



**Multipoint Measurement of Latitudinally Propagating EMIC Waves  
by Arase, Van Allen Probe A, PWING and CARISMA**

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Electromagnetic ion cyclotron (EMIC) waves are an important plasma waves that control energetic ion and relativistic electron precipitations in the terrestrial inner magnetosphere. We successfully measured latitudinally propagating EMIC waves using multipoint measurement data observed by Japanese Arase, U.S. Van Allen Probes, the PWING ground based magnetometer, and the CARISMA magnetometer array during a field-line conjunction event on 18 April 2019. We analyzed the wave data obtained by the aforementioned spacecraft and ground stations, and found that the appearance of fine structures in the observed EMIC waves clearly coincided with the ambient electron density irregularities in the magnetosphere, which can cause periodic wave growth and waveguiding on their propagation. By comparing the footprints and wave spectra of both satellites, we concluded that the observed EMIC wave activity was spatially localized (185 km latitudinal width at an auroral altitude of 100 km) and the spatial scale of the wave propagation duct was smaller (<80 km) than the EMIC wave activity region. The estimated latitudinal width of the propagation duct is consistent with a comprehensive study of the isolated proton auroras (IPAs) by Sakaguchi et al. (2015), suggesting that IPAs are a visual manifest of wave-particle interaction regions. We also found that the clear heating of protons with local pitch-angles of approximately 30 and 150 degrees was detected by Arase concurrently with the appearance of fine-structured EMIC waves. This thermal ion distribution was also observed in the equatorial region by ECT/HOPE aboard Van Allen Probe A. Additionally, the thermal He<sup>+</sup> heating was observed coincident with fine-structured EMIC waves.

1. Sakaguchi, K., K. Shiokawa, Y. Miyoshi and M. Connors (2015), Isolated Proton Auroras and Pc1/EMIC Waves at Subauroral Latitudes, *In Auroral Dynamics and Space Weather* (eds Y. Zhang and L.J. Paxton). <https://doi.org/10.1002/9781118978719.ch5>