

Using the LWA Radio Telescope to Observe the Ionosphere

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Earth's ionosphere consists of a highly variable plasma that disrupts radio communication, navigation, and science such as radio astronomy. At mid-latitudes, traveling ionospheric disturbances (TIDs) and Sporadic E play a large role in the short term (minutes to hours) variability. This variability can be characterized and monitored using a variety of techniques including high frequency (HF; 3-30 MHz) sounding.

Traditionally, HF sounding is done with a single transmitter and a handful of receiving antennas. With just a few antennas, imaging is possible but lacks resolution and fidelity. However, new opportunities have arisen due to the recent advent of many element radio telescopes, such as the Long Wavelength Array at Sevilleta (LWA-SV). With 256, pseudo randomly spaced dipole elements, LWA-SV has unmatched imaging sensitivity down to 3 MHz. LWA-SV is capable of leveraging existing HF transmitters, such as the DPS4D Digisonde at Kirtland AFB and WWV in Boulder, CO, as well as natural emitters, such as lightning and celestial sources to get high temporal and spatial resolution images of ionospheric variability.

In my talk I will discuss how LWA-SV is used as an ionospheric instrument and highlight some science results. Specifically I will discuss recent/ongoing work in which a DPS4D digisonde is paired with LWA-SV as an HF receiver. While long integrations can be used to characterize TIDs, short time-scale integrations down to 20 milliseconds can be used to measure the effects of scintillation. These effects, which show structure down to sub-second timescales, have implications for both HF radar and low frequency radio astronomy.