URSI GASS 2023, Sapporo, Japan, 19 – 26 August 2023

Electron Precipitation Processes due to Oblique Chorus Emissions

Yikai Hsieh* (1), and Yoshiharu Omura (1)
(1) Research Institute for Sustainable Humanosphere, Kyoto University, Japan e-mail: ayikaih@gmail.com; omura@ rish.kyoto-u.ac.jp

Nonlinear wave-particle interaction between whistler mode chorus emissions and energetic electrons affects energetic electron distribution in the Earth's inner magnetic field and radiation belt dynamics. Electrons can be scattered by whistler-mode chorus emissions and precipitate into the Earth's upper atmosphere. Especially nonlinear interactions cause rapid energetic electron precipitation. This study aims to clarify precipitation processes via different n-th cyclotron resonances of oblique chorus wave-particle interactions. We apply 12 chorus wave models with 4 various wave normal angle sets (the maximum wave normal angles are 0, 20, 60, and 90% of resonance cone angles) and 3 wave amplitude sets (the maximum wave magnetic fields are 2,1 nT, 300 pT, and 50 pT) at L = 4.5. We use Green's function method [1,2] to calculate the possibility of electrons being precipitated by the waves. The simulation results show that in the 2.1 nT cases, all the oblique cases result in more electron precipitation. The very oblique chorus emissions contribute to the most electron precipitation rates, especially at 50–100 keV. Checking the highest initial equatorial pitch angles of the precipitated electrons, we find that the very oblique chorus waves can precipitate electrons from > 45 degrees. In contrast, the other chorus waves can only precipitate electrons from < 30 degrees. Then, we derive the pitch angle scattering rates and verify the precipitation processes by n-th cyclotron resonances with oblique chorus emissions. The effective precipitation of oblique chorus emissions is due to strong nonlinear scattering of the n = 2 cyclotron resonances and nonlinear trapping of the n<1 resonances.

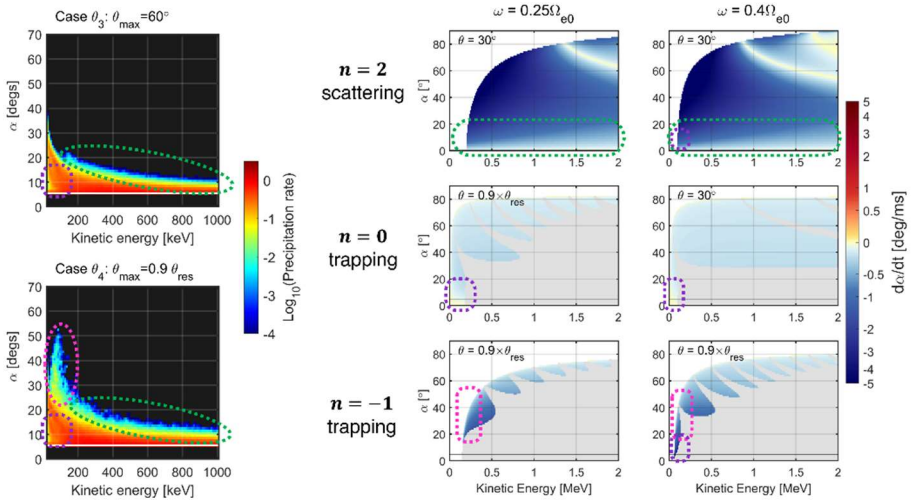

Figure 1. (Left panel) Energetic electron precipitation rates of the 2 oblique chorus cases. (Right panel) Negative pitch angle scattering rates, which directly connect to electron precipitation. The dotted ovals point out the electron precipitation and the related nonlinear processes.

References

[1] Y. Kubota, and Y. Omura, (2018) "Nonlinear dynamics of radiation belt electrons interacting with chorus emissions localized in longitude," *Journal of Geophysical Research: Space Physics*, **123**. doi:10.1029/2017JA025050.

[2] Y-K. Hsieh, and Y. Omura, "Precipitation rates of electrons interacting with lower-band chorus emissions in the inner magnetosphere," *Submitted to Journal of Geophysical Research: Space Physics.*