Anomalous trapping of low pitch angle electrons by coherent whistler mode waves

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Chorus emissions that are one of coherent whistler-mode waves observed in the inner magnetosphere scatter energetic electrons in pitch angle, while the pitch angle scattering is closely related to energetic electron precipitation into the atmosphere contributing to diffuse/pulsating aurora. Conventionally, it is considered that energetic electrons satisfying the cyclotron resonance condition in the energy range from a few keV to tens of keV are scattered toward the loss cone by chorus emissions. However, previous studies indicate that low pitch angle electrons tend to be scattered away from the loss cone by coherent whistler-mode waves [e.g. Li et al., 2015]. In this study, we derive the equations of the motion of electrons including the terms neglected in previous studies and theoretically reveal anomalous trapping of low pitch angle electrons scattered away from the loss cone. Furthermore, we carry out a spatially one-dimensional test particle simulation along a dipole magnetic field assuming whistler mode waves propagating along the field line with frequency sweeping. In the simulation results, we reproduce that the large amplitude chorus waves generate a bump in the pitch angle distribution. We find that particles near the loss cone are more effectively scattered away from the loss cone and the bump generated in the pitch angle distribution becomes large for larger wave amplitude.