Using Radio Emission from Planetary-Mass Brown Dwarfs to Understand Planetary Magnetism

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Magnetic fields play a pervasive role in stellar and planetary systems, impacting interior structure, atmospheric evolution, and habitability. Empirical studies of fully convective dynamos are particularly important for characterizing the magnetic fields of planetary systems and cool substellar objects because such dynamos are ubiquitous in low mass stars, brown dwarfs, gas giant planets, and even small rocky planets. Observations of coherent radio pulses at GHz frequencies provide the only direct measurements of magnetic fields on L and later type brown dwarfs, complementing optical and infrared spectropolarimetric methods used to observe M dwarf magnetic fields. Radio observations of brown dwarfs are especially valuable because these stellar/gas giant intermediaries can probe planetary characteristics, and their observability has made them attractive exoplanet analogs for studying planet atmospheres, clouds, evolution, and now, magnetic fields and dynamo mechanisms.

Until we can measure fields on exoplanets, the best tests of exoplanetary convective dynamos are young planetary-mass brown dwarfs. Recent refinements of young moving group membership and the resulting advances in the age-dating and mass-determination of cool brown dwarfs provide a new avenue for probing dynamo physics at planetary masses. I present the first radio detection of a young, planetary-mass free-floating brown dwarf and discuss implications for searches of radio emission from extrasolar planets.

Finally, I will review the state of the art for measurements of radio emission from young planetary-mass brown dwarfs, highlight implications for models of substellar magnetism, and discuss how next generation VLA capabilities can push our understanding of brown dwarf and extrasolar planetary magnetism.