Observational evidence for rapid loss of relativistic electrons by EMIC waves: Arase, Van Allen Probes, and the PWING observatory collaboration

*栗田 怜[1]、三好 由純[1]、塩川 和夫[1]、東尾 奈々[2]、三谷 烈史[3]、高島 健[3]、松岡 彩子[3]、篠原 育[3]
*Satoshi Kurita[1], Yoshizumi Miyoshi[1], Kazuo Shiokawa[1], Nana Higashio[2], Takefumi Mitani[3], Takeshi Takashima[3], Ayako Matsuoka[3], Iku Shinohara[3]

1. 名古屋大学宇宙地球環境研究所、2. 宇宙航空研究開発機構、3. 宇宙航空研究開発機構　宇宙科学研究所
1. Institute for Space-Earth Environmental Research, Nagoya University, 2. Japan Aerospace Exploration Agency, 3. Japan Aerospace Exploration Agency, Institute for Space and Astronautical Science

EMIC waves are generated by temperature anisotropy of energetic ions near the magnetic equator and satellite observations show that the waves tend to be observed on the dusk side and noon side magnetosphere. EMIC waves can propagate from the magnetosphere to the ground and they are observed by ground-based magnetometers as Pc1 pulsation. It has been pointed out that EMIC waves can resonate with relativistic electrons through anomalous cyclotron resonance, and cause strong pitch angle scattering of radiation belt electrons. It has been considered that precipitation loss of relativistic electrons by pitch angle scattering induced by EMIC waves is an important loss mechanism of radiation belt electrons.

We report on the observation of relativistic electron loss observed by the Arase satellite on the dawn side magnetosphere during a geomagnetic disturbance, which was related to an EMIC wave activity. During the event, the EMIC wave activity in conjunction with the relativistic electron loss was identified from observation by the ground-based induction magnetometer array deployed by the PWING project. The magnetometer array observation reveals that EMIC waves were distributed in the wide magnetic local time range from the dusk to midnight sector.

Just before the EMIC wave event, Van Allen Probe-A traversed the outer radiation belt, and Arase passed the same L-shell range just after the activation of EMIC waves. Measurements of relativistic electron flux by Arase and Van Allen Probe-A showed that ~2.5 MeV electron flux at L=4.75 decreased by a factor of 5 within 15 minutes, suggesting that loss time scale for relativistic electrons was comparable to their drift period (5-10 minutes). Loss time scale for MeV electrons by EMIC wave-induced pitch angle scattering is theoretically estimated based on the quasi-linear diffusion theory, and we find that loss by EMIC waves is rapid enough to explain observed flux decrease of relativistic electrons.
While we reveal that EMIC waves can cause rapid precipitation loss of relativistic electrons, the Arase observation shows that significant electrons are survived where EMIC waves were not present. It is suggested that loss by EMIC waves alone cannot fully explain dropout of radiation belt electrons in wide L-shell range.

キーワード：ERG/あらせ、Van Allen Probes、EMIC waves、radiation belt
Keywords: ERG/Arase, Van Allen Probes, EMIC waves, radiation belt