4th URSI AT-RASC, Gran Canaria, 19-24 May 2024

GMRT status update, new results and future plans

Yashwant Gupta [(1)]
(1) NCRA-TIFR, Pune University Campus, Pune 411007, India. e-mail: ygupta@ncra.tifr.res.in

The Giant Metrewave Radio Telescope (GMRT), located near Pune in India, is a major international facility at low radio frequencies, run by NCRA and operational since 2002. Consisting of 30 fully steerable antennas of 45 metre diameter each, it can be used as an aperture-synthesis array for imaging, as well as a phased array to study compact, time varying radio sources such as pulsars. The original GMRT was designed to operate in 5 radio bands located between 150 and 1450 MHz, with a maximum bandwidth of 32 MHz. Around 2019, a major upgrade of the GMRT (uGMRT) was completed, to improve its sensitivity by a factor of upto three and make it a much more versatile instrument [1], by providing (a) near seamless frequency coverage from about 100 to 1500 MHz; (b) improved receiver systems with higher G/Tsys; (c) maximum instantaneous bandwidth of 400 MHz; (d) matching improvements in infrastructure and computing. This upgrade maintains the GMRT as one of the most sensitive facility in the world in the 100 to 1500 MHz range, till the SKA phase-1, and has led to a wave of interesting new results. A status update on the uGMRT, including how well it is working, learnings from the upgrade, and a sample of the new science coming from it, will be presented.

Following up on the upgrade, several new features have been implemented at the uGMRT in the recent past. These include (a) capability for VLBI observations; (b) facility for raw voltage recording from all 30 antennas followed by flexible playback options enabling new observing modes; (c) pipelines for automated analysis of wideband interferometric data (including polarimetric modes) and beamformer data. Details about these features and early results from these will be presented.

Amongst the new features coming up in the near future is the ongoing installation and commissioning of a 2 Pflop, GPU-based back-end for real-time detection of transients. This system will utilise a novel idea [2] to generate ~ 2000 beams within the primary beam and run a real-time algorithm to detect transients. This will add a powerful new capability of real-time commensal search for FRBs, pulsars and other transients. The uGMRT will become equipped to provide simultaneous detection and arcsec localisation of FRBs, over 300−1460 MHz.

Furthermore, a plan for adding complementary capability at higher frequencies (up to 10 GHz) at the GMRT site is being initiated. This involves the relocation and reuse (after appropriate retrofitting) of two telecom antennas (18-m and 32-m in diameter) that are lying idle at Arvi, a location near to the GMRT. This project, which is just approved and is getting underway, will allow high frequency (up to 10 GHz) VLBI capabilities from the favourable location of the Indian subcontinent to become available in about 2-3 years from now.

On longer time scales of a decade or so, a proposal for implementation of the expanded GMRT (eGMRT) [3] is being submitted for funding support. The eGMRT envisages a quantum jump in the capabilities of the GMRT, by adding another 30 antennas to the array (mostly on short baselines in and around the central 1 km x 1 km core of the array), alongwith euipping each antennas with a focal plane array working over 400-800 MHz. This will put the eGMRT in the same league as the SKA1-Mid, keeping it a competitive facility for a long time.

NCRA also operates the Ooty Radio Telescope (ORT) – a 530 m x30 m cylindrical telescope working at 325 MHz located in the southern part of India, built in 1970 – which is being revived and made fully operational, including a major upgrade of the electronics [4]. Status update on this will also be provided.

References

[1} Y. Gupta et al., "The upgraded GMRT: opening new windows on the radio Universe", Current Science, 113, 4, 707, 2017. doi: 10.18520/cs/v113/i04/707-714.
[2] Jayanta Roy et al, “A Post-correlation Beamformer for Time-domain Studies of Pulsars and Transients”, ApJ, 864, 160, 2018.
[3] N. N. Patra, et al., “The expanded Giant Metrewave Radio Telescope”, MNRAS, vol. 483, 3007, 2019.
[4] C.R. Subrahmanya et al., “The Ooty Wide Field Array”, JoAA, 38, 10, 2017.