Full particle simulation of whistler-mode chorus emissions in the magnetosphere

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We perform an electromagnetic full particle simulation to study the generation mechanism of VLF whistler-mode chorus emissions in the equatorial region of the magnetosphere. Parabolic variation of the static magnetic field is assumed as a model for the dipole magnetic field in the vicinity of the equator. We have cold thermal electrons and relatively low anisotropic hot electrons as plasma particles.

In the initial phase, the amplitude growth of the incoherent whistler-mode waves is determined by the linear growth rate. When the wave amplitude reaches a certain level, it begins to grow more rapidly with a series of rising chorus elements consisting of coherent phase structures in the vicinity of the magnetic equator, and their wave packets propagate away form the magnetic equator. The frequency sweep rates of the excited chorus elements decrease gradually. We find a distinct threshold for such a nonlinear wave growth generating chorus elements. The relation between the wave amplitude and the frequency sweep rate of rising chorus elements found in the simulation fully supports the nonlinear wave growth theory of chorus emissions.