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In Search of Dark Matter with the MeerKAT Radio Telescope: Insights from Reticulum II dSph

Radio astronomy has emerged in the last decade as a promising approach for detecting Weakly Interacting Massive Particles (WIMPs) annihilation and decay signatures, particularly due to its capability to distinguish and detect diffuse emission.

Local Group dwarf spheroidal galaxies (dSphs) are ideal targets for these searches due to their high dark-matter content and low astrophysical backgrounds. Their combination of proximity and low luminosity makes them excellent observational candidates, while their minimal background emission ensures cleaner detection possibilities.

This work presents novel constraints on dark matter annihilation using radio observations. Using the South African MeerKAT radio telescope, a precursor to the Square Kilometre Array (SKA), we observed the Milky Way dSph Reticulum II in the UHF band to search for synchrotron emission from WIMP annihilations. Data analysis involved rigorous reduction and self-calibration, including initial processing, flagging, cross-calibration, imaging, and multiple rounds of self-calibration.

The results establish constraints on WIMP masses and annihilation cross sections across three annihilation channels, improving upon previous indirect observations by up to two orders of magnitude. These constraints were derived from 8 hours of observation with the 64-dish MeerKAT array. With its unprecedented sensitivity, the SKA will greatly improve upon its precursors in ruling out a large portion of the WIMP parameter space and potentially leading to detection.

Collaboration(s)

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