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The GMRT : Current Status, New Results and Plans for the Future

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The Giant Metrewave Radio Telescope (GMRT), located near Pune in India, is a major international facility at low radio frequencies, 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, targeted 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) a maximum instantaneous bandwidth of 400 MHz; (d) matching improvements in infrastructure and computing. This upgrade will maintain 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 also to drive a new wave of interesting new results. A status update on the uGMRT, including appraisal of how well the upgrade has worked, learnings from the upgrade, and a sample of the new science coming from it, will be presented in this paper.

Following up on the upgrade, several new features have been implemented. Amongst these is the capability for VLBI observations. Successful test observations have been carried out with telescopes in Europe, Australia, and China. Given its unique geographical location, the GMRT can play a major role in global VLBI networks. The VLBI mode uses a configuration where the phased array voltage sum from the beamformer, for a selected set of antennas, is tapped for recording data in VLBI format. As a further enhancement of this capability, and to provide a more flexible platform for working with Nyquist sampled voltages, an extension of the uGMRT back-end is being implemented where the voltages from each antenna can be recorded for specific observations, and compute capabilities to process these voltages in a flexible, user defined manner is being provided. On the software side, new pipelines have been developed to facilitate analysis of wideband interferometry data from the uGMRT (including polarimetric data), as well as for beamformer data. Quality polarimetric observations have now become possible with the uGMRT. Details about these features will be presented.

One of the major new developments 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.

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.

References

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