2nd Asia-Pacific Conference on Plasma Physics, 12-17,11.2018, Kanazawa, Japan

Dynamic variation of Earth's outer radiation belt due to whistler-mode chorus EMIC waves

Yoshiharu Omura[1]

[1] Research Institute for Sustainable Humanosphere, Kyoto University

omura@rish.kyoto-u.ac.jp

During space weather events, energetic particles are injected from the magnetotail to the inner magnetosphere, and various kinds of wave-particle interactions take place. Whistler-mode chorus emissions are one of the most important waves for the dynamics of relativistic electrons forming the outer radiation belt. Chorus emissions are excited via interaction with 10 – 100 keV electrons outside the plasmasphere, and they can accelerate a fraction of resonant electrons to MeV energy through nonlinear wave trapping mechanisms called relativistic turning acceleration (RTA) and ultra-relativistic acceleration (URA) [1, 2, 3]. The time scale of acceleration is much shorter than that predicted by the quasi-linear theory. Effective acceleration of electrons through Landau resonance with obliquely propagating chorus emissions can also take place [4]. Another kind of waves important for the radiation belt dynamics is EMIC rising-tone emissions excited by nonlinear interaction with 10 – 100 keV protons both inside and outside the plasmasphere. The EMIC emissions can interact with relativistic electrons (> 0.3 MeV) and scatter them to lower pitch angles efficiently by nonlinear wave trapping, resulting in significant precipitation of radiation belt electrons as well as energetic protons [5]. In these nonlinear wave-particle interactions, the rising-tone frequencies of the emissions and the gradient of the magnetic field play essential roles in particle acceleration and pitch angle scattering. We review recent development of nonlinear theory and simulations that can describe dynamic nature of the radiation belts under intense space weather events.

References:

1. Kubota, Y., and Y. Omura, Nonlinear dynamics of radiation belt electrons interacting with chorus emissions localized in longitude, J. Geophys. Res. Space Physics, doi:10.1029/2017JA0250504, 2018.
2. Omura, Y. et al., 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, 2015.
3. Foster, J.C., et al., Van Allen Probes Observations of Prompt MeV Radiation Belt Electron Acceleration in Non-Linear Interactions with VLF Chorus, J. Goephy. Res. Space Physics, 121, 324-339, 2017.
4. Hsieh, Y.-K., and Y. Omura, Nonlinear dynamics of electrons interacting with oblique whistler mode chorus in the magnetosphere, J. Geophys. Res. Space Physics, 122, 675–694, doi:10.1002/2016JA023255, 2017.
5. Kubota, Y., and Y. Omura, Rapid precipitation of radiation belt electrons induced by EMIC rising tone emissions localized in longitude inside and outside the plasmapause, J. Geophys. Res. Space Physics, 122, 293–309, doi:10.1002/2016JA023267, 2017.