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Non-linear Coupling and Decay Instability of Plasma Waves[1] M. AFFOLTER, F. ANDEREGG, C.F. DRISCOLL, UCSD, F. VALENTINI, Univ. of Calabria — We measure the non-linear coupling of plasma waves, for both the "standard" Langmuir waves with $v_{phase} \gg v_{bar}$, and for the unusual "EAW" (KEEN) waves with $v_{phase} \sim v_{bar}$. These are θ-symmetric standing modes on pure ion and (separately) pure electron plasma columns, with discrete wavenumbers $k_z = m_z(\pi/L_p)$. The 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 $\Delta\omega = 2\omega_1 - \omega_2$. For Langmuir waves 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, theory and simulations predict phase-locked exponential growth of the $m_z = 1$ mode. Experimentally we find the effects of detuning to be more pervasive than simple theory would suggest. Typically at these large amplitudes we observe strong amplitude bouncing, with a yet unexplained slower average growth. In contrast, EAW waves exhibit phased-locked exponential growth or no growth at all, apparently due to "frequency fungibility" of the EAW waves. Measurements on higher temperature Langmuir waves with $v_{phase} \sim 4v_{bar}$ are being conducted to investigate the effects of wave-particle kinetics on the non-linear coupling rates.

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