PhD project in ASTROPHYSICS

Title: Unveiling the spectral properties of radio halos in the galaxy clusters of the LOFAR survey

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Abstract:
Radio halos in galaxy clusters are generated by relativistic electrons interacting with magnetic fields in the intra-cluster-medium (ICM). In the last decade we have demonstrated a connection between radio halos and the dynamics of galaxy clusters, suggesting that these radio sources form in the turbulent ICM when clusters merge with each other in the process of large scale structure formation. However this scenario has key predictions on the spectral properties of radio halos that have not been tested so far because of the lack of low frequency sensitive radio observations.
Thanks to the combination of the LOw-Frequency ARray (LOFAR; observing at 144 MHz) and the uGMRT (observing at 330 MHz), this thesis project will overcome this issue. We already have LOFAR data of a large sample of Planck clusters. We ask and obtained uGMRT data at higher frequency (330 MHz, more than 100 hrs already available) of clusters with radio halos detected with LOFAR. The aim of the Thesis is: 1) to analyse LOFAR and uGMRT data of these radio halos; 2) to derive the unbiased spectral properties of the population of radio halos in the LOFAR sample and 3) to test the most important prediction of current models for the formation of radio halos, i.e. that about half of these radio halos should have steep synchrotron spectra. Finally, these results will be interpreted in the framework of the latest theoretical models and expectations for future radio surveys with SKA1-LOW and SKA1-MID will be also derived.