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uGMRT Observation Band-2 in GAMA-23 field: Calibration, Catalog and Source Count

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The development of highly sensitive radio telescopes has enabled numerous large-area surveys across different radio bands. These wide-area surveys, with their exceptional sensitivities, have been instrumental in uncovering various astrophysical processes occurring in various sources. They also provide insights into how these sources interact with their environments and probe the underlying cosmological mechanisms driving structure formation and evolution in the Universe. The primary advantages of radio surveys include their ability to quickly cover vast regions of the sky and to detect high-redshift sources, unhindered by dust attenuation. As a result, radio surveys are essential for studying the temporal evolution of different source populations. The extensive source catalogs generated from these surveys facilitate statistical analyses of radio source properties, such as source counts, luminosity functions, and clustering. These analyses, in turn, are invaluable for tracing the distribution of dark matter through comparisons with simulations.

In recent decades, advancements in data processing techniques and the advent of highly sensitive instruments have led to several impactful radio surveys conducted by various telescopes. Notable surveys include NVSS and FIRST at 1.4 GHz, TGSS at 150 MHz, and recent high-sensitivity surveys like LoTSS, MIGHTEE, GLEAM, EMU, RACS, and DINGO. Despite the wealth of data from these surveys, certain gaps remain. One significant challenge is the limited sky overlap between telescopes located in opposite hemispheres. For instance, ASKAP primarily observes the sky south of $\delta \sim +40°$, while LOFAR's sensitivity diminishes substantially below $\delta \sim -5°$. Consequently, the ability to combine data from the low- and high-frequency ends of the radio spectrum is restricted to a relatively small portion of the sky.

The Galaxy and Mass Assembly (GAMA) Project is a comprehensive multi-band imaging and spectroscopic survey targeting five distinct fields in the southern sky. The G23 field has been very popular in the southern sky to understand the low-frequency sky, systematics, RFI, and ionospheric challenges.

In this work, we have calibrated the wideband data of the G23 field from observations of 9 hours of data with direction-dependent method. We have reached resolution of 15.35″ and RMS of 316 μJy beam^{-1} for Band-2 (120-250 MHz). This image is deeper in terms of resolution and sensitivity in comparison to the TGSS coverage of the G23 field. We have generated a catalog consists of 569 sources at a central frequency of 183 MHz with flux densities $\geq 5\sigma$. We are presenting the Euclidean normalized source counts for the sources detected in G23 field. The source flux density is in 5σ of the background for source detection. The uGMRT Band-2 data produced excellent signal-to-noise and provided dynamic range of ~4500 for G23 field. This work presents initial results of deep field in southern sky using uGMRT. This work also showcases the improved proficiency of uGMRT for high redshift sensitive deep field survey.

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