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Nonlinear Interactions of Trivelpiece-Gould Waves[1] ARASH ASHOURVAN, DANIEL H.E. DUBIN, UCSD — We study nonlinear Trivelpiece-Gould waves in a cold, finite length plasma model. Analytical expressions for the forms and frequencies of both traveling and standing cnoidal waves are obtained, and parametric resonances between waves are studied and compared to numerical solutions of the 1D fluid equations. For waves with $k_m < k_\perp$, where k_m and $k_\perp$ are the axial and perpendicular wave numbers respectively, 3-wave resonance conditions can be satisfied. Using perturbation theory we obtain a reduced system of evolution equations for slowly varying mode amplitudes in a 3 wave interaction. We use them to study the parametric resonance between a dominant $m = 2$ mode and a small amplitude $m = 1$ mode, including the effect of higher harmonics. We obtain an instability threshold amplitude A_2^{th} for mode $m = 2$. For $A_2 > A_2^{\mathrm{th}}$ mode $m = 1$ becomes unstable and grows exponentially, whereas for $A_2 < A_2^{\mathrm{th}}$, mode $m = 1$ exhibits beat wave oscillations. We find that if enough harmonics are kept in the theory, A_2^{th} converges to a value independent of the number of harmonics. On the other hand, for a short plasma with $k_1 \sim k_\perp$, 3-wave resonances cannot occur but conditions allow 4-wave resonances, especially in the short wave-length scales ($k_m > k_\perp$). In our simulations we observe mode instabilities that have signatures of this 4-wave interaction.

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