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Radio-mode feedback in high-redshift galaxy clusters with the International LOFAR Telescope

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As the intracluster medium (ICM) in galaxy clusters cools through the emission of X-ray radiation, it sinks down toward the central galaxy where it fuels the AGN. This AGN subsequently emits radio-mode feedback in the form of powerful jets of relativistic plasma which re-energize the ICM, completing the feedback cycle. Measurements of the energy injected by radio-mode feedback into the cluster environment have mostly relied on X-ray observations, which reveal cavities in the ICM excavated by the radio lobes. However, the sensitivity required to accurately constrain the dimensions of these cavities has proven to be a major limiting factor, and forms the main bottleneck on high-redshift (z>0.6) measurements. Recent developments by Timmerman et al. (2022) opened a new observational window on radio-mode feedback by demonstrating that low-frequency radio observations taken with the International LOFAR Telescope (ILT) provide the combination of sensitivity and resolution required to reliably map the radio lobes in detail. Sufficiently sensitive and detailed radio observations resolve the primary bottleneck experienced with X-ray observations and enable radio-mode feedback studies toward the high-redshift regime for the first time. In this talk, we explain this method for measuring the amount of radio-mode feedback in galaxy clusters and present the first results of applying this method using ILT observations of galaxy clusters up to a redshift of z=1.

Primary author: TIMMERMAN, Roland (Leiden Observatory)

Co-authors: Dr VAN WEEREN, Reinout (Leiden Observatory); Dr BOTTEON, Andrea (INAF-IRA); Dr MORABITO, Leah (Durham University); Prof. RÖTTGERING, Huub (Leiden Observatory); Mr SWEIJEN, Frits (Leiden Observatory)

Presenter: TIMMERMAN, Roland (Leiden Observatory)

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