Frequency and Amplitude Analysis of Chorus Emissions Observed by GEOTAIL

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Abstract

We try to find the observational evidence of the nonlinear evolution of chorus emissions, by examining their wave form data observed by the GEOTAIL spacecraft. Especially we investigate the relationship between the frequency shift and the amplitude variation of each chorus element. We evaluate statistically the correlation between their frequency sweep rates, frequencies and amplitudes. As a result, a positive correlation is found, which is consistent with the nonlinear growth feature of the chorus emissions obtained in simulation and theory.

1. Introduction

The generation mechanisms of chorus emissions have been widely analyzed by both theory and simulation. In recent studies, full-particle simulations on chorus generation around the geomagnetic equator have revealed its nonlinear growth and frequency shift [1], just as predicted by the nonlinear growth theory [2]. In the present study, we try to investigate the observational evidence of the nonlinear evolution of chorus emissions, by examining the wave form data of chorus emissions observed by the GEOTAIL spacecraft mainly in the Earth's dayside outer magnetosphere. Especially we evaluate the relationship between their frequency and amplitude variations.

2. Analysis

We analyze the wave form data of rising-tone chorus emissions observed by GEOTAIL. Each chorus element is extracted by using a band-pass filter with the center frequency dynamically adapted to the frequency variation of the element. Then its frequency, amplitude and k-vector variations are computed from their analytic wave forms. In particular we evaluate statistically the correlation between their frequency sweep rates, frequencies and amplitudes, which was obtained in the simulation and the theory [1-2].

3. Results

As a result, a positive correlation is found between their frequency sweep rates and frequencies multiplied by amplitudes. In the saturation phase, slow modulation of amplitude is observed while the frequency sweep rate is extremely stable, as observed by the simulations. Such characteristics would be the observational evidence of the nonlinear growth of chorus emissions. We also observe an interesting relationship between the frequency and the wave normal angles, which would be explained by the effect of generation and propagation characteristics.

References

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