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Amplitude dependence of the generation process of whistler-mode chorus emissions

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

In the dawn side of the Earth's magnetosphere during geomagnetically disturbed periods, the strong enhancement of whistler-mode chorus emissions has been observed *in situ* by various spacecrafts. Results of high time resolution observations revealed that whistler-mode chorus emissions are a group of coherent electromagnetic emissions often consist of rising tones originating from the magnetic equator.

The generation process of chorus has been reproduced by self-consistent simulations in recent years. In addition, 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 revealed that the theoretically estimated frequency sweep-rates are consistent with the simulation results.

In the present study, we show results of further analyses of the simulations reproducing the chorus generation process. 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 gyro-frequency) 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 also analyzed the amplitude threshold in generating coherent chorus elements by evaluating the wave magnetic field amplitude during the time interaval at which a first coherent chorus element emerges. We find that the simulation results are consistent with the estimated threshold of wave magnetic field amplitude based on the nonlinear wave growth theory.