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Constraints on Dark Matter Content in Ultra-Compact Dwarf Galaxies: Insights from Fornax UCD3 and M59 UCD3

We investigate the astrophysical signatures of dark matter (DM) annihilations in ultra-compact dwarf galaxies (UCDs), focusing on the Virgo and Fornax galaxy clusters. We analyze Fornax UCD3, the most luminous UCD, and M59 UCD3, the most massive, while incorporating the presence of a 3.5 million solar mass black hole in Fornax UCD3. Our findings suggest minimal DM content in Fornax UCD3 based on comparisons of stellar and dynamical masses. Although M59 UCD3 has been less studied, deep radio imaging and X-ray observations provide constraints on its DM content. We model the DM content of both UCDs and analyze constraints from γ-ray and radio sources for dark matter particles. In the absence of strong γ-ray signals, we demonstrate that synchrotron emissions from DM annihilations are highly sensitive for indirect DM searches, allowing for significant constraints on DM parameters at radio frequencies and highlighting the role of spike profiles in understanding DM and black hole interactions in ultra-compact galaxies.

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