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The Hydrogen Intensity and Real-time Analysis eXperiment: Status and Early Deployment

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1 Extended Abstract

The Hydrogen Intensity and Real-time Analysis eXperiment (HIRAX [1, 2]) is a radio interferometer array under development at the South African Radio Astronomy Observatory (SARAO) Square Kilometre Array (SKA) site in the Karoo desert of South Africa. The initial deployment is targeting a 256-element array of 6 metre, statically pointed, composite dishes, each instrumented with dual-polarisation cloverleaf receivers operating over the frequency range of 400-800 MHz. The eventual goal of the project is to build out to a 1024-element array. Significant deployment operations will commence in 2024 with the early stages of dish production already underway.

HIRAX's science goals include performing a sensitive, tomographic survey of large-scale structure, as traced by the 21 cm line of neutral hydrogen. By re-pointing the dishes over the course of multiple years of data acquisition, a large cosmological volume corresponding to $\sim$15,000 square degrees will be observed over the redshift range of 0.775–2.55. This survey is expected to have the statistical power to provide tight constraints on the cosmological parameters describing the distribution of matter in the post-reionisation Universe, as well as those describing the geometric expansion of the Universe, such as the dark energy equation of state parameters. Due to the presence of bright galactic and extragalactic foreground signals at low frequencies, the success of this survey relies on the careful control of calibration and systematics. The project has endeavoured to mitigate these effects as much as possible through the stringent physical requirements on the telescope mechanical assembly.

HIRAX will additionally provide a powerful platform for other science goals including observing neutral hydrogen absorbers along the line-of-sight to bright emitters as well as detecting and characterising radio transients such as fast radio bursts (FRBs) and pulsars. A dedicated very-long-baseline outrigger project will allow for precise localisation of triggered FRB detections.

Recent updates from HIRAX that will be presented include the development and integration of the X-engine correlator and the on-site science data processing (SDP) systems, catering to the high computational needs of the real-time analysis required to process the raw data. Additionally the fabrication of the dishes has begun with careful collaboration between the contractor and the project to verify the physical requirements on the composite dishes and their mounts. The status of this early phase of HIRAX deployment will be reported on.

References

[1] D. Crichton and the HIRAX Collaboration, "Hydrogen Intensity and Real-Time Analysis Experiment: 256-element array status and overview," *Journal of Astronomical Telescopes, Instruments, and Systems*, vol. 8, p. 011019, Jan. 2022.

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