

A Spectral Census of Mini-Haloes with MeerKAT

Abstract

The new generation of radio interferometers is changing our view of non-thermal phenomena in galaxy clusters, with ever more diffuse objects being detected in a range of different environments. Our taxonomy -- with the three canonical types of source being radio relics, haloes and mini-haloes -- is becoming increasingly stretched, and must be re-examined based on the underlying physics. Of the three canonical classes, mini-haloes are the least understood as they are the rarest, with only some 32 known. This is mainly due to instrumental limitations, as both high resolution (a few arcsec) and high sensitivity at low radio frequencies (below 1 GHz) are needed to disentangle the diffuse emission from the central cluster galaxy. We propose to observe 13 galaxy clusters that host known radio mini-haloes in order to perform the first spectral census of these objects, using MeerKAT in conjunction with high-resolution low-frequency data from LOFAR. We will map the spectra of these objects in unprecedented detail, in order to understand the acceleration mechanism at work in MH, and study the association with cluster-member radio galaxies. We will also use our highly-sensitive MeerKAT data to search for the presence of ultra-diffuse Mpc-scale emission in these clusters, study the acceleration mechanism at work, and how these objects relate to the cluster dynamical state. Finally, we will use our data to attempt the first full-polarisation census of mini-halo clusters, in order to study the magnetic field configuration via Rotation Measure synthesis.