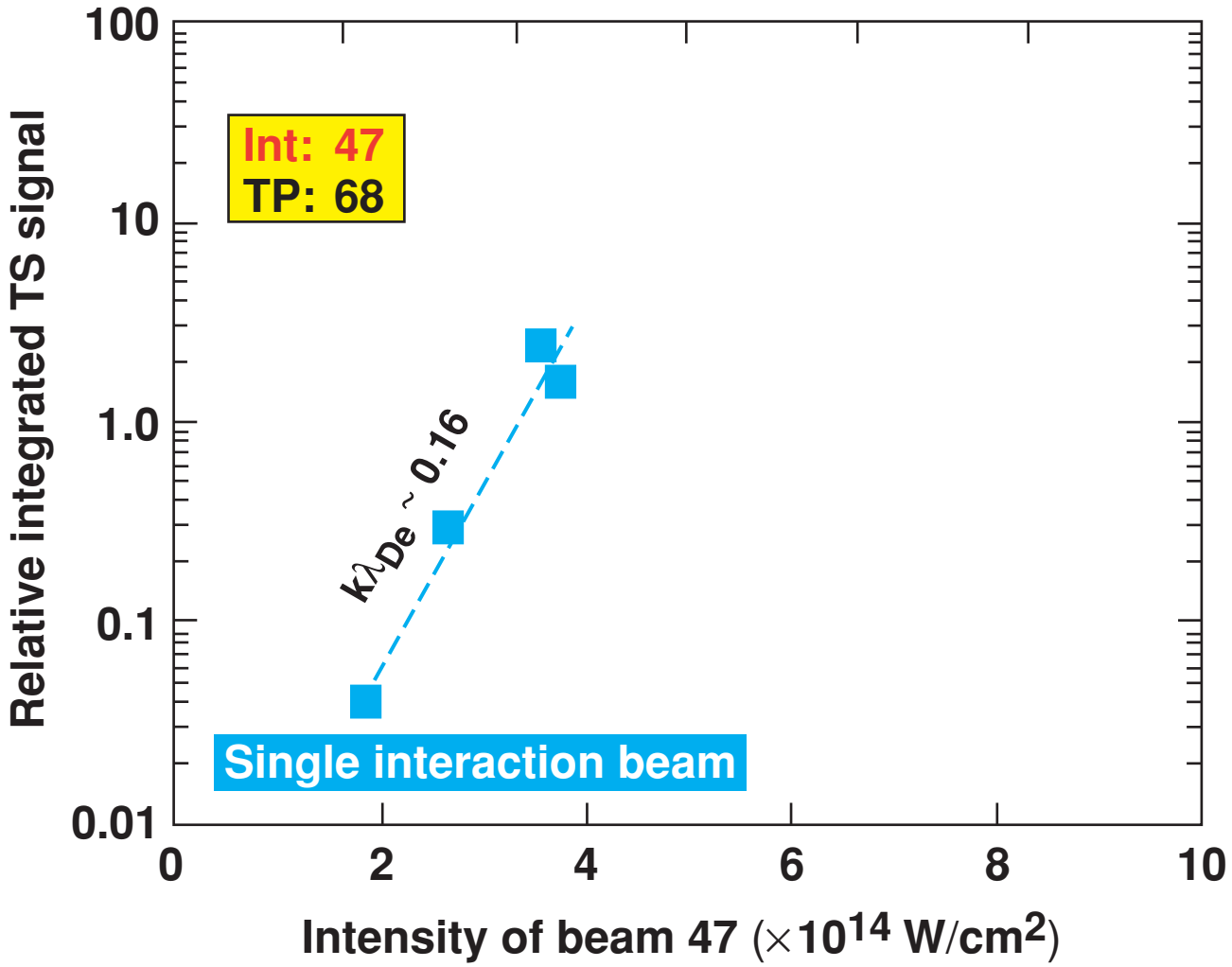
E12310

Exponential intensity scaling of TPD plasmons with $k\lambda_{De} \sim 0.16$ was observed with Thomson scattering



E12310

Intensity scaling of TPD plasmons sensitively depends on $k\lambda_{De}$ of TPD plasmons involved



E12311

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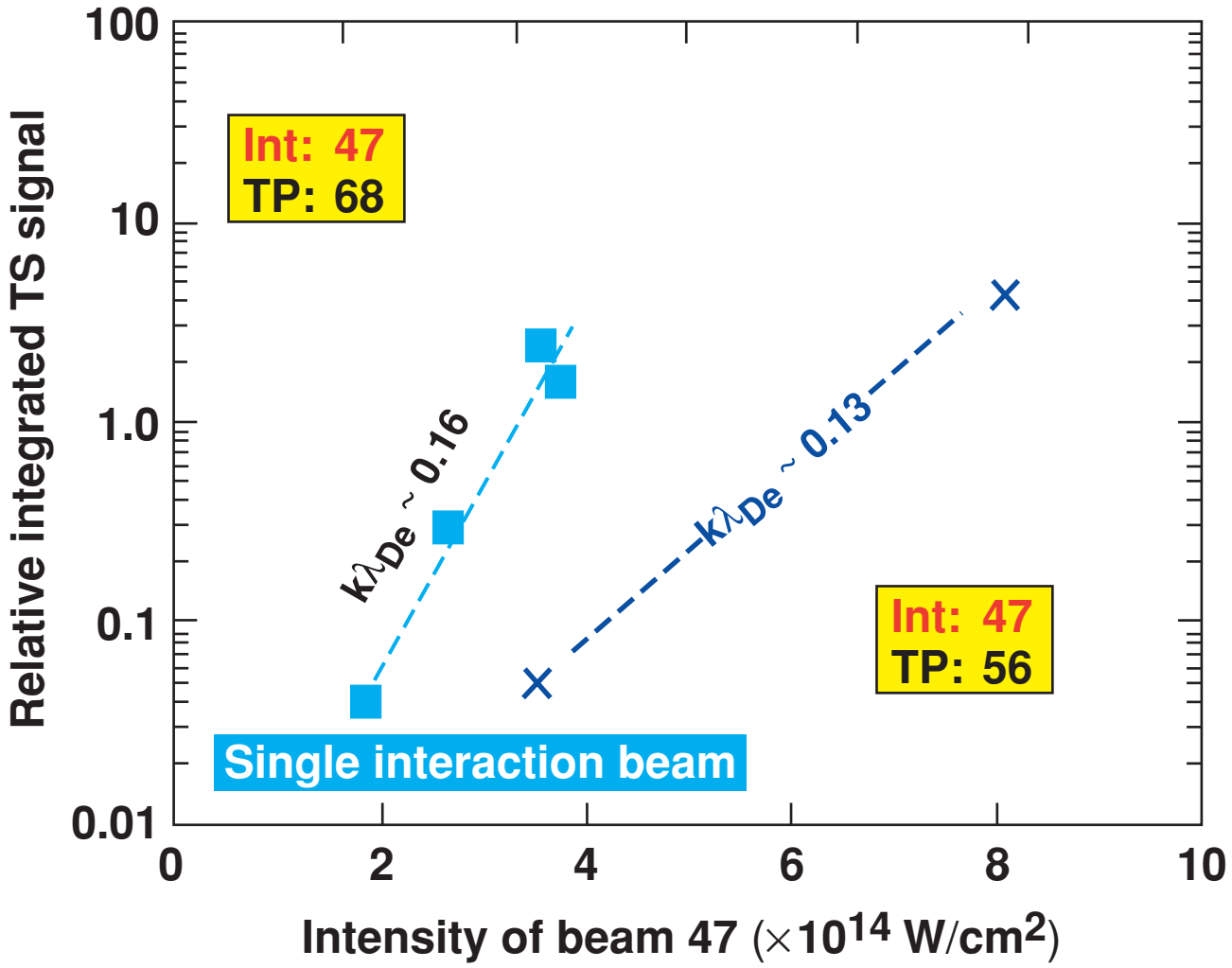

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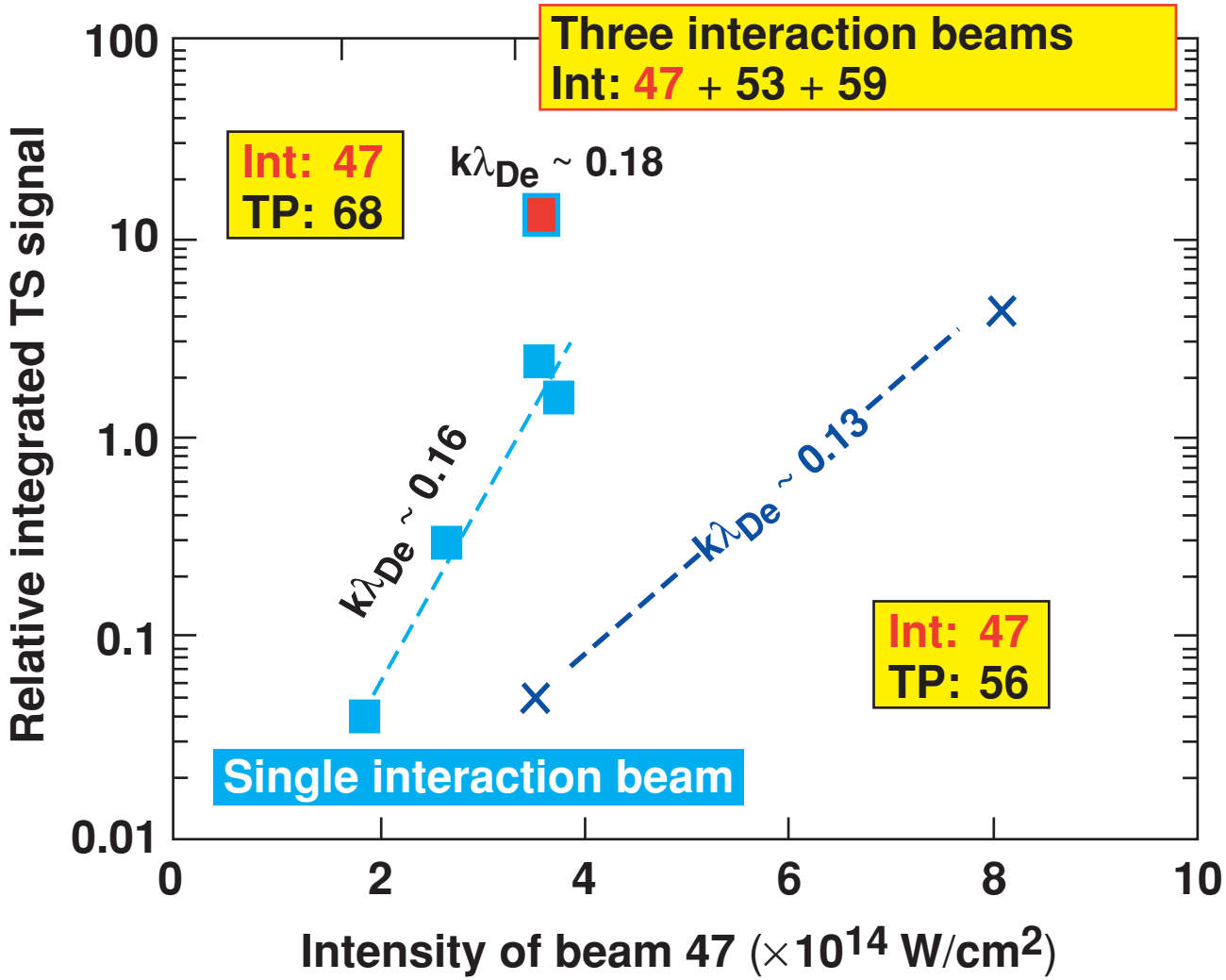

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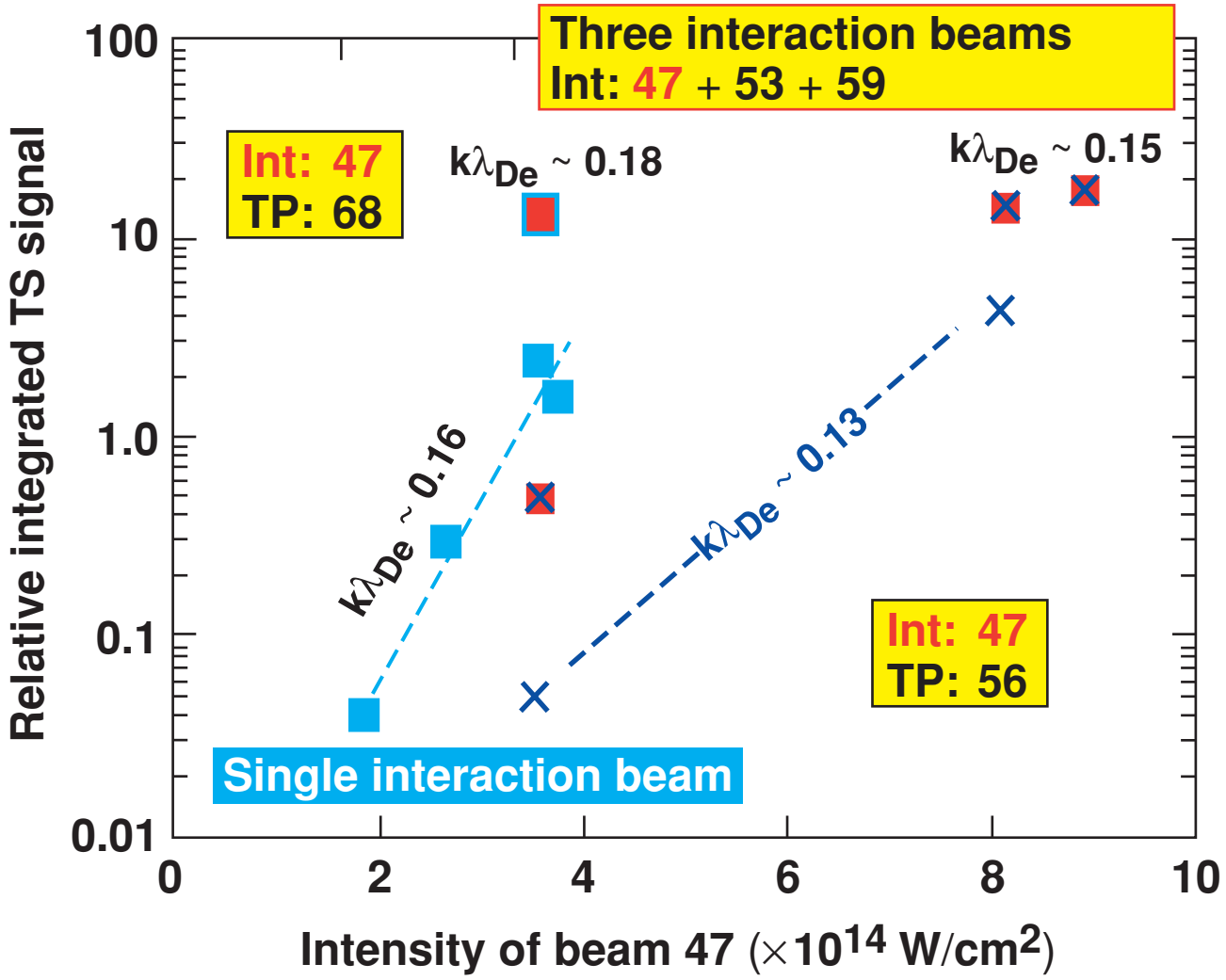
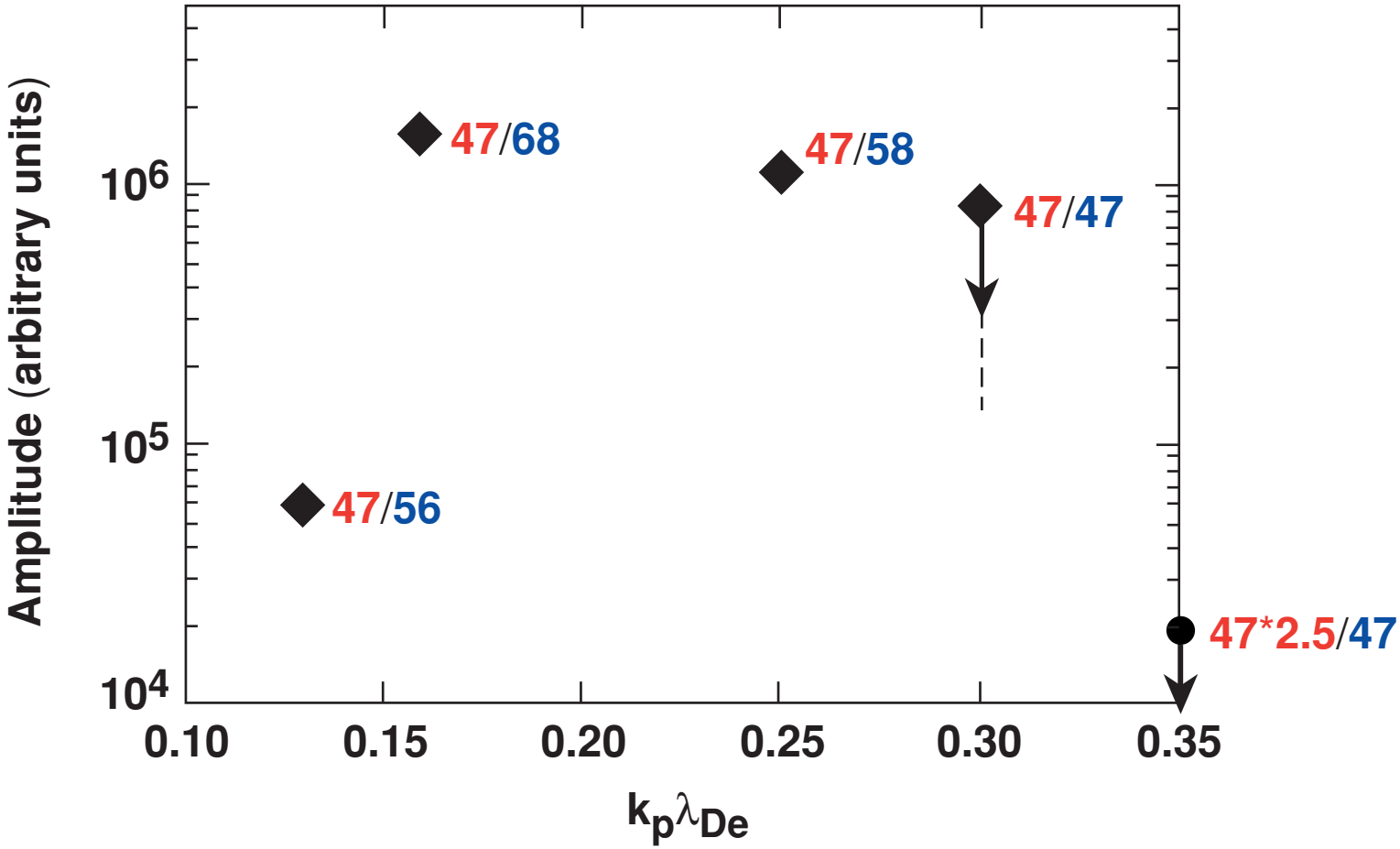


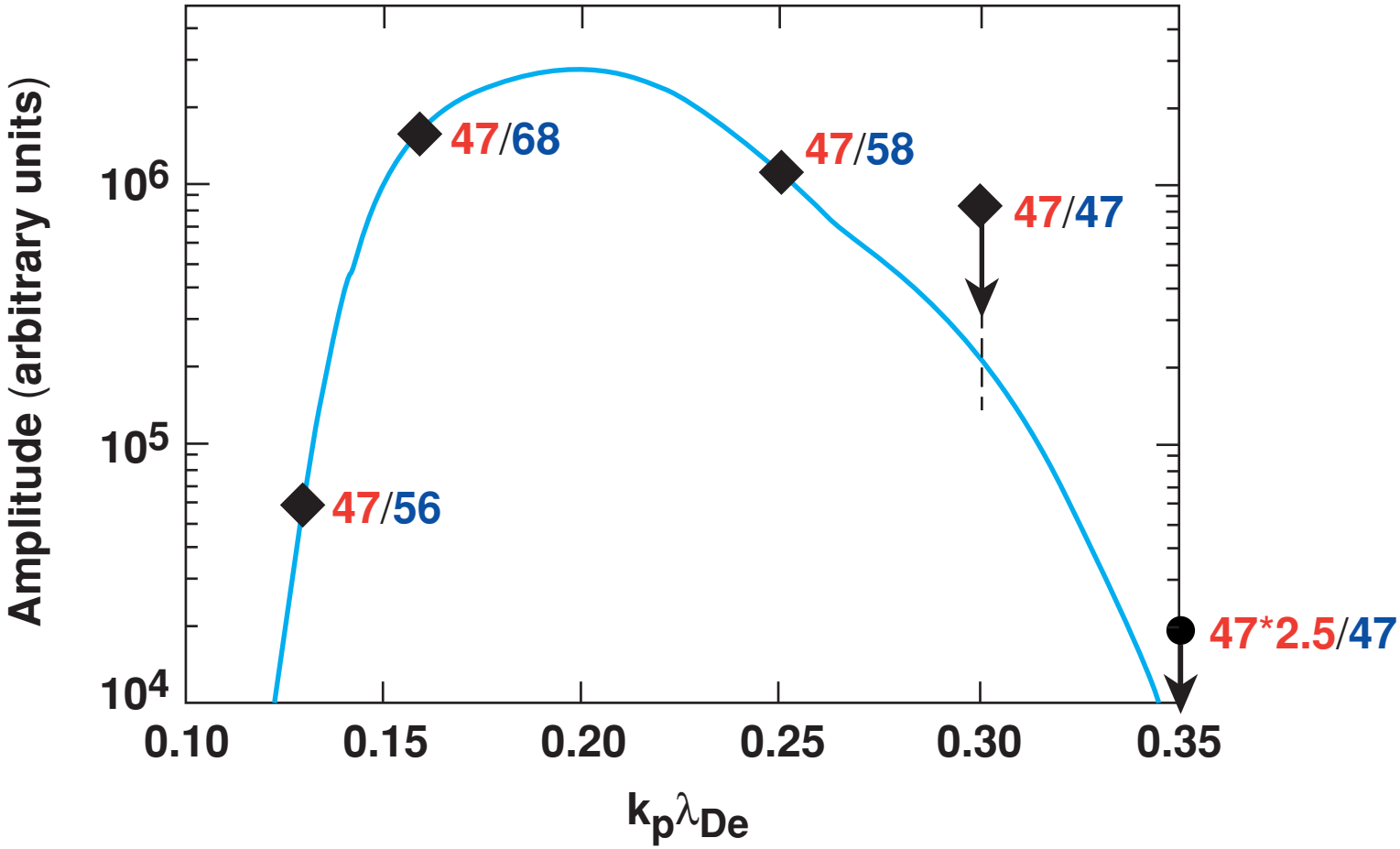
E12311

The current TPD experiments allow for a rough estimate of the plasma-wave spectrum



E12312

The current TPD experiments allow for a rough estimate of the plasma-wave spectrum



The absolute instability would be just above threshold for $k_p\lambda_{De} < 0.13$.

E12312

Summary/Conclusions

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