Study of the threshold of wave amplitude in generating chorus emissions

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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 simultion results, validating the accurary of the nonlinear growth theory.

In the present study we discuss the amplitude threshold of coherent waves in generating chorus emissions. We have found the existence of the threshold amplitude of coherent waves by analyzing the simulation results. We show that the coherent chorus elements appear after the wave amplitude of whistler-mode waves exceeds the certain level through the linear growth phase due to the instability driven by the temperature anisotropy of energetic electrons. These results suggest that chorus emissions cannot be generated in a case that the amplitude of excited whistler-mode waves does not reach the certain level enough to generate chorus emissions.