

Preliminary Master’s Thesis Abstract

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Abstract

The structure, extent, and mass of the Milky Way’s (MW) dark matter (DM) halo are observationally challenging to determine due to our internal position within the galaxy. To overcome this limitation, we study a combined sample of 127 MW analogs from the IllustrisTNG-50 cosmological simulation with observations of 11 nearby galaxies. Using both spatial and spectral high-resolution data from VLA and GMRT telescopes, we employ the 3D-Barolo algorithm to derive precise kinematic maps and rotation curves (RCs). To perform a careful analysis of the stellar component, we use Spitzer mid-IR imaging at 3.6 and 4.5 μm . We decompose the RCs into their different mass components, enabling the construction of a DM radial profile for each galaxy. By using a MCMC-based routine, we account for the DM contribution for the observed RCs. For our simulated sample, we obtain DM radial profiles directly from the TNG50 database. We probe for the universality of the DM profiles in this sample of MW analogs by deriving and comparing the equivalent local DM density (LDMD), a critical parameter linked to DM direct detection experiments on Earth. We calculate the DM density at the corresponding location of the Sun in each of the analog galaxies. Our analysis yields a final LDMD range of $0.17 - 0.46 \text{ GeV cm}^{-3}$. Finally, by leveraging our mass estimates (M_{200} , M_{gas} and M_{\star}), we contextualize our findings with the efficiency of star formation in MW-like galaxies, as well as with the diversity of galaxies inhabiting similar halo masses.

This work is based on a recently submitted paper to ApJ.

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