Particle simulation of the nonlinear triggering process by monochromatic whistler-mode waves in a homogeneous magnetic field

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We perform one-dimensional particle-in-cell simulations of triggered emissions for the understanding of wave-particle interaction in the vicinity of the magnetic equator. A uniform magnetic field is used for the simulation. Cold and hot electrons initialized by bi-Maxwellian and subtracted bi-Maxwellian distributions, respectively. We put an antenna at the center of the simulation region, and oscillate a current with a circular polarization to excite a finite length of whistler-mode waves. The frequency of the external currents is below the electron cyclotron frequency. We observe the frequency increase of triggered waves at the termination of the triggering waves. The formation of an electron hole is locally observed during the triggered emissions. In this presentation we focus on the process of the triggered emissions with frequency variations under a homogeneous magnetic field. We analyze dynamics of resonant electrons in the velocity phase space and resonant currents, based on the nonlinear wave growth theory [1]. At the wavefront, we find that the kinetic energy of hot electrons transfers to the triggering wave. At the same time, resonant electrons are scattered into the loss cone. Subsequently, the electron hole structure appears in the velocity phase space. We discuss the initial phase of the formation process of an electron hole from a monochromatic whistler-mode wave in a uniform magnetic field.

References

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