

Effect of the magnetic field inhomogeneity on the generation process of whistler-mode chorus emissions

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Whistler-mode chorus emissions with rising tones are generated through the nonlinear wave-particle interactions occurring in the region close to the magnetic equator. The mirror force plays an important role in the nonlinear interactions and the spatial inhomogeneity is a key parameter of the chorus generation process. The spatial magnetic field inhomogeneity along a field line is widely changed during a geomagnetically disturbed period. In the present study, by a series of self-consistent electron hybrid code simulations, we discuss the effect of the spatial inhomogeneity of the background magnetic field on the generation process of whistler-mode chorus emissions. We have conducted numerical experiments with different spatial inhomogeneities of the background magnetic field, while we assume that the initial velocity distribution function and the number density of energetic electrons are the same at the magnetic equator in all simulation runs. The simulation results reveal that the spectral characteristics of chorus significantly varies depending on the magnetic field inhomogeneity. In the simulation result assuming the smallest inhomogeneity, we observe the excitation of broadband whistler-mode waves whose amplitude is comparable to distinct chorus elements appeared in other simulation runs. We find that the broadband waves are a group of wave elements with rising tones nonlinearly triggered in the region close to the magnetic equator. Based on the simulation results, we show that the small spatial inhomogeneity of the background magnetic field results in the small threshold amplitude for the nonlinear wave growth and makes the triggering process of rising tone elements to emerge easily in the equatorial region of the magnetosphere.

Keywords: whistler-mode chorus, numerical experiment, wave-particle interaction