Computer simulations of electron scatterings through chorus-wave particle interactions

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Whistler mode chorus waves cause scattering and acceleration of energetic electrons in the inner magnetosphere, and recent studies identified that chorus waves cause the pulsating aurora. The interaction processes have been modeled as diffusions in the velocity space, and the scattering rate increases with increasing the wave amplitude. However, actual wave-particle interactions with chorus waves are non-linear process, so that it is expected that the scattering rate does not have a simple correlation with wave amplitude. In this study, we conduct a computer simulation to investigate electron scattering process through chorus-wave particle interactions with the GEMSIS-RBW code. The GEMSIS-RBW simulation calculates variations of local pitch angle and energy of each test particle by the imposed chorus wavesby calculating the Max well equations.

We calculate the trajectory of a number of electrons with various energy and pitch angles. We analyzed the electron motion in the phase space and try to discriminate the motion with the parameter ρ [Bortnick et al., 2008] that is a proxy of the ratio of the wave-induced and the background inhomogeneity effects for the momentum change of the resonant electron. We identified that the phase trapping effect decreases the precipitating flux and contribute to generation of the butterfly type pitch angle distributions. Moreover, we identified diffusion and dislocation contribute to the precipitations into the atmosphere. Multiple resonance changes the ρ of electrons from the phase trapping to dislocation, which causes rapid precipitations of electrons.

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