Using long baseline interferometry to study the dark matter distribution in Milky Way analog galaxies

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Abstract

Our current understanding of how dark matter (DM) is distributed within the Milky Way (MW) halo, particularly in the solar neighborhood, is based on either careful studies of the local stellar orbits, model assumptions on the global shape of the MW halo, or from direct acceleration measurements. In this talk, I will present a study of external galaxies with the intent of gaining insights into the DM distribution in MW analogs. I will also draw parallels between our current knowledge of radio interferometry in this field, its limitations, and our expectations for the optical counterpart. To achieve this, we carefully selected a sample of galaxies resembling the MW. Given the need for deep, high-resolution HI observations, our resulting sample comprises 15 galaxies observed through two approved programs with the VLA and GMRT. To perform our baryonic analysis, we use deep Spitzer mid-IR images at 3.6 and 4.5 μm from the S4G survey. Based on the dynamical three-dimensional modeling software 3D-BAROLO, we construct rotation curves (RCs) and directly derive the gaseous and stellar contributions from their mass surface density profiles. Through a careful decomposition of the RCs into their baryonic (stars, gas) and DM components, we isolate the DM contribution by using an MCMC-based approach. Based on the Sun's location and the MW's R25, we define the corresponding location of the solar neighborhood in these systems. We put forward a window for the DM density (ρ_dm=0.21-0.46 GeV cmˆ-3) at these galactocentric distances in our sample, consistent with the values found for the MW's local DM density, based on more traditional approaches.

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