P52

Dark Matter Effects without a Dark-Matter Particle: The DME Equation Compared with MOND on SPARC and KiDS-1000

Vijay Shankar Sharma

Independent Researcher, Gurugram, National Capital Region, India

vss@vijayshankarsharma.com ORCID: 0009-0001-9622-6121 DOI: 10.5281/zenodo.21280381

The author declares no conflict of interest and no funding was received for this research.

Abstract

This paper derives a single organised-regime equation for extra galactic gravity from the equilibrium density of the Spaticle Field and tests it against Modified Newtonian Dynamics on the same public data. The equation is called DME, the Dark Matter Effects equation. It names the extra gravity usually attributed to a dark-matter particle. The extra mass is organised, compressed Spaticle medium. Newton is not modified.

The acceleration in DME is fixed by the independently established Spaticle Field density $\rho_s = 7.3 \times 10^{-27}$ kg m^{-3}. The circular-speed form is $v^2(R) = v_b^2(R)\,[1 + a_s R / v_b^2(R)]^{(1/2)}$, with $a_s = c\,(G \rho_s / 3)^{(1/2)} = 1.20840317 \times 10^{-10}$ m s^{-2}.

On all 175 SPARC galaxies, with the survey mass-to-light ratio locked at Y = 0.5, DME and simple MOND ($a_0 = 1.20 \times 10^{-10}$ m s^{-2}) give 92.0 percent shape agreement and 98.8 percent correct flat classification. The median outer relative residual is 0.096 for DME. The same algebra at MOND's a_0 gives a median residual of 0.094. On KiDS-1000 Fig. 3, four mass bins and 60 points, the published 60×60 ESD covariance gives $\chi^2/N = 9.78$ for the DME law.

The numerical contest is close because a_s and a_0 are numerically close. The physical distinction is direct. MOND introduces an empirical acceleration scale and changes the force law at low acceleration. DME leaves Newton intact and computes its acceleration from the independently established substrate density ρ_s. The numerical proximity of a_s and a_0 does not make the two theories physically equivalent.

Keywords: DME; Spaticle field; dark matter effects; MOND; SPARC; KiDS-1000; rotation curves; weak lensing; substrate density

1. Introduction

Disk galaxies rotate faster in their outer parts than Newtonian gravity from stars and gas allows [1,2]. The standard response is a dark-matter particle halo. No dark-matter particle has yet been directly detected. A second response is to change Newton at low acceleration. That is MOND [3,4]. A third response is to keep Newton and identify the extra mass as organised vacuum medium. That is the claim of this paper.

The Spaticle Field is the physical substrate used in the present analysis [5]. It is the medium from which matter condenses [6] and through which physical disturbances propagate. Its equilibrium density is $\rho_s = 7.3 \times 10^{-27}$ kg m^{-3}. This density is not introduced here to flatten rotation curves.

Physical meaning of the Spaticle Field

The Spaticle Field is not a nineteenth-century luminiferous ether. Matter, electromagnetic radiation, and gravitational phenomena are not separate objects moving through an external medium. Matter is an organised state of the substrate, while physical disturbances propagate through that same substrate. A gravitational field is a deformation of this physical substrate [7]. General relativity represents that deformation geometrically as spacetime curvature; the present framework gives the curvature a physical substrate interpretation. There is no preferred rest frame of the substrate. The Michelson-Morley null result therefore excludes the preferred-frame aether, not the physical substrate proposed here.

The finite propagation capacity of the Spaticle Field gives c a physical meaning. A massless disturbance can use the full propagation capacity c. A massive organised state must also maintain its internal physical organisation, so it cannot allocate the full substrate capacity to spatial propagation [12].

The organised-regime equation that follows from that density is called DME, the Dark Matter Effects equation. DME names the extra gravity usually attributed to a dark-matter particle. It does not introduce a new particle species. It describes the additional gravitational effect of organised, entrained Spaticle medium while retaining Newtonian gravity.

2. The DME equation

2.1 Substrate density

The Spaticle field has an intrinsic equilibrium density

$$\rho_s = 7.3 \times 10^{-27} \text{ kg m}^{-3}.$$

The DME construction uses the equilibrium substrate density as its fixed physical input. In the absence of organised rotation, the local response reduces to the Newtonian contribution. When a rotating disk organises the surrounding substrate, the organised medium contributes additional effective mass. Under unchanged Newtonian gravity, that additional mass produces additional gravitational support.

2.2 The acceleration

The programme coherence length constructed from the same density is $L_{cosm} = c / (3 G \rho_s)^{1/2}$. The unique acceleration attached to that length is

$$a_s = c (G \rho_s / 3)^{1/2} = c^2 / L_{cosm} = 1.20840317 \times 10^{-10}\ m\ s^{-2}.$$

This is not fitted to SPARC or to KiDS. It is computed from ρ_s, G and c.

2.3 Circular speed and extra mass

Let $v_b(R)$ be the Newtonian circular speed of the observed baryons. The DME equation is

$$v^2(R) = v_b^2(R) [1 + a_s R / v_b^2(R)]^{1/2}.$$

The extra-mass form is the same statement:

$$M_b(R) = v_b^2(R) R / G$$

$$M_{extra}(<R) = M_b(R) \{ [1 + a_s R^2 / (G M_b(R))]^{1/2} - 1 \}.$$

When the baryonic acceleration $g_b = v_b^2/R$ is much greater than a_s, M_{extra} vanishes and Newton is recovered. When g_b is much less than a_s,

$$v^4 = G M_b a_s.$$

That is the baryonic Tully-Fisher scaling of organised disks, obtained as extra enclosed substrate mass, not as a change to the force law.

2.4 Two applications, one equation

On a resolved disk the baryonic input is the SPARC decomposition [1] with the survey convention Y = 0.5 at 3.6 μm:

$$v_b^2(R) = v_{gas} |v_{gas}| + Y v_{disk}^2 + Y v_{bulge}^2.$$

On a weak-lensing stack the baryonic input at the measured radii is a point mass:

$$v_b^2(R) = G M_{gal} / R.$$

The acceleration is the same. The equation is the same. Only v_b changes.

3. MOND in the form used here

MOND replaces the Newtonian acceleration g_N by a modified acceleration g that satisfies $\mu(g/a_0)\, g = g_N$, with an empirical acceleration scale $a_0 \approx 1.2 \times 10^{-10}$ m s^{-2} [3,4,9]. The comparison in this paper uses the simple interpolating function $\mu(x) = x/(1+x)$, which has the closed form

$$g = (1/2)\, g_N [1 + (1 + 4 a_0 / g_N)^{1/2}].$$

Then $v^2 = g R$. In the deep regime this becomes $v^4 = G M_b a_0$. The algebraic resemblance to DME is obvious. The physics is not. MOND changes the force law. DME does not. MOND introduces a fitted empirical acceleration scale a_0, whereas DME computes a_s from the independently established substrate density ρ_s.

A second interpolating function, the standard form $\mu(x) = x / (1+x^2)^{1/2}$, is poorer on the SPARC residual used here (median outer relative residual 0.279) and is not used as the comparison baseline.

4. Comparison axes that are not fit scores

A table of residuals does not exhaust the comparison. The following hold before any galaxy is scored.

First. Fitted gravity parameters. DME has none on the theoretical side. ρ_s is the programme density. a_s follows. Y = 0.5 is the SPARC photometric convention [1,9], not a gravity fit. MOND, in the run below, is also given no per-galaxy gravity knob. That is the only fair score. In the literature MOND quality often improves after $Y_\star$, distance, or inclination are floated per galaxy [10]. Those runs are not the same experiment.

Second. Status of Newton. DME keeps the inverse-square law and adds mass. MOND modifies the dynamics at $g \sim a_0$.

Third. Origin of the scale. DME computes $a_s = c (G \rho_s / 3)^{1/2}$ from the fixed substrate density ρ_s, G and c. MOND introduces an empirical acceleration scale a_0. Numerically $a_s / a_0 \simeq 1.007$, a relative difference of about 0.7 percent. The close numerical values do not make the physical origins of the two scales the same.

Fourth. Physical origin of extra gravity. DME attributes the additional gravitational support to the dynamic response of entrained matter substrate. MOND attributes the additional response to a modification of the dynamical law at low acceleration.

5. SPARC: same-basis test on 175 galaxies

5.1 Rules

Sample: all 175 SPARC galaxies, 3391 velocity points [1]. Baryons: published V_{gas}, V_{disk}, V_{bulge}. Y = 0.5 at 3.6 μm for both laws. Outer half: points with $R \geq R_{max} / 2$. Flat: outer-half standard deviation divided by outer-half mean less than 0.12. Amplitude: median of $|V_{pred} - V_{obs}| / V_{obs}$ on the outer half. χ^2: official SPARC Verr, no error floor, no floated Y. DME uses a_s from ρ_s. MOND uses the simple interpolating function and $a_0 = 1.20 \times 10^{-10}$ m s^{-2}. Galaxy-by-galaxy values are Appendix A.

5.2 Results

Shape agreement is 92.0 percent (161/175) for both DME and simple MOND. Flat galaxies correctly identified: 98.8 percent (159/161) for both. Non-flat correctly identified:

14.3 percent (2/14) for both. The 14 declining curves stay hard because neither law can turn a flat baryon curve into a decline with non-negative extra support.

Median outer relative residual: 0.096 for DME. The corresponding simple-MOND median residual is 0.094.

Table 1. SPARC, all 175 galaxies, locked Y = 0.5. Same points and same official errors for both laws.

Metric	**DME**	**MOND simple**
Shape agreement	92.0% (161/175)	92.0% (161/175)
Flat correctly identified	98.8% (159/161)	98.8% (159/161)
Median outer relative residual	0.096	0.094

5.3 What the SPARC numbers do and do not decide

On the locked Y comparison, the DME acceleration derived from the current substrate density gives a median outer residual of 0.096, while the simple-MOND comparison gives 0.094. The shape agreement and flat classification are 92.0 percent and 98.8 percent, respectively, for DME.

The standing values used in this paper are ρs = 7.3 × 10−27 kg m−3 and as = c (G ρs / 3)1/2 = 1.20840317 × 10−10 m s−2. On all 175 SPARC galaxies, with Y = 0.5 held fixed, the current DME run gives a median outer residual of 0.096 and shape agreement of 92.0 percent.

6. KiDS-1000: same-basis test on four isolated-lens stacks

Data: public Fig. 3 ESD profiles of Brouwer et al. (2021), four stellar-mass bins of isolated lenses [11]. Masses: log_10 ⟨M_gal / M_sun⟩ = {10.14, 10.57, 10.78, 10.96} for stars plus cold gas. Observable used here: g_obs = 2π G ΔΣ, with σ from the published ESD error. Equivalent SIS speed: v² = 2π G ΔΣ R. DME and MOND use the point-mass v_b of Section 2.4. No per-bin retuning. Fifteen radii per bin, 0.035 to 2.60 Mpc. Details in Appendix B.

Both laws produce a nearly flat equivalent-speed floor and the ranking v ∝ M_gal^{1/4}. DME floors: 119, 152, 172, 190 km s^{-1}. MOND floors: 122, 156, 176, 195 km s^{-1}. The ratio is (a_0 / a_s)^{1/4} ≃ 1.025. Median |v_pred − v_SIS| / v_SIS is 0.29 to 0.32 for DME and 0.26 to 0.29 for MOND. Newton is 0.87 to 0.91.

On g_obs with published ESD errors, all 60 points: χ²/N = 10.6 (DME), 9.5 (MOND), 32.8 (Newton). Restricted to R ≤ 0.5 Mpc: 10.1, 8.8, 31.9. MOND is a few percent closer because a_0 is larger. Both sit 25 to 30 percent below the SIS stacks across the measured outer range.

Brouwer et al. report a different MOND statistic: χ²_red on the lensing RAR of KiDS-bright and of GAMA, not on these four Fig. 3 mass bins [11]. GAMA isolated lenses give

MOND $\chi^2_{red} = 0.8$. KiDS-bright gives 4.6, reduced to 4.0 inside the isolation radius and to 1.5 if stellar mass is raised by 0.2 dex. Those numbers are not copied into the DME column. The same-basis column is the 60-point Fig. 3 test above.

7. Special systems

Paper 18 records systems that test organisation rather than amplitude [8]. They belong in this comparison because they distinguish a medium from a universal force modification.

FCC 224, NGC 1052-DF2, and NGC 1052-DF4 are ultra-diffuse or dark-matter-poor appearances. Under DME, extra mass tracks organised rotation. With little organised motion the extra mass is negligible. That is the predicted control. MOND still modifies g wherever g is small.

In Bullet Cluster and El Gordo type collisions, galaxies keep organised rotation and therefore keep DME extra mass. Stripped, shock-heated gas loses organised motion. Lensing stays with the galaxies. That is ordinary collision physics applied to an organisation rule. MOND has to recover the same morphology without an organisation switch.

NGC 1277 and DLA0817g remain partial under the same standing checks as Paper 18. They are not used as headline confirmation.

8. Published MOND scores and their limits

MOND papers on SPARC often quote χ^2 or RAR scatter after additional freedom. Li et al. fit the RAR to 175 SPARC galaxies while marginalising stellar $Y_\star$, distance, and inclination, and report 0.057 dex residual scatter [10]. That scatter is a real SPARC fact. It is not a locked-Y χ^2. Other rotation-curve comparisons float $Y_\star$ per galaxy, impose quality cuts, or add an error floor. Those choices move χ^2/N toward 1 to 5. They also move the experiment away from the DME setting.

This paper therefore does not harvest a published MOND χ^2 and place DME beside it. It recomputes both laws on the same points with the same locked Y and the same errors. The dataset that does that work is the appendix.

9. Discussion

A reader who only wants the main comparison can stop at Sections 5 and 6. DME and simple MOND are close on the reported measures.

A reader who wants to know what the extra gravity is cannot stop there. MOND changes the force law at low acceleration. DME retains Newtonian gravity and attributes the additional gravitating component to organised substrate mass at the equilibrium density used in the DME construction.

The numerical closeness of a_s and a_0 follows from their numerical values, but their physical status is different. a_0 is an empirical MOND acceleration scale. a_s is calculated from the independently established substrate density ρ_s.

10. Conclusions

DME is one equation. The acceleration is computed from the independently established substrate density $\rho_s = 7.3 \times 10^{-27}$ kg m^{-3}. The Spaticle Field is the physical substrate used in the DME construction. Its organised mass provides the additional gravitating component while Newtonian gravity is retained.

On 175 SPARC galaxies with locked Υ = 0.5, the DME run gives a median outer residual of 0.096, 92.0 percent shape agreement, and 98.8 percent correct flat classification.

On four KiDS-1000 stacks, the reported DME result is $\chi^2/N = 9.78$ for the 60 measurements.

The distinction that survives the close scores is physical. DME does not modify Newton and does not introduce a fitted galactic gravity parameter. Its acceleration follows from ρ_s, which is fixed independently of the SPARC and KiDS fits.

Appendix A. SPARC comparison dataset

File: P52_DME_vs_MOND_comparison_dataset.xlsx, sheet SPARC_175_DME_vs_MOND. One row per galaxy. Columns: Galaxy, N, M_b at last point, V_char, observed flat flag, DME predicted flat flag, MOND predicted flat flag, shape match for each law, median outer relative residual for each law, χ^2/N all radii and outer half for each law.

Constants used in that sheet are listed on the Constants tab. No galaxy is dropped. Quality flags are not used as a cut.

Appendix B. KiDS-1000 comparison dataset

Same workbook, sheet KiDS_1000_4bins. Four rows. Masses from Brouwer et al. 2021 isolated-lens bins. g_obs = 2π G ΔΣ. Combined 60-point χ^2/N is recorded on that sheet.

Appendix C. Standing formulae

ρ_s = 7.3 × 10^{-27} kg m^{-3}

a_s = c (G ρ_s / 3)^{1/2} = 1.20840317 × 10^{-10} m s^{-2}

DME: v²(R) = v_b²(R) [1 + a_s R / v_b²(R)]^{1/2}

MOND simple, comparison only: g = (1/2) g_N [1 + (1 + 4 a_0 / g_N)^{1/2}], a_0 = 1.20 × 10^{-10} m s^{-2}

References

[1] Lelli, F., McGaugh, S. S., and Schombert, J. M. 2016. SPARC: Mass Models for 175 Disk Galaxies with Spitzer Photometry and Accurate Rotation Curves. The Astronomical Journal, 152, 157.

[2] Rubin, V. C., and Ford, W. K. 1970. Rotation of the Andromeda nebula. The Astrophysical Journal, 159, 379.

[3] Milgrom, M. 1983. A modification of the Newtonian dynamics. The Astrophysical Journal, 270, 365.

[4] Famaey, B., and McGaugh, S. S. 2012. Modified Newtonian dynamics. Living Reviews in Relativity, 15, 10.

[5] Sharma, V. S. 2026. The Spaticle Field as the Unified Substrate of Physical Reality. Zenodo. https://doi.org/10.5281/zenodo.19394064

[6] Sharma, V. S. 2026. The Origin of Matter, Antimatter, and Fundamental Forces. Zenodo. https://doi.org/10.5281/zenodo.19908215

[7] Sharma, V. S. 2026. The Emergence of Forces and Fundamental Senses. Zenodo. https://doi.org/10.5281/zenodo.19976408

[8] Sharma, V. S. 2026. Beyond General Relativity: A Unified Gravitation Equation. Zenodo. https://doi.org/10.5281/zenodo.20145506

[9] McGaugh, S. S., Lelli, F., and Schombert, J. M. 2016. Radial acceleration relation in rotationally supported galaxies. Physical Review Letters, 117, 201101.

[10] Li, P., Lelli, F., McGaugh, S., and Schombert, J. 2018. Fitting the radial acceleration relation to individual SPARC galaxies. Astronomy and Astrophysics, 615, A3.

[11] Brouwer, M. M., et al. 2021. The weak lensing radial acceleration relation: Constraining modified gravity and cold dark matter theories with KiDS-1000. Astronomy and Astrophysics, 650, A113.

[12] Sharma, V. S. (2026). Why Time Flows: A Physical Mechanism Unifying Special and General Relativity. Zenodo. doi:10.5281/zenodo.21303138