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Exploring Dark Matter in Galaxy Clusters with MeerKAT: South Africa's powerful radio telescope at the forefront of astronomy

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Current radio interferometers, with their high sensitivity and angular resolution, are uniquely positioned to investigate the predicted faint signals arising from Weakly Interacting Massive Particles (WIMPs). Among the most powerful instruments in the southern hemisphere is MeerKAT, a precursor to the Square Kilometre Array (SKA), which offers world-leading capabilities for probing dark matter through radio observations.

In this study, we leverage data from the MeerKAT Galaxy Cluster Legacy Survey to investigate galaxy clusters as promising candidates for detecting WIMP signals. Our approach combines a cutting-edge dark matter modeling tool with advanced radio astronomy techniques to probe the WIMP parameter space. We present competitive upper limits on the WIMP annihilation cross-section in galaxy clusters, spanning over three orders of magnitude. Our results are superior to those produced with gamma-ray experiments, such as Fermi-LAT and HESS.

These results represent a significant advancement, providing new insights into the search for dark matter through galaxy clusters.

This presentation will discuss the challenges of comparing predicted WIMP-induced radio emissions with actual measured fluxes from galaxy clusters. A particular focus will be on the importance of using processed images versus raw visibility data—an issue that will become increasingly critical as the large data volumes produced by the SKA demand more computationally efficient analysis and interpretation strategies.

Collaboration(s)

Authors: BECK, Geoff; LAVIS, Natasha (SARAO, University of the Witwatersrand)

Presenter: LAVIS, Natasha (SARAO, University of the Witwatersrand)

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