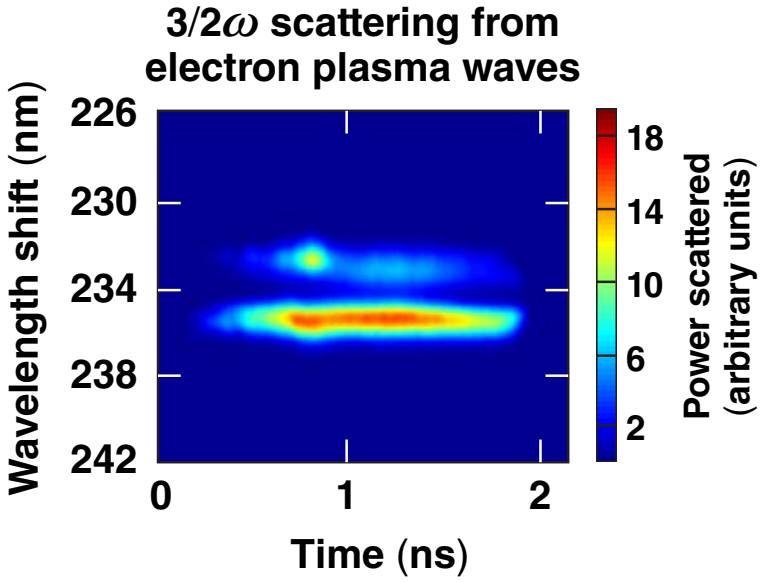
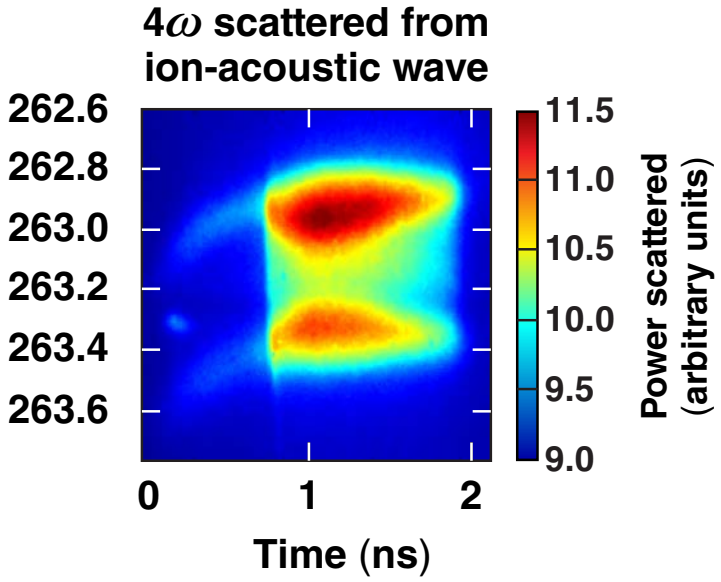
Thomson-Scattering Measurements of Ion-Acoustic Wave Amplitudes Driven by the Two-Plasmon–Decay Instability





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American Physical Society
Division of Plasma Physics
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Summary

Ion-acoustic waves (IAW's) driven by ponderomotive beating of electron plasma waves (EPW's) from two-plasmon decay (TPD) have been observed

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- Time-resolved 4ω Thomson-scattering spectra at quarter critical show that ion-acoustic wave amplitudes follow 3ω self-Thomson-scattering amplitudes from EPW's
- Ion-acoustic waves grow rapidly to large amplitudes ($\Delta n_e/n_e \sim 0.01\%$) once a threshold in EPW amplitude is reached
- *ZAK* simulations show similar behavior*,**

*K. Y. Sanbonmatsu *et al.*, Phys. Rev. Lett. 82, 932 (1999).

**D. A. Russell, presented at the Workshop on Laser Plasma Instabilities, Livermore, CA, 3–5 April 2002

Collaborators

S. X. Hu, D. T. Michel, J. F. Myatt, B. Yaakobi, and D. H. Froula

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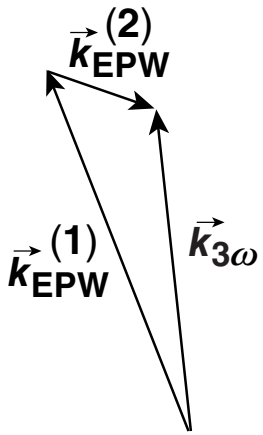
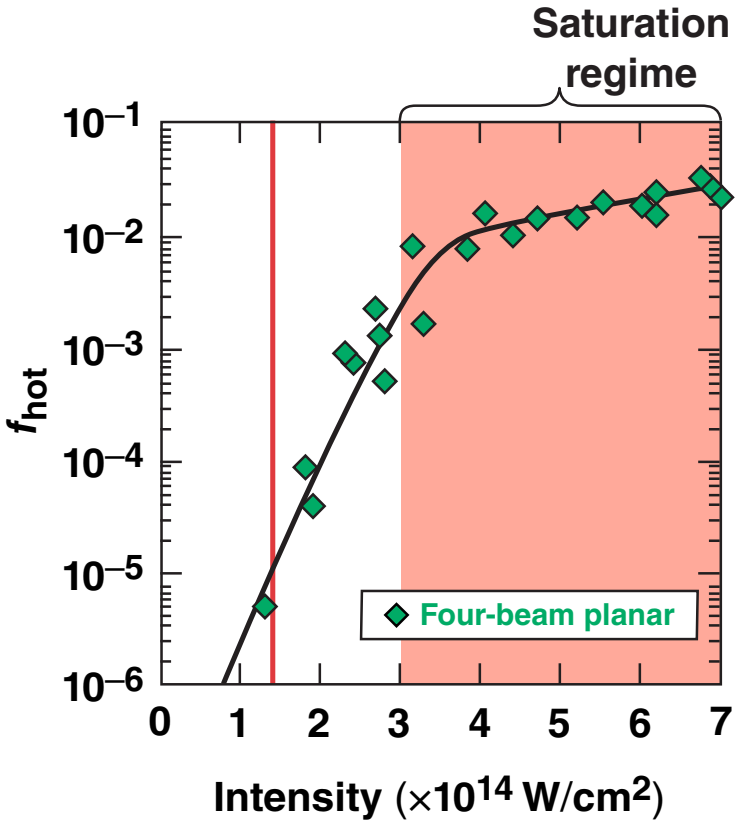
University of Rochester

Hot-electron generation by TPD is measured to saturate at ~1% of the incident laser energy*

$$f_{hot} = \frac{E_e}{E_{laser}}$$



Large amplitude electron-plasma waves can accelerate electrons to high energies

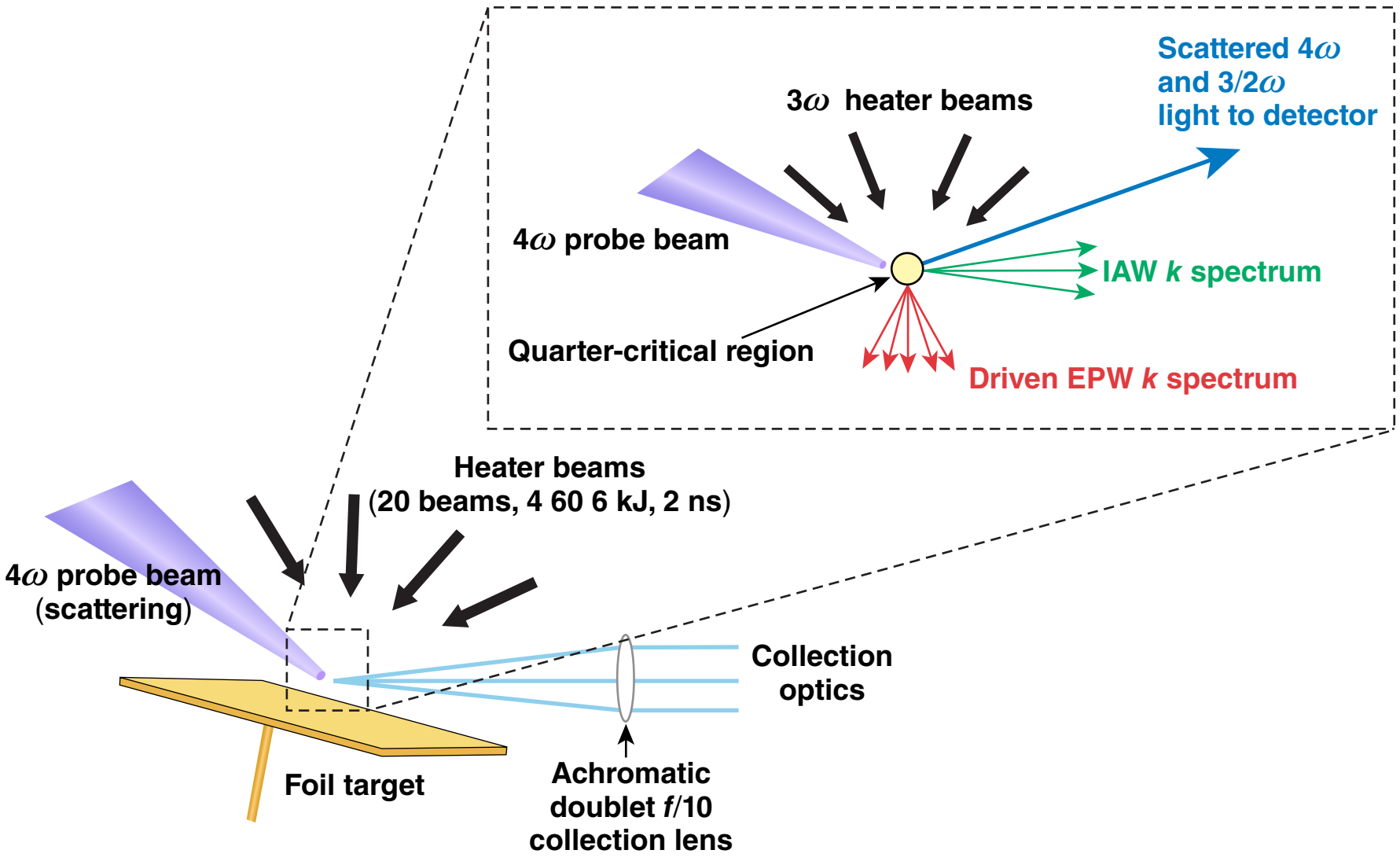


Ion-acoustic wave growth is predicted to be a saturation mechanism for two-plasmon decay.

E21769

*Froula *et al.*n Phys. Rev. Lett. 108, 022707 (2012).

The amplitudes of both the ion-acoustic and electron plasma waves were measured using Thomson scattering



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Electron plasma wave amplitudes are measured using 3ω self-Thomson-scattering

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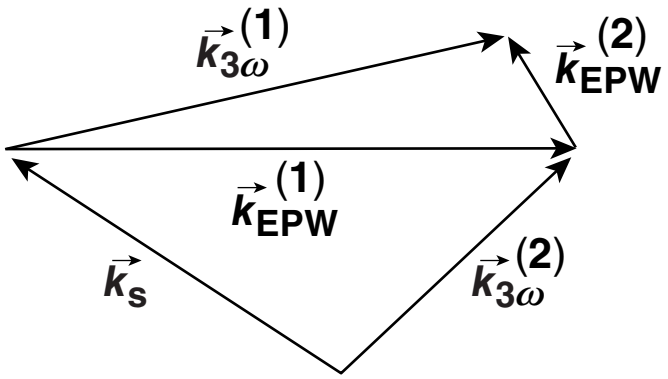
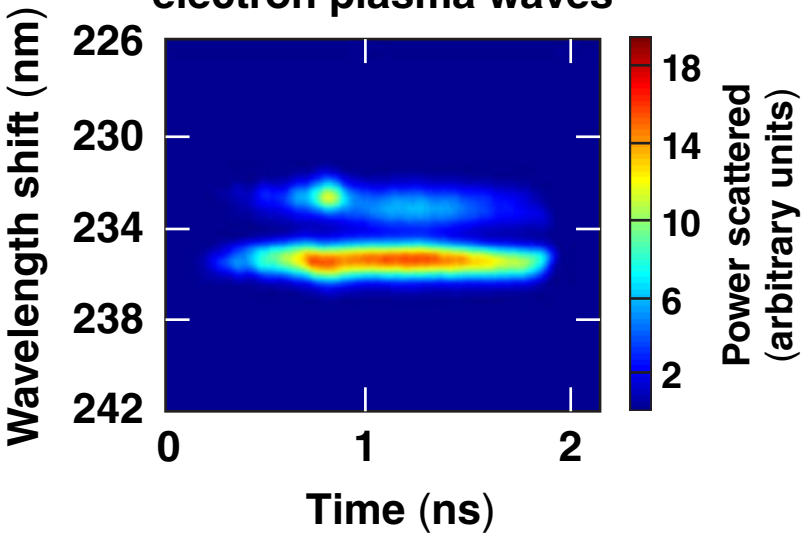
3ω self-Thomson-scattering from two-plasmon decay generated electron-plasma waves



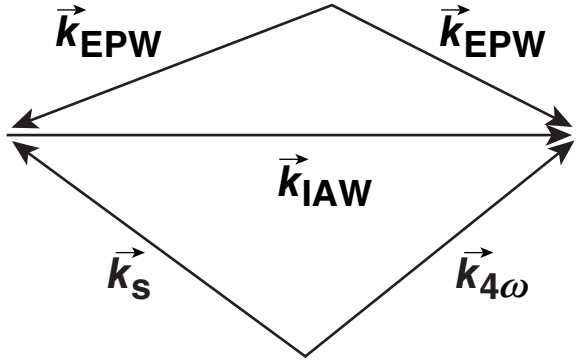
3/2ω scattering from electron plasma waves

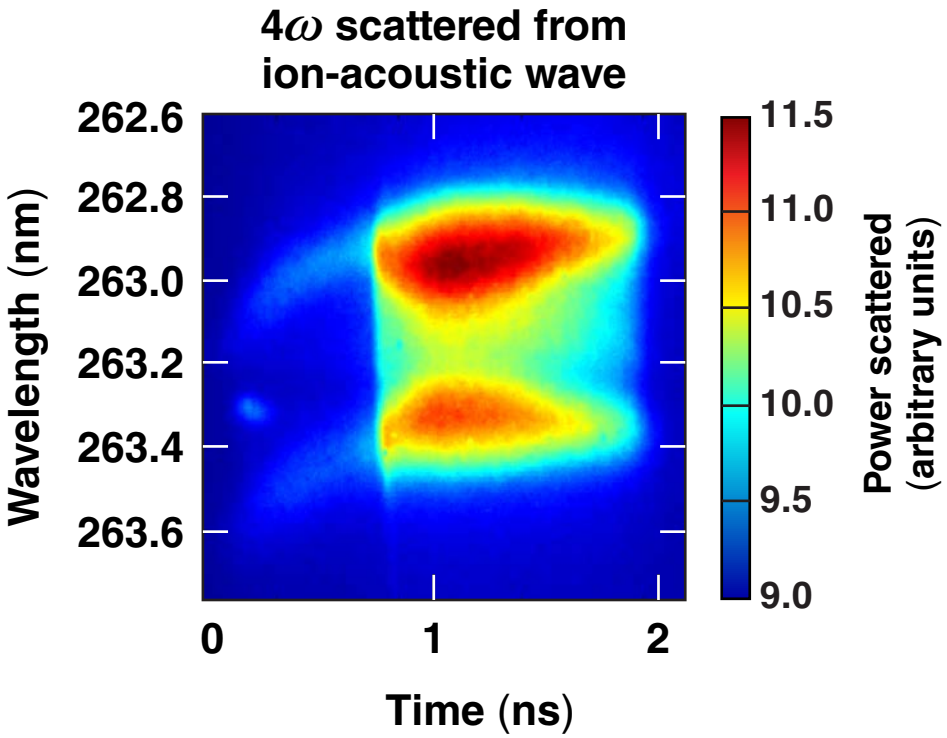


Large amplitude electron-plasma waves are measured at the quarter-critical surface.

Ion acoustic wave amplitudes are measured using 4ω Thomson scattering

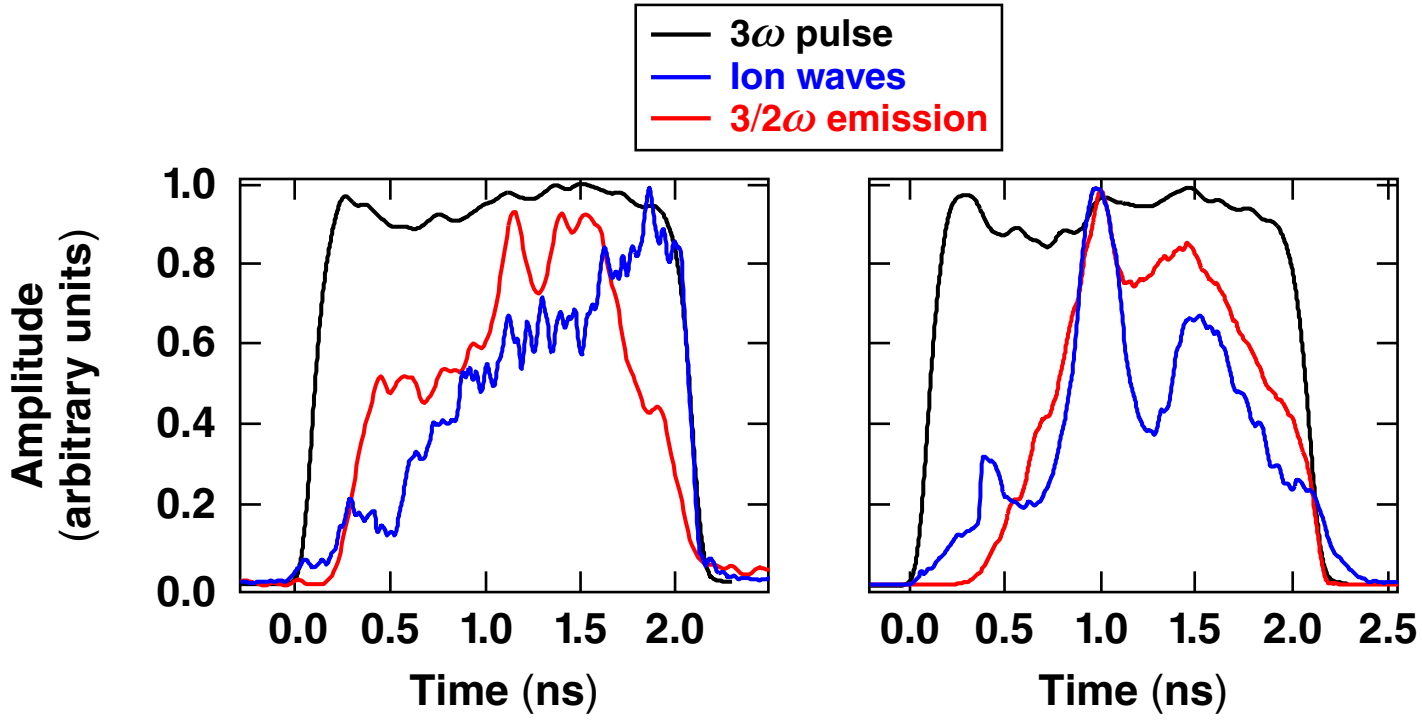
4ω Thomson-scattering from ion-acoustic waves generated by ponderomotive beating of electron-plasma waves





Large amplitude ion–acoustic waves are measured at the quarter critical surface.

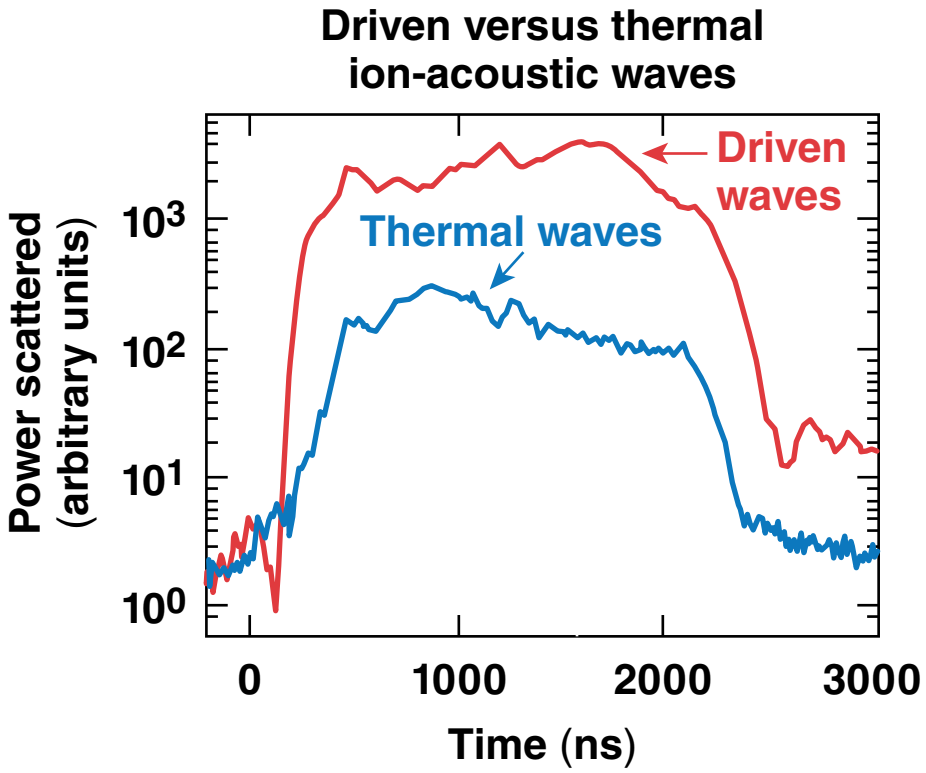
Time-resolved spectra are used to compare the temporal evolution of ion-acoustic waves and 3/2ω amplitudes

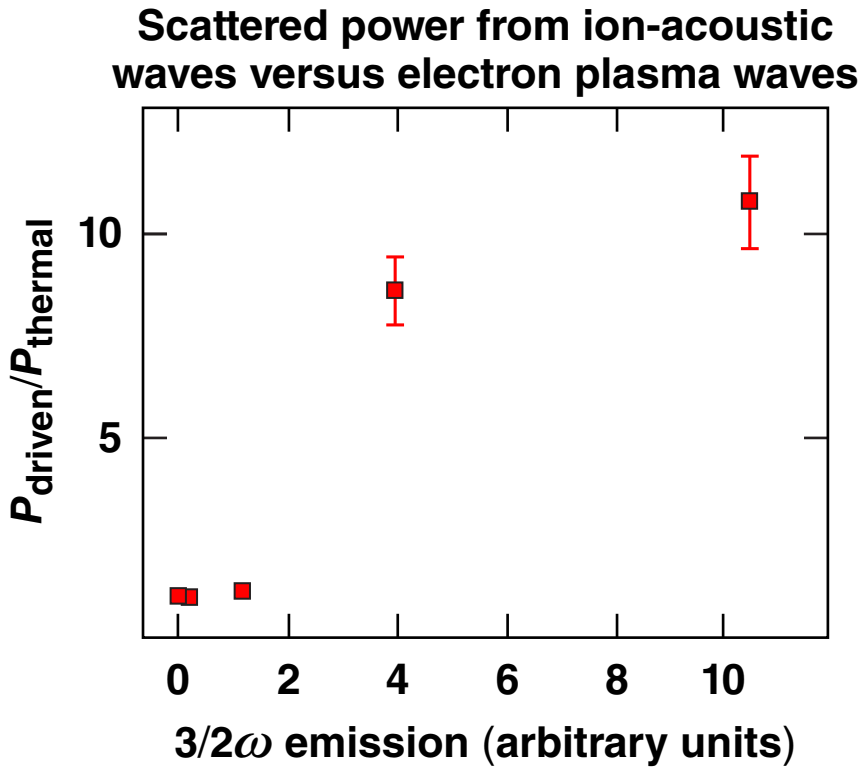


Ion-wave amplitudes follow the amplitude of 3/2ω emission.

Large-amplitude ion-acoustic waves are seen only when there are also large-amplitude electron plasma waves

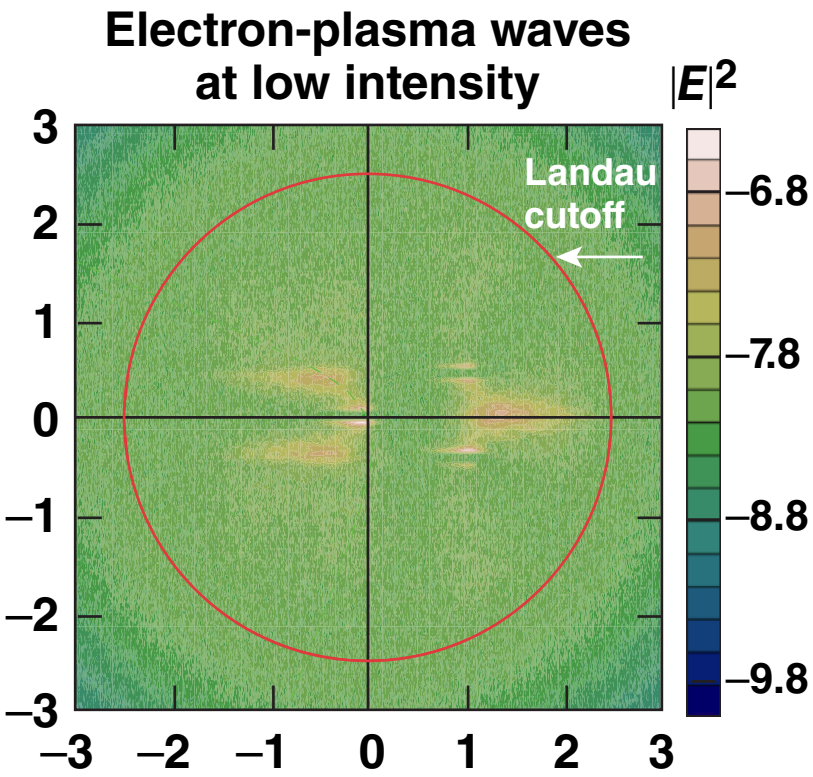
$$\frac{\delta n}{n} = \sqrt{\frac{P_{driven}}{P_{thermal}}}\,\frac{2d\Omega}{n_e \lambda_i^2 L}$$

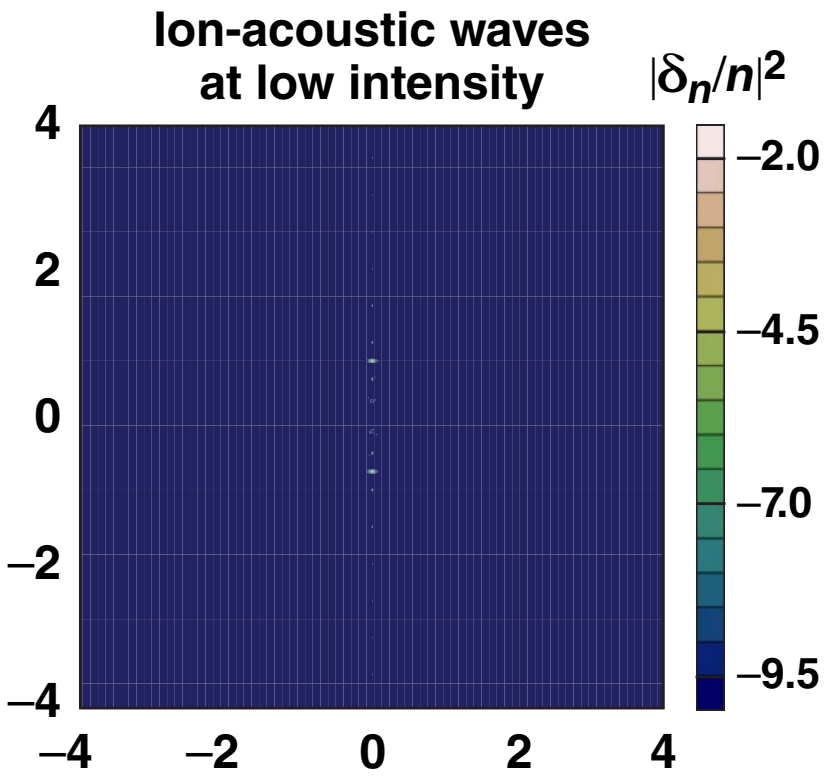




E21324a

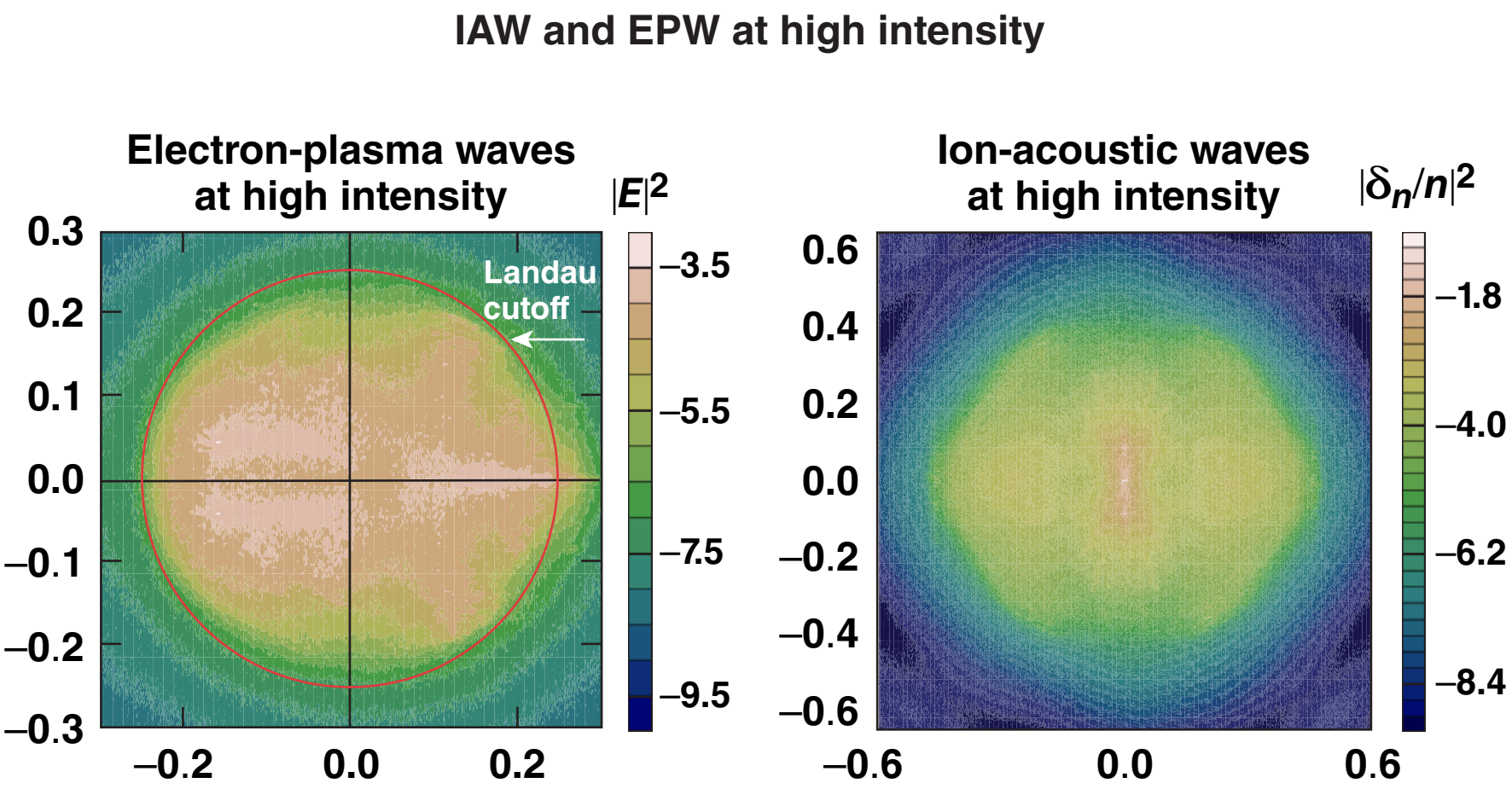
ZAK simulations show ion-acoustic wave growth when the electron-plasma wave spectrum is saturated by TPD





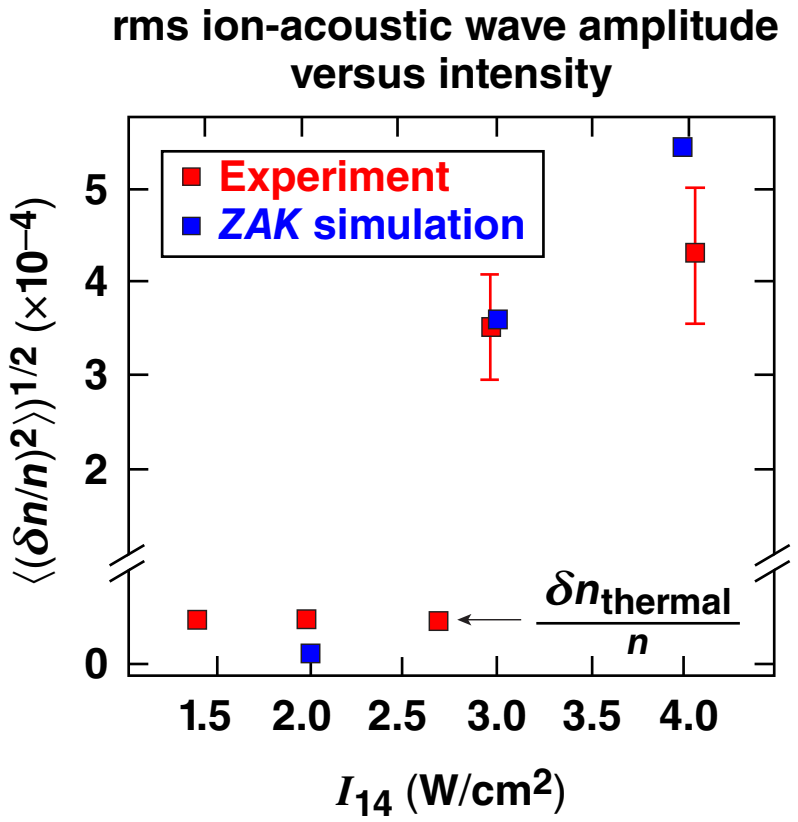
E21628

ZAK simulations show ion-acoustic wave growth when the electron-plasma wave spectrum is saturated by TPD



E21628a

Ion-density perturbations are compared to *ZAK* simulations and a similar growth threshold is observed



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