# Examining Minimum Cyclotron Resonant Electron Energy of EMIC Waves with MMS

*Si Liu[1]

1. Changsha University of Science and Technology

Electromagnetic ion cyclotron (EMIC) waves can be in cyclotron resonance with relativistic electrons, causing relativistic electron precipitation. The four ideal Magnetospheric Multiscale (MMS) spacecraft provide great opportunity to directly calculate the wave vector ***k*** of EMIC waves by phase differencing technique and hence estimate the minimum resonant energy by the resonance condition. Deriving a simplified analytic solution, we find that the phase differencing method can still provide an estimate of the dominant wave number when a finite wave number spread or a finite frequency spread is present. Numerical calculations indicate that quasi-antiparallel propagation dominates the EMIC event on 20 November 2015, which is consistent with the FFT spectral analysis results. We also find that obtained wave vectors, roughly agreeing with the validity of cold plasma theory, might significantly vary from wave packet to wave packet. Moreover, minimum resonant electron energies gradually increase from 0.5 MeV to tens of MeV with a decreasing parallel componet of ***k***. Current results provide evidence that EMIC waves can be in resonance with the electrons of energies down to hundreds of keV. It further demonstrates that EMIC waves in a narrow frequency band can effectively interact with the relativistic electrons with a broad energy range.

Keywords: EMIC waves, minimum resonant electron energy, wave vector, phase differencing