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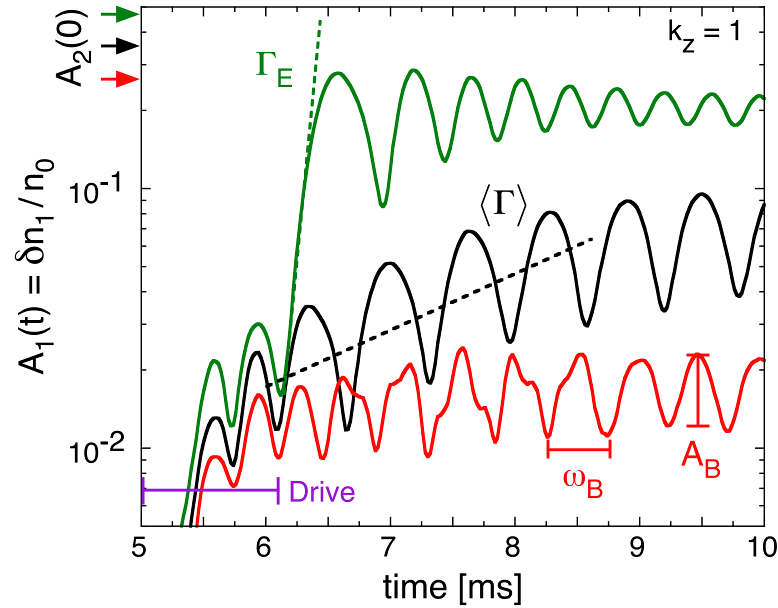
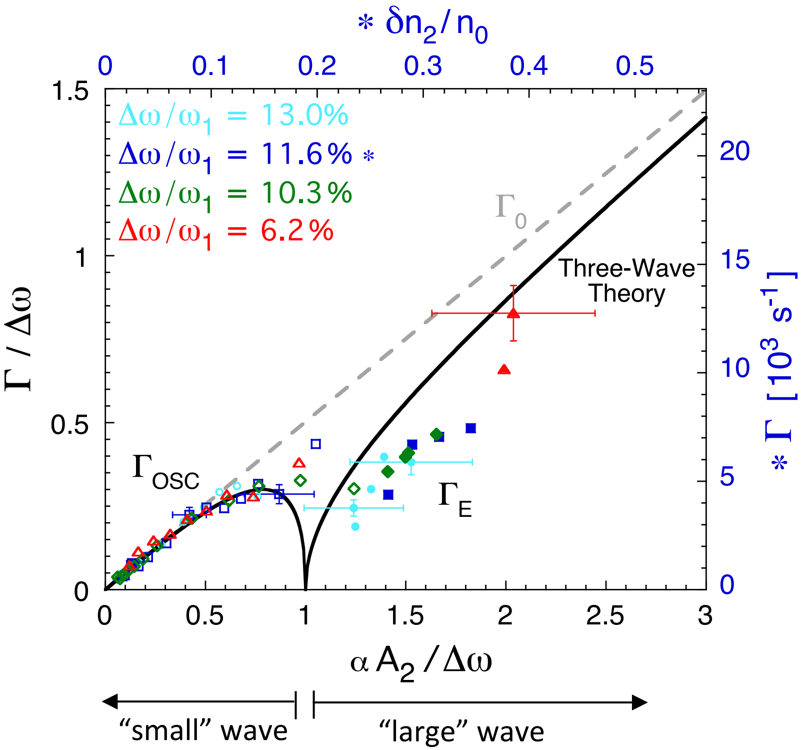
Decay Instability of Near-Acoustic Plasma Waves

Experiments investigating large amplitude, near-acoustic Langmuir waves have provided the first quantitative measurements of wave-wave coupling rates and the decay instability. The $k_z = 2$ pump wave and $k_z = 1$ daughter wave have a slight frequency detuning $\Delta\omega = 2\omega_1 - \omega_2$. For large pump amplitude A_2 (green curve), phase-locked exponential growth of the daughter wave at a rate Γ_E is observed. In contrast, for small pump amplitudes (red curve), the detuning causes the daughter wave amplitude to "bounce" at a frequency near $\omega_B \approx \Delta\omega$, with oscillatory energy exchange between the modes at a rate Γ_{OSC}.





These oscillatory coupling rates (open symbols) and exponential growth rates (closed symbols) are in quantitative agreement with cold fluid, three-wave theory. However, near the decay threshold, we observe a puzzling slow oscillatory growth of the daughter wave (black curve).

Recently, our measurements at higher temperatures, together with simulations, show that the pump amplitude required for instability is significantly *lowered* by kinetic effects. Similar threshold lowering is seen in the highly kinetic Electron Acoustic Waves, and theory is being developed.

D.H.E Dubin and A. Ashourvan, Phys. Plasmas, **22**, 102201 (2015)
F. Anderegg et al., AIP Conf. Proc. **1668**, 020001 (2015)