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Cosmological implications of the Gaia Milky Way declining rotation curve.

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Although the existence of dark matter is widely accepted, its true nature remains unknown, motivating alternative explanations such as \textbf{Modified Newtonian Dynamics (MOND)}. MOND modifies Newton's laws for low accelerations (around $a_0 \sim 1.2 \times 10^{-10}\,\mathrm{m/s^2}$) and generally reproduces the flat rotation curves of galaxies.

However, recent \textit{Gaia} data reveal a \textbf{declining} rotation curve in the Milky Way, which differs from the usual flat behavior. This study tests whether MOND can accomodate this decline.

A standard baryonic model of the Milky Way is first built, and an \textbf{NFW dark matter} model successfully fits the decline with a scale radius of about $4\,\mathrm{kpc}$. In contrast, the standard MOND framework fails to do so.

By relaxing the baryonic parameters and using an \textbf{MCMC} analysis, we find that MOND could only match the data if the stellar disk is very massive ($\sim 10^{11} M_\odot$), while a_0 is consistent with zero and limited to $0.53 \times 10^{-10}\,\mathrm{m/s^2}$, much smaller than the standard MOND value.

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