

## High Altitude Echoes of the Inner Plasmasphere: Theory and Observations

This talk will focus on a recently observed phenomenon in the early morning topside ionosphere consisting of high altitude coherent echoes in the range of 1000 - 2200 km (Derghazarian et al. 2021). The echoes are distinct from Equatorial Spread-F (ESF) in terms of their altitude of occurrence, layered morphology and the presence of spectral sidebands at the lower hybrid (LH) frequency in their backscatter spectra. These sidebands are associated with electrostatic LH waves and are measured at greater intensities at higher altitudes and lower densities present during low solar flux conditions. The echoes were observed in data obtained from recent high-altitude experiments using Jicamarca's 50MHz ( $\lambda = 3$  m) 1 MW VHF transmitter, as well as by examining archival long pulse experiment datasets from 2010 onwards during low to medium solar flux conditions. More recent experiments carried out at high solar flux and using a shorter wavelength radar (AMISR-14 where  $\lambda = 20$  cm) will also be presented.

In addition, we examine the origin of lower hybrid waves in the echoes by presenting numerical simulation results that prove the feasibility of an inverse energy cascade along with the lower hybrid drift instability (LHDI) in explaining the presence of the 3 m lower hybrid waves measured by the Jicamarca VHF radar.

The simulation results indicate that the inverse cascade is a feasible process when appropriate background densities and magnetic fields are present. Several plots will be presented which include spectrograms, wavenumber-time plots and two dimensional spatial and spectral plots that show evolving structures. The relevance of the numerical simulation results to the experimental observations will be described in detail. Lastly, we present preliminary Van Allen Probe satellite data of lower hybrid waves in the topside equatorial and nighttime sector and explain their relevance to this study.



**Thursday, February 1st**

4:00-5:00 p.m.

725 Commonwealth Ave | Room 502

**Sevag Derghazarian**

Massachusetts Institute of Technology