Lunar Observing with the MWA

Little is known observationally about the period in the early Universe between when the first stars formed and when the Universe was completely ionised by radiation from stars, galaxies and active black holes. Our group here at the Curtin Institute for Radio Astronomy is attempting to learn about this epoch by observing the 21-cm radiation emitted by neutral hydrogen, which has been redshifted by the expansion of the Universe to metre wavelengths. To achieve this, we use the Murchison Widefield Array (MWA) telescope - an interferometer consisting of 256 antenna tiles, tuned to low radio frequencies (including both the FM radio and digital TV bands), situated in the West Australian outback, about 800 km north-east of Perth.

Research Field
Radio Astronomy/Engineering

Project Suitability
PhD
Honours

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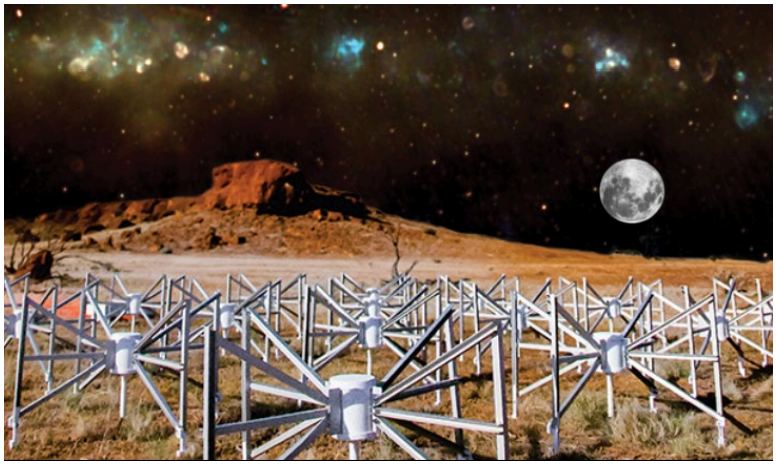
In this project, we aim to measure the all-sky signal from neutral hydrogen, using the Moon as a thermal reference source. This is a novel technique that relies on imaging the Moon with the MWA across a wide band from 70 to 230 MHz. The thermal radiation from the Moon, however, is corrupted by reflections from radio transmitters on Earth and emission from relativistic electrons in our own Galaxy. Couple this with the fact that different radio wavelengths penetrate to different depths in the lunar regolith, and you have a very challenging experiment.



Dipole antennas in a single tile of the MWA telescope. Superimposed on the background is a radio image of our Galaxy (and the Moon!)

Depending upon the interests and skills of the student, the project could be tailored to include: interferometric calibration and imaging, computer modelling of reflected terrestrial transmissions (earthshine), separation of earthshine from the Moon's thermal emission, modelling and removal of Galactic foregrounds and extraction of the faint cosmological signal from multiple epochs of observations. There are a lot of data already collected and waiting to be processed, offering a great opportunity to learn how to do exciting science with a low-frequency radio interferometer.