Interaction between whistler waves and electrons at Earth's magnetotail: Test particle simulation and THEMIS observation

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Whistler waves play important roles in electron scattering in a collisionless plasma. We have analyzed a dipolarization event detected by THEMIS satellite on 19 February 2008. The event shows emission of whistler waves that lasted for a few seconds at the dipolarization site near the nightside equator at ~10 Re. Two types of waves were observed: one type has a frequency below ~0.1 f_{ce} (electron gyrofrequency) with the wave propagation angle relative to the background magnetic field around 120 degrees. The other type has a higher frequency from ~0.25 to ~0.5 f_{ce} with the propagation angles at ~20 and 160 degrees. Simultaneous observation of the electron pitch-angle distribution (PAD) reveals that associated with these waves, electron flux for energies below 4 keV is decreased while that with higher energies remains almost constant. These observations may indicate that the whistler waves are excited by the lower energetic electrons, whereas the higher energetic electrons may be treated as test particles in the given electromagnetic field.

In this presentation, we discuss electron scattering by obliquely propagating whistler waves performing test particle simulations and apply the results to the dipolarization event. The whistler waves are given as a superposition of sinusoidal waves obeying a cold plasma dispersion relation, using parameters consistent with the observation. Stretched dipole magnetic field is used as the background field model, assuming a Harris-type current sheet. Variation of the electron PAD is evaluated as a function of the electron energy and is compared with the THEMIS data. We discuss how the pitch-angle scattering by the whistler waves affects the variation of the PADs.

Keywords: whistler waves, electron scattering, earth's magnetotail

