

Sharp-threshold modified gravity: falsifiable wide-binary predictions with Gaia

Luc Côté

Independent researcher, Québec, Canada

Zenodo deposit, DOI 10.5281/zenodo.22801278 — The attached shape-test protocol was deposited before execution on 14 September 2026 under 10.5281/zenodo.22715013.

Abstract. Modified-gravity phenomenology at low acceleration is usually captured by interpolating functions introduced by hand, and rests on field equations whose nonlinearity makes the two-body problem solvable only numerically. We proceed from a construction with neither feature. We show that a transition function follows instead from the static equilibrium of a tension interface, $\sigma \cdot \text{Tr}(\mathbf{K}) = \rho E$, once five structural statements are posited which this Letter declares without deriving, and whose observable consequences it draws. No parameter is fitted to wide-binary data; the inputs are the vacuum energy density, Newton's constant and the local baryonic slope, all three measured elsewhere. The resulting form differs qualitatively from the usual interpolations: it predicts a sharp threshold at the front, at a separation $r_t = \sqrt{A}$, a transition twice as steep than standard interpolations in the region of the step, and a plateau whose height is fixed by the local baryonic field rather than being universal. The single dimensional input, the interface tension, is fixed by the cosmological vacuum energy density and Newton's constant, so that no acceleration scale is fitted. Passed through a projection pipeline applied identically to all models, the framework separates from MOND-type interpolations by 0.31 to 0.37 in dynamical ratio in the 4–10 kAU (kilo-astronomical units, 10^3 AU) window, a zone accessible to current deep samples. This functional form has not yet been injected into any published wide-binary likelihood: the comparison presented here is model to model. We provide the discriminating curves, delineate where the prediction can be falsified, and confront it explicitly with the three published analyses covering the same window — two of which contradict it. We do not arbitrate the ongoing observational controversy.

Context. Since 2023, several analyses of Gaia wide binaries have reported, at large separations, an excess relative velocity compared to the Newtonian prediction, in the regime where the internal acceleration falls below $\sim 10^{-10} \text{ m} \cdot \text{s}^{-2}$: some groups read this as the signature of a departure from standard gravity [3,4,7,8], others conclude Newtonian compatibility [6,10]. The question remains open and debated. We do not enter this arbitration: we derive, from an independent theoretical framework, a transition function whose form is distinct from both Newton and MOND-type interpolations, and whose signatures are confrontable with the same data.

1. The foundation: a tension interface between three fields

The fundamental object of this framework is an interface Σ — a codimension-1 hypersurface — carrying a tension σ . The low-acceleration modification does not arise from an addition to the law of gravitation, but from the static equilibrium of this interface.

The action and its equilibrium. The action of an interface combining tension, coupling to energy density, and curvature rigidity reads

where dA is the induced area element on Σ , dV the volume element of the enclosed domain Ω , $H = \text{Tr}(\mathbf{K})$ the mean curvature (trace of the extrinsic curvature $\mathbf{K}$), and (σ, p, κ, H_0) the couplings. Stationarity $\delta S = 0$ under any variation of the interface imposes the shape equation — the generalized Young-Laplace law, $\sigma \cdot \text{Tr}(\mathbf{K}) = -p$. The conjugate "pressure" being here the energy density ρ_E that the interface separates, one obtains the exact static form

The equilibrium is therefore not postulated: it is the minimality condition of the action, its first variation. The form written here is that of the long-wavelength regime, where the rigidity term is negligible: the full variation of the action yields a Helfrich-type shape equation whose κ contribution is of order $\kappa/(3\sigma L^2)$ relative to the tension term, L being the relevant curvature scale. The coefficient 3 comes from the contribution of the three fields to the effective tension, as it appears in the linearised form below: at scale L , $\nabla^2 u \sim u/L^2$ and $\nabla^4 u \sim u/L^4$, so that the ratio of the rigidity term to the tension term is $\kappa \nabla^4 u / 3\sigma \nabla^2 u \sim \kappa/(3\sigma L^2)$. The form used therefore assumes $\kappa/(3\sigma L^2) \ll 1$, a condition met at the

separations treated here. It is this condition, not the vanishing of κ , that licenses the form above; the linearised form does retain the term, where it appears as $\kappa \nabla^4 u$. It possesses a complete dynamical form, linear in the displacement u ,

whose linearity is what allows, below, the multiplicative composition of clock rates for several bodies.

Regime of validity. The present construction sits in the static, weak-field regime. In this regime, the exponential clock rate carried by matter identifies with the temporal component of the metric, $g_{00} = e^{(2\Phi/c^2)}$, and the Letter restricts itself to the dynamics of bound systems at low acceleration. The treatment of light propagation — deflection, lensing — involves the response of the interface at higher order and is the subject of separate work; it lies outside the scope of this Letter.

Why three fields. The interface separates three fields. The fields are not carried by the dimensions: they are what the interface separates, and their number follows from the stability constraint that fixes the three-dimensionality of space (Ehrenfest [1], Tangherlini [2]); the full argument belongs to the framework [17]. The factor 3 of the field equation follows from this. The counting that fixes the presence fraction $f = 1/16$ (Supplement) bears on something else — the directions through which an excitation leaves the interface, four in number: the three of the interface itself and its normal. The two countings are independent: one bears on what the interface separates, the other on the exits it offers.

What the construction posits. Five statements are posited upstream of what follows, and the complete framework [17] establishes them: the linearity of the field equation in the displacement u ; the exponential clock rate $e^{(2\kappa u)}$ carried by that displacement; the counting of the channels through which an excitation leaves the interface, which fixes the presence fraction; the coefficient $4/3$ of the interference term, whose two factors read off the shape equation in spherical geometry (Supplement); and the relation between the tension σ , the vacuum energy density and Newton's constant, which fixes the scale. The present Letter establishes none of these five points: it takes their observable consequences and makes them testable.

1.5 What the construction fixes before any number

Four structural properties hold independently of the numerical predictions below, and can be checked by reading the equations rather than by measuring anything.

Exact many-body composition. The field equation is linear in the displacement u , so the displacements of several sources add: $u_1 + u_2$. The clock rates, exponential in that displacement, therefore multiply — $e^{(2\kappa(u_1+u_2))} = e^{(2\kappa u_1)} \cdot e^{(2\kappa u_2)}$. The composition is exact and carries no external-field-effect parameter. This matters quantitatively: in theories whose field equation is nonlinear, the effective one-body treatment universally used for wide binaries overestimates the relative acceleration by up to 28 % for equal masses [16], a correction requiring a three-dimensional numerical solution. Here the problem that correction addresses does not arise. The nonlinearity is not absent — it resides in the dressing of the geometry, since multiplying clock rates is not adding them — but it is absent from the field equation, which is what makes the two-body composition exact.

An inherited scale, not a fitted one. The single dimensional input, the interface tension σ , follows by inversion from two quantities measured outside this regime altogether: the vacuum energy density $\rho\Lambda$ and Newton's constant G . No acceleration scale is fitted to the dynamics it is then used to predict.

A form with no latitude. The transition function admits no choice of interpolating shape: the coefficient $4/3$, the presence fraction and the 2π are each fixed by the construction. Where a family of interpolating functions leaves the predicted ratio adjustable, here it is not. The predictions below are therefore falsifiable without prior arbitration over which member of a family to test.

A threshold proper to each system. The threshold grows as $\sqrt{M}$ and the plateau is set by the baryonic field at the location of the pair: two pairs of different masses at the same place do not share a threshold, and two identical pairs at different galactocentric radii do not share a plateau. The enhancement is therefore a property of each pair, carried by its mass and by its environment. The same local Galactic field which, compared against a universal asymptotic value, leaves the target undetermined, here provides a measured input that bounds the prediction system by system.

2. The derived transition function

The dynamical ratio follows from the equilibrium $\sigma \cdot \text{Tr}(K) = \rho E$ with no fitting assumption. The control variable is the Newtonian slope $x = |\nabla u_N|$, dimensionless, referred to the front acceleration: $x = g_N/(c^2 k)$ with $c^2 k = 12\pi G \sigma / c^2$, so that the threshold equals unity at the front. This is the same normalisation as in the galactic sector, where it gives $a_0 = (5/48) \cdot c^2 k = 1.203 \times 10^{-10} \text{ m/s}^2$ and a plateau velocity of 200 km/s for $10^{11} M_\odot$: one equation, one unit, from stars to galaxies. Below the threshold, intermittency interference gives

where $f = 1/16$ is the presence fraction, a structural property: an excitation leaves the interface through a half-turn and has four directions in which to do so — the three of the interface and its normal — each halving the presence. Above the threshold, the crossing coordinate becomes evanescent: the presence of each direction then rises as $f_1(x) = 1 - \frac{1}{2} \cdot e^{-(2\pi \sqrt{x-1})}$, the total presence remaining their product $f = f_1^4$. The ratio is therefore damped by the variation of f in the unified form above, and by nothing else:

$$f_1(x) = 1 - \frac{1}{2} \cdot e^{-(2\pi \sqrt{x-1})}, \quad f = f_1^4,$$

whose factor 2π is the period of the crossing coordinate — an angle closing over one turn. None of these numbers is adjusted: the coefficient 0.323 is $(4/3) \cdot \sqrt{f(1-f)}$ evaluated at $f = (1/2)^4 = 1/16$; the framework records an alternative counting, $f = 1/18$, which would give 0.305 — the predictions below use the former, and the 5.7 % spread on the coefficient is smaller than the one separating this construction from the usual interpolations; the threshold $\sqrt{A}$ is the front, the radius where the source's Newtonian acceleration reaches $12\pi G \sigma / c^2$; the 2π comes from the phase equation of the crossing mode. The transition function is therefore not proper to binaries: it is an instance of an intermittency structure, whose other occurrences belong to the complete framework and lie outside the scope of this Letter.

The same field equation being linear in the displacement, the displacements of several sources add, and the clock rates (exponential in the displacement) multiply: $e^{(2k(u_1+u_2))} = e^{(2ku_1)} \cdot e^{(2ku_2)}$. This superposition rule, exact, fixes the effect of a local field with no parameter.

The tension and its origin. All the numerical predictions below pass through the interface tension σ . This is not a free parameter nor fitted on the binaries: it is fixed by inversion of two independently measured quantities, the vacuum energy density $\rho_\Lambda \approx 5.3 \times 10^{-10} \text{ J} \cdot \text{m}^{-3}$ and Newton's constant G ,

No acceleration scale enters this determination; the closure curvature $k = \rho_\Lambda / \sigma$ is a derived quantity. The Newtonian acceleration at the front, $12\pi G \sigma / c^2 = c^2 k$, fixes the unit of x ; that of the crossing radius, half as large, reads $6\pi G \sigma / c^2 = \sqrt{(3\pi G \rho_\Lambda)}$ — an algebraic identity once σ is defined through G and ρ_Λ . Its closeness to the scale where the analyses locate the onset of the anomaly belongs to the already known coincidence $a_0 \sim \sqrt{(G \rho_\Lambda)}$, and Section 5 states what the framework adds to it.

This relation serves here only to fix the value of σ from two measured constants: it is a parametrization, not a claim. The physical interpretation of the link between G and ρ_Λ belongs to the complete framework and lies outside the scope of this Letter. No acceleration scale enters the determination of σ , and no quantity is fitted on the binary data.

Accordingly, the exact statement of the model's economy is: the transition function comprises four equations and no parameter fitted on wide-binary data — the only dimensional scale, σ , being inherited from the cosmological sector. The comparison of the following sections with Gaia is therefore a test, not a fit.

3. Three signatures, and the central figure

The figure below compares, for a total mass of $1.5 M_\odot$, the ratio $\gamma = g_{\text{obs}}/g_N$ predicted by the framework and by MOND with external-field effect (simple interpolating function, external field $g_{\text{ext}} = 1.8 a_0$), both passed through the same projection machinery (projected separations and velocities, thermal eccentricity distribution, orbital phases), so as to be compared on equal footing in the observable plane. For reference, the published AQUAL predictions for wide binaries give a plateau $\gamma \approx 1.35\text{--}1.40$. Newtonian gravity (dotted) serves as reference.

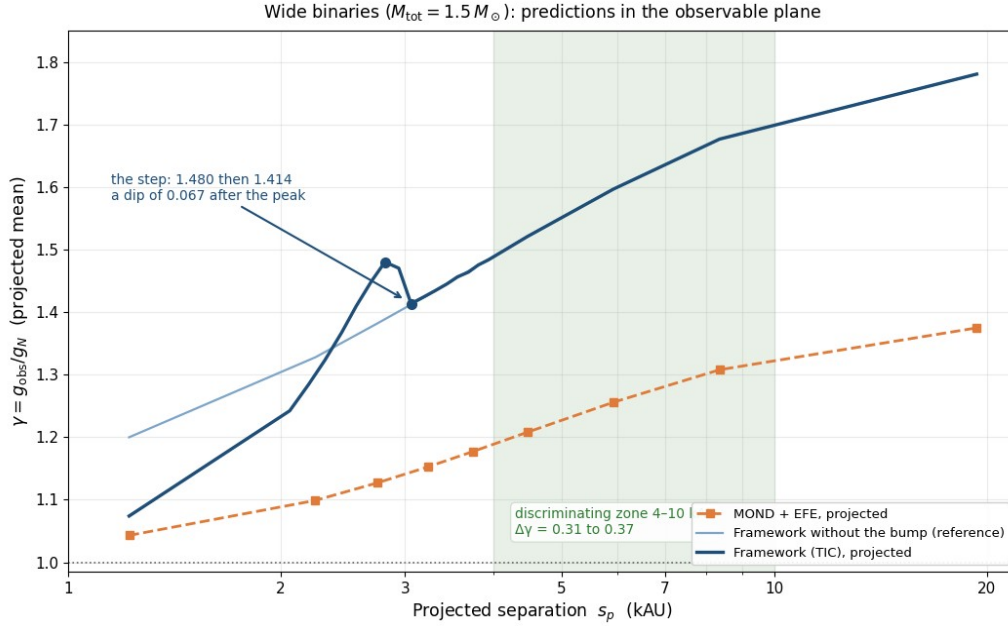


Figure 1. Predictions in the observable plane (means projected over eccentricities and phases). Below ~ 3 kAU, projection renders the two models indistinguishable; between 2 and 5 kAU the framework rises twice as fast, and between 4 and 10 kAU the gap with MOND is 0.31 to 0.37 in dynamical ratio, in a zone accessible to Gaia DR3. The interference maximum leaves, after projection, a shoulder at 2–3 kAU: it is the shaded gap between the framework curve and the thin trace, which gives the same prediction without the bump. No monotonic MOND-type interpolation can produce such a shoulder.

The three signatures follow from the construction; the height of the plateau further involves a measured quantity, the local baryonic slope.

(1) The step. Two distinct radii enter here and must not be conflated. The threshold is the front: the place where the Newtonian acceleration reaches the universal front acceleration $12\pi G\sigma/c^2 = c^2k$. It falls at $rt = \sqrt{A}$, equals $0.322 \cdot r_{\text{MOND}}$, and grows as $\sqrt{M}$ — 1,603 AU at $0.5 M_{\odot}$, 2,776 at 1.5, 3,583 at 2.5. That is where the transition operates. The crossing radius $\sqrt{(2A)}$, where the acceleration is half that of the front, is a different place and does not mark the turnover. Composition with the background field then moves the observable crossing inward, the background slope adding to that of the source. The $\sqrt{M}$ scaling is shared with MOND and therefore does not discriminate on its own; it is the coefficient 0.322 — which places the framework's step well inside the MOND radius — and the abrupt character of the transition that distinguish the two predictions. Sorting the binaries by mass and measuring the position of their transition thus constitutes a test in its own right.

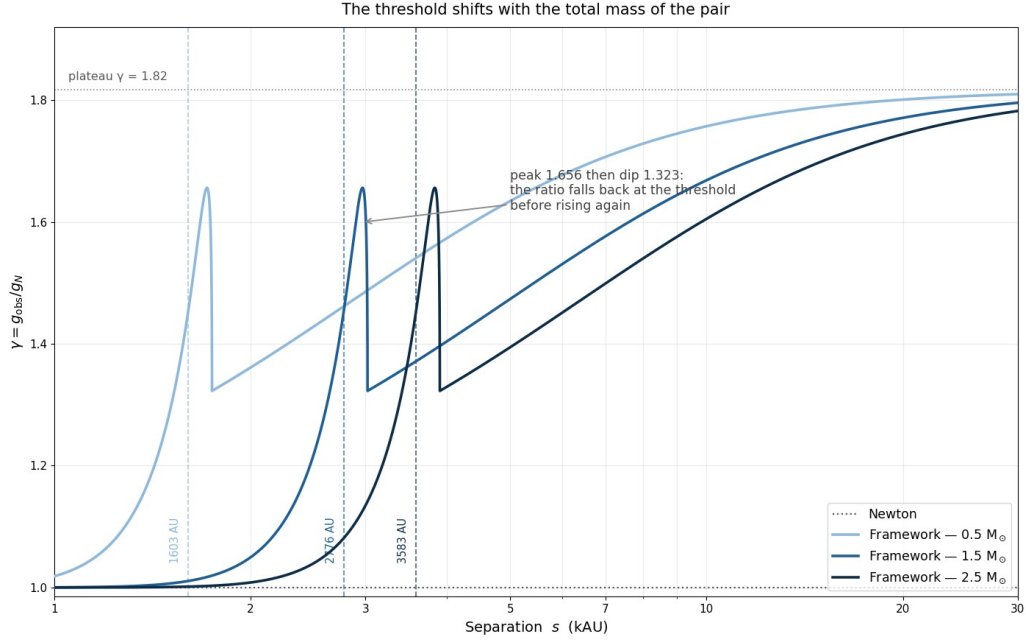


Figure 2. The crossing shifts with the total mass of the pair and with the background field. The dashed lines mark the threshold at the front, $rt = \sqrt{A} \propto \sqrt{M}$, where the Newtonian acceleration reaches $12\pi G\sigma/c^2$. Sorting the binaries by mass and measuring the position of their transition constitutes a test in its own right, independent of the plateau height.

(2) The steepness. In the physical plane, the dynamics remains Newtonian below the threshold then rises abruptly; projection onto the observables softens this step, but the rise remains markedly steeper than that of the usual interpolations, and it is in the region of the step that it must be measured. Between 2 and 5 kAU projected, the framework's ratio goes from 1.30 to 1.52, against 1.10 to 1.21 for MOND: a rise twice as steep in that window (Table 1) — this is the ratio of the slopes between 2 and 5 kAU, not an intrinsic property of the law. Beyond that the step has been crossed and it is the gap that remains — between 4 and 10 kAU it is 0.31 to 0.37, in the sense that the framework is higher.

(3) The plateau. The framework reaches its asymptotic plateau, $\gamma \approx 1.80$ – 1.90 depending on the local baryonic slope, the projection reading only 1.78 at 25 kAU; it does so by about 7 kAU, while MOND keeps growing beyond 20 kAU without attaining it. The height of this plateau comes not from the framework but from a measurable, local input: the value of the baryonic slope $\bar{g}_B$ at the location of the pair. The framework therefore predicts that the plateau is not universal — it rises where the background baryonic field is weaker. On the current sample, this input is nearly uniform and the plateau constant; its variation with the local environment is a testable prediction, distinct from the height itself.

Smoothing assumptions. The projected values above result from a draw of 6×10^5 systems with log-uniform semi-major axes, thermal eccentricities and sampled orbital phases, under isotropic line of sight. This is a first-order smoothing: the orbits are drawn through Kepler's equation, and it includes neither selection cuts, nor measurement noise, nor integration under the modified force. This law not being Keplerian — it makes the orbit precess by of order 37° per revolution — the Supplement redraws the radius with the time density of the potential itself, $dt \propto dr/|v_r|$: the shoulder is unchanged to within 0.003 in every bin. A complete confrontation with data would require a statistical inference of the kind employed by recent analyses; it constitutes the next step and is not undertaken here.

Reproducibility. Every number in this Letter is produced by a standalone script deposited with it, taking only measured constants as input: `reproduce_letter.py`. It recomputes the tension and the derived scales, the transition function, Table 1 through the projection chain described above, the shoulder, the sensitivity to the local baryonic slope, and Table 2 from the Gaia sample rebuilt by the query given. The orbit-integration module used for the checks, `nonkeplerian_dynamics.py`, is included and carries its own tests.

Correspondence. Section 1 of the script produces σ , the threshold acceleration, the three rt and the ratio $rt/r_{\text{MOND}} = 0.322$; Section 2, the transition function, the match at the threshold and the peak; Section 3, Table 1 and Figure 1; Section 4, the projected shoulder; Section 5, the plateau against the local baryonic slope; the `--table2` option produces

Table 2. The accompanying module runs on its own and returns its own checks, including the precession per orbit. The sample of Table 2 is rebuilt by a Vizier query on catalogue J/MNRAS/506/2269; BinType = MSMS, $R < 0.01$, $200 < \text{sepAU} < 40000$, $\text{Plx1} > 5 \text{ mas}$, $\text{RPlx1} > 100$, $\text{RPlx2} > 100$, $\text{RUWE1} < 1.2$, $\text{RUWE2} < 1.2$; masses follow the magnitude–mass relation of Banik et al. [6], inverted on its monotone branch, the inversion being included in the script. SHA-256 fingerprints of the two files, truncated to twelve characters: 5d2f2e88f2b3 and 25e7351c6a74.

The table gathers the projected values of Figure 1.

s_p (kAU)	1–1.5	2–2.5	2.5–3	3–3.5	3.5–4	4–5	5–7	7–10	15–25
Framework (TIC)	1.09	1.30	1.45	1.43	1.47	1.52	1.60	1.68	1.78
MOND + EFE	1.05	1.10	1.13	1.15	1.18	1.21	1.26	1.31	1.37
Newton	1	1	1	1	1	1	1	1	1

Table 1. Keplerian projection of the force ratio, not integrated orbits: $\gamma = \text{gobs/gN}$ averaged in the observable plane, at fixed $M_{\text{tot}} = 1.5 M_{\odot}$ as a function of projected separation s_p . Orbits are drawn through Kepler's equation and the mass is not resolved; a real catalogue mixes masses, which moves the front from 1,600 to 3,600 AU over the 0.5–2.5 $M_{\odot}$ range and smooths the fine structure. Values computed at $\text{gbar} = 1.80 \times 10^{-10} \text{ m/s}^2$; the 1.5–1.9 range moves the plateau from 1.90 to 1.80 (Section 5).

The framework predicts in addition a fine bump of the ratio just above the threshold. The same chain that fixes the slope below the threshold governs the regime above: only the presence fraction changes. Below the threshold, equipartition fixes it at $1/16$; above, the crossing coordinate becomes evanescent and the presence of each of the four directions rises as $f_1(x) = 1 - \frac{1}{2} \cdot e^{(-2\pi\sqrt{x-1})}$, the total presence being their product, $f = f_1^4$. The match at the threshold is exact and unadjusted: f_1 equals $\frac{1}{2}$ there, so $f = (\frac{1}{2})^4 = 1/16$, the equipartition value — the ratio is continuous. It reads, on both sides, in a single form, $\text{gobs/gN} = 1 + (4/3) \cdot \sqrt{(f(1-f))}/\sqrt{x}$, and peaks where the interference is maximal, $f = \frac{1}{2}$, reached at $x = 1.03$: $\gamma = 1.656$, with no parameter. The curve then falls back to 1.323 at the threshold itself, and rises again toward the plateau — a narrow peak followed by a dip of 0.33, before the final climb. In separation this peak falls at 1.07 rt — 2.97 kAU for 1.5 $M_{\odot}$ — with the dip just beyond. Projection smooths them without erasing them: the mean ratio peaks at 1.480 between 2.75 and 2.88 kAU, falls back to 1.414 between 3.00 and 3.13, then resumes its climb. A step of 0.067, reproducible, in the observable plane.

4. Testability

Immediate (Gaia DR3). The discriminant lies between 4 and 10 kAU projected, where the gap between the framework and MOND is 0.31 to 0.37 in dynamical ratio, i.e. a relative-velocity difference of 12 to 13 %. Given a per-pair dispersion of about 35 % (projection and eccentricity), of order 150 to 300 pairs would separate the two models at 3–5 σ in this zone. This count covers measurement noise alone; contamination by unresolved companions, which recent analyses place at the heart of the debate, would raise it. By a clean pair we mean here a system passing the usual cuts of gravity tests — relative parallax better than 20 %, projected relative velocity compatible with a bound state, rejection of resolved companions and chance alignments; the required count is comparable to that of current deep Gaia DR3 samples. Below about 3 kAU, by contrast, projection renders the two models indistinguishable: this zone does not discriminate.

Forthcoming (Gaia DR4). The plateau height is read on a few hundred pairs beyond 10 kAU; the fine bump requires a mass-resolved sample.

Solar-system limit. At small separations, the Newtonian slope x becomes very large and the extinction factor $e^{(-2\pi\sqrt{x-1})}$ suppresses any deviation. Near the Sun, x is of order 10^5 at 10 AU and grows further inward: x there exceeds 10^5 , and the exponential suppression places the departure beyond any ephemeris precision, so that the dynamics of bound systems there remains Newtonian well beyond the precision of the ephemerides. This statement concerns the weak-field dynamics treated here; the relativistic observables — deflection, Shapiro delay, light propagation — involve the response of the interface at higher order and are not covered. The modified regime is confined to very low accelerations.

4.5 The published measurements, and what the comparison establishes

Several analyses cover the window where this prediction is decided. Banik et al. [6], Cookson et al. [10] and Saad & Ting [13] conclude in favour of Newtonian or near-Newtonian behaviour; Chae et al. [14] and Hernandez et al. [7] instead maintain an anomaly of order $\gamma \approx 1.6$. Taken at face value, the former exclude the value predicted here, and more strongly than they exclude MOND, since this prediction is higher. Our own execution sheds light on part of that disagreement: in the control window inside the threshold, where everything should be Newtonian, the cuts of [14] give a median $\hat{\gamma}$ 14.5 % above the Keplerian prediction and those of [10] 14.0 % below it — the two selections do not agree on the reference before the transition is even examined. It must be added that the published anomaly itself, $\gamma \approx 1.4$ to 1.6, is lower than the predicted plateau: the discriminant does not only set Newton against modified dynamics, it sets this construction against the other readings of that regime. If the anomaly is confirmed around $\gamma \approx 1.5$, this construction is excluded just as Newton is for the analyses that maintain it — and the range of the local baryonic slope, which moves the plateau from 1.90 to 1.80, cannot bring it closer. A fact from our own execution bears on this disagreement: in the control window, inside the threshold for every mass, the two published sets of cuts depart from the Keplerian reference in opposite directions — that of [14] by +12 to +14.5 % depending on the mass relation, over 34,892 pairs; that of [10] below it, at $p = 0.014$ over 120 pairs, by an amount that this sample size does not determine — and require eccentricity distributions on either side of thermal. Before the transition itself, the two selections do not agree on what Newtonian means; whatever is measured beyond adds to that offset.

What Table 2 carries. Both predictions are given on a sample anyone can reconstruct. Inside the threshold the extinction factor suppresses any deviation and the prediction is exactly 1.00 — where a continuous interpolation departs from Newton as soon as the acceleration approaches its scale. Beyond, the step is crossed and the difference changes sign. Both curves then reach a plateau: 1.58 here, 1.40 for MOND with external-field effect; the gap does not grow without bound, it settles near 0.18 beyond 8 kAU. The 1–3 kAU range, used as a Newtonian control regime, therefore separates the two hypotheses as well as the discriminating zone does, with a difference of opposite sign and three quarters of the pairs.

What a single factor can establish. The statistical methods that infer a single enhancement across a wide separation window [15] take it to be constant within that window. The prediction established here varies by a factor 1.5 inside that window. The product of a law factor and a fitting residual is constrained by the data; the split between the two is not. Two laws predicting enhancements 13 % apart thus return almost identical total factors, the residual absorbing the difference. Testing a threshold transition therefore requires injecting the function into the inference chain and comparing the recovered factor with that of the data — the procedure Chae [14] describes as necessary for testing a non-standard model. A reservation is due on what that injection can settle: a single global factor together with a free semi-major axis per system does not test a law whose ratio varies with separation — we checked this by injecting three laws into the chain of [13], which return total factors 1.9 % apart for predicted enhancements 11.9 % apart. The useful comparison is between the likelihoods of three closed dynamics with no free factor, and it does not yet exist. The shape-test protocol — deposited before any execution on 14 September 2026 under 10.5281/zenodo.22715013, which fixes its priority — has been run on Gaia DR3 with the cuts of [14]: it does not recover the predicted location — the knee falls at $\xi = 3\,691$, between the two windows — and its mass-mixing control shows that the observed rise is not structured by mass. It does not conclude, for want of a model of unresolved companions which alone would separate modified gravity from growing contamination, and it awaits DR4. The prediction is therefore neither confirmed nor refuted, and the burden of carrying that test through is ours. Table 2 compares two models with each other; it does not show the agreement of either with the observed velocities.

Separation (kAU)	Pairs	Framework (TIC)	MOND + EFE	Difference
0.2–1	9,176	1.00	1.01	–0.01
1–2	4,278	1.00	1.03	–0.03
2–3	1,999	1.03	1.08	–0.05
3–5	1,950	1.33	1.14	+0.19
5–8	1,191	1.41	1.24	+0.17
8–15	1,054	1.49	1.32	+0.17
15–40	674	1.55	1.37	+0.18

Table 2. A model-to-model comparison, with no confrontation to observed velocities: median predicted γ per separation bin, on 20,322 pairs from El-Badry et al. (2021) with Chae's cuts. The sign of the difference reverses at the threshold: the 1–3 kAU range, treated as a Newtonian control regime, separates the two hypotheses as well as the discriminating zone does.

5. Scope

We provide discriminating curves and the corresponding decision zones; we do not arbitrate the ongoing observational controversy over the existence of the anomaly. What the framework brings is a transition form — sharp threshold, step, plateau — specific and falsifiable, distinct from both Newtonian gravity and MOND-type interpolations. In particular, the plateau predicted here, $\gamma \approx 1.80\text{--}1.90$, sits above the asymptotic AQUAL value with external-field effect ($\gamma \approx 1.35\text{--}1.40$) and above recent empirical estimates ($\gamma \approx 1.4\text{--}1.5$): this height gap is in itself a discriminant. We note finally that the acceleration at the crossing radius, $6\pi G\sigma/c^2 \approx 5.8 \cdot 10^{-10} \text{ m/s}^2$ — half that of the front, which sets the threshold —, also reads $\sqrt{(3\pi G\rho\Lambda)}$: it coincides with the scale where the analyses locate the onset of the anomaly ($\approx 5 \cdot 10^{-10} \text{ m/s}^2$) and belongs to the family of constructions relating the transition acceleration scale to the cosmological vacuum, and the framework's own contribution is not this scale — common to those constructions — but the form of the transition: a threshold at the front, $r_t = 0.322 \cdot r_{\text{MOND}}$, its abruptness, and a plateau whose height is indexed on the local baryonic slope.

We further note that this threshold acceleration should not be confused with the front acceleration, $12\pi G\sigma/c^2 \approx 1.2 \cdot 10^{-9} \text{ m/s}^2$, which is twice it: the former is the Newtonian value at the crossing radius $r_t(GM/(2A) = 6\pi G\sigma/c^2 \approx 5.8 \cdot 10^{-10} \text{ m/s}^2$), where the dynamics deviates; the latter is a distinct derived quantity of the framework and does not enter the comparison with the observed threshold.

We remain deliberately in the context of Gaia wide binaries: this is the low-acceleration regime where data of sufficient precision exist to render the framework's predictions falsifiable. Extending the construction to other scales would call for no new ingredient, but would move the discussion outside the domain where it can be refuted; we prefer to state signatures first where they can be confronted.

We state finally what this construction does not yet have: any independent confrontation. The plateau prediction is at present in tension with the analyses concluding in favour of Newton, and in agreement with those maintaining the anomaly; the controversy being unsettled, that prediction awaits a test carried out in this form.

Finally, the transition function established here is not proper to binaries: the same construction, applied to other scales where a tension source meets the background, extends to the low-acceleration regime in general. The consequences of this extension will be the subject of separate work.

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