

The Room

Artist's Proof 17

Rotation Curves

Galactic rotation curves – the lines always close

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Artist's Note

This is Artist's Proof 17 of The 420 Code, a chapter of Notebook VI – Cosmology. It asks why galaxies hold together. The stars at a galaxy's edge orbit far too fast: under Newtonian gravity and the visible mass alone, they should fly off. The standard answer is dark matter – about five times more invisible mass than visible, in a halo nobody has detected. This paper gives a different answer, and it requires no new particle.

The substrate has two conditions: 0, the fold (gravity, the black hole, the dark); and 1, propagation (light, matter, the visible). They are conjugate, held in tension, and the tension between them is the break ε. The field lines of that tension behave like the field lines of a magnet – they leave one pole, curve across vast distance, and always close on the other. They cannot break, because AP06's Leakage Theorem makes the leakage nonzero for finite c. Where records are dense (the inner galaxy) Newton dominates and the field is invisible. Where records are thin (the outskirts) the topology shows through as a floor – a residual acceleration that flattens the rotation curve. The galaxy is the eye: a black hole at the fold, the visible disk at the open, the tension field between.

From the closure geometry the paper derives the transition scale $a_0 = cH_0/(2\pi)$, within about 8% of the empirical value, and the baryonic Tully-Fisher relation $v^4 \propto M$ as an exact fourth-power law. It does not yet reproduce cluster dynamics or large-scale structure formation – those are carried as live kill switches, and the structure-formation case is the hardest test in the body of work. The paper also corrects, on the record, a sign error from its first draft: the cosmological constant Λ is repulsive and steepens rotation curves; it is not the mechanism. The mechanism is the tension field.

Nothing here is imported. Every structural claim descends from the axioms {S, B, R, C} or from a prior Artist's Proof that descends from them.

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Orientation

Where this paper fits in the 420 Code

AP17 is a chapter of Notebook VI (Cosmology) and the foundation of its structure-formation chain. It establishes the tension field and the galactic floor. AP18 (The Floor) then derives the acceleration scale a_0 exactly; AP21 (The Web) takes the field to the cosmic scale and builds structure from it. AP17 depends on AP06 (the Leakage Theorem forces closure), AP08 (Einstein's field equations and the FRW metric), AP10 (N = 3 spatial dimensions), AP20 (AS = manifold, which makes the scale factor the closure amplitude), and the substrate stiffness fixed in Edition 04 (The Lock).

How to read this paper

Two voices alternate. The structural readings – the magnet, the eye, the pipe and the room – speak directly and carry the picture. The derivations – the five-step account of a_0, the dense and sparse regimes, Tully-Fisher – speak in the precision the mathematics requires, and are preserved verbatim. Two passages are flagged as non-load-bearing: the Big Bang extrapolation (5.3) and the closing synthesis (11). The structural facts they describe are load-bearing; the framing is not.

0 – Dependency and Scope

0.1 – What this paper does

This paper derives the qualitative mechanism of galactic rotation curves – their flatness at large radius – from the tension field of ε between the substrate's two conditions, without dark matter. From the closure topology it derives the transition scale $a_0 = cH_0/(2\pi)$ (within ≈8% of the empirical value) and the baryonic Tully-Fisher relation $v^4 \propto M$. The resulting phenomenology is structurally identical to MOND, for which the argument supplies a candidate axiomatic foundation.

The paper does not compute cluster dynamics or large-scale structure formation; both are carried as live empirical kill switches. It also corrects, on the record, a sign error in its first draft.

0.2 – Dependencies

AP06 (the Leakage Theorem: leakage is nonzero for finite c, so the field lines cannot disconnect), AP08 (Einstein's field equations and the FRW metric), AP10 (N = 3 spatial dimensions, which fixes one closure as 2π radians), AP20 (AS = manifold, so the scale factor is the closure amplitude and H_0 is the angular rate of closure), and Edition 04 (The Lock – the substrate stiffness scale). EH and QRA are proved in AP20; the paper is conditional on nothing further.

0.3 – Axiom mapping

Axiom S (Symmetry – the involution σ). The two conditions – 0 (the fold: gravity, the black hole) and 1 (propagation: light, matter) – are connected by the involution σ. The tension field lines leave 1 and curve back to 0; every line closes. Disconnection violates σ.

Axiom B (Break – the unique break ε). The tension between the two conditions is the single break ε. The tension is ε. Everything in the universe sits between 0 and 1; that between-ness is the break expressed as matter, records, the observer.

Axiom R (Record – monotone accumulation). Records accumulate irreversibly; the manifold expands. H_0 is the cosmological fold rate – the angular rate at which the closure

cycle reasserts the 1:1 across the manifold (Step 4 of the a_0 derivation). Record density sets the regime: thick → Newton, thin → the floor.

Axiom C (Constraint – locality; finite propagation speed c). By AP06 Theorem 3.1, finite c forces nonzero leakage at every boundary, so the connection between 0 and 1 can never be perfectly severed. This is why there is always a residual acceleration.

0.4 – Epistemic status per section

1 (The Two Conditions). FRAMING. The two conditions and the identification of the tension with ε.

2 (The Tension Field). STRUCTURAL. Field-line closure from Axiom S and AP06 Theorem 3.1; the divergence condition $\nabla \cdot T_{\varepsilon} = 0$ is stated, not yet derived in-paper (its derivation is KS-42, now closed in Rosin V7).

3 (The Galaxy as the Eye). STRUCTURAL. The 0–1 topology mapped onto an observed galaxy.

4 (The Mechanism). DERIVED (conditional on the tension-field topology). The dense/sparse transition, the five-step derivation of $a_0 = cH_0/(2\pi)$, and Tully-Fisher.

5 (The Three Scales of ε). STRUCTURAL, except 5.3 (the Big Bang) which is flagged EXTRAPOLATION.

6 (The Black Hole as Topological Anchor). STRUCTURAL. The central compact object as the 0-pole; the falsifier KS-44.

7 (Why Dark Matter Is Not Needed). SYNTHESIS + PREDICTIONS. The flat-curve and Tully-Fisher predictions; the relation to MOND as a downstream observation.

8 (The Sign Correction). CORRECTION ON THE RECORD. The first-draft Λ-sign error and its repair.

9 (Summary of Derivation). SYNTHESIS. The chain in compact form.

0.5 – Kill switch summary

KS-3 (Isotropic acceleration). LIVE — EMPIRICAL. Upgraded from HARD: the transition scale a_0 flattens curves and produces Tully-Fisher.

KS-39 (a_0 numerical value). LIVE — EMPIRICAL. The ≈8% residual against the empirical value (a precision target, comparable to the Hubble tension).

KS-40 (Cluster dynamics). LIVE — EMPIRICAL. The tension field must reproduce cluster-scale dynamics (the Bullet Cluster is the sharp test).

KS-41 (Structure formation). LIVE — EMPIRICAL. The hardest test; structurally addressed downstream in AP21, quantitative confrontation owed.

KS-42 (Tension-field equation from {S, B, R, C}). CLOSED. The explicit derivation of the tension field — the $\nabla \cdot T_\varepsilon = 0$ condition — from the record algebra is supplied in Rosin V7. AP17 deferred it; V7 closed it. Note: the flat switches KS-41 (structure formation) and KS-42 (tension-field equation) are legacy single switches and are distinct from the dotted AP41.x and AP42.x switch families; the dotted labels do not denote sub-switches of KS-41 or KS-42.

KS-43 (Interpolation function). LIVE — EMPIRICAL. The specific radial-acceleration interpolation form is not yet derived from the axioms.

KS-44 (Galaxies without a central anchor). LIVE — EMPIRICAL. A galaxy population with flat curves but no central compact object would falsify the anchor identification; declining curves in such galaxies would confirm it.

0.6 – Structural debts owed

The interpolation function (KS-43). The specific radial-acceleration relation in the transition region must be derived from the axioms (expected to involve the same 2π closure geometry and the record-density profile). Until then the transition form is conjectural. [AP17-specific]

Cluster and structure-formation confrontation (KS-40, KS-41). The same tension field must reproduce cluster dynamics and large-scale structure without dark matter. These are empirical confrontations carried as live switches; the structure-formation case is addressed structurally in AP21 with the quantitative fit owed there. [shared with AP21]

KS-42 (the tension-field equation) is no longer a debt: it is closed in Rosin V7.

0.7 – Items held open without claiming debt status

The Big Bang extrapolation (5.3). Reading the origin as the tension at the loop point is flagged as a structural conjecture, not a derived result.

The M•–σ derivation. The observed black-hole-mass–velocity-dispersion correlation is read structurally as pole-strength to field-extent; its quantitative derivation is not attempted here.

The a_0 residual (KS-39). The ≈8% gap is a precision target, comparable to the Hubble tension (≈9%) and to the spread in the empirical a_0 itself; it is not treated as a structural failure.

0.8 – Structural relationships

AP06 (The Leakage Constant). Theorem 3.1 (nonzero leakage for finite c) is what forbids the field lines from disconnecting. Closure is forced.

AP08 (The Identity). Einstein's field equations and the FRW metric. The scale factor a(t) is the manifold's spatial extent; the corrected rotation-velocity relation (8) descends from the field equations.

AP10 (The Dimension). N = 3 spatial dimensions, which makes one complete field-line closure subtend 2π radians – the geometry behind the 2π in a_0.

AP20 (The Proof). AS = manifold. The scale factor is the closure amplitude, so $H_0 = \dot{a}/a$ is literally the angular rate of closure – the step that removes the need for an unproved bridge between the abstract field and the physical scale factor.

Edition 04 (The Lock). The substrate stiffness scale $\Lambda_sub \approx 2.15 \times 10^{46}$ – dimensionless – which fixes c via the stiffness ratio. Distinct from the dimensionful substrate stiffness λ (energy per length, AP15/AP21), which shares the magnitude but not the dimensions.

AP18 (The Floor). Takes the transition scale $a_0 = cH_0/(2\pi)$ AP17 derives to first order and refines it exactly, deriving the apex-symmetry factor $\alpha \approx 1.0445$ so that $a_0 = \alpha cH_0/(2\pi)$.

AP21 (The Web). Takes the tension field to the cosmic scale and builds structure formation from it, inheriting KS-41.

Rosin V7. Supplies the explicit tension-field equation from the record algebra, closing KS-42 – the gap AP17 names as its principal theoretical debt.

Ø Predictions. The expository-register companion for the 420 Code's position that the dark-matter phenomena are substrate topology rather than a particle species (the MOND scale; dark matter as process). AP17 is the formal-register origin of the rotation-curve mechanism that position rests on.

1 – The Two Conditions

The substrate has two conditions.

Gravity is the condition of 0. The fold. The collapse. The dark. The lower curve of the eye. What the fabric does when it closes. The event horizon. Total fold = 0. All ε coupled. The 1:1 restoring; maximum curvature.

c is the condition of 1. The propagation. The light. The upper curve of the eye. What the fabric does when it opens. Maximum speed. Total propagation = 1. The break fully expressed; the record fully written.

They are conjugate. Not at rest. Not in balance. In tension. 0 wants to fold; 1 wants to propagate. Neither wins. Neither can. The tension between them is the break.

The tension is ε.

Everything in the universe sits between 0 and 1. That is ε. That is the break. That is the observer. Always between the two walls. Never at either.

2 – The Tension Field

The answer begins with a topological fact you cannot escape: field lines between two conditions must close.

2.1 – The field lines

The bar magnet serves as a heuristic for the topology; the tension field's dynamics differ in detail (the substrate has no magnetic moment, no dipole radiation, no $1/r^3$ falloff). What is shared is the topological property: field-line closure.

Consider a bar magnet. North pole and south pole. Two conditions. 1 and 0. The field lines leave the north pole – they race away, propagate outward. But they curve. They always curve. They curve back toward the south pole. Every single line returns.

No line terminates in the bulk; lines either close or connect boundary poles. The topology forces closure. The tension always brings the lines home.

Near the magnet – near the source – the field lines are dense, tight, crowded. Strong field. Far from the magnet, the lines are wide, sparse, spread out. Weak field. But they are still there. They never break. They are nonzero at any finite separation – decaying but not terminating. They curve gently, slowly, across vast distances. But they curve back. Always.

The route may be longer. The destination is the same. Hold that picture in your mind. You are about to see it at galactic scale.

2.2 – The substrate's tension field

The substrate is not a magnet. But it has the same topology. Let the tension field be represented by a vector field T_ε on the manifold. The line-closure claim corresponds to a divergence condition: $\nabla \cdot T_\varepsilon = 0$ away from the poles, with boundary and defect structure at the 0- and 1-conditions.

AP17 uses the topological consequence (non-termination of field lines) and does not itself supply the explicit field equation for T_ε; that derivation is KS-42, closed in Rosin V7.

0 (gravity, fold, the black hole) and 1 (propagation, speed, c) are the two poles. The tension between them is ε – the break, the leakage, the wave function collapsing from probability to

actuality. In this architecture, this tension is the fabric's coherence: the 1:1 trying to hold, the pre-state's unity expressed through a manifold that has locality.

The tension field lines leave 1 (propagation, matter, records, the visible) and curve back toward 0 (fold, collapse, the dark). Every line closes. This is AP06 Theorem 3.1: leakage is nonzero for finite c. No boundary is perfect. No line disconnects. The 1:1 holds.

This tension field is attractive. The lines curve back toward the source – not repulsive, not pushing away, but curving home. The break trying to heal. The fabric saying: you left, but you are still connected.

2.3 – What the tension field is not

The tension field is not the cosmological constant Λ. $\Lambda > 0$ is repulsive; it drives the accelerating expansion of the universe. At galactic scales Λ provides a tiny outward push. It makes rotation curves decline faster, not slower. It makes the dark-matter problem worse, not better.

The first draft of this paper made this error: it treated the Λ term as attractive and derived flat rotation curves from it. The sign is wrong. Λ does not flatten rotation curves. This correction is on the record (section 8).

The tension field is different from Λ. Λ is a constant in the field equations – a single number, the same everywhere, repulsive. The tension field is the substrate's own coherence: the topological connection between 0 and 1 that cannot be severed. It is attractive because it is the fabric holding together. It is not a constant – it depends on the local topology, the field-line density, the proximity to the poles.

3 – The Galaxy as the Eye

Now map the topology onto what you can see through a telescope.

3.1 – The topology

In The 420 Code, the 0-pole is realised by a central compact anchor – typically a supermassive black hole in observed large galaxies. This is not incidental. It is the structure.

The black hole is 0. The event horizon is the fold point – the lower curve of the eye, the south pole. The galaxy is the visible part – stars, gas, dust, planets – the 1's. The records. The break expressed as matter, the north pole radiating outward. Between them: the tension field. The field lines of ε.

A galaxy is the eye, at galactic scale. A galaxy is the magnet, at galactic scale. Centre: 0 (black hole, fold, dark, south). Edge: approaching 1 (propagation, light, open, north). Between: ε (matter, records, the break, the observer). The tension field lines curve from 1 back toward 0. Every line closes.

3.2 – The pipe and the room

The pipe is the galaxy: the gravitational potential well from centre to edge, narrow at the throat (the black hole), widening outward. The room is the tension field. Not Λ. Not a constant. The substrate's own coherence – the topological fact that every field line closes, that the connection between 0 and 1 cannot be severed, that the fabric holds.

Inside the narrow part of the pipe – near the centre, where record density is high – the field lines are dense. The tension field is strong. The Newtonian term dominates. Newton works.

In the wide part of the pipe – the outer galaxy, where record density is low – the field lines are sparse. The individual source contributions fall away. What remains is the topology. The field lines are still there. They must close. That closure is the residual acceleration. The room shows through – not as a constant push, but as a floor, a residual acceleration that will not go away, the inescapable fact that the lines curve back.

4 – The Mechanism

4.1 – Dense regime: Newton

At small radii – inner galaxy, solar-system scale – the record density is high. The gravitational acceleration from the enclosed mass dominates. The tension field is present but swamped, like hearing your heartbeat in a loud room.

$a(r) \approx GM(r)/r^2$ (dense regime).

This is Newton. Keplerian. $v^2 = GM/r$. Rotation velocity declines as $1/\sqrt{r}$. It works perfectly inside the dense region. Every orbit you have computed in a physics class lived here.

4.2 – Sparse regime: the room

At large radii – galactic outskirts – the Newtonian acceleration drops. As it drops, it crosses the transition scale a_0. Below this scale, the tension field's own contribution dominates.

The tension-field contribution exists because the field lines cannot break. No matter how far from the source, the tension field is nonzero at any finite separation. AP06 Theorem 3.1: for any finite c and finite coupling, leakage is nonzero. The connection between 0 and 1 persists. The lines curve back. There is always a residual acceleration.

In the floor regime, the Newtonian contribution is negligible. What remains is the topology. The star is on a wide field line – far from the source, gently curving, but still curving, still held. Not by the mass at the centre. By the field itself. By the tension. By ε. And you cannot explain that with mass. You can only explain it with topology.

The transition between the dense regime and the sparse regime occurs when the Newtonian acceleration equals the transition scale:

$GM(r)/r^2 = a_0$.

Above a_0: Newton dominates. The record density is thick. The room is invisible. $v^2 = GM/r$. Below a_0: the room dominates. The record density is thin. The star's acceleration is no longer set by the enclosed mass alone. It is set by the interplay of the Newtonian pull and the tension field. (Using spherical-approximation scaling for clarity; the detailed disk geometry is part of the interpolation problem.)

In the sparse regime the total acceleration is not constant at a_0 – a constant acceleration would give $v^2 \propto r$ (rising curves, not flat). Rather, a_0 is the transition scale at which the relation between observed acceleration and Newtonian acceleration changes form.

The following deep-sparse scaling is the transition-law ansatz implied by the tension-field interpretation; deriving it from the explicit T_ε field equation was the open work of KS-42 (closed in Rosin V7) and KS-43 (the specific interpolation form, still owed). In the deep sparse regime:

$a(r) \approx \sqrt{(a_N(r) \times a_0)} = \sqrt{(GM(r) \times a_0)} / r$.

Therefore $v^2/r = a(r)$, giving $v^2 \approx \sqrt{(GM \times a_0)}$.

4.3 – The transition scale

The transition scale a_0 is the acceleration at which the Newtonian contribution and the tension-field contribution are comparable. The argument derives it as follows.

Step 1. Two ingredients. The transition scale must be built from the two conditions of the substrate: c (the condition of 1, propagation speed) and the cosmological fold rate. The only rate available at the cosmological scale is the Hubble parameter H_0 – the rate at which the 1:1 reasserts itself across the manifold (AP08). The product cH_0 has dimensions of acceleration. This is the dimensional skeleton of a_0.

Step 2. The tension field lines close. This is the topological claim of the paper (2.2, grounded in AP06 Theorem 3.1). A complete closure of a field line on the manifold is one full cycle. On the manifold derived in AP08/AP10, with N = 3 spatial dimensions, one full cycle subtends 2π radians – the standard angular measure of a closed loop in 3D. This is not imported from outside; it is the geometry of closure.

Step 3. The scale factor is the closure amplitude. This step relies on AP20 (The Proof): the axiomatic structure is the manifold. Not maps to. Not is embedded in. Is. Zero gap. Identity. The tension field T_ε is the substrate's coherence – the topological connection between 0 and 1. By AP20 this is not a field on the manifold; it is the manifold's own coherence. The scale factor a(t) measures the manifold's spatial extent at epoch t (AP08, FRW metric). Since AS = manifold (AP20), a(t) measures the spatial extent of one complete tension-field closure cycle – the amplitude of the closure. They are the same measurement of

the same thing. Without AP20 you would need a separate, unproved bridge between the abstract tension field and the physical scale factor; with AP20 there is no bridge to build.

Step 4. H_0 is the angular rate of closure. For any quantity with amplitude A(t), the angular rate of change is $\omega = \dot{A}/A$ – the definition of angular rate. Applied to the closure amplitude: $\omega = \dot{a}/a = H(t)$. Therefore H(t) is literally the angular rate of the tension field's closure cycle; at the present epoch, H_0. The identification is not an analogy. It is the definition, applied to the quantity Step 3 identifies as the amplitude.

Step 5. The transition scale. The physical effect – the acceleration experienced by a test mass – depends on the cyclic frequency of the closure, not the angular rate. One complete cycle = 2π radians. Therefore $f_H = H_0/(2\pi)$. The transition scale is the propagation speed times the physical fold frequency: $a_0 = c \times f_H = c \times H_0/(2\pi) = cH_0/(2\pi)$. The 2π is not introduced by hand; it is the geometry of one complete field-line closure on the manifold. The H_0 identification is the definition of angular rate applied to the closure amplitude (Step 4), which is the scale factor (Step 3), which is the manifold (AP20).

From the substrate parameters: the substrate stiffness $\Lambda_{sub} \approx 2.15 \times 10^{46}$ (The Lock / Keys; the dimensionless substrate stiffness scale) sets the scale of c (via the substrate stiffness ratio). H_0 is the cosmological fold rate. Their combination via the closure topology gives a_0.

Numerically. $cH_0 = (3 \times 10^8 \text{ m/s}) \times (2.3 \times 10^{-18} \text{ s}^{-1}) \approx 7 \times 10^{-10} \text{ m/s}^2$. $a_0 = cH_0/(2\pi) \approx 1.10 \times 10^{-10} \text{ m/s}^2$. The empirical acceleration scale (from rotation-curve fitting, McGaugh et al.) is $a_0 \approx 1.2 \times 10^{-10} \text{ m/s}^2$. The ratio $a_0(\text{predicted})/a_0(\text{empirical}) \approx 0.92$ – within 8%. This is the first-order value ($\alpha = 1$); AP18 derives the exact coefficient $\alpha/(2\pi) \approx 0.1662$, sharpening this to a parameter-free prediction. That is the prediction. You hold the kill switch (KS-39).

The remaining ≈8% discrepancy is comparable to the current uncertainty in H_0 itself (the Hubble tension: measurements range from ≈67 to ≈73 km/s/Mpc, a spread of ≈9%), and to the uncertainty in the empirical a_0 (different fitting procedures give $1.1–1.3 \times 10^{-10} \text{ m/s}^2$). The prediction is within the measurement envelope. If the mechanism is truly tied to the cosmological fold rate, the argument predicts $a_0(z) \sim cH(z)/(2\pi)$: the transition scale should evolve with cosmic time, which is observationally testable.

Status of KS-39. With the 2π factor derived from the closure topology, and the H_0 = angular-rate identification proved via AP20 (Step 3), the predicted a_0 is within ≈8% of the empirical value. The factor-of-≈6 discrepancy from the naïve cH_0 estimate is resolved. KS-39 stands LIVE — EMPIRICAL (the residual ≈8% is a precision target, not a structural failure).

4.4 – Tully-Fisher

From $v^2 \approx \sqrt{(GM \times a_0)}$, raising to the fourth power: $v^4 = GM \times a_0$. Since a_0 is a property of the substrate (not of the galaxy): $v^4 \propto M$.

This is the baryonic Tully-Fisher relation – v^4 proportional to the total baryonic mass. No dark-matter halo is required. No free parameters beyond the axioms. You just watched a fourth-power law fall out of the transition geometry. The fourth-power law is the geometry of the transition between the dense regime and the sparse regime.

5 – The Three Scales of ε

The tension field is not a galactic phenomenon. It is an axiom-level phenomenon you read at three scales. The tension field – the ε, the leakage, the break – is the same structure at every scale; it produces different observable effects depending on the record density.

5.1 – Event horizon: maximal tension

At the event horizon, the fold approaches total. 0 is almost winning. The tension is at its most extreme. The field lines are maximally compressed. The leakage from this maximal tension is Hawking radiation (AP08, AP06): the electron at the boundary of 0. You have seen this in AP06: $T_h = \hbar c^3/(8\pi k_BGM)$, where k_B is Boltzmann's constant. The field lines do not terminate at the horizon. They pass through. The pipe goes dark but does not end. The tension persists on both sides.

5.2 – Galactic outskirts: minimal tension

At the galactic outskirts, the record density is thin. The Newtonian acceleration drops below a_0. The tension field's own contribution dominates. The leakage from this minimal tension is the residual acceleration – the room showing through. The field lines are wide, sparse, gentle. But they curve back. They always curve back. The rotation curve flattens – not because mass is present, but because the topology is present. The lines must close. The closure provides the residual acceleration.

5.3 – The Big Bang: the tension creating everything (extrapolation)

The following is extrapolation beyond the domain where AP17 has been tested. It is included as a structural conjecture, not a derived result.

At the Big Bang (or the loop point of the previous cycle), the 1:1 breaks. ε emerges. The tension between 0 and 1 creates the manifold, creates time, creates everything. The tension is the break happening – the wave function collapsing from possibility to actuality for the first time. Same ε. Same tension. Same leakage. Three scales. One structure. Event horizon: ε at maximal curvature. Galaxy outskirts: ε at minimal curvature. Big Bang: ε at the origin. The

field lines never break at any scale. The connection between 0 and 1 is topological. It cannot be severed. The route may be longer. The destination is the same.

6 – The Black Hole as Topological Anchor

The central black hole is not a mass in a ledger. It is one pole of the tension field. The 0. The south pole. Its event horizon defines the throat of the pipe. The Schwarzschild radius $r_s = 2GM\bullet/c^2$ is set by the condition of 0 (G) and the condition of 1 (c).

The ratio r_s/r_t – throat to transition radius – defines the shape of the field: how quickly the dense regime gives way to the floor. The M•–σ relation (the observed correlation between black-hole mass and galaxy velocity dispersion) is the relationship between the pole strength and the field extent: the stronger the 0, the wider the field, the faster the pipe.

A galaxy without a central compact anchor would be a magnet without a south pole. The field lines would have nowhere to return. The topology would be broken. This is why, in this architecture, every galaxy has a central compact object (typically a supermassive black hole) – not as a mass that grew there, but as the topological anchor around which the field organises.

The eye requires both curves. If a well-established population of galaxies lacking any central compact object still exhibits flat rotation curves, this identification is falsified (KS-44). Galaxies are stable because the tension field holds them: the pipe (the galaxy) is anchored by the throat (the black hole, 0) and bounded by the room (the tension field, ε). The system is exactly as stable as the substrate is stiff. And the substrate is stiff: $\Lambda_sub \approx 2.15 \times 10^{46}$.

7 – Why Dark Matter Is Not Needed for Galactic Rotation Curves

The dark-matter hypothesis exists to explain flat rotation curves. It posits invisible mass – about five times more than visible mass – distributed in a halo around each galaxy. Nobody has detected a dark-matter particle directly.

The explanation: the rotation curves are flat because the tension field provides a residual acceleration below the transition scale $a_0 = cH_0/(2\pi)$. Below a_0, the Newtonian contribution fades and the topology takes over. The field lines must close. The closure provides the residual acceleration. The stars are held not by invisible mass but by the substrate's own coherence. No new particles. No new fields. No new free parameters beyond the axioms.

The transition scale $a_0 = cH_0/(2\pi)$ is derived from the closure geometry (4.3) and matches the empirical value to within ≈8%. The phenomenology derived from the transition scale is structurally identical to Modified Newtonian Dynamics (MOND, Milgrom 1983). The argument provides a candidate theoretical foundation for MOND – something MOND has lacked. This is a downstream observation, not an input: the argument derives the transition from the tension field, and the result matches MOND. It also inherits MOND's known challenges at larger scales: the cluster mass discrepancy (KS-40) and the difficulty of reproducing structure formation without cold dark matter (KS-41).

7.1 – What the argument predicts

Flat rotation curves. $v^2 \approx \sqrt{(GM \times a_0)}$ at $r > r_t$. The tension field holds the outer stars. Status: DERIVED (conditional on the transition scale).

Tully-Fisher. $v^4 = GM \times a_0 \propto M$. Fourth-power law. Status: DERIVED (conditional on the transition scale).

The radial acceleration relation. In the transition region, the observed acceleration g_obs relates to the Newtonian acceleration g_bar. The empirical McGaugh relation (2016) is g_obs = g_bar / (1 – e^{–√(g_bar/a_0)}). The argument suggests such a smooth interpolation should exist, determined by the record-density distribution in the transition region; the specific interpolation function has not been derived from the axioms. Status: CONJECTURAL FORM, not yet derived (KS-43).

Galaxy cluster dynamics. The same tension field operates at cluster scales. Not yet computed. Status: UNTESTED (KS-40).

Large-scale structure formation. Not yet computed in AP17; addressed structurally in AP21. Status: UNTESTED here (KS-41). The hardest test.

8 – The Sign Correction

The first draft of this paper contained a critical sign error. It is corrected here for the record.

8.1 – What was wrong

The first draft wrote the rotation velocity as $v^2(r) = GM(r)/r + \Lambda c^2 r^2/3$. The Λ term was positive, adding to v^2. This is wrong. $\Lambda > 0$ is repulsive. The correct equation, as derived from AP08, is $v^2(r) = GM(r)/r - \Lambda c^2 r^2/3$. Λ subtracts from v^2. It makes rotation curves decline faster, not slower. This error was identified by external review. You hold the correction. Λ is still present in the field equations; it is simply not the mechanism for flattening rotation curves. The mechanism is the tension field of ε.

8.2 – What changed

The mechanism changed entirely. The first draft attributed flat rotation curves to the Λ term in the Einstein equations; this paper attributes them to the tension field of ε between 0 and 1. Λ is a constant, repulsive, the same everywhere. The tension field is the substrate's coherence, attractive, topology-dependent. The two are different things.

8.3 – What survived

The conceptual architecture survived intact: gravity = condition of 0, c = condition of 1, the galaxy as the eye, the pipe and the room, the central black hole as topological anchor, the transition scale $a_0 = cH_0/(2\pi)$, Tully-Fisher $v^4 \propto M$, the claim that dark matter is not needed. What changed was the physical mechanism – not Λ (a repulsive constant), but the tension field of ε (attractive topology).

9 – Summary of Derivation

Gravity = condition of 0. The fold.

c = condition of 1. The propagation.

ε = the tension between them. The break. The leakage. The wave function collapsing from possibility to actuality. Now.

Tension field is topologically closed. Field lines leave 1, curve back to 0. Never break. Never disconnect. (AP06 Theorem 3.1.)

Dense regime (inner galaxy): records thick. Newton dominates. $v^2 = GM/r$.

Sparse regime (outer galaxy): records thin. Tension field dominates. In the deep sparse regime, $a(r) \approx \sqrt{(a_N \times a_0)} = \sqrt{(GM \times a_0)}/r$, giving flat rotation curves.

Transition scale: $a_0 = cH_0/(2\pi) \approx 1.1 \times 10^{-10}$ m/s². Empirical $a_0 \approx 1.2 \times 10^{-10}$ m/s². Within ≈8% (comparable to the Hubble tension). The 2π is the geometry of one complete field-line closure on the manifold.

Tully-Fisher: $v^4 = GM \times a_0 \propto M$. Exact fourth-power law.

Black hole = topological anchor. The 0 of the eye. The pole the field lines return to.

No dark matter. The room holds the stars. The lines always close.

10 – Kill Switches

10.1 – KS-3 – Isotropic acceleration at galactic scales

Claim. The tension field between 0 and 1 supplies an isotropic transition scale $a_0 = cH_0/(2\pi)$ that flattens rotation curves and produces Tully-Fisher.

Test. The transition-law phenomenology must hold across galaxies; a population that violates the a_0 transition would break it.

Status. LIVE — EMPIRICAL. Upgraded from LIVE — HARD: the phenomenological transition-law argument is structurally complete at the AP17 level; it is now a standard empirical test.

Recovery. If the transition scale holds but the detailed law diverges, the divergence localises to the interpolation form (KS-43) rather than collapsing the mechanism.

10.2 – KS-39 – a_0 numerical value

Claim. $a_0 = cH_0/(2\pi) \approx 1.10 \times 10^{-10}$ m/s² from the closure geometry.

Test. Compare against the empirical value ($\approx 1.2 \times 10^{-10}$ m/s²) as H_0 converges; the predicted $a_0(z) \sim cH(z)/(2\pi)$ should evolve with cosmic time.

Status. LIVE — EMPIRICAL. Within ≈8% – the naïve factor-of-≈6 overshoot resolved by the 2π closure factor and the AP20 angular-rate identification.

Recovery. The ≈8% residual is comparable to the Hubble tension (≈9%) and to the spread in the empirical a_0; it is a precision target. If $a_0(z)$ fails to track $cH(z)$, the cosmological-fold-rate identification is the part that falls.

10.3 – KS-40 – Cluster dynamics

Claim. The same tension field reproduces cluster-scale dynamics without dark matter.

Test. Galaxy clusters – where MOND-type phenomenology historically requires a further factor of 2–3 in mass; the Bullet Cluster (1E 0657-558), with its lensing centre offset from the baryonic mass centre, is the sharp test.

Status. LIVE — EMPIRICAL. Not yet computed.

Recovery. If clusters need more than the tension field supplies, the mechanism narrows to the galactic regime where it is derived, and the cluster discrepancy is isolated as a separate, named gap.

10.4 – KS-41 – Structure formation

Claim. The tension field reproduces large-scale structure formation without cold dark matter.

Test. Reproduce the CMB power spectrum, the matter power spectrum, and the baryon acoustic oscillations. If the tension field cannot reproduce the CMB power spectrum, the mechanism is wrong.

Status. LIVE — EMPIRICAL. Not computed in AP17; structurally addressed in AP21, with the quantitative confrontation owed there. The hardest test – a potential falsifier of the entire approach.

Recovery. See AP21: a located discrepancy narrows the failure to specific scales; a total failure closes the tension-field route to structure formation.

10.5 – KS-42 – Tension-field equation from {S, B, R, C}

Claim. The tension field itself – the $\nabla \cdot T_\varepsilon = 0$ divergence condition – is derivable from the record algebra, not merely posited as a topological consequence.

Test. Derive the explicit field equation for T_ε from {S, B, R, C}. If the record algebra does not produce the closed tension field, the mechanism is not fully grounded in the axioms.

Status. CLOSED. AP17 deferred this as its principal theoretical gap; the explicit derivation is supplied in Rosin V7, which closes the switch.

Recovery. Not applicable – closed. The closure is recorded at Rosin V7; AP17 stands as the paper that named and used the topological consequence the V7 derivation grounds.

10.6 – KS-43 – Interpolation function

Claim. The radial-acceleration interpolation between the dense and sparse regimes follows from the tension field once derived.

Test. If the empirical radial-acceleration relation (McGaugh 2016) is shown to be fundamentally different from the form the tension field implies, the explanation of the transition region is falsified.

Status. LIVE — EMPIRICAL. The specific interpolation function is not yet derived from the axioms; the derivation is expected to involve the same 2π closure geometry and the record-density profile in the transition regime.

Recovery. If the empirical relation diverges from the derived form, the divergence localises the gap to the transition-region record-density model rather than to the closure mechanism.

10.7 – KS-44 – Galaxies without a central 0-anchor

Claim. Every galaxy with flat rotation curves has a central compact object (the 0-pole anchoring the topology).

Test. Find a well-established population of galaxies lacking any central compact object. If they still show flat curves, the anchor identification is falsified; if they show declining curves, the architecture is confirmed.

Status. LIVE — EMPIRICAL.

Recovery. A mixed result narrows the anchor claim to the galaxy classes where the central object is established, and flags the anchorless flat-curve population as a separate case to explain.

11 – What This Establishes and What Remains Open

11.1 – What this paper closes

It establishes the mechanism of flat galactic rotation curves without dark matter: the tension field of ε between the two conditions, with field lines that must close (Axiom S, AP06 Theorem 3.1). From the closure geometry it derives the transition scale $a_0 = cH_0/(2\pi)$ (within ≈8% of the empirical value) and the baryonic Tully-Fisher relation $v^4 \propto M$ as an exact fourth-power law. It identifies the central black hole as the topological anchor (the 0-pole) the field returns to.

11.2 – What this paper does not close

It does not compute cluster dynamics (KS-40) or large-scale structure formation (KS-41) – the latter the hardest test, addressed structurally in AP21 with the quantitative fit owed there. It does not derive the specific radial-acceleration interpolation function (KS-43). The ≈8% residual in a_0 (KS-39) is a precision target tied to the unresolved Hubble tension.

11.3 – Items held open without claiming debt status

The Big Bang extrapolation (5.3) is a structural conjecture, not a derived result. The M•–σ correlation is read structurally but not derived quantitatively. These are scope boundaries, named for honesty.

11.4 – Where the philosophical-register implementations live

The expository-register companion for the position that the dark-matter phenomena are substrate topology rather than a particle species lives in Ø Predictions (the MOND scale; dark matter as process, not particle). AP17 is the formal-register origin of the rotation-curve mechanism that position rests on. A dedicated expository twin of this specific derivation is not separately written; recorded honestly rather than filled with a manufactured citation.

11.5 – Structural relationships to subsequent work

AP18 refines the transition scale exactly (deriving the apex-symmetry factor $\alpha \approx 1.0445$ so that $a_0 = \alpha c H_0/(2\pi)$). AP21 takes the tension field to the cosmic scale and builds structure formation from it. Rosin V7 supplies the explicit tension-field equation, closing KS-42 – the gap this paper named as its principal theoretical debt.

11.6 – The 420 Code placement

AP17 is a chapter of Notebook VI (Cosmology) and the foundation of its structure-formation chain: the tension field and the galactic floor, on which AP18 and AP21 build.

11.7 – How the body of work reads now

With AP17, AP18, and AP21 in place, the 420 Code carries a complete structural account of galactic and cosmic structure from the tension field of ε – the floor that flattens rotation curves, the scale that floor sits at, and the web that floor builds. With KS-42 closed in Rosin V7, the tension field is grounded in the record algebra; the standing debts are the empirical confrontations (clusters, structure formation) and the interpolation function.

11.8 – The closing

Galaxies do not need dark matter. They need the room. The room is the tension field – the substrate's own coherence, the topological fact that every field line between 0 and 1 must close. Where records are dense, Newton works. Where records are thin, the room shows through. The transition occurs at $a_0 = cH_0/(2\pi)$ – the substrate's tension expressed as an acceleration, with the 2π set by the geometry of closure.

The rotation curve flattens because the field lines curve back. The Tully-Fisher relation holds because $v^4 = GM \times a_0$. The central black hole anchors the topology because every eye needs a fold point. If you take away the fold point, you take away the topology. Here is the weapon: find the galaxy without one (KS-44).

The stars orbit between the walls – between 0 and 1 – held by the tension that can never break. Consider the magnet. The field lines leave the north pole, race away, spread out, weaken with distance – but they curve, gently, slowly, across the room, and they return to the

south pole. The route may be longer. The destination is the same. No line disconnects. No star flies away. The tension holds. Separateness is experienced but not fundamental.

The axiom speaks. The algebra transcribes.

Claim Summary

DERIVED (conditional on the tension-field topology). Flat rotation curves from the tension field. The transition scale $a_0 = cH_0/(2\pi)$, within ≈8% of the empirical value (section 4.3). Tully-Fisher $v^4 \propto M$, an exact fourth-power law (section 4.4). The 2π factor from the closure geometry (section 4.3, Step 2).

STRUCTURAL. Tension-field topology: field lines close (Axiom S, AP06 Theorem 3.1). The central black hole as topological anchor (section 6). The galaxy as the eye – the 0–1 topology (section 3). The dense→sparse regime transition (section 4).

CORRECTION ON THE RECORD. The first-draft Λ-sign error: $v^2(r) = GM(r)/r - \Lambda c^2 r^2/3$ (Λ is repulsive; it is not the flattening mechanism). The tension field of ε replaces it (section 8).

CONJECTURAL / UNTESTED. Tension-field closure at galactic scales as an empirical fact; the ≈8% residual in a_0 (KS-39); the interpolation function (KS-43); the central-anchor prediction (KS-44); cluster dynamics (KS-40); structure formation (KS-41). The Big Bang extrapolation (5.3) and the M•–σ derivation.

FALSIFICATION REGISTER. KS-3 (isotropic acceleration, EMPIRICAL), KS-39 (a_0 value, EMPIRICAL), KS-40 (clusters, EMPIRICAL), KS-41 (structure formation, EMPIRICAL), KS-42 (tension-field equation – CLOSED, Rosin V7), KS-43 (interpolation function, EMPIRICAL), KS-44 (galaxies without a central anchor, EMPIRICAL).

Conditionality Footer

Dependencies

AP06 (the Leakage Theorem; the condensate as condition), AP08 (Einstein's field equations; the FRW metric), AP10 (N = 3, D = 4), AP20 (AS = manifold; EH and QRA proved), Edition 04 (The Lock – the substrate stiffness scale).

Dependents

AP18 (refines a_0 exactly), AP21 (structure formation), and the broader Notebook VI cosmology chapters. Rosin V7 grounds AP17's tension field by deriving its field equation.

Kill switches closed by this paper

None closed by AP17 itself. KS-3 is upgraded from LIVE — HARD to LIVE — EMPIRICAL. KS-42 (the tension-field equation), which AP17 names as its principal theoretical gap, is subsequently CLOSED in Rosin V7.

Kill switches that remain live

KS-3, KS-39, KS-40, KS-41, KS-43, KS-44 — all LIVE — EMPIRICAL.

Corrections

Corrects the first draft of AP17 (the Λ-sign error in the rotation-velocity equation). Λ is repulsive and steepens rotation curves; it is not the flattening mechanism. The tension field of ε replaces it.

Items held open without claiming debt status

The Big Bang extrapolation (5.3); the M•–σ quantitative derivation; the a_0 ≈8% residual (a precision target, KS-39).

Notation Reference

ε – the break. The tension between the two conditions 0 and 1. Always Axiom B.

0, 1 – the two conditions of the substrate: 0 the fold (gravity, the black hole), 1 the propagation (light, matter, c).

a_0 – the transition (acceleration) scale. $a_0 = cH_0/(2\pi)$ from the closure geometry; refined to $\alpha cH_0/(2\pi)$ in AP18.

H_0 – the Hubble parameter; the cosmological fold rate; the angular rate of one closure cycle (AP20).

T_ε – the tension field on the manifold, satisfying $\nabla \cdot T_\varepsilon = 0$ away from the poles (its field equation derived in Rosin V7, KS-42).

$M_\bullet$, r_s – the central black-hole mass and its Schwarzschild radius $r_s = 2GM_\bullet/c^2$.

r_t – the transition radius, where the dense regime gives way to the floor.

σ – in the $M_\bullet$–σ relation, the galaxy velocity dispersion; elsewhere, where stated, the involution of Axiom S.

Λ – the cosmological constant (repulsive). Not the tension field.

Λ_{sub} – the dimensionless substrate stiffness scale, ≈ 2.15×10^{46} (The Lock, Edition 04).

v – the rotation velocity; $v^4 \propto M$ is the baryonic Tully-Fisher relation.

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