

Disentangling the History of Particle Acceleration In Ultra Steep Spectrum Relic Clusters Abell 2443 and CIZA J0719.5+0043

Abstract

Galaxy cluster mergers drive shocks and turbulence into the intracluster medium (ICM) and are thought to accelerate or re-accelerate relativistic particles and compress magnetic fields in the ICM. Merging clusters are often host to large diffuse central radio halos or peripheral radio relics and a handful host ultra steep spectrum ($\alpha < -1.5$) radio relics. While the connection of these regions of diffuse radio emission to clusters undergoing mergers is clear, the acceleration mechanism, particularly for the USS relics, is still uncertain and may require a seed population of relativistic particles for re-acceleration. We propose MeerKAT L-band observations of two dynamically complex cluster hosting USS relic emission. Both systems contain additional low frequency radio archival data at the same spatial resolution as MeerKAT, thus enabling high resolution spectral index studies of the diffuse emission. These systems also have archival X-ray data available for study of the merger geometry, including shocks and cold fronts as seen through surface brightness jumps as well as temperature jumps. Our goal is to map the young and old relativistic particle populations with MeerKAT at high spatial resolution to reveal the connection between the active radio galaxies, the diffuse emission, and the merger shocks. By mapping the details of the spectral index and spectral curvature and comparing to the X-ray merger signatures we aim to identify the re-acceleration processes at work in these USS relic systems and investigate the connection to a seed populations of relativistic particles from active radio galaxies in the cluster.