Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM07-09 Room:304 Time:May 22 11:40-11:55

Nonlinear spatio-temporal evolution of magnetospheric whistler-mode waves

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Radiation belt dynamics play an important role in space weather science since,for instance,highly energetic radiation belt electrons generated during magnetic storms are potentially hazardous to orbiting spacecraft. In turn, whistler-mode chorus waves are an important ingredient in electron radiation belt physics since chorus waves are considered a prime candidate for generating relativistic electrons in Earth's inner magnetosphere. Whistler-mode chorus waves are generated at the magnetic equator,and here we examine their nonlinear spatio-temporal evolution along a magnetic field line. We solve numerically the wave evolution equations off the equator for the wave magnetic field and wave frequency,subject to boundary conditions at the equator comprising model "chorus equations" that define the generation of a seed chorus element. We assume that the electron distribution function evolves adiabatically off the equator. We find that the adiabatic variation of the distribution function plays an essential role

in the saturation process of nonlinear wave growth. Our study is valuable because wave saturation and dispersion effects cannot currently be monitored by particle simulations. In future extensions of this study,electron energization by wave trapping and associated wave energy loss should be included.

Keywords: nonlinear whistler-mode waves, magnetospheric chorus