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Pitch Angle Scattering by Electrostatic Electron Cyclotron Harmonic Waves Based on Arase Observations

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Extended Abstract

Pulsating auroras (PsAs) are thought to be generated by precipitating electrons scattered by lower-band chorus (LBC) waves near the magnetic equator through cyclotron resonance. Recently, it was reported that LBC wave intensity had correlation with electron flux inside a loss cone and pulsating auroral intensity based on coordinated Arase satellite and ground-based optical observations. In addition, electrostatic electron cyclotron harmonic (ECH) waves can also interact with magnetospheric electrons and scatter their pitch angle theoretically. It was reported that not only LBC but also ECH wave intensity had correlation with the PsA intensity [1]. On the other hand, correlations between ECH wave intensity and loss cone electron flux have not been reported yet. Therefore, this study aims to reveal whether wave-particle interactions between ECH waves and electrons occur or not at the magnetic equator.

To verify whether ECH waves scatter electrons into a loss cone or not, we compared ECH wave intensity with electron flux inside the loss cone obtained with low-energy particle experiments-electron analyzer (LEP-e) onboard the Arase satellite. The cross-correlation coefficient between ECH intensity and loss cone electron flux at the energy of ~5 keV was statistically significant while that between LBC intensity and loss cone electron flux at the same energy was not. We calculated pitch angle diffusion coefficients of ECH waves and found that the diffusion coefficient of 5-keV electrons is 10 times larger than that of other energies where cross-correlation coefficients were small when the wave normal angle is 87.0 degree if we can assume the electron temperature is 1 eV. The linear growth rate of ECH waves is also large when the wave normal angle and electron temperature satisfy this condition. The electron flux which has correlation with ECH wave intensity can cause the 557.7-nm auroral emission whose column emission rate is four kilo-Rayleigh according to model calculation.

Unfortunately, we could not compare ECH wave intensity and loss cone flux with pulsating auroral intensity at the Arase's footprint due to contamination of sunlight. However, this study suggests that ECH waves scatter a few keV electrons into a loss cone which contribute to cause auroral emission.

This study has been already published [2].

References

[1] M. Fukizawa, T. Sakanoi, Y. Miyoshi, K. Hosokawa, K. Shiokawa, and Y. Katoh, "Electrostatic Electron Cyclotron Harmonic Waves as a Candidate to Cause Pulsating Auroras," *Geophys. Res. Lett.*, vol. 45, no. 12, pp. 661–668, 2018, doi: 10.1029/2018GL080145.

[2] M. Fukizawa *et al.*, "Pitch-angle scattering of inner magnetospheric electrons caused by ECH waves obtained with the Arase satellite," *Geophys. Res. Lett.*, pp. 0–3, 2020, doi: 10.1029/2020gl089926.