



Deciphering the Radio Emission of RXCJ0232.2–4420: Combined Insights from uGMRT and MeerKAT

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Diffuse radio sources like radio halos and relics associated with the intra-cluster medium (ICM) are direct probes of relativistic electrons and magnetic fields in galaxy clusters. There are two types of radio halos: giant radio halos (GRH; sizes $\sim 1 - 2$ Mpc) and mini halos (MH; sizes $\sim 100 - 500$ kpc). While GRHs are hosted by merging clusters, their smaller counterparts, MHs, are found in relaxed clusters. The link between the origin of GRHs and MHs is still under debate and remains an open question. Clusters transitioning from cool-core to merger could help answer this question. RXCJ0232.2–4420 is one of the few transitioning systems showing MH and GRH properties. While X-ray observation shows the cluster has a cool-core signature of MHs, the size of this radio halo compares with the typical size of GRHs. We have carried out the first multi-frequency spectral analysis of this system with uGMRT (Band-3 and 4) and MeerKAT (L-band). The resolved spectral index map provides a better understanding of turbulent acceleration at local scales. To locate the regions of reacceleration precisely, we have examined the spectral index maps using the uGMRT and MeerKAT images. We also perform a point-to-point correlation analysis with radio and X-ray to understand the relation between thermal and non-thermal components of ICM and get insight into the underlying formation mechanism of GRH. Our work suggests that RXCJ0232.2–4420 may have undergone a merger event that has disturbed the ICM without disturbing the cool-core and is powering the MH to transform into GRH.