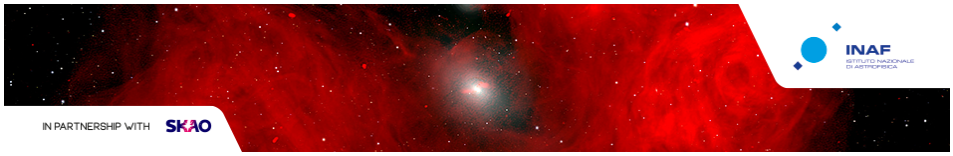

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Recovering diffuse extended emission in the SKA era

Wednesday, 29 November 2023 09:20 (20 minutes)

LOFAR is the most important pathfinder of SKA-low observing the radio sky at long wavelengths. One of the aims of both instruments is the study of diffuse synchrotron radio emission from galaxy clusters, such as radio halos that typically extend on large angular (~2'-20') scales. The LOFAR Two Meter Sky Survey (LoTSS-DR2) recently provided the largest sample (309 targets) of mass-selected clusters ever observed at radio frequencies. In a sub-sample of 140 clusters, no radio halos are detected, which may be explained as intrinsic absence of radio emission or extrinsic instrumental/observational limits.

For this sub-sample, we simulated radio halos by injecting mock visibilities into the observed uv-datasets. While previous-generation interferometers (e.g. VLA, GMRT) are highly sensitive to losses of flux density associated with missing short baselines, we showed that a standard LoTSS pointing can fully recover targets up to scales of ~15' thanks to its unprecedentedly dense inner uv-coverage.

Furthermore, the injection technique can be used to derive upper limits to the radio powers of possible halos, which are fundamental when compared with detections in statistical analysis of clusters. We obtained an empirical relation that allows us to rapidly constrain the level of the upper limit based on the image noise and extent of the mock halo, thus dramatically reducing the number of injection cycles and required computing time with respect to standard procedures.

Very large samples of clusters will be soon provided by SKA surveys. I will summarize the results achieved for LoTSS-DR2 clusters and present our public and flexible injection code, which are important starting points to refine strategies that allow to efficiently deal with forthcoming non-detections in SKA observations.

Reasearch area

Extragalactic Continuum (galaxies/AGN, galaxy clusters)

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