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The MeerKAT View of the Shapley Supercluster: Calibration, Imaging and Mosaicing

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The Shapley Supercluster (mean redshift $z = 0.048$) has one of the most extensive collections of galaxy clusters in the local Universe. At its heart lies the Shapley Supercluster Core (SSC), consisting of many clusters and groups at various evolutionary stages of merger activity. The SSC is thus a unique test bed to study mass assembly history and the complex kinematics of large-scale structure formation in the Universe. The entire complex spans $\sim 3°$ on the sky and was recently observed by MeerKAT (L-band) and ASKAP (being a POSSUM Pilot2 target). It contains an extremely faint ~ 1 Mpc inter-cluster radio bridge (diffuse synchrotron emission that connects pairs of gravitationally interacting galaxy clusters) and many other intriguing non-thermal diffuse sources that probe the underlying dynamics of this chaotic environment. New uGMRT Band-3 observations show a partial detection of the bridge and allow us to perform a preliminary spectral study and confirm the presence of very mild ongoing in-situ particle (re)-acceleration. However, tracing the merger history of this exciting region in detail with robust spectral index and ageing maps requires ultra-deep continuum images of uniform sensitivity across the entire complex. Hence, in anticipation for up-coming follow-up MeerKAT UHF-Band observations, we demonstrate using DDFacet and other radio interferometric data reduction software a novel technique of visibility-plane primary-beam-corrected mosaicing up, including direction-dependent calibration and point source subtraction. This technique can be extended to large survey projects such as those planned for the MeerKAT+ and the SKA to, in principle, image the entire radio sky at an unprecedented uniform sensitivity.

keywords

imaging, calibration, mosaicing, extragalactic, continuum, galaxy clusters

In-person or online?

in-person

Career level

Student

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