Massotron: A Frequency–Informational Model of Gravity at the Boundary of the Region of Darkness

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Abstract

We propose a speculative conceptual framework in which gravity and the dark components of the Universe are treated as emergent responses of spacetime at a boundary with a *Region of Darkness* — a domain posited to possess neither spatial extension nor dimensionality. The central object of the model, the *Massotron*, is defined as a localised topological perturbation of this boundary rather than a field propagating within spacetime. Phenomenologically, the model reduces to a MOND-class modification of the gravitational acceleration, $g_{\rm eff} = g_N + \sqrt{g_N a_0}$, with a single universal acceleration scale a_0. We show that this relation reproduces the asymptotically flat rotation curves and the baryonic Tully–Fisher relation, and we discuss the known numerical coincidence $a_0 \sim cH_0/2\pi$ as a possible cosmological constraint on the boundary dynamics. We further introduce the *Decollapse Sphere*, a hypothetical closed shell undergoing isolation, resonant accumulation and phase transition, and outline its potential observational signatures. **This work is a conceptual hypothesis, not a validated theory:** it contains no covariant field equations, and the rotation-curve illustrations use synthetic data rather than published measurements. Quantitative testing against the SPARC database and a relativistic formulation are required.

Keywords: modified gravity, MOND, dark matter, dark energy, baryonic Tully–Fisher relation, emergent gravity, speculative cosmology

1 Introduction and Scope

The ΛCDM model describes cosmological observations with high accuracy, but the physical nature of cold dark matter and the cosmological constant remains unidentified. On galactic scales, an alternative phenomenology is provided by Modified Newtonian Dynamics (MOND) [1, 2], which posits a universal acceleration scale $a_0 \approx 1.2 \times 10^{-10}\,\mathrm{m\,s^{-2}}$ and accounts for the tight empirical coupling between baryonic and dynamical mass, including the radial acceleration relation [3] and the baryonic Tully–Fisher relation.

The present work does not claim a new dynamical law. Its phenomenology belongs to the MOND class. The aim is instead to propose an *ontological interpretation* of why such a scale exists, by replacing the notion of an additional spatial dimension with a boundary adjoining a domain that has no dimensions at all.

Section 2 states the postulates. Section 3 presents the phenomenological relation and its consequences. Section 4 gives illustrative numerical examples. Section 5 outlines speculative extensions. Section 6 states the limitations and the conditions under which the framework would be falsified.

2 Postulates

2.1 Postulate 1: The Massotron as a boundary mode

The Massotron is defined as a localised topological perturbation existing at the boundary between spacetime ($3+1$ dimensions) and the Region of Darkness. Since the latter is posited to lack spatial and dimensional properties, the Massotron is not an object *within* any medium; it is the mode of the boundary itself.

Consequence. Gravity is treated as an emergent response of spacetime to this boundary mode rather than as a fundamental interaction mediated by a particle within spacetime.

2.2 Postulate 2: Nonlinear response of the acceleration

In vacuum the Massotron carries no rest mass. In the presence of baryonic matter its contribution to the gravitational field is not additive in mass but nonlinear in the Newtonian acceleration:

$$g_{\mathrm{eff}}(r) = g_N(r) + \sqrt{g_N(r)\,a_0}, \qquad g_N(r) = \frac{GM_b(r)}{r^2}, \tag{2.1}$$

where a_0 is a universal acceleration scale. Equation (2.1) is a MOND-class interpolation: it recovers Newtonian dynamics for $g_N \gg a_0$ and the deep-modified regime $g_{\mathrm{eff}} \to \sqrt{g_N a_0}$ for $g_N \ll a_0$.

2.3 Postulate 3: Decoherence by baryonic matter

Baryonic matter is assumed to degrade the coherence of Massotron modes. Coherent, unperturbed configurations are therefore expected only in regions of extremely low baryon density.

2.4 Postulate 4: The speed of light as a projected rate

The invariant speed c is interpreted as the macroscopic projection of the boundary update rate. This interpretation is not derived here and must eventually reproduce existing Lorentz-invariance constraints.

2.5 Postulate 5: Boundary scars

At extreme spacetime curvature the boundary is assumed to undergo a structural transition whose imprint persists after the transition completes. Such imprints are referred to as *scars*. No stability calculation supporting this assumption is presented in this work.

3 Phenomenology

3.1 Flat rotation curves

For circular orbits, $v^2(r) = r\, g_{\rm eff}(r)$. Substituting Eq. (2.1),

$$v^2(r) = \frac{GM_b(r)}{r} + \sqrt{GM_b(r)\, a_0}. \tag{3.1}$$

At radii where $M_b(r) \to M_b = \text{const}$, the first term decays as r^{-1} while the second is radius-independent. Hence

$$v^2_{\rm flat} = \sqrt{GM_b a_0}. \tag{3.2}$$

3.2 Baryonic Tully–Fisher relation

Squaring the above yields

$$v^4_{\rm flat} = GM_b a_0, \tag{3.3}$$

which is the baryonic Tully–Fisher relation. We emphasise that Eq. (3.3) is a known result of MOND phenomenology [1, 3] and is reproduced here, not newly predicted.

3.3 Parameter economy: a methodological comparison

Fitting a rotation curve within ΛCDM using an NFW halo [5],

$$\rho_{\rm NFW}(r) = \frac{\rho_s}{(r/r_s)\,(1+r/r_s)^2}, \tag{3.4}$$

requires per-galaxy adjustment of the halo scale density ρ_s, scale radius r_s (or concentration $c = r_{\rm vir}/r_s$), and the stellar mass-to-light ratio M_*/L. These are free fitting parameters, not predictions of the theory.

MOND-class relations, including Eq. (2.1), instead employ a single universal constant, with M_*/L remaining the dominant astrophysical uncertainty. This economy is a property of the MOND class as a whole and is *not* a distinguishing advantage of the present model over other modified-gravity proposals.

3.4 Cosmological coincidence of the acceleration scale

The empirically inferred scale satisfies

$$a_0 \approx \frac{cH_0}{2\pi} \approx 1.1 \times 10^{-10}\,\mathrm{m\,s^{-2}}, \tag{3.5}$$

a coincidence noted in the MOND literature. Within the present framework it motivates the conjecture that a_0 is set by the global state of the boundary rather than being an independent constant. This remains a conjecture: no derivation is given. If $a_0 \propto H(z)$, the relation predicts an epoch-dependent BTFR zero point, which is testable and which also places strong constraints on the model.

4 Illustrative Numerical Examples

Data disclaimer. The data points used in this section are smooth synthetic representations constructed to resemble published H I rotation curves. They are *not* the original published measurements, and no quantitative claim of agreement is made. A fit to the SPARC database [4] is required before any such claim.

4.1 NGC 3198

Using a spherical exponential approximation with $M_b = 3.5 \times 10^{10} M_\odot$ and $R_d = 3.5$ kpc, Eq. (2.1) with $a_0 = 1.0 \times 10^{-10}\,\mathrm{m\,s^{-2}}$ produces a flat outer curve at $\approx 150\ \mathrm{km\,s^{-1}}$ (Fig. 1), whereas the baryonic Newtonian curve declines. The corresponding effective mass, $M_{\rm eff}(r) = r^2 g_{\rm eff}(r)/G$, grows approximately linearly beyond $3R_d$ (Fig. 2).

4.2 M33: a fixed-parameter cross-check

For an M33-like system ($M_b = 1.0 \times 10^{10} M_\odot$, $R_d = 2.0$ kpc) with a_0 *fixed* at the value above and no re-fitting, the model again produces a flat plateau, but at $\approx 119\ \mathrm{km\,s^{-1}}$ against $\approx 109\ \mathrm{km\,s^{-1}}$ in the synthetic reference curve: a systematic overestimate of $\approx 9\%$.

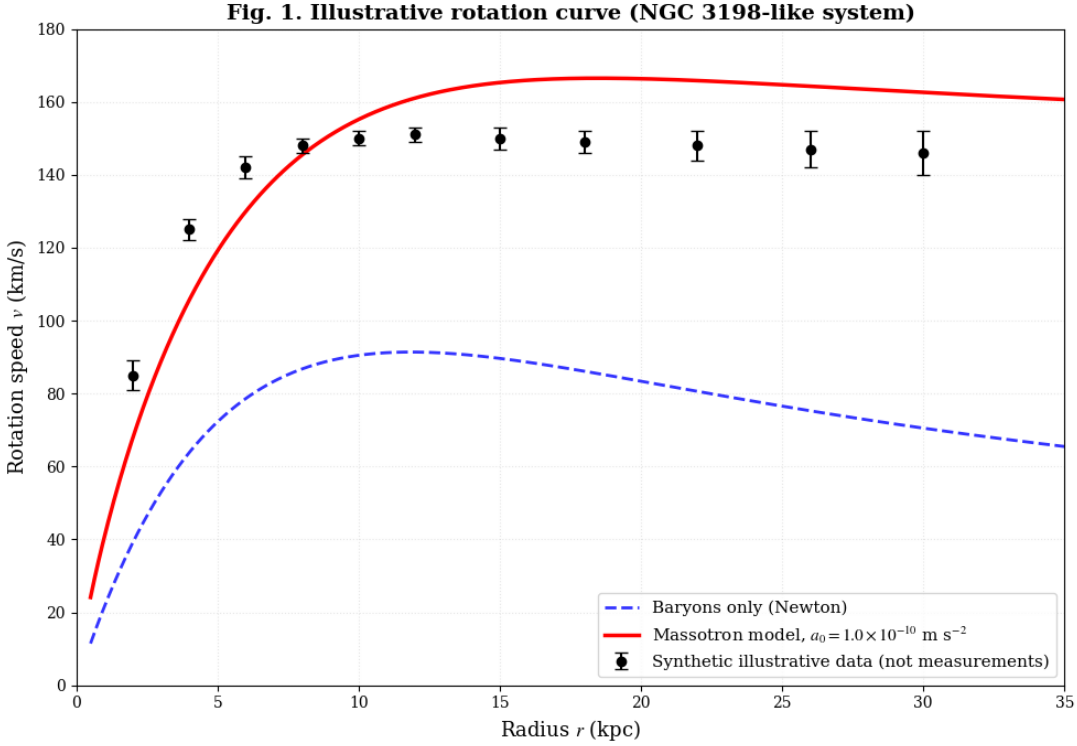


Figure 1: Illustrative rotation curve for an NGC 3198–like system. Points: synthetic illustrative data. Dashed: Newtonian baryonic contribution. Solid: Eq. (2.1) with $a_0 = 1.0 \times 10^{-10}\,\mathrm{m\,s^{-2}}$.

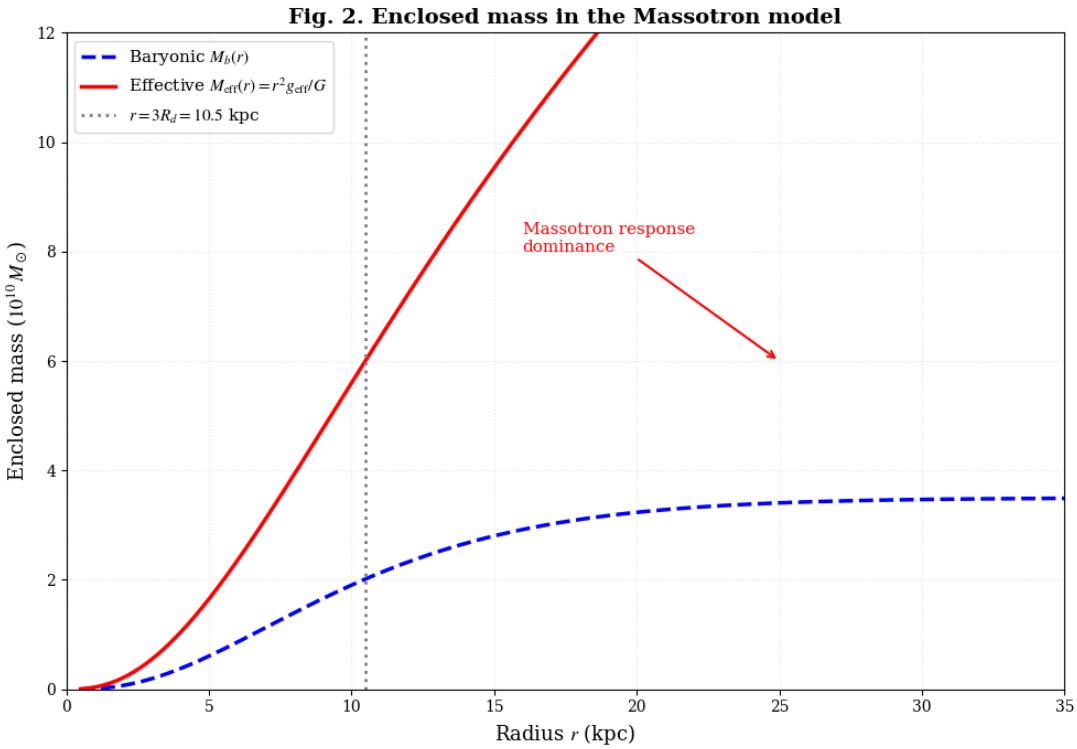


Figure 2: Enclosed mass. Dashed: baryonic $M_b(r)$, saturating at the total baryonic mass. Solid: effective $M_{\rm eff}(r) = r^2 g_{\rm eff}/G$, growing approximately linearly at large radii.

This residual is reported as-is. Its origin is not established here. Plausible contributors include the crude spherical approximation of a gas-rich disc, the adopted M_b, and the synthetic nature of the reference points. A genuine variation of a_0 between galaxies cannot be inferred from this exercise, and would in any case be tightly constrained by existing BTFR scatter [3, 4].

5 Speculative Extensions

The following proposals are qualitative and currently lack quantitative support. They are separated from the phenomenology of Sec. 3 for that reason.

5.1 The Decollapse Sphere

A closed shell isolating a compact object would permit accumulation of internal perturbations without external dissipation. Coincidence of the internal driving rhythm with cavity modes would produce resonance; a critical tension would then trigger a transition from reflection to absorption and shell dissipation. No hydrodynamic stability analysis or mode spectrum is computed here, so no echo interval is predicted numerically.

5.2 Galaxies with little dynamical mass discrepancy

If the modified response is sourced by baryons, systems with unusually diffuse baryon distributions may exhibit small discrepancies. We note, however, that ultra-diffuse galaxies reported as dark-matter deficient (e.g. NGC 1052-DF2) are a known difficulty for MOND-class models, because the external field effect and the low internal accelerations generally *increase* the predicted discrepancy. This is a challenge to the present framework, not a confirmation.

5.3 Compact objects in voids

Postulate 3 suggests that coherent configurations, if they exist, would be restricted to extremely low-density environments. No formation calculation is presented, and the claim is currently untestable as stated.

5.4 Gravitational-wave echoes

Internal structure near the horizon would in principle produce repeating post-merger signals. We stress that claimed echo detections to date have not reached statistical consensus, and standard general relativity predicts none. Without a computed mode spectrum this proposal yields no falsifiable timing prediction.

6 Limitations and Falsifiability

This manuscript is a conceptual hypothesis with illustrative numerical examples. Its principal limitations are:

1. No action, field equations, or stress–energy tensor are given; the framework is not relativistically covariant.
2. The rotation-curve examples use synthetic data and simplified spherical mass models.
3. Postulates 3–5 are qualitative and unsupported by calculation.
4. Any variation of c or of the constants must respect existing laboratory and astrophysical bounds.
5. The model must reproduce the cosmic microwave background and large-scale structure, where particle dark matter succeeds and where MOND-class theories face well-known difficulties. No such calculation is attempted here.

The framework would be disfavoured if a covariant completion cannot reproduce lensing and CMB observables, if a_0 inferred from independent systems proves inconsistent with a single universal value beyond astrophysical uncertainties, or if dark matter is identified as a particle species whose distribution is uncorrelated with baryons.

7 Conclusion

We have set out a conceptual framework interpreting MOND-class galactic phenomenology in terms of a boundary adjoining a dimensionless domain. The dynamical relation is not new; the proposed interpretation is. The value of the framework depends entirely on whether it can be developed into a covariant theory that yields the acceleration scale rather than assuming it, and that survives cosmological tests. Until then it should be read as a hypothesis, not a result.

Acknowledgements

[See the discussion below for the recommended wording.]

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