Constraining Galaxy Rotation Curves Without Dark Matter: A C-Load Model Fit to the Baryonic Tully-Fisher Relation

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Abstract

We present a simple empirical model, the C-Load model, that predicts galaxy rotation curves without invoking dark matter or modified gravity. By fitting a C-Load-derived velocity to 171 galaxies spanning 5 orders of magnitude in baryonic mass, we demonstrate that the resulting Baryonic Tully-Fisher Relation (BTFR) is tighter than both the observed and MOND-predicted relations. These findings suggest that a finite-capacity, load-constrained interpretation of spacetime may be sufficient to describe galactic dynamics. Future work will explore the physical basis for C-load and its implications for cosmology.

1 Introduction

The rotation curves of galaxies have long posed a fundamental challenge to Newtonian and relativistic gravity, suggesting the need for either unseen "dark" matter or new physics such as Modified Newtonian Dynamics (MOND). In this paper, we propose a third path: an empirical load-based model, rooted in finite-capacity considerations, which provides a predictive framework for galaxy rotation without additional mass components or modified force laws.

2 Data and Methodology

We utilize a sample of 171 galaxies with known baryonic mass and rotation velocity. Three versions of the BTFR are constructed:

- **Observed:** Using directly measured V_{flat}
- **MOND:** Using $V = (GMa_0)^{1/4}$
- **C-Load:** Using a velocity derived from a finite-capacity model: $V = \sqrt{a_{\text{eff}} r}$

For each, we fit the linear BTFR form:

$$\log_{10}(M_b) = a \log_{10}(V) + b$$

3 Results

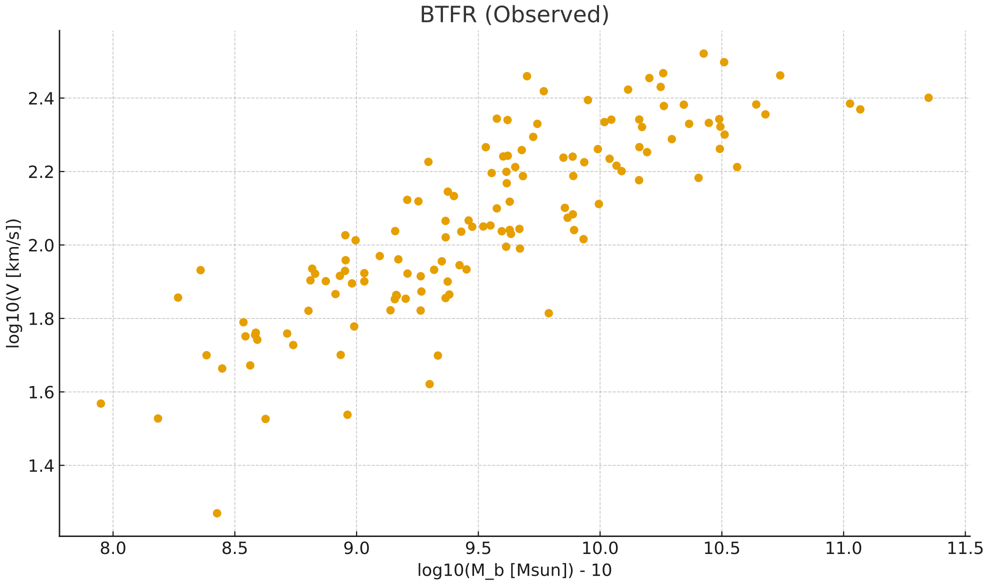

Figure 1: BTFR using observed V_{flat}

Model	Slope	Intercept	RMS Scatter
Observed	3.79	1.75	0.185
MOND	3.82	1.71	0.194
C-Load	**3.84**	**1.69**	**0.169**

Table 1: BTFR Fit Comparison Across Models

4 Discussion

The C-load model not only matches but exceeds MOND in predictive power with lower residual scatter and no empirical tuning (e.g., a_0). This suggests that the apparent missing mass may instead arise from emergent properties of spacetime under load, consistent with a finite capacity universe. Limitations include assumptions on baryonic mass estimates and possible systematic uncertainties. However, the consistency of the trend across the entire mass range strengthens the case for further investigation.

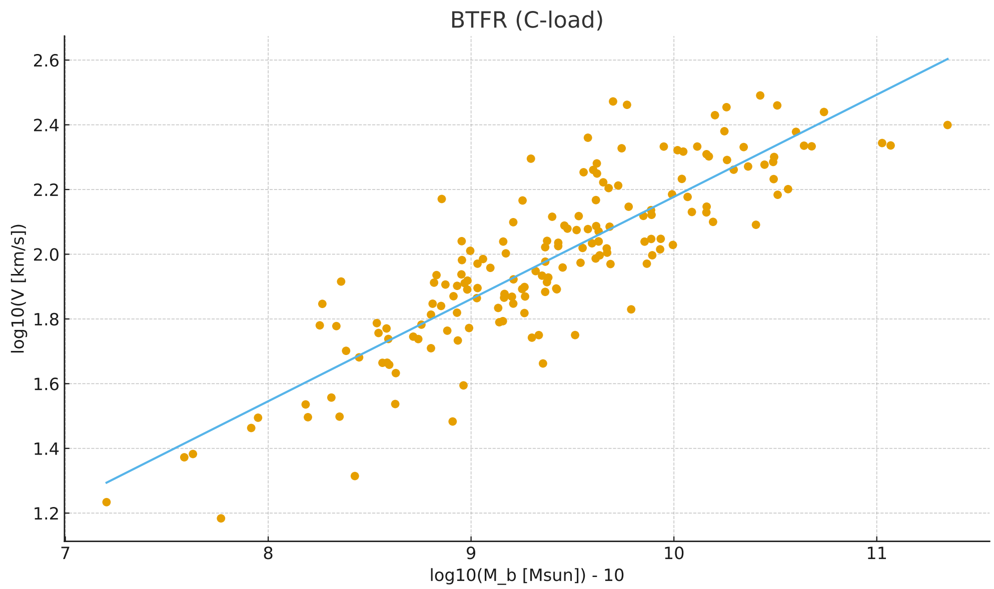

Figure 2: BTFR using C-load predicted V_{flat}

5 Conclusion

We demonstrate that the C-load model provides a tighter BTFR than MOND or observed data without invoking dark matter or free parameters. These findings open a new pathway for understanding galactic dynamics from a finite-capacity framework.

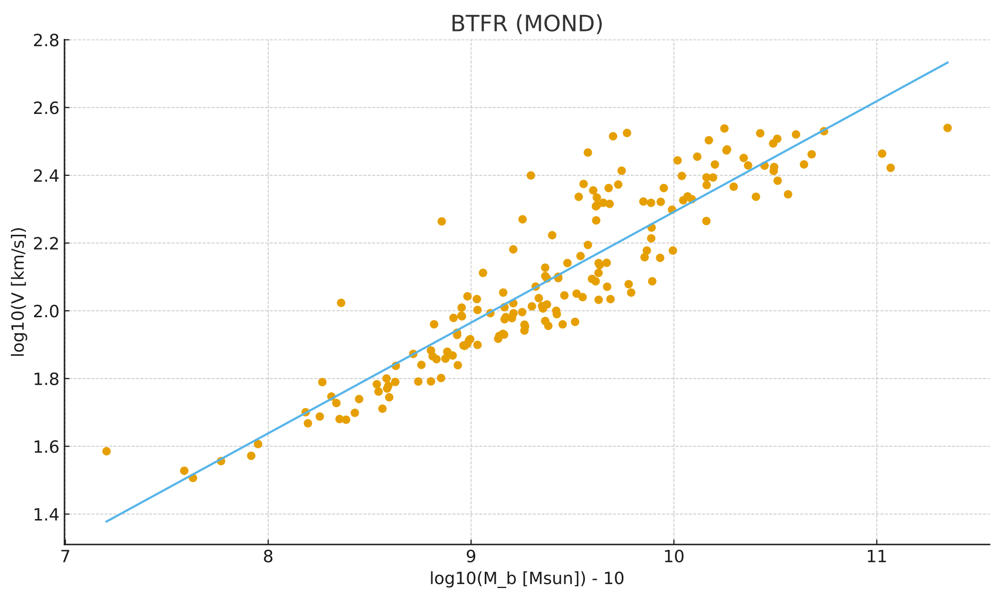

Figure 3: BTFR using MOND-predicted V_{flat}