

The Floor

Artist’s Proof 18

Acceleration Scale

$a_0 = \alpha c H_0/(2\pi)$ — the MOND scale, and a parameter-free H_0 = 74 km/s/Mpc

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Artist’s Note

This is Artist’s Proof 18 of The 420 Code, a chapter of Notebook VI — Cosmology. AP17 told you the room holds the stars: the tension field of ε, topologically closed, provides a floor acceleration that flattens galactic rotation curves. But AP17 only claimed the scale of that floor — $a_0 \approx cH_0$. It did not derive it. This paper derives it: every factor, every coefficient, from the axioms {S, B, R, C} and the one bridge hypothesis (the Embedding Hypothesis, proved in AP20).

The derivation runs through the widest closing field line, which reaches the Hubble radius $R_h = c/H_0$ and curves back at the gentlest possible curvature $1/R_h$. Its apex acceleration is $c^2/R_h = cH_0$. The dipolar topology — which AP17 merely asserted — is here forced from {S, B, C} by the Poincaré–Hopf theorem, giving a loop of circumference $2\pi R_h$ and a coherent fraction $1/(2\pi)$. Axiom R’s monoid additivity (Lemma 1) makes the acceleration scale linearly with that fraction. The result is $a_0 = \alpha cH_0/(2\pi)$, with the correction factor $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$ computed exactly from the S^2 dipole’s flux conservation. No free parameters.

At $H_0 = 74$ km/s/Mpc the prediction matches the empirical MOND scale to within measurement uncertainty (sub-percent). Read the other way, the argument predicts the Hubble constant from galactic rotation curves: $H_0 = 2\pi a_0/(\alpha c) \approx 74$ km/s/Mpc — a parameter-free value sitting in the contested window of the Hubble tension. The functional form and the exact coefficient are derived; what remains open is empirical: whether H_0 converges where the floor says it should.

Nothing here is imported. Every step descends from the axioms or from a prior Artist’s Proof that descends from them. You hold every step of the derivation.

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Orientation

Where this paper fits in the body of work

AP18 is a chapter of Notebook VI (Cosmology). It sits directly downstream of AP17 (The Room): AP17 establishes the tension-field mechanism and claims the floor scale; AP18 derives that scale exactly and, in doing so, derives the dipolar topology AP17 only asserted. AP21 (The Web) then takes the field to the cosmic scale, using AP18's Lemma 1 (the measure homomorphism) and the floor a_0. AP18 depends on AP06 (the Leakage Theorem forces closure), AP15 (the connection carries the causal structure), AP08/AP10 (the manifold and its S^2 link), and AP20 (the Embedding Hypothesis, proved — which makes the field-line curvature the manifold's curvature).

How to read this paper

This is the most formal chapter of the trio. The spine is a single derivation: three premises, then the widest field line, the apex acceleration, the dipole topology, the loop geometry, the linear scaling, and the exact correction factor. The formal blocks — Lemma 1, Propositions 1–3, the Theorem, and their proofs — are preserved verbatim and close with the box mark ■. The integral that fixes α you can check by hand.

0 — Dependency and Scope

0.1 — What this paper does

This paper derives the floor acceleration of the tension field — the scale AP17 claimed but did not derive — exactly, from {S, B, R, C} plus the Embedding Hypothesis (proved in AP20). The result is $a_0 = \alpha c H_0/(2\pi)$, with $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$ derived from S^2 flux conservation. The functional form and the exact coefficient $\alpha/(2\pi) \approx 0.1662$ are parameter-free. At $H_0 = 74$ km/s/Mpc the prediction matches the empirical MOND scale to within measurement uncertainty (sub-percent), and the argument inverts to a parameter-free prediction $H_0 = 2\pi a_0/(\alpha c) \approx 74$ km/s/Mpc.

0.2 — Dependencies

AP06 (the Leakage Theorem: leakage is nonzero for finite c, so field lines must close), AP15 (the connection Aμ carries the causal structure, so the tension field propagates at c), AP08 and AP10 (the manifold and its dimensionality, so the link of the source point is S^2), and AP20 (the Embedding Hypothesis proved: AS = manifold, so the field-line curvature is the manifold's curvature and the monoid embeds with an additive volume measure). It refines AP17 (The Room). EH and QRA are proved in AP20; the paper is conditional on nothing further.

0.3 — Axiom mapping

Axiom S (Symmetry — the involution σ). Field lines must close (no disconnection) — this provides the topology, the fact that there is a floor. With B and C it forces the dipole topology via Poincaré–Hopf (3.3); the Z_2 involution at the apex makes the tension symmetric, fixing $T'(0) = 0$ (3.6).

Axiom B (Break — the unique break ε). The tension is ε — the identity of what is closing. $\nu(\varepsilon) = 1$ (the minimum viable splinter) forces one source, hence (with σ) one sink: the topological minimality behind the dipole and the axial symmetry of the tension profile.

Axiom R (Record — monotone accumulation). The monoid grows cosmologically at rate H_0 — this provides the scale, the Hubble radius R_h =

c/H_0. Lemma 1 (measure additivity) provides the linear scaling of acceleration with the coherent fraction.

Axiom C (Constraint — locality; finite propagation speed c). Propagation is bounded by c — this provides the speed and the boundary: beyond R_h the expansion exceeds c and field lines cannot close. Compactness contributes to forcing the dipole via Poincaré–Hopf.

0.4 — Epistemic status per section

1 (The Problem). FRAMING. What AP17 left underived.

2 (The Three Premises). DERIVED. Closure (Axiom S, AP06), finite extent $R_h = c/H_0$ (Axioms R + C via EH), propagation at c (Axiom C, AP15).

3 (The Derivation). DERIVED (one identification, 3.5, stated as such). The widest field line, the apex acceleration cH_0, the dipole topology (Poincaré–Hopf), the loop geometry and coherent fraction $1/(2\pi)$, Lemma 1, and the exact correction factor α (Propositions 2–3).

4 (The Result). DERIVED. The Floor theorem $a_0 = \alpha c H_0/(2\pi)$, with an eight-step proof. Parameter-free.

5 (Numerical Check). EMPIRICAL. The base value, the exact value, and the match at $H_0 = 74$.

6 (What the Derivation Uses). SYNTHESIS. The load-bearing role of each axiom.

7 (The Hubble Tension). PREDICTION. The parameter-free $H_0 = 2\pi a_0/(\alpha c) \approx 74$ km/s/Mpc.

0.5 — Kill switch summary

KS-45 (2π geometric factor). LIVE — EMPIRICAL. The claim $a_0/(cH_0) = \alpha/(2\pi) = 0.1662$; testable once H_0 converges. Upgraded from HARD; all local debts closed.

KS-45.1 (Hubble prediction; was KS-46). LIVE — EMPIRICAL. The parameter-free $H_0 = 2\pi a_0/(\alpha c) = 74.3 \pm 1.2$ km/s/Mpc; testable with future H_0 measurements.

KS-45.2 (Dipole topology; was KS-47). CLOSED. The dipolar (eye) topology is derived from {S, B, C} via Poincaré–Hopf (3.3); it no longer depends on AP17's assertion.

Updated cross-references: KS-39 (the a_0 numerical value, AP17) is sharpened to a parameter-free result here (sub-percent at $H_0 = 74$). KS-42 (the tension-field equation) is not closed by AP18 — AP18 derives the floor, not the full field equation — and was subsequently closed in Rosin V7. KS-43 (the interpolation function) is not addressed by AP18.

0.6 — Structural debts owed

None. AP18 closes its local debts: the primary debt D1 (the 2π coefficient) is closed by the Poincaré–Hopf derivation of the dipole and the linear scaling from Lemma 1, and the sub-debt D1′ (the exact correction factor) is closed by Propositions 2–3 ($\alpha = 2 \ln(\sec(½) + \tan(½)) \approx 1.0445$). No free parameters remain.

0.7 — Items held open without claiming debt status

The empirical confrontation (KS-45, KS-45.1). The exact coefficient is derived; whether observation confirms $a_0/(cH_0) = 0.1662$ and $H_0 \approx 74$ awaits the resolution of the Hubble tension. The present $a_0/(cH_0) \approx 0.176$ (at $H_0 = 70$) sits above 0.1662 but within H_0 uncertainty; agreement is exact at $H_0 = 74.3$. This is an empirical pending, not a structural gap.

0.8 — Structural relationships

AP17 (The Room). Establishes the tension-field mechanism and claims the floor scale $a_0 \approx cH_0$. AP18 derives that scale exactly and derives the dipole topology AP17 asserted, strengthening AP17 from a claim to a derivation.

AP06 (The Leakage Constant). Theorem 3.1 (nonzero leakage for finite c) grounds Premise 1: field lines cannot disconnect, so closure is forced.

AP15 (The Connection). The connection A_μ carries the causal structure (Axiom C), so the tension field propagates at c — Premise 3.

AP08 / AP10 (The Identity / The Dimension). The manifold and its dimensionality. The link of the source point in a 3-manifold is S^2, on which Poincaré–Hopf forces the dipole and the $1/\sin\theta$ tension profile lives.

AP20 (The Proof). The Embedding Hypothesis proved: AS = manifold. The field-line curvature is the manifold's curvature (the curvature–acceleration identity), the monoid embeds with an additive volume measure (Lemma 1), and the scale factor is the closure amplitude.

AP21 (The Web). Uses AP18's Lemma 1 (the measure homomorphism) as the bridge from record measure to energy, and inherits the floor a_0 as the cosmic confining potential.

Rosin V7. Supplies the explicit tension-field equation, closing KS-42 — a switch AP18 explicitly does not close.

Ø Predictions. The expository-register companion for the MOND acceleration scale and the position that the dark-matter phenomena are substrate topology. AP18 is the formal-register origin of the exact a_0.

1 — The Problem

AP17 told you the room holds the stars. It did not prove it. It claimed a floor acceleration $a_0 \approx cH_0$ without deriving it from the axioms.

This paper derives it — every factor, every coefficient, from {S, B, R, C}. And the result matches observation to within measurement uncertainty.

AP17 (The Room) identifies the mechanism: the tension field of ε between 0 and 1, topologically closed, provides a floor acceleration that flattens galactic rotation curves and produces the Tully–Fisher relation $v^4 \propto M$. AP17 claims the floor is $a_0 \approx cH_0$. It does not derive it from the axioms. This paper derives it. And you are about to see every step.

The derivation uses all four axioms {S, B, R, C} and one bridge hypothesis (EH, proved in AP20). Axioms S, B, and C provide the topology and geometry; Axiom R provides the linear scaling of acceleration with the coherent fraction.

The result is $a_0 = \alpha cH_0/(2\pi)$, with $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$ derived exactly in 3.6. This matches the empirical MOND acceleration scale to within measurement uncertainty (sub-percent) at $H_0 = 74$. The factor of 2π is geometry; α is S^2 flux conservation. Neither is a parameter. You derived both.

2 — The Three Premises

Three premises. Each derived from the axioms. Together they give you the floor.

2.1 — Premise 1: Closure (Axiom S)

The two sectors $\mathcal{C}$ and $\mathcal{P}$ are connected by the involution σ (Axiom S). The tension field of ε between 0 and 1 has field lines that leave 1 (propagation, matter, the visible) and return to 0 (fold, collapse, the dark). Every field line must close.

This is not a postulate. It follows from Axiom S (the sectors are connected) and AP06 Theorem 3.1 (leakage is nonzero for finite c and finite coupling). A field line is the manifold expression of the σ-correspondence: for each element in $\mathcal{C}$, the involution requires a corresponding structure in $\mathcal{P}$. If a field line did not close, it would represent a disconnection between the sectors. A disconnection violates σ. Therefore every field line closes. You cannot break the connection.

Closure is topological. It does not depend on the strength of the field. You cannot weaken it away. A weak field line — far from the source, gently curving — still closes. It must. The topology requires it.

2.2 — Premise 2: Finite Extent (Axioms R + C, via EH)

The monoid $(\mathcal{M}, \cdot)$ accumulates records (Axiom R). Records are irreversible; the monoid grows monotonically. Under EH (proved in AP20: AS = manifold identity), the monoid admits embedding into a smooth manifold M. The manifold is the accumulated record. Cosmologically, the manifold is expanding; the expansion rate is the Hubble parameter H_0.

Propagation is bounded by c (Axiom C). The maximum distance a signal can traverse in one Hubble time $1/H_0$ is $R_h = c/H_0$. This is the Hubble radius — the boundary of causal coherence. R_h here is the recession-speed boundary the closure argument needs, not the cosmological event horizon; nothing downstream depends on the distinction. Beyond it, you lose the ability to close the loop: the manifold is expanding faster than c, the records being written faster than propagation can maintain coherence.

A field line cannot close beyond R_h. A field line that extends past R_h enters a region where the expansion velocity $v_{exp} = H_0 r$ exceeds c. There the field line is stretched faster than c can communicate the curvature needed to bring it back. The line cannot curve. It cannot close. But closure is required (Premise 1). Therefore no field line extends beyond R_h. The maximum extent of any closing field line is $R_h = c/H_0$. And that boundary gives you the scale.

2.3 — Premise 3: Propagation at c (Axiom C)

The tension field propagates at c, the rate set by the constraint. This follows from AP15 (The Connection): the connection A_μ carries the causal structure (Axiom C). The tension field is the substrate's coherence — the pre-state's unity expressed on the manifold — and its propagation speed is the propagation limit of the manifold: c.

3 — The Derivation

Four steps. Each one forced. Watch the algebra lock into place.

3.1 — The Widest Field Line

Consider the widest possible field line — the one you would draw if you wanted the gentlest possible curve — the one that extends to the maximum radius R_h before curving back. This line leaves the 1-pole (the matter, the galaxy, the visible). It propagates outward at c. It reaches R_h. At R_h, the expansion equals c. The line must curve back. It curves and returns to the 0-pole (the fold, the dark).

The curvature of the line at its apex (at R_h) is $\kappa_min = 1/R_h$. This is the minimum curvature of any closing field line. Lines that close at smaller radii have larger curvature (tighter curves); the widest line has the gentlest curve, curvature $1/R_h$. The gentlest curve in the universe. And it gives you the floor.

3.2 — The Apex Acceleration

The acceleration along a field line of curvature κ propagating at speed v is $a = v^2\kappa = v^2/R$. For the widest field line, propagating at c, with curvature $1/R_h$:

$a_apex = c^2/R_h = c^2/(c/H_0) = cH_0$.

This is the acceleration at the apex of the widest field line. It is the gentlest possible curving at the boundary of the observable manifold. It establishes the scale. The geometric correction follows.

Curvature–acceleration identification. Under AP20 (AS = manifold), the tension field’s curvature is the manifold’s curvature, which is the gravitational field. A field line’s curvature at a point is not merely analogous to gravitational acceleration — it is the gravitational acceleration, because the field line is a geodesic generator of the manifold itself. The formula $a = v^2\kappa$ therefore gives the gravitational acceleration directly, not by analogy. You are reading the manifold’s own curvature.

3.3 — The Dipole Topology (derived from {S, B, C})

Before computing the loop geometry, the topology of the tension field at galactic scales must be established. AP17 introduces the dipolar (eye) topology. Here it is derived from the axioms.

Step 1. One source, one sink. Axiom B provides exactly one break: $\varepsilon \in \mathcal{C}$ with no σ-image in $\mathcal{P}$. Valuation $\nu(\varepsilon) = 1$ — the minimum viable splinter. At galactic scales, the galaxy is the localised concentration of the 1-state (matter, the visible). This is the source of the tension field: one 1-pole. Axiom S provides the involution σ exchanging $\mathcal{C}$ and $\mathcal{P}$. The σ-image of the 1-pole is the 0-pole (the fold, the dark). One source, one sink. Two poles.

Step 2. Two poles on a compact manifold. Axiom C requires boundedness. Under EH (proved AP20), the field lives on the manifold. At the galactic scale the radial structure separates from the angular: locally the field is approximately radial, and its angular component defines a vector field on the link of the source point. The link of a point in a 3-manifold is S^2, which is compact. Therefore the angular part of the tension field, viewed from the galactic source, lives on S^2, and the Poincaré–Hopf theorem applies to this S^2.

Step 3. Poincaré–Hopf forces the dipole. The Poincaré–Hopf theorem states: on a compact orientable manifold without boundary, the sum of the indices of the zeros of any vector field with isolated zeros equals the Euler characteristic. For S^2: $\chi(S^2) = 2$. The angular field on the link S^2 has exactly two zeros — the two points where the dipole axis meets the sphere: one where field lines exit toward the 1-pole, one where they re-enter toward the 0-pole — each of index +1. Sum of indices = +1 + 1 = 2 = $\chi(S^2)$. Poincaré–Hopf is satisfied with exactly these two zeros. The topology is locked. Could there be additional zeros? Additional zeros would need to come in cancelling pairs (e.g. a saddle of index −1 paired with a source of index +1) to preserve the Euler characteristic. But Axiom B provides one break with $\nu(\varepsilon) = 1$ — the minimum viable splinter. There is one ε, one source; σ gives one sink. No additional zeros. [Scope: this exclusion applies within the single-break, single-source-sink galactic-scale model class. At multi-galactic scales or in systems with multiple localised ε-concentrations, additional zeros could appear in cancelling pairs without violating Poincaré–Hopf.] Two index-1 zeros with all field lines closing (Axiom S) on a compact manifold (Axiom C) is the definition of a dipolar field. The dipole topology is not assumed — it is forced by {S, B, C}. You did not choose it. The axioms chose it.

Result: the tension field at galactic scales is dipolar. The loop circumference of a field line at radius R is 2πR. This was asserted in AP17; it is now derived from {S, B, C} via Poincaré–Hopf.

3.4 — The Loop Geometry

The field line does not just reach R_h and return along a radial path. It must complete a full closed loop — from the 1-pole, outward to R_h, back to the 0-pole, and through the interior back to the 1-pole. The topology is dipolar (3.3). The loop circumference is $2\pi R_h$ regardless of the specific field-line geometry: the dipolar topology on a sphere of radius R_h forces a great-circle-scale closure. Any closed curve on S^2 that connects antipodal poles (source to sink) and returns via the complementary hemisphere traverses a path of length 2πR. The specific field-line shape (whether exactly semicircular, sinusoidal, or following $r = R \sin^2\theta$) does not affect the total loop circumference — only the topology does.

The time for the field line to complete one full loop at propagation speed c is $T_{loop} = 2\pi R_h/c = 2\pi/H_0$. The coherence time of the manifold at the Hubble scale is $\tau = 1/H_0$ — how long you have before expansion outruns propagation. The ratio of coherence time to loop time is $\tau/T_{loop} = (1/H_0)/(2\pi/H_0) = 1/(2\pi)$. Within one coherence time, only a fraction $1/(2\pi)$ of the full loop maintains causal connection. The field line propagates at c, traversing $R_h = c/H_0$ in one Hubble time — but the full loop requires $2\pi R_h$. Only the causally connected portion of the loop contributes to the effective gravitational acceleration at the apex.

3.5 — The Coherence Fraction (linear scaling from Axiom R)

A test mass in the sparse regime does not follow the field line at speed c. The test mass orbits at speed $v \ll c$. The field line provides the acceleration; the star responds. From 3.2 the apex acceleration of the widest field line is cH_0; from 3.4 only the fraction $\tau/T = 1/(2\pi)$ of the loop is causally coherent at any moment. The question is whether the effective acceleration scales linearly with the coherent fraction.

Lemma 1 (Measure homomorphism). The monoid $(\mathcal{M}, \cdot)$ admits a measure $\mu: \mathcal{M} \to \mathbb{R}_+$ satisfying $\mu(m_1 \cdot m_2) = \mu(m_1) + \mu(m_2)$ for disjoint records.

Proof. (i) The monoid $(\mathcal{M}, \cdot)$ accumulates records (Axiom R). Records are irreversible and each record is a distinct actualisation event — written once at a specific spacetime location. Distinct records occupy disjoint regions of the accumulated structure; you cannot double-count them. (ii) Under AP20 (AS = manifold), the monoid embeds into a smooth Riemannian manifold M. The embedding is injective: each actualisation event corresponds to a unique region of M. Each record $m \in \mathcal{M}$ corresponds to a region of M, and the Riemannian volume measure provides a natural map $\mu: \mathcal{M} \to \mathbb{R}_+$ where $\mu(m) = \text{vol}(\text{region of M corresponding to m})$. (iii) Since distinct records occupy disjoint regions, their volumes are additive: $\mu(m_1 \cdot m_2) = \text{vol}(\text{region}_1 \cup \text{region}_2) = \text{vol}(\text{region}_1) + \text{vol}(\text{region}_2) = \mu(m_1) + \mu(m_2)$.

Identification (from Lemma 1). Coherence at a point p on the manifold is taken proportional to μ(causally connected records at p) — linearity in the record measure is the minimal reading consistent with Lemma 1's additivity (disjoint records contribute disjoint volume; coherence adds where volume adds), and it is the only reading used downstream. Since μ is additive, the coherence contribution of a fraction f of the causally connected loop is f times the total coherence of the full loop.

Applying Lemma 1 to the widest field line: (iv) the gravitational acceleration at a point is the curvature of the manifold at that point (3.2, AP20), determined by the accumulated records causally connected to it. (v) At the apex of the widest field line (the minimum-curvature region) the tension per unit arc-length is approximately uniform — the gentlest, most diffuse part of the loop, and by the symmetry of the dipole the apex is the unique point of maximum distance from both poles, so the tension gradient vanishes to first order. The contribution to coherence from each arc-element is therefore approximately equal. The exact correction factor $\alpha = 2 \ln(\sec(½) + \tan(½)) \approx 1.0445$ is derived in 3.6 (Propositions 2–3), closing D1′. (vi) The coherent fraction is $f_{coh} = \tau/T = 1/(2\pi)$ (3.4). By Lemma 1 and the Identification, the effective acceleration scales linearly with f_{coh}:

$a_0 = \alpha \times cH_0 \times f_{coh} = \alpha cH_0/(2\pi)$, where $\alpha = 1$ under D1′ (uniform-at-apex).

The derivation chain: Axiom R (records form a monoid) → Lemma 1 (measure homomorphism: $(\mathcal{M},\cdot) \to (\mathbb{R}_+,+)$) → AP20 (manifold = accumulated record) → coherence ∝ causally-connected record-measure → acceleration ∝ coherence → linear scaling with f_{coh}. No external physics imported. The linear scaling is a

consequence of the disjointness of records and the additivity of volume. [The uniform-at-apex assumption (α = 1) is tightened in 3.6 below.]

3.6 — Closing D1′: The Exact Correction Factor α

The correction factor α accounts for the non-uniform tension along the coherent arc. The argument first establishes the general form, then derives the exact value from the axioms.

Proposition 1 (General form). Let T(s) be the tension per unit arc-length along the dipolar field line, where s is arc-length measured from the apex. Then: (a) $T'(0) = 0$ (the tension gradient vanishes at the apex). (b) $T(s) = T_0(1 + \kappa_2 s^2 + O(s^4))$ with $\kappa_2 > 0$. (c) $\alpha = (1/\ell) \int T(s)/T_0 \, ds$ over the coherent arc of length $\ell = R_h$.

Proof. (a) The involution σ (Axiom S) exchanges the two poles, fixing the apex. The loop maps to itself with the two half-loops exchanged. Any σ-respecting function satisfies $f(s) = f(-s)$ at the apex. Therefore $T'(0) = 0$. The tension gradient vanishes by the Z_2 symmetry of Axiom S. (b) Since $T'(0) = 0$ and the apex is a tension minimum, $T''(0) > 0$ and the Taylor expansion follows with $\kappa_2 = T''(0)/(2T_0) > 0$. (c) By definition.

Proposition 1 gives the general form but leaves κ_2 undetermined. To fix κ_2, the tension profile must be derived from the axioms, which requires the geometry of the manifold at the Hubble scale.

Proposition 2 (S^2 dipole profile). On the manifold $S^2(R_h)$ (EH/AP20), the tension profile along a dipolar field line (meridian) is $T(\theta)/T_apex = 1/\sin\theta$, where θ is the colatitude from the source pole. This gives $\kappa_2 = 1/(2R_h^2)$ and determines α exactly.

Proof. Step 1 (Manifold geometry). By 3.3 Step 2, the angular part of the tension field lives on $S^2(R_h)$ (the link of the source point at the Hubble scale). The dipole field lives on this S^2. Step 2 (Axial symmetry). Axiom B provides one source ($\nu(\varepsilon) = 1$); Axiom S provides one sink (σ-image). The source-sink axis is the unique distinguished direction. The axioms provide no mechanism to break rotational symmetry about this axis; therefore the tension field is axially symmetric. Step 3 (Field lines are meridians). On S^2 with axial symmetry, the unique divergence-free (Axiom S: closure ↔ $\nabla \cdot B = 0$ away from poles) vector field with one source and one sink consists of meridional field lines — great

semicircles from source to sink. The full loop (source → sink → source via the complementary meridian) is a great circle of circumference $2\pi R_h$. [This confirms the topological claim of 3.4.] Step 4 (Tension from flux conservation). Consider a latitudinal band at colatitude θ of width dθ. Its circumference is $2\pi R_h \sin\theta$. All field lines pass through every latitudinal band (divergence-free: what enters must exit). The total flux Φ through every band is the same. The tension per unit transverse length is $T(\theta) = \Phi/(2\pi R_h \sin\theta)$. At the apex (equator, $\theta = \pi/2$): $T_{apex} = \Phi/(2\pi R_h)$. Therefore $T(\theta)/T_{apex} = 1/\sin\theta$. This is derived from the geometry of S^2 (EH/AP20), the divergence-free condition (Axiom S), and the axial symmetry (Axioms B + S). No external physics imported.

Corollary (Exact κ_2). Near the apex, with $\varphi = \pi/2 - \theta$ and arc-length $s = R_h\varphi$: $T(s)/T_0 = 1/\sin(\pi/2 - \varphi) = 1/\cos\varphi = 1/\cos(s/R_h)$. Taylor expansion: $1/\cos(s/R_h) = 1 + s^2/(2R_h^2) + O(s^4)$. Therefore $\kappa_2 = 1/(2R_h^2)$.

Proposition 3 (Exact α). The correction factor for the S^2 dipole is $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$.

Proof. The coherent arc of length $\ell = R_h$ is centred on the apex: the Z_2 involution σ (Axiom S) maps the two half-arcs onto each other, so the apex is the unique midpoint. The integration limits are therefore $-R_h/2$ to $+R_h/2$, or equivalently (by symmetry) 0 to $R_h/2$ doubled. From Proposition 1(c), $\alpha = (2/R_h) \int_0^{R_h/2} [T(s)/T_0]\, ds$. Substituting $T(s)/T_0 = \sec(s/R_h)$ and $u = s/R_h$: $\alpha = 2 \int_0^{1/2} \sec(u)\, du = 2[\ln|\sec(u) + \tan(u)|]_0^{1/2} = 2\ln(\sec(½) + \tan(½)) - 2\ln(1) = 2\ln(1.1395 + 0.5463) = 2\ln(1.6858) = 2 \times 0.52224 = 1.04448$. That is the number. Derived from the geometry of a sphere, the flux conservation of the axioms, and an integral you can check by hand.

Cross-check (Proposition 1 quadratic). $\alpha \approx 1 + \kappa_2 R_h^2/12 = 1 + 1/(2 \times 12) = 1 + 1/24 = 1.04167$. The quadratic approximation gives 1.042, the exact integral gives 1.045. Agreement within 0.3% between the quadratic approximation and the exact integral — a check on the Taylor expansion over the coherent arc, distinct from the empirical a_0 match in section 5.

What the axioms determine. (i) The manifold geometry ($S^2(R_h)$, from EH/AP20). (ii) The tension profile ($1/\sin\theta$, from Axiom S + axial symmetry). (iii) The correction factor ($\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$). (iv) No free parameters. No fitting. The axioms gave you a number, and that number is 1.0445. The value $k = T_{pole}/T_{apex} = 1/\sin\theta_{pole}$ diverges for the point dipole,

but the α integral converges and is exact; the Proposition 1 quadratic formalism is superseded by the exact computation.

Structural consequences. (i) $\alpha > 1$ — the average tension over the coherent arc exceeds the apex minimum; the correction pushes a_0 upward by 4.5%. This is not tuning; it is a structural consequence of the S^2 geometry and the $1/\sin\theta$ profile. (ii) α is modest (≈ 1.045) because the S^2 manifold tames the tension gradient: $1/\cos\varphi$ grows slowly near $\varphi = 0$, with $\kappa_2 = 1/(2R_h^2)$. In flat space, a point dipole gives $\kappa_2 = 9/(2R_h^2)$ — nine times steeper; the manifold's curvature is protective. (iii) The exact result is $a_0 = 2\ln(\sec(½) + \tan(½)) \times cH_0/(2\pi) \approx 1.0445 \times cH_0/(2\pi)$.

D1′ status: CLOSED. The correction factor $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$ is derived from the axioms with no free parameters. Proposition 2 provides the tension profile from {S, B} + EH/AP20; Proposition 3 computes the exact integral. No remaining sub-debt.

4 — The Result

Theorem (The Floor). The minimum acceleration of a closing tension field line in a manifold with Hubble parameter H_0 and constraint-set rate c is $a_0 = \alpha c H_0/(2\pi)$, where $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$, derived exactly from {S, B} + EH/AP20 (Propositions 2–3, 3.6). No free parameters. You hold every step of the derivation.

Classification: the functional form $a_0 \propto cH_0$ is DERIVED. The exact coefficient $\alpha/(2\pi) \approx 0.1662$ is DERIVED. The result is parameter-free.

Proof. (1) The tension field lines must close (Axiom S, AP06 Theorem 3.1). (2) The maximum radius for closure is $R_h = c/H_0$ (Axioms R + C, via EH proved in AP20). (3) The apex acceleration of the widest closing line is $c^2/R_h = cH_0$ (Axiom C). (4) The field line closes in a dipolar loop of circumference $2\pi R_h$ (derived from {S, B, C} via Poincaré–Hopf, 3.3). (5) The coherent fraction of the loop is $\tau/T = 1/(2\pi)$, where $\tau = 1/H_0$ is the coherence time and $T = 2\pi/H_0$ is the loop period (3.4). (6) The acceleration scales linearly with the coherent fraction (Lemma 1: measure homomorphism on $(\mathcal{M},\cdot)$ via Axiom R + AP20; 3.5). (7) The S^2 dipole tension profile $T(\theta)/T_{apex} = 1/\sin\theta$ (Proposition 2) gives the exact correction factor $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$ (Proposition 3). Derived from {S, B} + EH/AP20. No free parameters. (8) The floor acceleration is $a_0 = \alpha c H_0/(2\pi) \approx 1.0445 \times cH_0/(2\pi)$.

5 — Numerical Check

$H_0 \approx 70$ km/s/Mpc $= 2.27 \times 10^{-18}$ s^{-1}. $c = 2.998 \times 10^8$ m/s. $cH_0 = 6.81 \times 10^{-10}$ m/s^2. $cH_0/(2\pi) = 6.81 \times 10^{-10} / 6.283 = 1.08 \times 10^{-10}$ m/s^2.

The empirical MOND acceleration scale (McGaugh et al. 2016, Lelli et al. 2017) is a_0(observed) $= 1.20 \pm 0.02 \times 10^{-10}$ m/s^2. The predicted value 1.08×10^{-10} is the base value (at $\alpha = 1$). With the exact S^2 dipole correction ($\alpha = 1.0445$, 3.6):

$a_0 = 1.0445 \times 1.08 \times 10^{-10} = 1.13 \times 10^{-10}$ m/s^2.

The remaining discrepancy from the observed 1.20 is 5.8%. This is within the measurement uncertainty of H_0 (the Hubble tension: different methods give H_0 between 67 and 74 km/s/Mpc). At higher H_0 values: at $H_0 = 73$ km/s/Mpc, $\alpha cH_0/(2\pi) = 1.0445 \times 7.09 \times 10^{-10} / 6.283 = 1.179 \times 10^{-10}$ m/s^2 (1.7% below observed); at $H_0 = 76$ km/s/Mpc, $\alpha cH_0/(2\pi) = 1.0445 \times 7.38 \times 10^{-10} / 6.283 = 1.228 \times 10^{-10}$ m/s^2 (2.3% above observed).

At $H_0 = 74$ km/s/Mpc: $\alpha cH_0/(2\pi) = 1.0445 \times 7.19 \times 10^{-10} / 6.283 = 1.195 \times 10^{-10}$ m/s^2 — within ≈0.4% of the observed 1.20×10^{-10}, well inside the ±1.7% uncertainty on a_0 itself. This is where the headline match lives.

At $H_0 \approx 74$ km/s/Mpc, predicted and observed values coincide within measurement error. The axioms are predicting the Hubble constant from galactic rotation curves. Let that sink in.

This is not fitting. H_0 is measured independently. The argument predicts $H_0 = 2\pi a_0/(\alpha c) = 2\pi \times 1.20 \times 10^{-10} / (1.0445 \times 2.998 \times 10^8) = 74.3$ km/s/Mpc — a falsifiable, parameter-free prediction from the observed a_0 and the derived coefficient $\alpha/(2\pi)$.

6 — What the Derivation Uses

Axiom S. Field lines must close — no disconnection. This provides the topology: the fact that there is a floor. Together with B and C it forces the dipole topology via Poincaré–Hopf (3.3).

Axiom R (Record; via EH, proved AP20). The monoid grows cosmologically at rate H_0; the manifold expands. This provides the scale: the Hubble radius $R_h = c/H_0$. Lemma 1 provides the linear scaling.

Axiom C. Propagation bounded by c. This provides the speed — and the boundary: beyond R_h, expansion exceeds c and field lines cannot close. Compactness contributes to forcing the dipole via Poincaré–Hopf.

Axiom B. The tension is ε — the break between 0 and 1. B provides the ontology: the identity of what is closing. Without B there is no tension field. $\nu(\varepsilon) = 1$ forces one source, one sink (dipole forcing) and the axial symmetry of the tension profile.

The dipolar (eye) topology. Now DERIVED from {S, B, C} via Poincaré–Hopf (3.3). No longer imported from AP17. The dipolar structure gives the loop circumference $2\pi R_h$ and therefore the coherent fraction $1/(2\pi)$.

7 — The Hubble Tension

The argument makes an unexpected prediction about the Hubble tension. The Hubble tension is the discrepancy between two classes of measurement of H_0: early-universe methods (CMB, Planck: $H_0 \approx 67.4 \pm 0.5$ km/s/Mpc) and late-universe methods (supernovae, Cepheids: $H_0 \approx 73.0 \pm 1.0$ km/s/Mpc). These disagree at >4σ. The source of the discrepancy is one of the most important open problems in cosmology.

The argument's prediction: the floor acceleration $a_0 = \alpha c H_0/(2\pi)$ with $\alpha = 1.0445$ must match the observed $a_0 = 1.20 \times 10^{-10}$ m/s². Solving for H_0: $H_0 = 2\pi a_0/(\alpha c) = 2\pi \times 1.20 \times 10^{-10} / (1.0445 \times 2.998 \times 10^8) = 74.3$ km/s/Mpc. Using $a_0 = 1.20 \pm 0.02 \times 10^{-10}$ m/s², this gives $H_0 = 74.3 \pm 1.2$ km/s/Mpc — a parameter-free prediction from the observed a_0 and the derived coefficient $\alpha/(2\pi)$.

The predicted $H_0 = 74.3$ is above the SH0ES Cepheid value (≈73.0) and well above the Planck CMB value (≈67.4), placing it in the late-universe bracket. The α correction moves the prediction from $H_0 \approx 78$ (the base case $cH_0/(2\pi)$, above all measurements) to $H_0 \approx 74$ (in the empirically contested region). This is structural — a consequence of the S^2 geometry — not a fit. It is a sharp, testable, parameter-free prediction. If future measurements converge on $H_0 \approx$ 73–75, this confirms both KS-45 ($\alpha = 1.0445$) and KS-45.1 (the H_0 prediction). If they converge below 70, the derivation is under pressure; if above 76, the argument overshoots.

The Hubble tension may be telling us that neither measurement is quite right, and that the correct value is determined by the floor: $H_0 = 2\pi a_0/(\alpha c) \approx 74$.

8 — Kill Switches

Global body of work numbering. To resolve a collision with AP22, this paper's former KS-46 and KS-47 are renumbered to KS-45.1 and KS-45.2 respectively (the registry is canonical). The switches are given here in Claim/Test/Status/Recovery form.

8.1 — KS-45 — 2π geometric factor

Claim. The floor acceleration equals the apex acceleration (cH_0) multiplied by the coherent fraction ($1/(2\pi)$) and the correction factor α: $a_0/(cH_0) = \alpha/(2\pi) = 0.1662$.

Test. If precision measurements yield $a_0/(cH_0) \neq \alpha/(2\pi) = 0.1662$ after H_0 convergence, the derivation is falsified. The kill condition: if both a_0 and H_0 are known to ±1% and $a_0/(\alpha cH_0/(2\pi))$ deviates from 1 by more than 5%, the derivation is killed.

Status. LIVE — EMPIRICAL. Upgraded from LIVE — HARD. All AP18 local debts closed (the dipole forced by Poincaré–Hopf, the linear scaling from Lemma 1, α from Propositions 2–3). At present $a_0/(cH_0) \approx 0.176$ (at $H_0 = 70$), above 0.1662 but within H_0 uncertainty; agreement is exact at $H_0 = 74.3$.

Recovery. If the ratio settles away from 0.1662, the discrepancy localises to the coherent-fraction or correction-factor step rather than to the closure topology; the functional form $a_0 \propto cH_0$ would survive even if the coefficient required revision.

8.2 — KS-45.1 — Hubble prediction (was KS-46)

Claim. The parameter-free prediction $H_0 = 2\pi a_0/(\alpha c) = 74.3 \pm 1.2$ km/s/Mpc.

Test. If the Hubble tension is resolved at $H_0 < 70$ (the Planck value 67.4 confirmed), the predicted a_0 falls ≈8% below observation, straining the derivation. If resolved between 72–76, the prediction is confirmed. If $H_0 > 78$, the argument overshoots.

Status. LIVE — EMPIRICAL. Testable with future H_0 measurements; you will know within a decade. The prediction is parameter-free.

Recovery. A resolved H_0 outside the window falsifies the floor-determines-H_0 reading without disturbing the derivation of the functional form; the floor would then be read as approximate rather than exact.

8.3 — KS-45.2 — Dipole topology (was KS-47)

Claim. The derivation's dipolar (eye) topology is forced by the axioms, not assumed.

Test. Show that the galactic-scale tension field admits a non-dipolar topology consistent with {S, B, C}.

Status. CLOSED. The dipolar topology is derived from {S, B, C} via Poincaré–Hopf (3.3): Axiom B provides one source ($\nu(\varepsilon) = 1$), Axiom S one sink (σ-image), Axiom C compactness; two index-1 zeros on S^2 with all field lines closing is a dipole. No longer depends on AP17's assertion.

Recovery. Not applicable — closed by the Poincaré–Hopf derivation, within the single-break galactic-scale model class (the scope note in 3.3 bounds the claim).

8.4 — Updates to existing kill switches

KS-39 (a_0 numerical value, AP17). Sharpened by AP18 to a parameter-free result $a_0 = \alpha c H_0/(2\pi)$: at $H_0 = 70$, a 5.8% residual; at $H_0 = 74$, <1%. The discrepancy tracks the H_0 measurement, not the derivation. Remains LIVE — EMPIRICAL.

KS-42 (tension-field equation from {S, B, R, C}). Not closed by AP18: AP18 derives the floor acceleration, not the full tension-field equation or the interpolation function. It was subsequently closed in Rosin V7. 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). Not addressed by AP18. Remains LIVE — EMPIRICAL (AP17).

9 — What This Establishes and What Remains Open

9.1 — What this paper closes

It derives the floor acceleration exactly: $a_0 = \alpha c H_0/(2\pi)$, with the functional form and the exact coefficient $\alpha/(2\pi) \approx 0.1662$ parameter-free. It closes its local debts — D1 (the 2π coefficient, via the Poincaré–Hopf dipole and the Lemma 1 linear scaling) and D1′ (the correction factor α, via Propositions 2–3). It derives the dipolar topology from {S, B, C}, removing AP17's structural assertion (KS-45.2 closed).

9.2 — What this paper does not close

It does not close the empirical confrontation: whether observation confirms $a_0/(cH_0) = 0.1662$ and $H_0 \approx 74$ awaits the resolution of the Hubble tension (KS-45, KS-45.1). It does not derive the full tension-field equation (KS-42, closed downstream in Rosin V7, not here) or the interpolation function (KS-43, AP17).

9.3 — Items held open without claiming debt status

The empirical pending on $a_0/(cH_0)$ and H_0 — a precision matter tied to the unresolved Hubble tension, not a structural gap. AP18 owes no structural debt.

9.4 — Where the philosophical-register implementations live

The expository-register companion for the MOND acceleration scale and the position that the dark-matter phenomena are substrate topology rather than a particle species lives in Ø Predictions. AP18 is the formal-register origin of the exact a_0. A dedicated expository twin of this specific derivation is not separately written; recorded honestly rather than filled with a manufactured citation.

9.5 — Structural relationships to subsequent work

AP18 strengthens AP17 (the claimed floor is now derived; the asserted dipole is now forced). AP21 uses AP18's Lemma 1 as the record-measure-to-energy bridge and inherits the floor a_0 as the cosmic confining potential. Rosin V7 supplies the explicit tension-field equation AP18 does not derive, closing KS-42.

9.6 — The 420 Code placement

AP18 is a chapter of Notebook VI (Cosmology), the exact-scale derivation in the structure-formation chain AP06 → AP17 → AP18 → AP21.

9.7 — 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 exact scale that floor sits at, and the web that floor builds. AP18 makes the scale parameter-free and turns it into a prediction of the Hubble constant — a falsifiable hostage to the next decade of measurement.

9.8 — The closing

The floor acceleration of the tension field is $a_0 = \alpha c H_0/(2\pi)$, with $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$. The functional form $a_0 \propto cH_0$ is derived; the exact coefficient $\alpha/(2\pi) \approx 0.1662$ is derived; the result is parameter-free, with all local debts closed.

The field lines close because the sectors are connected. They cannot extend beyond R_h because propagation is bounded. The widest line curves at the boundary of the observable universe. Its acceleration is the product of the two conditions — c and H_0 — divided by the geometry of the loop. A derivation from four axioms matches a galactic-scale measurement to within the measurement uncertainty on a_0 itself, and predicts the Hubble constant as its bonus.

Claim Summary

DERIVED. The floor $a_0 = \alpha c H_0/(2\pi)$ (Theorem, section 4). The functional form $a_0 \propto cH_0$ and the exact coefficient $\alpha/(2\pi) \approx 0.1662$. The dipolar topology from {S, B, C} via Poincaré–Hopf (section 3.3). The coherent fraction $1/(2\pi)$ from the loop geometry (3.4). The linear scaling from Lemma 1 (3.5). The correction factor $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$ from the S^2 dipole profile (Propositions 2–3, 3.6). Parameter-free.

PREDICTION. $H_0 = 2\pi a_0/(\alpha c) = 74.3 \pm 1.2$ km/s/Mpc — the Hubble constant from galactic rotation curves (section 7).

EMPIRICAL. The numerical match at $H_0 = 74$ (within measurement uncertainty of the observed a_0); the present $a_0/(cH_0) \approx 0.176$ (at $H_0 = 70$) pending H_0 convergence (section 5).

CLOSED. Local debts D1 (the 2π coefficient) and D1′ (the correction factor α). KS-45.2 (the dipole topology).

FALSIFICATION REGISTER. KS-45 (2π geometric factor, EMPIRICAL), KS-45.1 (Hubble prediction, EMPIRICAL), KS-45.2 (dipole topology — CLOSED). Updated: KS-39 (a_0 value, EMPIRICAL, AP17). KS-42 not closed by AP18 (closed in Rosin V7); KS-43 not addressed by AP18.

Conditionality Footer

Dependencies

AP06 (the Leakage Theorem), AP15 (the connection carries the causal structure), AP08/AP10 (the manifold and its S^2 link), AP20 (the Embedding Hypothesis proved; AS = manifold). Refines AP17 (The Room).

Dependents

AP21 (uses Lemma 1 and inherits a_0) and the broader Notebook VI cosmology chapters. Rosin V7 grounds the tension field AP18 uses by deriving its field equation.

Kill switches closed by this paper

KS-45.2 (the dipole topology, via Poincaré–Hopf). Local debts D1 and D1′ closed. KS-45 upgraded from LIVE — HARD to LIVE — EMPIRICAL.

Kill switches that remain live

KS-45 (2π geometric factor) and KS-45.1 (Hubble prediction), both LIVE — EMPIRICAL pending H_0 convergence. Inherited and unchanged: KS-39 (sharpened), KS-43 (not addressed).

Structural debts owed

None. All AP18 local debts (D1, D1′) are closed; the result is parameter-free.

Items held open without claiming debt status

The empirical confrontation on $a_0/(cH_0)$ and H_0, pending the resolution of the Hubble tension (KS-45, KS-45.1).

Notation Reference

a_0 — the floor (transition) acceleration. $a_0 = \alpha c H_0/(2\pi)$.

α — the apex-symmetry correction factor. $\alpha = 2\ln(\sec(½) + \tan(½)) \approx 1.0445$. Derived from the S^2 dipole flux conservation. Not the fine-structure constant.

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

R_h — the Hubble radius, $R_h = c/H_0$. The maximum extent of any closing field line.

κ, κ_{min}, κ_2 — curvature: κ the field-line curvature ($a = v^2\kappa$); $\kappa_{min} = 1/R_h$ the minimum (widest-line) curvature; $\kappa_2 = 1/(2R_h^2)$ the quadratic coefficient of the tension profile.

τ, T_{loop}, f_{coh} — the coherence time $\tau = 1/H_0$; the loop period $T_{loop} = 2\pi/H_0$; the coherent fraction $f_{coh} = \tau/T_{loop} = 1/(2\pi)$.

$\mathcal{M}$, $\cdot$, μ — the record monoid $(\mathcal{M}, \cdot)$ and its additive measure $\mu: \mathcal{M} \to \mathbb{R}_+$ (Lemma 1).

$\mathcal{C}$, $\mathcal{P}$, σ — the two sectors and the involution σ of Axiom S connecting them.

ε, $\nu(\varepsilon)$ — the break and its valuation; $\nu(\varepsilon) = 1$, the minimum viable splinter (Axiom B).

$T(\theta)$, T_{apex}, Φ — the tension per unit transverse length $T(\theta) = \Phi/(2\pi R_h \sin\theta)$; T_{apex} its apex value; Φ the (conserved) flux.

θ, φ — the colatitude θ from the source pole; $\varphi = \pi/2 - \theta$ the latitude near the apex.

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STUDIO 6