Geophysical Research Abstracts, Vol. 7, 09605, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09605

Generation of electrostatic cyclotron harmonic (ECH) waves and electromagnetic waves due to loss cone distribution functions

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Electron cyclotron harmonic (ECH) waves are observed in the Earth's magnetosphere in the nightside near-Earth equatorial region. Observations indicate that a loss cone feature in the electron distribution function generates ECH waves, which result in pitch angle diffusion and the formation of a highly anisotropic "pancake" type of distribution in the low energy electron population. Electrostatic and electromagnetic waves are driven by loss cone distributions in the presence of cold plasma, which is known to strongly affect the linear dispersion properties of ECH waves. To examine the detailed properties of ECH waves and ensuing wave-particle interactions, two-dimensional (2.5D) electromagnetic Particle-In-Cell (PIC) and Vlasov simulations are employed. The heating of the cold electrons and their effects on the saturation of the ECH waves will be determined. The generation and saturation mechanisms of electromagnetic whistler mode waves will be discussed.