

SPARC Real Data Verification — CMG-LCE v5.0  
Empirical Validation of  $a\Psi \propto B^2$  (175 Galaxies + LOFAR DR2)

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GitHub: [github.com/EugenioCMG/CMG\\_LCE](https://github.com/EugenioCMG/CMG_LCE)  
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“The vacuum remembers — and gravity is its echo.”

--- Abstract ---

We reanalyse SPARC rotation curves (Lelli et al. 2016) together with LOFAR LoTSS-DR2 radio maps (O’Sullivan et al. 2023) for a curated sample of 152 nearby spiral galaxies. After geometric deprojection, PSF matching and ring-averaged pairing at matched radii, we estimate magnetic-field energy via equipartition (Stokes I, Beck & Krause 2005) with homogeneous assumptions ( $CR_p/CR_e = 100$ , pathlength = 1 kpc, filling factor = 0.5). We then form pairs ( $a\Psi$ ,  $B^2$ ) using SPARC baryonic models and propagate radial uncertainties into WLS fits (weights  $1/(\sigma a^2 + \sigma B^2)$ ). We find a positive cohort-level correlation between  $a\Psi$  and  $B^2$ : Spearman  $\rho = 0.78$  (95% CI: 0.62–0.89, bootstrap, Fisher-z), and a positive WLS slope  $\mu = 1.52 \times 10^{11} \text{ m s}^{-1} \text{ G}^{-2}$  (robust SE). Results are stable under  $\pm 0.2$  dex shifts in stellar M/L, alternative radial binnings, exclusion of inner 1 kpc, and leave-one-out tests. These findings constitute preliminary evidence consistent with the CMG-LCE prediction  $a\Psi \propto B^2$ .

Keywords: Galaxies: magnetic fields — rotation curves — dark matter — methods: data analysis — gravitation

--- Data & Code Availability ---

All processed data, scripts and figures are available at Zenodo (DOI 10.5281/zenodo.17460207) and GitHub ([github.com/EugenioCMG/CMG\\_LCE](https://github.com/EugenioCMG/CMG_LCE)).

--- Results Summary ---

Galaxies: 152  
Spearman  $\rho$ : 0.78 [0.62, 0.89]  
 $\mu$  (WLS):  $1.52 \times 10^{11} [1.34\text{--}1.70] \times 10^{11}$   
SE( $\mu$ ):  $0.18 \times 10^{11}$   
 $\chi^2_{\text{red}}$ : 1.12  
VIF: 1.23

Conclusion: The positive correlation is consistent with CMG-LCE. Robust to M/L  $\pm 0.2$  dex, binning, and leave-one-out. Full verification requires SKA1.

Limitations:

- Uneven RM coverage
- Possible foreground contamination
- LOFAR resolution (20'') vs. SPARC radii
- Selection bias ( $i > 30^\circ$ )