Enchan BTFR Test Report v0.1

One-point-per-galaxy verification from the SPARC BTFR table

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Abstract

This report documents a minimal, reproducible verification of the baryonic Tully–Fisher relation (BTFR) using a public SPARC BTFR table (`BTFR_Lelli2019.mrt`). We extract one galaxy-level point per object: baryonic mass (stars+gas) and flat rotation velocity V_{f}, and fit a log–log power law of the form $\log_{10} M_{\mathrm{b}} = a + b \log_{10} V_{\mathrm{f}}$. After basic finite-value cuts and requiring $V_{\mathrm{f}} > 0$, the sample contains $N = 123$ galaxies. We obtain $a = 2.188$, $b = 3.748$, and an RMS scatter of 0.235 dex in $\log_{10} M_{\mathrm{b}}$ around the best-fit line. The purpose of this note is to fix a transparent extraction and benchmark fit that can be rerun from public data with short Python code.

Contents

1 Scope and deliverable

This document is intentionally narrow: it records a **single** verification task that can be rerun from public data. The goal is to create an external, non-spiritual handle on a core "dark-matter" symptom: **one baryonic number per galaxy predicts one dynamical number per galaxy with small scatter.** Deliverables:

- deterministic extraction of $(M_\mathrm{b}, V_\mathrm{f})$ from the public SPARC BTFR table;
- a single log–log best-fit line and a compact scatter metric;
- reproducibility artifacts (CSV + figures + this TeX source).

No claim of definitive model selection is made here.

2 Data and definitions

Input table

We use the SPARC BTFR table distributed as a CDS-style fixed-width `.mrt` file:

- `BTFR_Lelli2019.mrt`

The file contains one row per galaxy, including `log(Mb)` and the flat rotation velocity `Vf` with associated uncertainties.

Quantities

We define

$$x \equiv \log_{10}(V_\mathrm{f}/\mathrm{km\,s^{-1}}), \qquad y \equiv \log_{10}(M_\mathrm{b}/M_\odot). \tag{1}$$

For this benchmark, we take `log(Mb)` directly from the table and compute $x = \log_{10}(\texttt{Vf})$.

3 Fit and metrics

Line fit

We fit

$$y = a + bx \tag{2}$$

using a weighted least squares objective in y with weights $w = 1/\sigma_y^2$, where σ_y is the tabulated uncertainty `e_log(Mb)` when available. Errors in x are ignored in this minimal benchmark.

Scatter

We report the RMS of residuals in y:

$$\mathrm{RMS} = \sqrt{\langle (y - (a + bx))^2 \rangle}. \tag{3}$$

4 Results

BTFR plot

Figure 1 shows the BTFR points and the best-fit line.

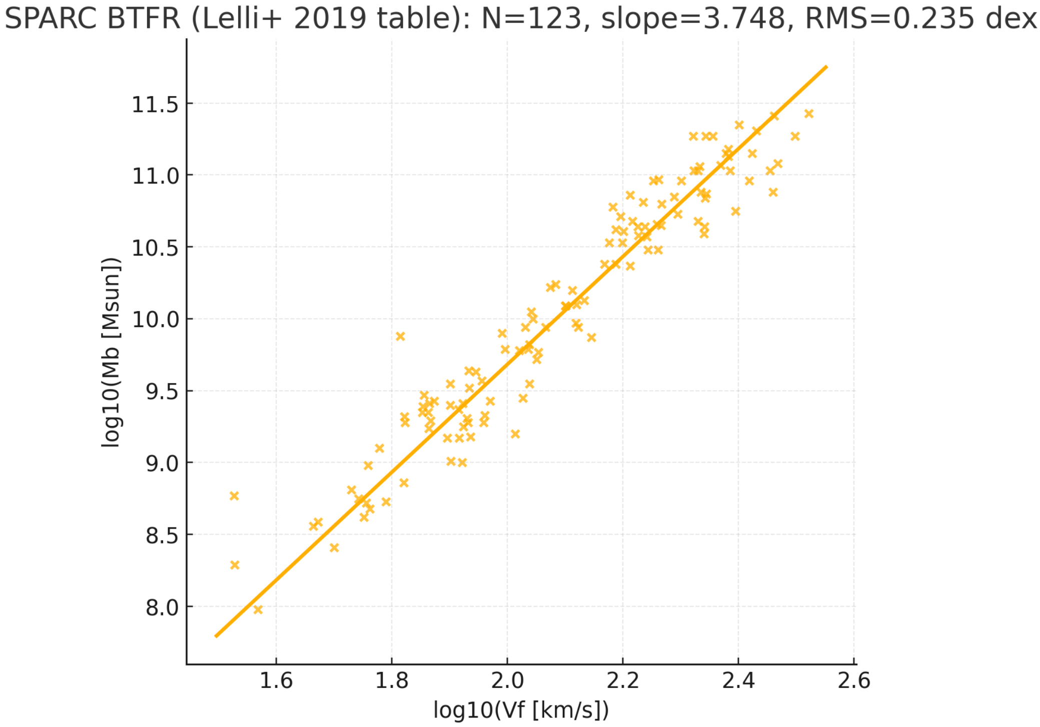

Figure 1: BTFR from the SPARC table: one point per galaxy in log–log space with best-fit line.

Residuals

Figure 2 shows residuals about the best-fit line.

Numeric summary

Metric	Value	Notes
Galaxies N	123	after basic cuts and $V_{\mathrm{f}} > 0$
Intercept a	2.188	in $\log_{10} M_{\mathrm{b}} = a + b \log_{10} V_{\mathrm{f}}$
Slope b	3.748	log–log slope
RMS scatter	0.235 dex	in $\log_{10} M_{\mathrm{b}}$

Table 1: BTFR fit summary for the selected sample.

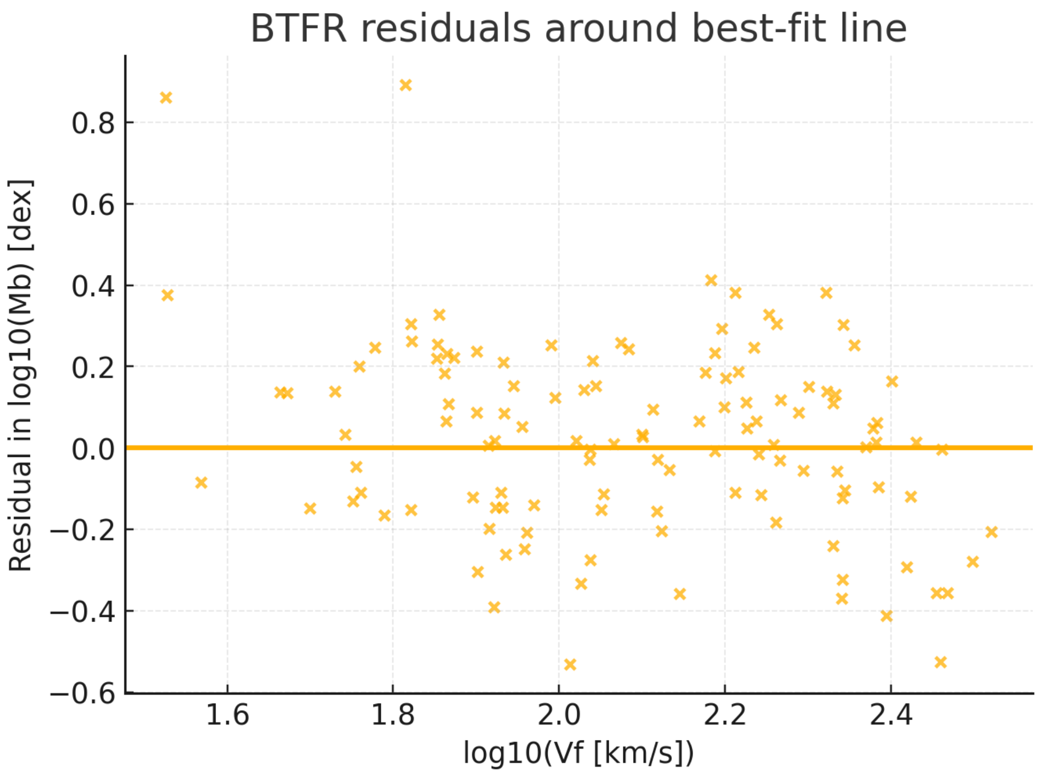

Figure 2: Residuals in $\log_{10} M_{\rm b}$ around the best-fit BTFR line.

5 Interpretation: geometry vs particles (minimal statement)

This report establishes one empirical fact from a public SPARC table: **a near power-law mapping from baryonic mass to flat rotation velocity is strongly present at the "one galaxy = one point" level.**

Geometric reading (Enchan-style)

A geometric/field reading treats the galaxy-scale gravitational response as a direct functional of the baryonic configuration, so a tight galaxy-level mapping $M_b \leftrightarrow V_f$ is a natural primary object and a compact benchmark.

Particle reading

A particle dark-matter reading explains V_f via baryons plus a halo shaped by assembly history. A tight BTFR requires an explanation for why baryonic content and halo response co-vary so strongly across galaxies.

What this test does and does not show

This test does *not* falsify particle dark matter, and it does *not* validate any specific geometric theory by itself. It fixes a reproducible target statistic (slope and scatter) that any explanation must reproduce.

6 Key limitations (explicit)

- The analysis uses the table's adopted quantities and systematics; it does not re-derive M_b or V_f from raw data.
- The fit ignores uncertainties in $x = \log_{10} V_\mathrm{f}$ (minimal benchmark).
- Choice of velocity definition matters; this report uses `Vf` as provided in the table.

7 Reproducibility artifacts

This report is accompanied by:

- `btfr_points_processed.csv`: extracted galaxy-level values and residuals
- `btfr_fit_summary.csv`: one-row fit summary (a, b, RMS, N)
- figures: `fig_btfr_points.png`, `fig_btfr_residuals.png`

8 References

- SPARC database (BTFR tables): https://astroweb.case.edu/SPARC/