R006-17
B 会場 ： 11/27　AM1（9:15-10:45）
10:00〜10:15:00

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ULF-Modulated Whistler Mode Wave and Electron Precipitation Observed by EISCAT and Arase

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We report analysis results of ULF waves observed by the Arase satellite, whistler-mode waves modulated by ULF oscillations, and precipitating electrons with ULF-period modulation observed by EISCAT during a conjugate event. Although ULF-period modulations of whistler-mode waves and precipitating electrons have been reported previously, conjugate observations have not yet been presented. Whistler-mode waves are thought to play an important role in the acceleration and loss processes of high-energy particles in the inner magnetosphere, and have been actively discussed in recent years. Recent studies also suggest that ULF waves influence the generation and propagation of whistler-mode waves, leading to phenomena such as whistler-mode waves enhanced at ULF periods and ducted propagation of whistler-mode waves guided by ULF waves. In this study, we investigate whether the flux of precipitating electrons is modulated at the ULF period through whistler-mode waves modulated by ULF oscillations.

The target event occurred between 02:00 and 03:00 UT on 23 October 2024. During this interval, the Arase satellite was traversing the dawn sector at magnetic local time 05:00 and L = 7.2, where it observed Pc5-band ULF waves with a period of about 300 s, as well as lower-band whistler-mode chorus waves whose intensity varied in synchrony with the ULF period. Simultaneously, electron fluxes in the 12 − 100 keV range exhibited periodic variations with the same timescale. At the same time, the EISCAT radar, located near the magnetic footprint of Arase, detected periodic enhancements of ionospheric electron density above 60 km altitude. This indicates intermittent precipitation of electrons with energies up to ˜100 keV from the magnetosphere into the ionosphere. Data analysis revealed a strong positive correlation between the intensity of whistler-mode waves observed by Arase and the electron density variations observed by EISCAT.

The observed electron precipitation is considered to be caused by pitch angle scattering due to whistler-mode waves. For whistler-mode waves to resonate with electrons in the observed energy range, they need to propagate to high latitudes along a field line at least the magnetic latitude of 18 degrees approximately. While the resonance energy near the loss cone is below 10 keV at the magnetic equator, it increases to several hundred keV at the observed latitude. To discuss the resonance energy in more detail, we perform ray-tracing calculations to evaluate the propagation angle and location of the waves along their ducted paths, and calculate the resonance energy at each point. These results are then directly compared with the energy characteristics of precipitating electrons observed by EISCAT. Furthermore, we use ground magnetometer data from IMAGE stations to examine the spatial extent of this event. This study contributes to advancing our understanding of wave − wave and wave − particle interactions among ULF waves, whistler-mode waves, and high-energy electrons.