Searching for Low-Frequency Radio Emissions from Nearby Stars and Exoplanets

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Detections of low-frequency (< 10 GHz) radio emissions can help characterize the radiation environments around nearby stellar systems. Planetary origins of the emission, produced primarily through charged particles radiating via the electron cyclotron maser [ECM] instability, correlate directly with the local magnetic field strength of the emitting body. Recent radio detections of active Brown Dwarfs have begun to constrain the observational and magnetic properties of extrasolar, near planetary-mass emitters of ECM. And additional non-detections of lower-mass objects of interest continue to refine the upper limits on the typical emission from exoplanetary systems. Stellar radiation environments, as well as exoplanetary magnetic fields, would play important roles in the elusive question of habitability.

In our study, we analyzed a variety of sample populations of interest using data from 3 low-frequency radio sky surveys to look for evidence of stellar and/or planetary emissions. We utilized archival data from the 74 MHz VLA Low-frequency Sky Survey redux [VLSSr], the 150 MHz TIFR GMRT Sky Survey [TGSS], and the 1.4 GHz NRAO VLA Sky Survey [NVSS] to look at the positions of exoplanetary systems within 300 parsecs, young stellar objects in the Taurus and Upper Sco star-forming regions, and stars within a few tens of parsecs in distance. We investigated direct, positional detections as well as stacked averages of the imaged data, deriving their statistical significance relative to their respective sky survey. Evidence of over a dozen tentative detections were made, which will require follow-up observations, and we also present upper limits on the emission fluxes from the ensemble-averaged samples for each surveyed frequency for consideration by the community.