

Mapping Extended Diffuse Radio Emission at $z = 1.23$: ACT-CL J0329.2-2330

Abstract

Current cosmic ray electron (CRE) turbulent re-acceleration models predict that a significant number of halos at high redshift ($z \sim 1$) is characterised by ultra steep spectra ($\alpha > 1.5$) and low luminosities because of increasing inverse Compton (IC) energy losses. We propose to obtain MeerKAT UHF-band imaging of ACT-CL J0329.2-2330, a galaxy cluster at redshift $z = 1.23$. This cluster was observed at L-band, and images indicate the presence of diffuse emission in the central region. This makes it the highest redshift cluster known to host a radio halo, and the first halo to be detected at $z > 1$. Preliminary analysis indicates a halo radio power of $P_{1.4} \sim 25.22 \pm 0.09 \times 10^{24} \text{ W Hz}^{-1}$, which makes it amongst the most luminous radio halos. Such observations challenge our current understanding of the merger history and magnetic fields of clusters in the early universe. At UHF band, we will be able to detect a larger extent of the emission and do a detailed spectral index study. This study will give insight into the underlying CRE population and constrain formation mechanisms of the radio halos. The lower frequency and full polarisation data will also help us investigate the properties of an extended source in the periphery of the halo to determine in the event that the source is a radio relic.