Driven frequency-sweeping in plasmas

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A generic simulation model of a kinetic plasma formed from a source and sink is presented which without instability would form a strongly unstable state due to a single mode. Instead, the resulting wave-particle resonant interaction maintains the distribution near a marginally-stable state through the continual production of fast frequency-sweeping modes that sweep unidirectionally (upward in our case) throughout the energy-inverted region of the distribution function. The energy of these modes can be channelled to the background plasma through wave dissipation and in our particular example one quarter of the injected energy is available to be channelled. The magnitude and time scale of the total frequency shift and the strength of the induced fields have been replicated by generalizing the Berk-Breizman hole-clump theory to deal with frequency shifts that are comparable to the resonance spread of the energetic particle distribution. Field amplitudes that are more than an order of magnitude larger than the origial theory are generated, and corellate well with the simulation.