Frequency and amplitude characteristics of whistler-mode chorus emissions reproduced by electron hybrid code simulations

Yuto Katoh[1]; Yoshiharu Omura[2]
[1] Dept. Geophys., Grad. Sch. Sci., Tohoku Univ.; [2] RISH, Kyoto Univ.

Whistler-mode chorus emissions are narrow band electromagnetic emissions often consist of rising tones observed on the dawn side of the Earth's magnetosphere. Results of *in situ* observations reveal that chorus emissions are generated in the equatorial region of the magnetosphere and that the activity is enhanced during geomagnetically disturbed periods. The nonlinear wave growth theory has been proposed for the generation mechanism of whistler-mode chorus emissions, based on the theoretical consideration and the analyses of the simulation result [Omura et al., 2008]. The nonlinear growth theory suggests that the frequency sweep-rate of a chorus element is related to the wave amplitude of coherent chorus elements in the region close to the magnetic equator. We have confirmed this prediction by performing simulations with different initial number densities of energetic electrons and have shown that the frequency sweep-rates of reproduced chorus vary depending on the variation of the wave amplitude of each chorus element. We have also found that the theoretically estimated frequency sweep-rates are consistent with the simulation results.

In this presentation we conduct further analyses of the simulation results reproducing chorus generation processes. The simulation results reveal that the characteristic frequency variation of chorus elements showing rising tones has been formed at the region very close to the magnetic equator (within 10 c Omega_e; Omega_e is the electron gyrofrequency) while the wave amplitude of elements have been significantly intensified through their propagation away from the equator (~100 c Omega_e). The spatial scale of the region where the explosive wave growth has been observed is varied in each simulation run, corresponding to the difference of the wave amplitude of reproduced chorus elements. We estimated the spatial scale h_c, a measure of the spatial extent of the generation region derived from the nonlinear wave growth theory, using parameters of each simulation run and found consistency with simulation results. We also analyzed the power spectra of reproduced chorus elements in the simulation results and found that the spectra of chorus are essentially different from the profile of the linear growth rate in frequency domain. This result clearly demonstrates that the nonlinear wave-particle interaction governs the chorus generation mechanism.