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Testing dark matter in galaxies with the normalized additional velocity distribution

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I will introduce a fast and complementary approach to study galaxy rotation curves directly from the sample data, instead of first performing individual rotation curve fits. The method is based on a dimensionless difference between the observational rotation curve and the expected one from the baryonic matter (δV^2). It is named as Normalized Additional Velocity (NAV). Using 153 galaxies from the SPARC galaxy sample, we find the observational distribution of δV^2. This result is used to compare with the model-inferred distributions of the same quantity. We consider the following five models to illustrate the method, which include a dark matter model and four modified gravity models: Burkert profile, MOND, Palatini $f(R)$ gravity, Eddington-inspired-Born-Infeld (EiBI) and general relativity with renormalization group effects (RGGR). We find that the Burkert profile, MOND and RGGR have reasonable agreement with the observational data, the Burkert profile being the best model. The method also singles out specific difficulties of each one of these models. Such indications can be useful for future phenomenological improvements. The NAV method is sufficient to indicate that Palatini $f(R)$ and EiBI gravities cannot be used to replace dark matter in galaxies, since their results are in strong tension with the observational data sample.

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