Verification and Measurement of Noise Coupling in a Low-Frequency Radio Telescope

Research Field
Radio Astronomy Engineering

Project Suitability
MPhil/ Honours

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A low-frequency radio telescope operates in the frequency range of tens to hundreds of MHz. Salient examples in the Western Australian context include the Murchison Widefield Array (MWA) which spans the 80-300 MHz bandwidth and the Low-Frequency Square Kilometre Array (SKA-Low) which covers 50 MHz to 350 MHz. In a low-frequency radio telescope, many antennas in an array are situated close to one another. In this environment, the noise generated by the low-noise amplifiers (LNAs) is re-radiated and pick up by all elements in the array which causes a bias in the correlation matrix produced by the telescope.

The potential impact of this effect to radio astronomy observation has been widely recognized. Theories and calculation methods have been published in the literature to account for this. However, verification of the results has generally been lacking. The primary objective of this project is to fill that gap. This particular project seeks to verify the theory by measuring the antennas under test in a controlled environment such as the anechoic chamber (see figure).

Since the noise generated by this environment is constant ambient noise, we expect this to be the ideal condition to verify the noise coupling theory. We will measure the electromagnetic coupling and noise coupling between two antennas connected to the LNAs with known noise parameters. We will then increase the number of elements to as many as the Curtin University anechoic chamber will accommodate. This is expected to be the first explicit verification of noise coupling in the context of antenna arrays.