Simulation of duct propagation of whistler-mode chorus and scattering of relativistic electrons

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By a spatially two-dimensional electron fluid code in dipole coordinates, we study properties of whistler-mode chorus emissions propagating in density enhanced and decreased ducts. We assume the wave source of whistler-mode waves in the equatorial region of the magnetosphere and generate whistler-mode waves by oscillating the electric field in the wave source region of the simulation system in space and time. We change the frequency of the generated whistler-mode waves in time to simulate rising/falling tones which are often observed in the frequency spectra of chorus emissions in the magnetosphere. The propagation properties of whistler-mode waves in ducts have been studied for decades [e.g., Smith et al., 1960], and the wave normal angle of whistler-mode waves varies depending on the spatial structure of cold plasma perpendicular to the background magnetic field. We have compared the simulation results of the propagation of whistler-mode waves in both cases of density enhanced and decreased ducts and have found that the simulation results are consistent with the theoretical expectations. In the density enhanced duct case, whistler-mode waves propagate along a field line corresponding to the maximum cold plasma density, while in the decreased duct case whistler-mode waves propagate along the duct with reflecting between both edges of the density structure. These results show that the propagation property of whistler-mode waves in a duct varies during their propagation away from the equator.

The variation of the propagation property should affect on the resonant scattering process of relativistic electrons by whistler-mode chorus. So as to study resonant scattering of relativistic electrons by duct propagating whistler-mode chorus, we compute equations of motion of test particles in the simulation of the wave propagation. The computation of the motion of relativistic electrons has also been conducted in the dipole coordinates, and the bounce motion of relativistic electrons is taken into account. In this presentation, we show details of the numerical scheme and the accuracy of the computation as well as initial results of the simulation.