# Properties of Quasi-periodical Emission of Electromagnetic Ion Cyclotron Waves

Muhammad Shahid[1,2], M. Fraz Bashir[1], Anton Artemyev[1], Xiao-Jia Zhang[1], Vassilis Angelopoulos[1], Ghulam Murtaza[2]

1. Department of Earth, Planetary, and Space Sciences (EPSS) University of California, Los Angeles, USA
2. Salam Chair in Physics, GC University, Lahore, Pakistan, Email: shahidm689@yahoo.com

EMIC Wave Generation Mechanisms

1. Night-side injections of hot ions from the plasma sheet 2. Day-side magnetosphere compression by solar wind

3. An alternate mechanism for the generation of EMIC wave population at the inner magnetosphere by compressional ULF-waves using THEMIS spacecraft observations.
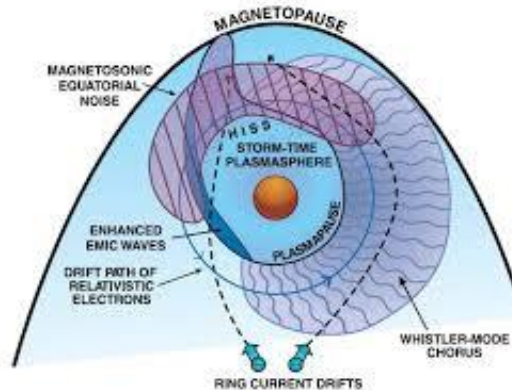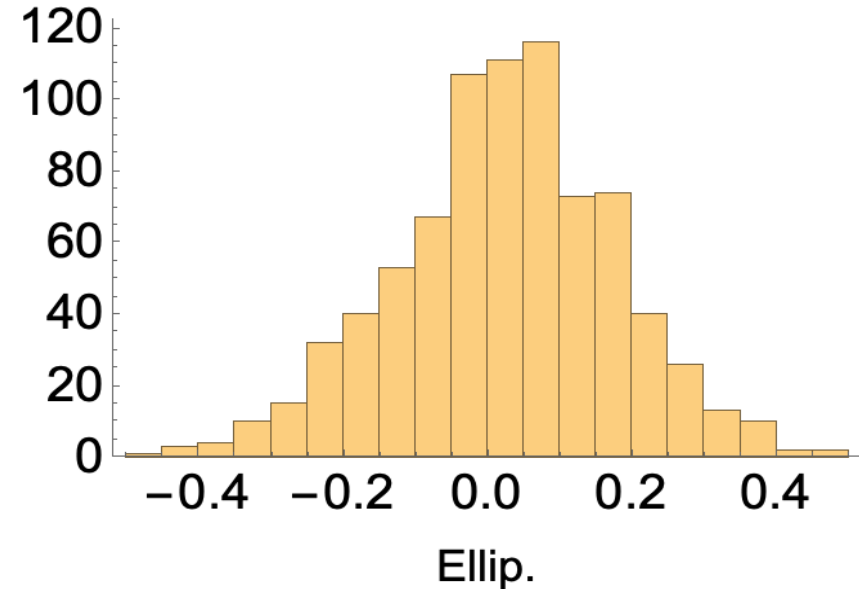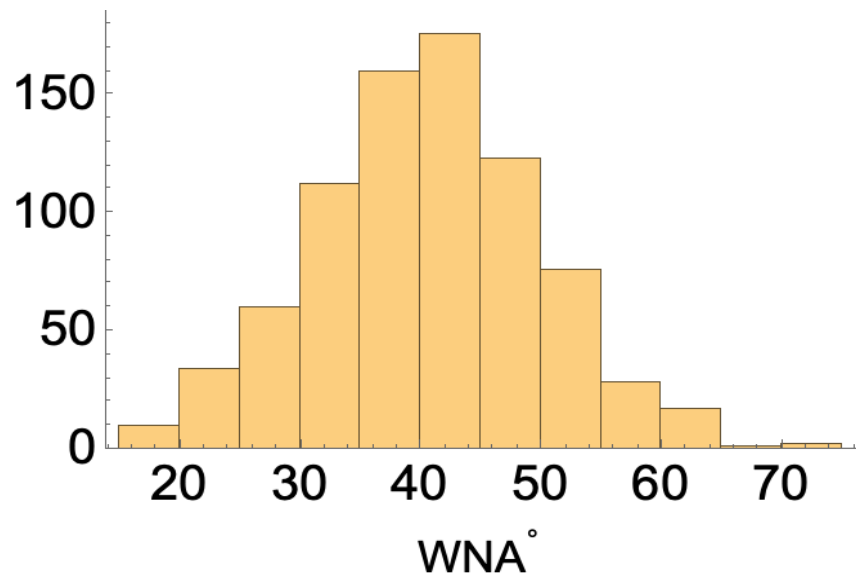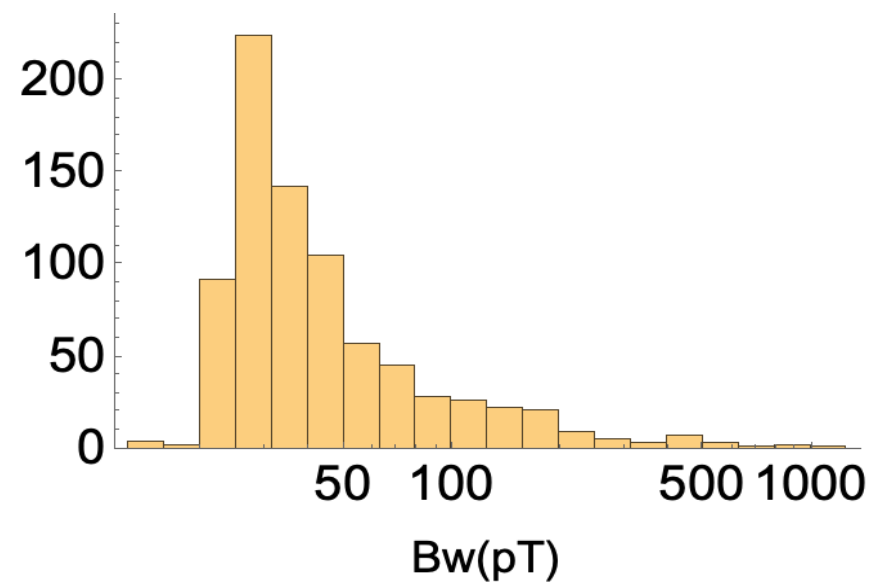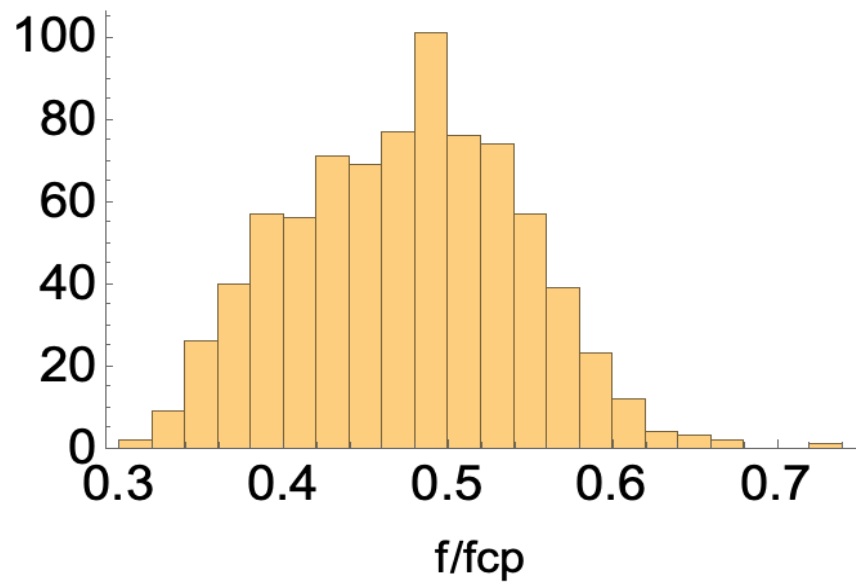
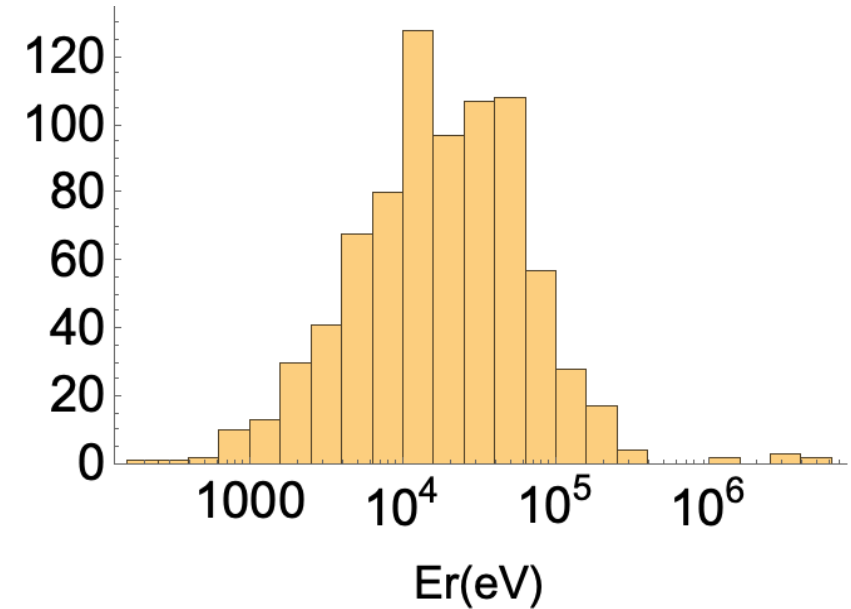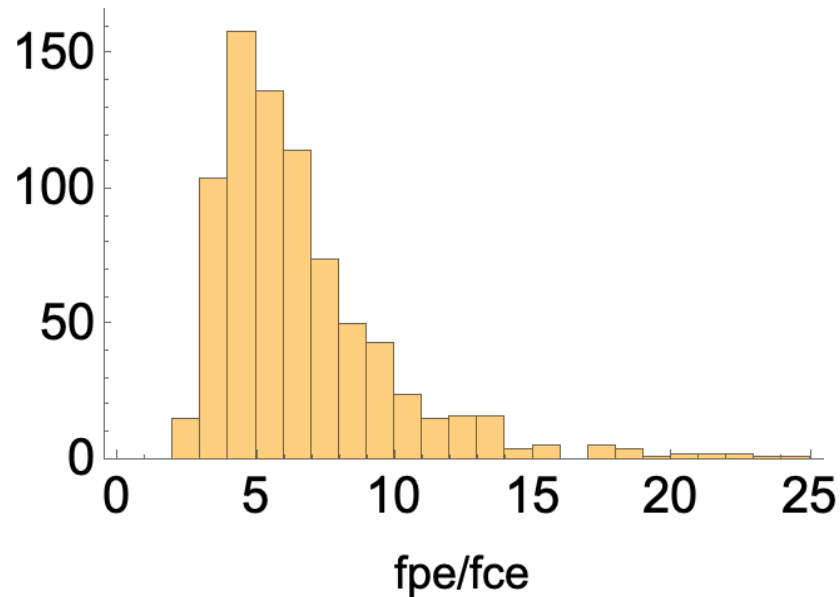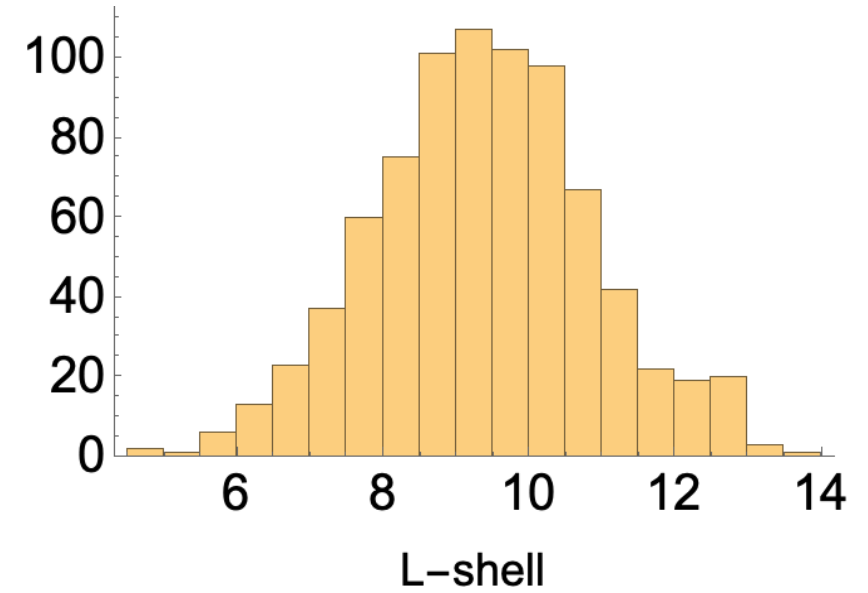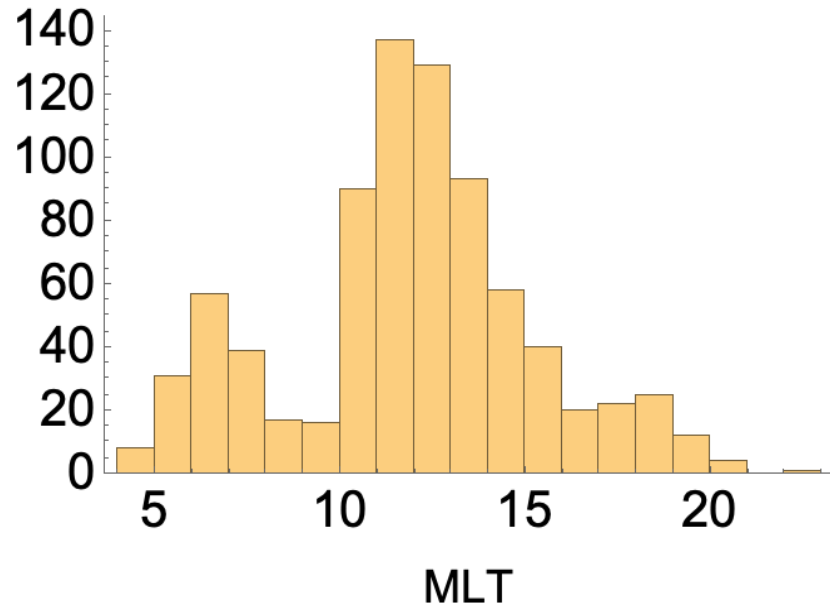# Examples of THEMIS Observations of Modulated EMIC Waves
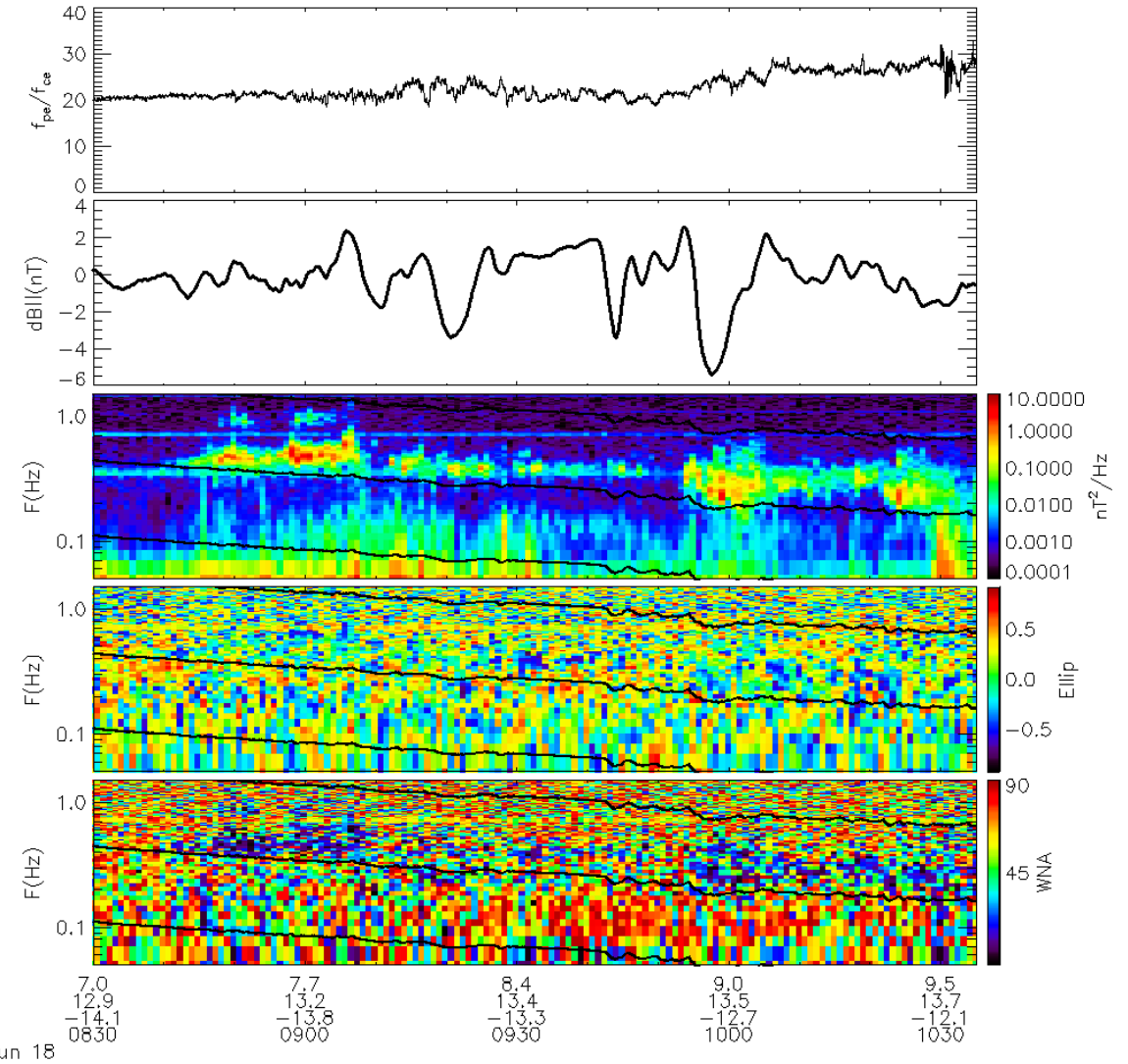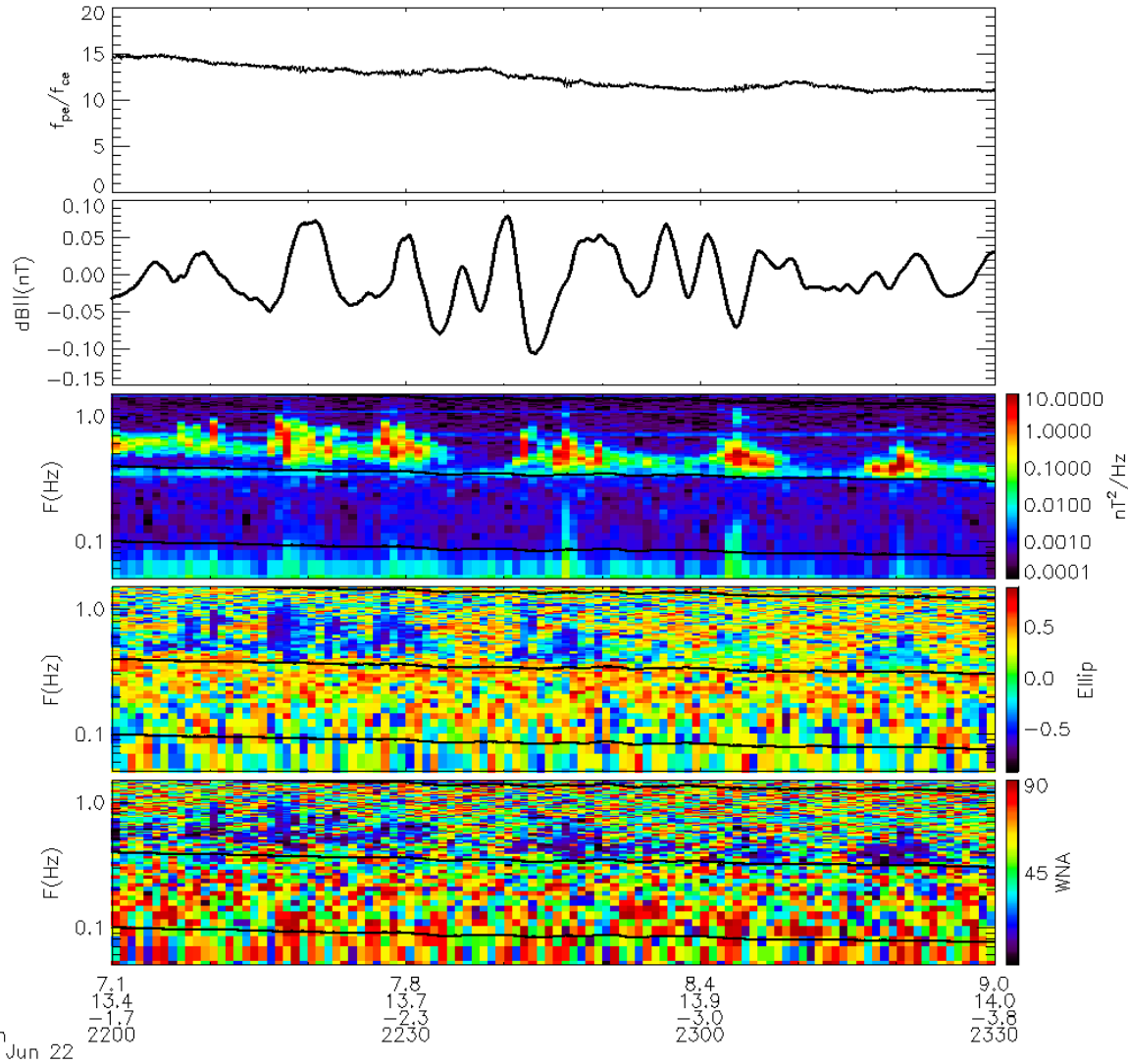
- 13 Months Data (Jan 2017-Jan 2018) from THEMIS E
- Proton band EMIC waves events = 200
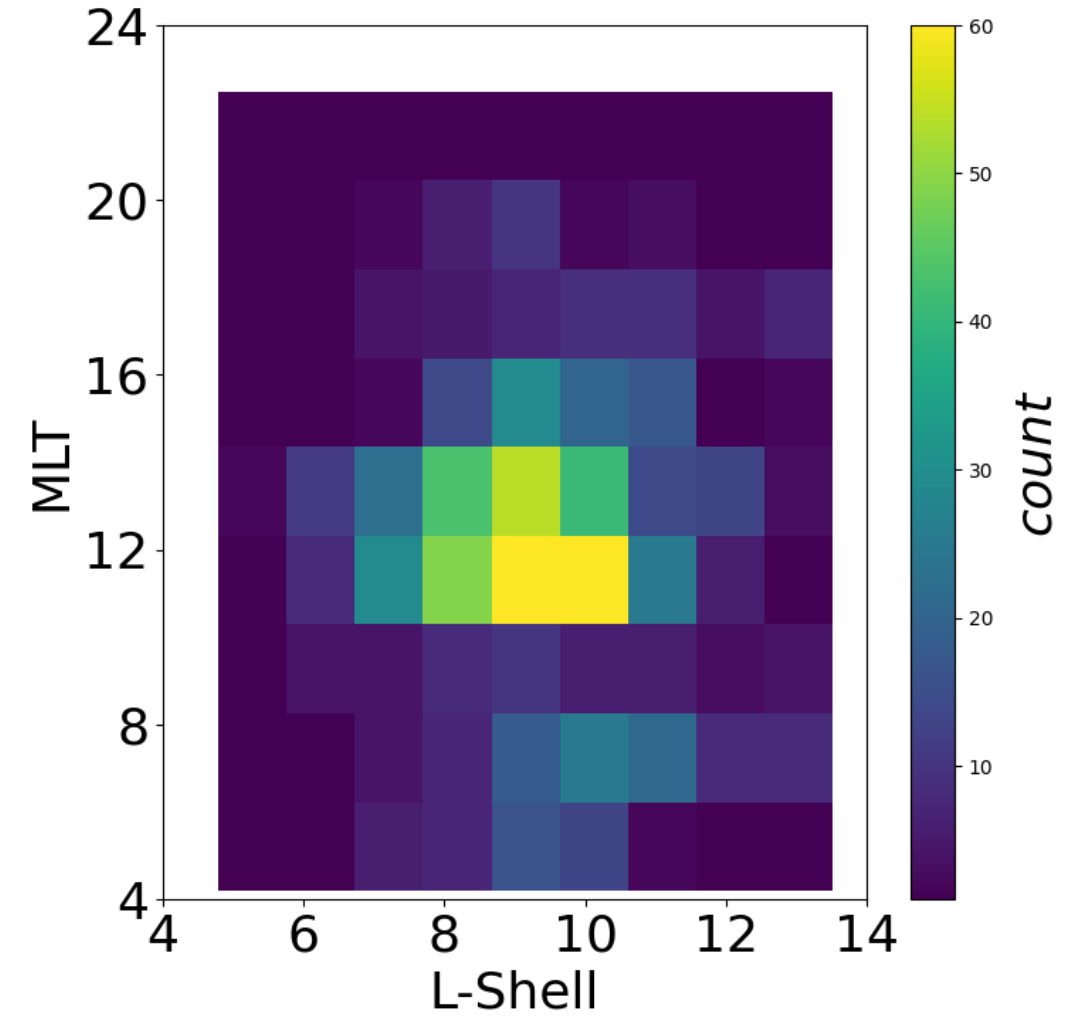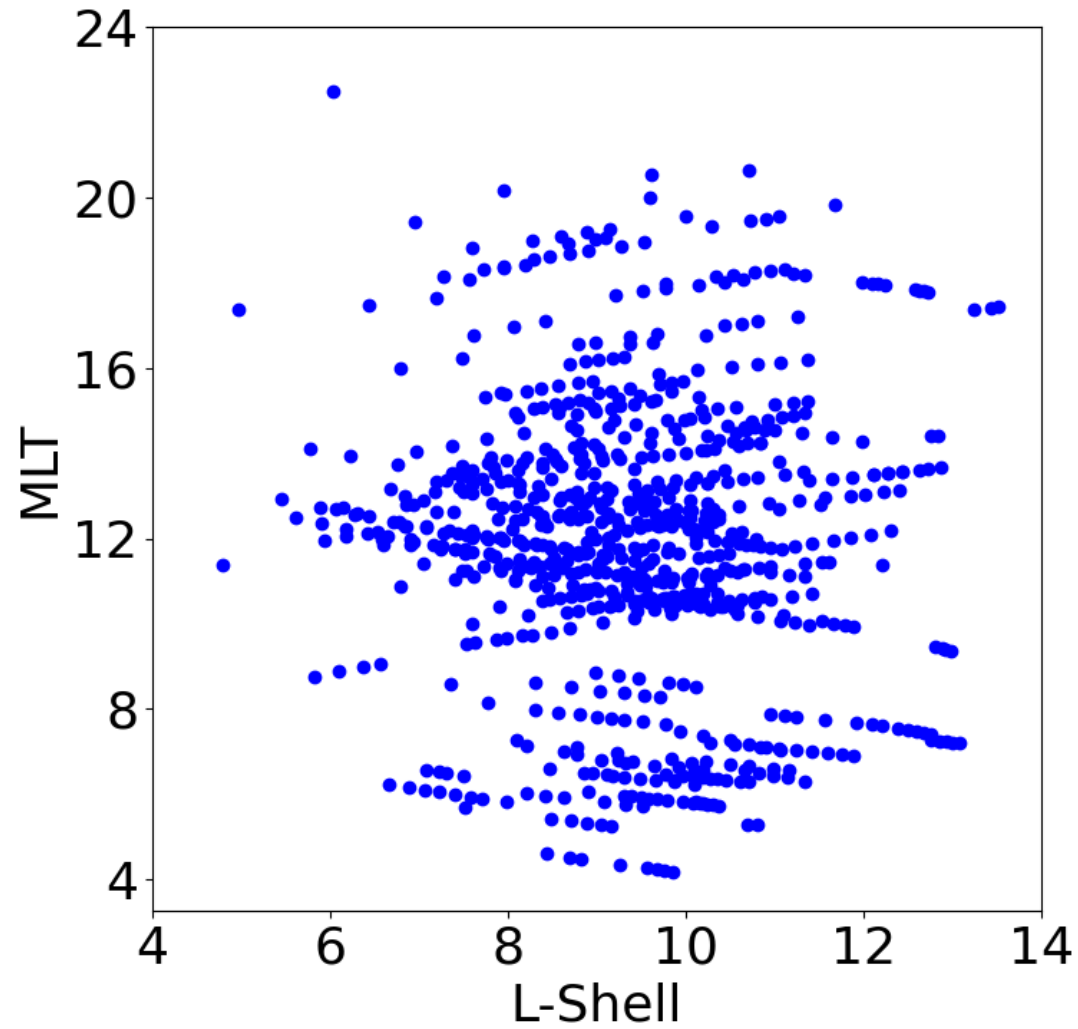- **Sub-intervals where EMIC waves are correlated with ULF waves = 800**

Statistical Properties of ULF modulated EMIC Waves Properties

Statistical Properties of EMIC Waves Location and Plasma Parameters

Statistical Properties of EMIC Waves as Function of L-MLT

Conclusion

- A statistics of H-band EMIC waves is collected associated with strong compressional ULF waves for 13 months of data from THEMIS-E.

- We observed 200 events of proton band EMIC waves with 800 sub-intervals when ULF waves is associated with EMIC waves

- These statistics show that EMIC waves observed at higher L-shells with widespread in MLT with wave intensity ~30-100 pT, f/fcp ~ 0.4-0.6 and quasi-parallel WNA (30^0-45^0).

- The fpe/fce ratio lies between 5-10 and ion resonant energy ~10keV..

- Our future plan is to increase the statistics for more years of date and develop an empirical model for ULF-modulated EMIC wave characteristics which will allow us to include such type of EMIC emissions into simulations of the radiation belt dynamics and into models of nonlinear wave-particle interactions.

Thank You