



## Electromagnetic Ion Cyclotron Waves Observed by THEMIS spacecraft in magnetosphere

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Electromagnetic Ion Cyclotron (EMIC) Waves play important role to study the dynamics of magnetosphere. Acceleration and the loss phenomenon in the magnetosphere like ring current charged particle acceleration, relativistic electron dropouts from the radiation belts and dumping into the lower altitudes due to the pitch angle scattering are caused by EMIC waves mainly. These waves have the capability to scatter MeV range of energetic particles. These waves are generated mostly by proton temperature anisotropy ( $T_{\perp} > T_{\parallel}$ ) and seen at mainly dusk-side plasmapause (around  $11^{\circ} - 15^{\circ}$  MLAT). Though the equatorial region is favorable for generation of EMIC waves, there are signatures of EMIC wave generation where the ambient magnetic field is low. These waves are in the range of Pc1 and Pc2 (0.1-5 Hz). EMICs are generated with left handed polarization (LH wave) and propagate almost parallel to the background magnetic field. When they propagate out they make different wave normal angles and thus LH and RH waves couple. At a certain frequency called “cross-over frequency” change of polarization happens. Depending upon the background ion species like  $H^{+}$ ,  $He^{+}$ ,  $O^{+}$ , we see three bands in EMIC –Proton band (below proton gyro freq.  $\Omega_H$ ), helium band (below  $\Omega_{He}$ ) and Oxygen band (below  $\Omega_O$ ). We have analyzed THEMIS magnetic field data for three different events to produce dynamics spectra, where rising (frequency increases for a certain time period), falling and constant frequency bands in EMIC can be seen. There are studies by Omura et.al 2010, 2017 for rising and falling tone EMIC bands, where it is shown that the difference between the rising and falling tone generation mechanism depend upon the particle population in wave packets. In the velocity phase space if the electron density is increased then ‘electron hill’ forms, which is generated by the non-linear interactions with the falling tone emissions. Whereas the deficiency in electron population termed as ‘electron hole’ is generated by the emissions of rising tone. But, simultaneous rising and falling tone, which we name as ‘Bifurcation’ phenomena, are also seen in the magnetosphere. It is first observational article for this kind of finding and we believe that change in some plasma parameters can lead to this local bifurcation. Stable points become unstable at the bifurcation point and branches develop. Correlation between rising and falling part and also individually Minimum Variance Analysis (MVA) is studied. The ellipticity, polarization and the wave normal angles are obtained by using MVA. It is seen that a single cycles change polarizations from right to left and vice-versa. We have also analyzed the correlations between rising and falling tones and the individual rotated magnetic components which provide information about the scattering efficiency of EMIC waves.