Hunting Dark Matter with Faint Radio Halos

Contributed Talk //

Astro-Particle Physics

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The latest generation of radio interferometry telescopes, which have high sensitivity and resolution capabilities, are providing an exciting new platform for indirect dark matter detection studies. Instruments like the Square Kilometre Array (SKA) and its precursors have been shown to be especially capable dark matter hunters. During the PhD project we have analysed data from one of the SKA's precursor instruments, MeerKAT, through the MeerKAT Galaxy Cluster Legacy Survey (MGCLS) programme. This analysis compared radio images of five nearby galaxy clusters to theoretical models of the expected dark matter-related radio emissions in those clusters, with the aim of placing constraints on the dark matter parameter space. A focus point of the analysis has been the accuracy of the theoretical models, and we thus present a solution implementation to the diffusion-loss transport equation, developed during the PhD, that more accurately captures small-scale physical effects and is more computationally efficient than previously published implementations. The results of our analysis are a set of constraints on the allowed WIMP annihilation cross-section which are almost always more constraining than previous searches with similar modelling scenarios. As we approach the era of the SKA, these refinements of radio-based indirect detection methodology are key to realising its full potential.

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