Contribution ID: **30** Type: **Talk**

Constraining the origin of radio halos in galaxy clusters

Friday, 10 May 2024 11:30 (15 minutes)

A number of galaxy clusters show extended, diffuse, synchrotron emission in their central region. These sources are called radio halos, and are produced by the (re-)acceleration of relativistic seed electrons that fill the magnetised plasma halo of galaxy clusters. However, the nature of the re-acceleration mechanism is unclear. The current leading scenario is based on second order Fermi mechanisms, which are poorly efficient and are predicted to generate a large population of radio halos with very steep spectra (⊠ < -1.5). In this talk, I will present an upcoming study where we provide strong evidence in favour of this scenario, using observations performed with LOFAR. By exploiting survey data from LoTSS and LoLSS of a sample of 11 radio halos, we prove for the first time that a large fraction (~65%) shows emission that fades quickly with increasing radio frequency,
implying an ultra-steep synchrotron spectrum. In addition, we find a trend between the cluster mass and the halo spectral index, with more massive clusters hosting flatter halos. The existence of a larger population of ultra-steep spectrum radio halos, with respect to flatter spectrum sources, further validates these models, which predict an increasing fraction of radio halos associated with less massive galaxy clusters. As a conclusion, I will also shortly present recent advances in our capabilities to calibrate LOFAR LBA-VLBI data.

keywords

clusters, radio halos, particle re-acceleration, diffuse emission, calibration

In-person or online?

in-person

Career level

ECR

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Session Classification: Clusters/LSS