URSI AP-RASC, Sydney, Australia, 17 – 22 August 2025

SKA-Low Science Commissioning: Progress and Plans

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1 Introduction

Later this decade, SKA-Low will be the largest radio telescope in the world operating at frequencies from 50 – 350 MHz. It will ultimately comprise 512 stations, each of 256 dual-polarization antennas and a diameter of 38 m, distributed with a maximum separation of 74 km and a highly concentrated core optimised for the detection and study of the Epoch of Reionisation (EoR) [1] and short duration transients such as pulsars [2]. At the end of 2024, construction of the first four stations was completed. These form "Aperture Assembly 0.5" (AA0.5), the first milestone of our staged deployment plan. Since late 2024 we have been undertaking a program of testing and validation that includes a focused Science Commissioning activity. The purpose of this contribution is to share progress and plans of this aspect of the SKA project.

2 Science Commissioning Progress

Our Science Commissioning program has focused on aspects related to: fundamental understanding of system performance and calibration; single-station beamforming; inter-station interferometry; and tied-array beamforming. These tests are distinguished from engineering commissioning by being focused on astronomical observations.

System fundamentals: Some of these activities involve fundamental aspects such as stability, direction-dependent antenna response patterns, optimisation of signal statistics, and environmental aspects including RFI.

Single-station beamforming: Testing in this area includes optimisation of station calibration, validating station beam sensitivity and shape, checking accurate pointing and tracking of the station beams, and ensuring basic polarimetric understanding of the system. Station calibration uses the Sun and/or a full Global Sky Model with diffuse Milky Way emission as a dominant component. Observations of known pulsars are particularly useful.

Interferometry: With our four-station array (maximum baseline $\approx$ 5.5 km) we are undertaking tests related to fringe detection, closure quantities, basic instrumental calibration, and rudimentary tests of interferometric imaging. Early tests use particularly bright and compact radio galaxies from the MWA GLEAM 4-Jy catalog [3].

Tied-array beamforming: Pulsar search and timing applications, as well as forming VLBI beams, will rely on high quality tied-array beamforming. Basic tests of this capability are being undertaken and have so far been based on assessing the sensitivity arising from observations of known pulsars.

Later this year Science Commissioning will evolve to test performance of increasingly large Array Assemblies.

References

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Acknowledgements. We acknowledge the Wajarri Yamaji as the Traditional Owners and Native Title Holders of Inyarrimanha Ilgari Bundara, the CSIRO Murchison Radio-astronomy Observatory, the site where the SKA-Low telescope is being built. Inyarrimanha ilgari bundara means "sharing sky and stars" in the Wajarri language.