Formation Process of the Outer Radiation Belt through Nonlinear Interaction with Chorus Emissions Localized in Longitude

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Assuming influx of 10-30 keV electrons into the inner magnetosphere outside the plasmapause, where chorus emissions are generated in the dawn side, we model the formation process of the outer radiation belt through nonlinear wave-particle interaction with chorus emissions being generated in a localized range of longitude. Performing test particle simulations of energetic electrons interacting with a pair of chorus emissions generated at the equator, we calculate Green's functions of kinetic energy and the equatorial pitch angle to model a long-time evolution of the electron distribution function after various interactions of many chorus emissions [Omura et al., 2015]. We construct a database of the numerical Green's functions of the electron distribution for an energy range of 10 keV –6 MeV, an equatorial pitch angle range of 10 –90 degrees, and the longitudinal range 0 -10 degrees for different wave packet structures and parameters. The effective acceleration by chorus emission results in rapid formation of the outer radiation belt within a time scale less than an hour. For a case with chorus emissions localized in a narrow range of longitude, we find that the electron acceleration process takes place efficiently mostly below 4 MeV. Because extremely relativistic electrons go through the wave generation region rapidly due to grad-Bo and curvature drifts, they don't have enough interaction time to be accelerated.

Reference:
Omura, Y., Y. Miyashita, M. Yoshikawa, D. Summers, M. Hikishima, Y. Ebihara, and Y. Kubota (2015), Formation process of relativistic electron flux through interaction with chorus emissions in the Earth's inner magnetosphere, J Geophys. Res. Space Physics, 120, 9545-9562, doi: 10.1002/2015JA021563.

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