Coherent nonlinear scattering of energetic electrons in the process of whistler-mode chorus generation

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The cyclotron resonant interaction of whistler-mode chorus waves with energetic electrons drives pitch angle scatterings of energetic electrons in the magnetosphere.

We present a coherent scattering process associated with generation of the whistler-mode rising chorus emissions near the geomagnetic equator in a self-consistent electromagnetic full-particle simulation. The simulation shows that the enhanced coherent whistler-mode rising chorus emissions scatter the energetic electrons very effectively through the nonlinear cyclotron resonant interaction. The nonlinear resonant interaction induces acceleration of resonant electrons trapped by the wave and deceleration of untrapped resonant electrons. When the frequency of a rising chorus element continuously increases in time from lower frequency to higher frequency, the parallel resonant velocity continuously decreases toward lower velocity regions resulting in significant scattering of resonant electrons, and create an *electromagnetic electron hole* in the distribution function. The lower limit of resonant parallel velocity is determined by the upper frequency limit of the rising chorus. The unscattered electrons with low parallel velocities and the accelerated resonant electrons trapped by the wave result in the distribution clearly peaked at 90 degrees. The successive generation of rising chorus elements can scatter resonant electrons in the same resonance velocity range. The repeated scatterings make the distribution much sharper at 90 degrees and flatter in lower pitch angles close to the loss cone angle, leading to formation of a pancake distribution function as observed in the inner magnetosphere.