

UTMOST-2D: UPGRADING THE MOLONGLO RADIO TELESCOPE TO LOCALISE FAST RADIO BURSTS IN 2D



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Abstract

At the cm wavelengths at which Fast Radio Bursts (FRBs) have been detected, associating an FRB with a single host galaxy requires an interferometer capable of real-time localisations with sub-arcminute spatial resolution in two dimensions. These localisations, achievable with UTMOST-2D, will greatly enhance our understanding of FRBs. Designing a highly sensitive, wide field-of-view, low-cost receiver system on an interferometer is challenging but critical in the effort to achieve the required localisation precision during blind searches and probe the faint and bright ends of the FRB brightness distribution. Thus, a complete upgrade to the receiver system on the currently dormant North-South arm of the Molonglo Radio Telescope is underway and being commissioned, and it is estimated to be ~12x more sensitive than the East-West Arm per unit collecting area.



- - Cosmology, perhaps?

(being commissioned)

North Arm



To associate with a host: Need 1-10 arcsecond precision \rightarrow i.e., sub-arcminute resolution \rightarrow i.e., $\rightarrow 1$ km

How do we make our system sensitive and cheap?

Maximise

scale structure

What is **UTMOST-2D? A Mills Cross** interferometer with a cylindrical parabolic dish

East Arm (operational)



~13



One East-West arm module!





10	¹⁰ ~22	¹⁰ ~24
⁰ 0 50 100 150 200 25	East-West Arm	north-South Arm
Area	4 x 11.6 m² "Module"	1.4 x 11.6 m ² "Cassette"
Bandwidth	25 MHz (effectively ~15MHz)	50 MHz At least twice the bandwidth
Aperture efficiency	η _{EW}	1.6 * η _{EW} (1.6x improvement!)
System temperature	T _{sys,EW}	T _{sys,EW} / 5 (5x improvement!)
The new system is projected to be ~12x more sensitive per unit telescope area!		

Future Instrumentation Developments Phased rollout of commissioning tests: \rightarrow Module on test dish with fixed beamformer \rightarrow Module on test dish with steerable beamformer → Module on North-South arm • Integrate N-S arm into voltage capture system **Obtain phase calibrations for** each module

Future Localisation Pipeline First step: Localise! Quantify positional uncertainties Make images Pre-correct positions (module phase) calibration)

- Calibrate source positions using existing catalogues (e.g. SUMSS)
- Get positional uncertainties
- Commission
- Pulsar data from Molonglo * ASKAP, ATCA, and VLA data

