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Testing Dark Matter and Modifications to Gravity using Local Milky Way Observables

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The observed flattening of rotation curves is usually considered strong evidence for the existence of dark matter on galactic scales. However, observations such as the Baryonic Tully-Fisher Relation and the Radial Acceleration Relation, suggest that the observed dynamics in galaxies are strongly correlated with the distribution of baryonic matter. Because they are challenging to explain in the context of dark matter, these observations have motivated low-acceleration modifications to gravity as an alternative to the dark matter hypothesis. I will present a framework to test a general class of modifications to gravity using local Milky Way observables, including the vertical acceleration field, the rotation curve, the baryonic surface density, and the stellar disk profile. For concreteness, I will focus on modifications to gravity that increase the magnitude but do not change the direction of the gravitational acceleration. MOdified Newtonian Dynamics (MOND) is one such example. I will show that a modification to gravity of this type is in tension with observations of the Milky Way's baryonic profile and that dark matter provides a better fit to the data.

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