Particle simulation with the triggered waves for chorus in a nonuniform magnetic field

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The many scientific spacecrafts has been observing many chorus emissions in the geomagnetosphere. From the significant observation data, the generation source region and propagation direction of the chorus emissions being cleared gradually. But the frequency changes in a few seconds such as riser and faller have not yet explained. The chorus emissions are generally considered that the chorus emissions are generated via nonlinear wave particle interaction between anisotropic electrons and whistler mode waves. With the well-known linear growth rate of a parallel propagating whistler mode wave, pitch angle anisotropy and its critical value are an important factor in determining whether a whistler mode waves will grow though cyclotron resonance with resonant electrons or not. In this study, we analyze the wave particle interaction involved in the generation and propagation of the chorus emissions by using electromagnetic full particle simulation. Our simulation model is one dimension, anisotropic cold and hot particles with Maxwellian are allocated in the background. In the propagation simulation of the whistler mode wave along the uniform external magnetic field, we can confirm the amplification of propagating wavefront (only several wavelength) including its saturation, and simultaneously the pitch angle diffusion of anisotropic resonant electrons by amplified wave. We also evaluate the time evolutions of pitch angle anisotropies and linear growth rates from the electron velocity distributions with the cyclotron resonance. By the cyclotron interaction, the initially unstable resonant electrons with the velocity corresponding to the resonant frequency of whistler mode wave are diffused. Then the anisotropy decreases down to the stable anisotropy, and the linear growth rate is reduced to 0. In the nonuniform simulation model, to simulate generation and propagation process of chorus emissions around the equatorial plane in the magnetosphere, we tentatively set up a spatially nonuniform magnetic field as the Earth’s dipole magnetic field in the simulation, and simulate a process that whistler mode waves triggered from a thermal noise existing in space are generated and propagate. From the simulation result, the several whistler mode waves are generated from equatorial region, and their waves propagate toward high latitude. This is consistent with the theory of chorus generation and chorus observation around the equatorial plane. We can also see the frequency shift similar to riser type shape from the spectra of waves. We will present the evolution of the resonant electrons in the nonuniform magnetic field.