AOGS 2006

Acceleration and Loss Mechanisms by Chorus Emissions During Magnetic Storms

YOSHIHARU OMURA[1], DANNY SUMMERS[2], YUTO KATOH[1]
[1] *Research Institute for Sustainable Humanosphere, Kyoto University*
[2] *Department of Mathematics and Statistics, Memorial University of Newfoundland*

It has been reported that the fluxes of relativistic electrons (> 1 MeV) in the inner magnetosphere (3 < L < 6) are related to magnetic storms. Typically, for many storms the electron fluxes diminish rapidly during the main phase of the storm, and subsequently, during the recovery phase of the storm, fluxes increase to beyond prestorm levels and peak about 4 days after the initiation of the storm. It is becoming apparent that electrons are accelerated to relativistic energies in the inner magnetosphere. As a result of substorm activity, electrons with energies up to 300 keV are injected near geosynchronous orbit, and these electrons seem to be accelerated by whistler mode chorus emissions which are frequently observed during geomagnetic storms. Close examination of whistler mode chorus emissions reveals that a chorus emission is a coherent monochromatic wave typically with a fast rising tone. The frequency of the emission increases rapidly along with growth of the wave amplitude. We first consider the generation mechanism of whistler-mode chorus emissions. The essential mechanism of the frequency change is critically related to the inhomogeneity of the geomagnetic field in the equatorial region. The rising tone emission is only possible when the coherent wave propagates away from the equator interacting with a sufficient flux of counter-streaming resonant electrons. We present a self-consistent particle simulation of chorus wave generation through the nonlinear interaction with highly anisotropicenergentic electrons injected to theinnter magnetosphere. Depletion of the resonant trapped electrons from the wave phase spaceresults in formation of an electromagnetic electron hole, which give riseto a transverse resonant current causing both wave growth and frequency increase. The wave growth of a rising tone can elongate the nonlinear trapping zone, which works as an effective wave train that guides a fraction of the resonant electrons moving toward the equator. We also present test particle simulations where we solve the relativistic equations of motion for high energy electrons under the action of the electromagnetic field of a coherent whistler-mode wave and the assumed dipole geomagnetic field. Through the trapping of energetic electrons by a coherent chorus emission, a fraction of the resonant electrons are accelerated, while the majority of the resonantelectrons are diffused to lower pitch angles, being lost from theradiation belt.