Nonlinear evolution of chorus generation in a nonuniform magnetic field

Mitsuru Hikishima[1]; Satoshi Yagitani[2]; Isamu Nagano[2]; Yoshiharu Omura[3]; Hiroshi Matsumoto[4]
[1] Kanazawa Univ.; [2] Kanazawa Univ.; [3] RISH, Kyoto Univ; [4] Kyoto Univ.

The theoretical analysis, satellite and ground observations of chorus emissions having origin in the geomagnetosphere have been actively studied since several decades ago. Especially, the detailed analysis of k-vector, pointing flux from wave data obtained by the many scientific spacecraft in situ has made clear that the generation source region of chorus locates in the vicinity of the magnetic equator. However the generation process of steep frequency shift and amplification of chorus packets in the order of milliseconds has not yet exactly explained. The chorus emissions are generally considered to be generated via nonlinear wave-particle interaction between anisotropic electrons and whistler mode waves. We use an electromagnetic full particle simulation to investigate chorus characteristics including much complicated nonlinear process. Our simulation model is spatially one dimensional along the dipole geomagnetic field line, and anisotropic cold and hot particles with bi-Maxwellian distribution are allocated. These particles are magnetically trapped around the magnetic equator by adiabatic invariant with gradient of external magnetic field intensity.

From the simulation result using this nonuniform magnetic field model, we can reproduce some whistler mode wave packets which are accompanied by a rise of frequency as seen in rising chorus. Their whistler mode wave packets are generated from thermal noise fluctuation with positive temperature anisotropy at the equatorial region. The generated several whistler mode packets propagate toward high latitudes. The initial growing frequency of each wave packet follows a linear theory. Its frequency seems increasing due to electron cyclotron frequency increase at a point of high latitude away from the equator.

We will present comprehensively the evolution of propagation of chorus from simulation result by the nonuniform magnetic field model.