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Computer simulations of pitch angle scattering process for pulsating aurora

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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 depends on the wave amplitude. However, the recent studies indicate that the wave-particle interactions with chorus waves are non-linear process, so that it is expected that the scattering rate will not simply depend on the wave amplitude. In this study, we investigate chorus wave amplitude dependence of electron scattering using the GEMSIS-RBW simulation code. The GEMSIS-RBW simulation calculates variations of local pitch angle and energy by the imposed chorus waves. In this simulation, chorus bursts that consist of multi rising tone elements are imposed at the equatorial plane, and these bursts propagate along the field line with L= 4. We calculate the trajectory of a number of electrons with initial energy of 50 keV. At small wave amplitudes, time variations of pitch angle and energy of electrons are similar to diffusive process. At large wave amplitudes, both pitch angle and energy of electrons increase at the interaction with the first rising tone element, and then they decrease at interaction with the second rising tone element. We classify these variations due to wave-particle interaction into three categories; diffusion, phase-trapping and dislocation, by taking into consideration of the parameter rho. Here, the parameter rho indicates the ratio of the wave-induced and the background inhomogeneity effects for the momentum change of the resonant electron. When rho<< 1, variations of pitch angle and the energy of electrons are diffusive. When rho˜1, both pitch angle and the energy of electrons increase because of the phase trapping. When rho>> 1, both pitch angle and the energy of electrons decrease because of the dislocation. In the simulation, energy and pitch angles of some electrons with rho˜1 increase due to the phase-trapping, which cause increase of rho. During the second interaction, energy and pitch angles with large rho decreases due to dislocation, in which rho also decreases. During the third interactions, energy and pitch angles increase again due to the phase trapping. Therefore, variations of dislocation and phase trapping occur alternately due to variations of rho. We also calculated the number of precipitating electrons with various wave amplitudes. The number of precipitating electrons increase if the wave amplitude increases from 10 pT to 200 pT. However, as the wave amplitude increases more than 200 pT, the number of precipitating electrons decreases. From this simulation, the simple relationship between the wave amplitudes and precipitating flux is not always satisfied due to the non-linear wave particle interactions, and the depression of the precipitating flux is expected with the wave amplitude of more than a few hundred pT.