Absolute flux density measurements of Southern Sky calibrator sources

Research Field
Radio Astronomy/Engineering

Project Suitability
PhD, Honours / Masters

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To fully exploit the scientific capabilities of the Murchison Widefield Array (MWA), and the upcoming low-frequency component of the Square Kilometer Array (SKA-Low), astronomers need a set of calibrator sources with accurately measured flux densities. The number of bright calibrator sources in the Southern Hemisphere is very limited. Therefore, sources of moderate flux densities have to be used in order to correctly calibrate flux density scale in sky images from the aforementioned low radio-frequency instruments. Perley & Butler 2017 extended their flux-density scale down to approximately 50 MHz based on their recent measurements with the Karl G. Jansky Very Large Array (VLA). Their flux scale includes several primary calibrator sources for the MWA and SKA. However, there is a need for more accurately measured flux density calibrators measured over the entire frequency band 50 - 350 MHz of the SKA-Low telescope. Moreover, we would like to develop a method to measure flux density of any source in an absolute way (without the need to calibrate/bootstrap using earlier measurements).

The absolute flux scale measurements are critical for future instruments such as the SKA in order to be able to accurately measure flux densities of the observed sources. This project aims in developing a technique of performing absolute flux-scale measurements by using the Engineering Development Array (EDA; Wayth et al. 2017) and absolutely calibrated total power radiometer BIGHORNS (Sokolowski et al, 2015). We would like to apply this technique to measure flux-densities of multiple low-frequency Southern Sky calibrators over the entire frequency range of the SKA-Low (50 - 350 MHz). As the first step flux-densities of the calibrator sources measured by Perley & Butler (2017) would be performed in order to verify the method and compare the newly measured flux-densities with the existing flux scale. The method would then be applied to a larger set of sources. Finally, we would like to extend the method to be applicable to the upcoming SKA-Low telescope.

Figure 1: Engineering Development Array (EDA) at the Murchison Radio-astronomy Observatory. Right : BIGHORNS total power radiometer enabling calibration of flux densities in the absolute units.