Study on Formation Process of Relativistic Electron Flux Through Interaction with Chorus Emissions in the Earth's Magnetosphere

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We perform test particle simulations of energetic electrons interacting with whistler-mode chorus emissions in the radiation belt. We assume a pair of chorus elements propagating northward and southward along the magnetic eld from the equator. The variation of the wave amplitude and frequency is determined by the nonlinear wave growth theory. By tracing trajectories of many particles of the same energy and pitch angle with different phases and locations along the magnetic field line, which forms a delta function in the energy and pitch angle phase space, we obtain numerical Green's function as a function of energy and pitch angle. We varied the energy and pitch angle over ranges 0:01 - 6 MeV and 10 - 90◦ respectively to obtain a set of Green's functions, showing efficient acceleration processes of the relativistic turning acceleration (RTA) and the ultra-relativistic acceleration(URA). Assuming the initial distribution function of energetic electrons (< 30 keV), we perform a convolution integral with the Green's functions numerically to find a variation of the distribution function in the phase space after the nonlinear inter-action with a pair of chorus elements. By repeating the convolution integral many times, we can follow a time evolution of the distribution function interacting with a sequence of the chorus elements occurring repeatedly in time. Rapid formation of relativistic electron ux is achieved through RTA and URA due to chorus emissions, while resonant particles in the lower energy range less than 100 keV are scattered to lower pitch angles resulting in precipitation to the polar atmosphere. In the pitch angle distribution function, we _nd a pancake type in a lower energy range (< 1:5 MeV) and a buttery type in a higher energy range (1:5 - 2:5 MeV). A long time evolution of the energy distribution function shows a plateau formation in an energy range of 1-2 MeV. The time scale of formation of relativistic electron ux is much shorter than that predicted by the quasi-linear diffusion model.