Abstract Submitted
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Non-linear Frequency Shifts, Mode Couplings, and Decay Instability of Plasma Waves[1] MATHEW AFFOLTER, F. ANDEREGG, C.F. DRISCOLL, University of California San Diego, F. VALENTINI, University of Calabria, Italy — We present experiments and theory for non-linear plasma wave decay to longer wavelengths, in both the oscillatory coupling and exponential decay regimes. The experiments are conducted on non-neutral plasmas in cylindrical Penning-Malmberg traps, θ-symmetric standing plasma waves have near acoustic dispersion $\omega(k_z) \propto k_z - \alpha k_z^2$, discretized by $k_z = m_z(\pi/L_p)$. Large amplitude waves exhibit non-linear frequency shifts $\delta f/f \propto A^2$ and Fourier harmonic content, both of which are increased as the plasma dispersion is reduced. Non-linear coupling rates are measured between large amplitude $m_z = 2$ waves and small amplitude $m_z = 1$ waves, which have a small detuning $\Delta\omega = 2\omega_1 - \omega_2$. At small excitation amplitudes, this detuning causes the $m_z = 1$ mode amplitude to "bounce" at rate $\Delta\omega$, with amplitude excursions $\Delta A_1 \propto \delta n_2/n_0$ consistent with cold fluid theory and Vlasov simulations. At larger excitation amplitudes, where the non-linear coupling exceeds the dispersion, phase-locked exponential growth of the $m_z = 1$ mode is observed, in qualitative agreement with simple 3-wave instability theory. However, significant variations are observed experimentally, and N-wave theory gives stunningly divergent predictions that depend sensitively on the dispersion-moderated harmonic content. Measurements on higher temperature Langmuir waves and the unusual "EAW" (KEEN) waves are being conducted to investigate the effects of wave-particle kinetics on the non-linear coupling rates.

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