ABSTRACTS (MASTER THESIS)

Acceleration Mechanism of Radiation Belt Electrons by Whistler-mode Chorus Emissions

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We analyze the mechanism of acceleration of energetic electrons interacting with whistler-mode waves in the Earth's radiation belts by using test particle simulations. First, in order to assess influence of the propagation angle of the whistler-mode wave on electron accelerations, we perform the test particle simulation in a simple model. By using the dispersion relation which is obtained from Maxwell's equations, we reproduce the electric field and the magnetic field of oblique whistler-mode waves. Then we set the electrons in the simulation field, we calculate the energy change of trajectory of electrons. In the simple model, we find that the larger propagation angle makes the effect of Landau resonance stronger. We then perform large-scale test particle simulations with chorus emissions for a prolonged time. By taking into account the adiabatic variation of the energetic particle distribution, we determine the resonant current. Then by solving general wave equations numerically, we obtain the time evolutions of the chorus wave frequency and amplitude along the Earth's dipole magnetic field. We simulate dynamics of electrons at the electron cyclotron scale by using the Buneman-Boris method. Following interactions with chorus emissions, we calculate a distribution function which corresponds to a Green's function for the chorus interaction. By repeating this process at different kinetic energies and pitch angles, we thereby obtain an electron distribution function after multi-cycle chorus emissions. The simulation results suggest that radiation belt electrons have been accelerated effectively by multi-cycle chorus emissions. Electrons which have energies less than 1 MeV have been accelerated strongly by the RTA process. On the other hand, electrons more than 1 MeV energies have been accelerated strongly by the URA process.