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Nonlinear energization of ions by beating electromagnetic waves[1]
P.A. ZESTANAKIS, Y. KOMINIS, K. HIZANDIS, NTUA, Greece, A.K. RAM, PSFC, MIT — We consider the interaction of ions with two high frequency electromagnetic waves in a uniformly magnetized plasma. The beat frequency of the waves is assumed to be close to the ion cyclotron frequency while the individual wave frequencies are much higher than the beat frequency. Analytical calculations using the Lie perturbation theory show that the beat wave can nonlinearly energize ions. The energization is due to a resonant interaction of the ions with the envelope of the beat wave. The analytical analysis is facilitated by the separation in time scales between the wave frequencies and the frequency of the beat wave. We construct a set of mapping equations which helps determine the dependence of ion energization on wave parameters. The mapping equations are an efficient means for calculating the evolution of a distribution function and determining the diffusion of ions in energy. Our analytical results are in very good agreement with exact numerical simulations of particle orbits from the Lorentz equation. The theory and computational results will be discussed in detail.

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