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Radiation belt electron acceleration by whistler chorus in three-dimensional magnetic field

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It is thought that whistler chorus waves accelerate radiation belt electrons efficiently. Test-particle simulation results also support the electron acceleration by whistler chorus and explain time scale of acceleration observed in the radiation belt. However, it is still unclear how the whistler chorus waves affect radiation belt electron distributions in both energy and pitch angle in three-dimensional geomagnetic field in long-time scale. To better understand the scattering processes, we study electron scattering by whistler chorus waves propagating parallel to magnetic field lines in the three-dimensional dipole magnetic field. For this study, we use three-dimensional relativistic gyrokinetic test particle simulation code including wave (whistler)-particle (electrons) interaction process which is developed under Geospace Environment Modeling System for Integrated Studies (GEMSIS) project in Solar-Terrestrial Environment Laboratory in Nagoya University. We demonstrated that a fraction of several hundred keV electrons are accelerated to a few MeV energy and some other electrons decrease their kinetic energy through interaction with whistler waves with a constant frequency in less than 1-hour, where the emission region of the chorus is localized in local times (delta LT is about 2-3 hours). We will further show the pitch angle and energy distribution of radiation belt electrons, and discuss how global distribution of the radiation belts changes through scattering by whistler chorus waves.

Keywords: whistler chorus, acceleration, radiation belt, wave-particle interaction