

Radio Recombination Lines with the MWA

Radio recombination lines (RRL) are produced when atoms cascade into a series of successively lower ionisation states. In particular, the RRLs found at low frequencies are highly sensitive probes of the environment where the atoms are found, making them useful diagnostics of temperature, density and pressure.

RRLs at low frequencies were first discovered in 1980 and have since been discovered at frequencies from 10 to 1420MHz. However, the region between 70 — 200MHz is not well-studied. Early studies suggest that somewhere between 100 and 200MHz the RRLs transition from emission lines to absorption lines. Recent constraints from studies by LOFAR have suggested that this transition may be around 130MHz, but it is highly dependent on the environment in which they are detected.

This project will use a new spectral line pipeline to process Galactic plane observations taken with the Murchison Widefield Array (MWA). While the pipeline is faster than previous pipelines, it has not yet been used on very large fields-of-view in the Galactic plane, and this project can test the utility over wide fields. The resulting spectra will be searched for RRLs, with a particular focus on carbon recombination lines, which are detectable at low radio frequencies, because the signal is boosted by collisional excitation.

Aims of the project:

- i. Use the new pipeline to process MWA data and compare with previous results;
- ii. Search for carbon RRLs across wide bandwidths, and search for the transition point between absorption and emission;
- iii. Use these results to probe the environments of the regions in which they are found.

This project is suited to a student with a good grounding in astrophysics, willingness to learn supercomputing, and a good understanding or willingness to learn statistics so that these sensitive measurements may be made in a robust and quantitative way.



Figure 1 The Orion Nebula in optical light (left) and radio (right), the latter as observed by the MWA GLEAM survey. This project would involve using the fine frequency resolution of the MWA to search for radio recombination lines in star-forming regions like Orion.

Research Field

Radio Astronomy

Project Suitability

Honours

Masters

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