



The Web

Artist's Proof 21

Structure Formation

The cosmic web from the global tension field

Status and Dependency

This paper derives the qualitative mechanism of cosmic structure formation — the cosmic web — from the global tension field established in AP17 and AP18. The vacuum's topological tension, forced to close by Axiom S and AP06 Theorem 3.1, bundles into filaments by energy minimisation.

Gas flows along filaments, pools at nodes, and collapses into primordial supermassive black holes that seed galaxies. No dark matter particles are required.

The paper does not provide quantitative fits to the CMB power spectrum, the matter power spectrum $P(k)$, or baryon acoustic oscillation data. These are computational debts, not structural gaps.

The dependency chain: AP06 Theorem 3.1 (leakage \rightarrow closure) \rightarrow AP17 (tension field) \rightarrow AP18 (acceleration floor a_0) \rightarrow this paper (global tension \rightarrow filaments \rightarrow structure).

Also depends on AP05 (Lorentzian spacetime), AP08 (Einstein field equations, substrate homogeneity), AP14 (quantum gravity correction), AP15 (substrate stiffness λ), AP18 Lemma 1 (monoid homomorphism), AP20 (EH and QRA proved, AS = manifold).

Epistemic status per section. §1 (Crisis of Structure): historical — summary of the Λ CDM problem. §2 (Tension Field Summary): established — summarises results proved in AP17 and AP18. §3 (Vacuum is the Covering): derived — follows from Axiom S + AP06 Thm 3.1 + expansion (Axiom R). §4 (Fractal Scaling): structural — same axioms at three scales. §5.1 (Stretching Energy): derived — $E = Tl$ from Axioms S, B, R + AP08 + AP18 Lemma 1 + AP15 + AP20. §5.2 (Filament Formation): structural/mathematical — Steiner Tree theorem applied to tension field network. §5.3 (Filaments from Topology): derived — follows from Propositions 1 and 2. §5.4 (Jeans Threshold): scaling argument — illustrative, not quantitative. §6 (The Direct Vacuum): structural/conjectural — SMBH-first is conjectural pending observation. §7 (Assessment): meta — epistemic self-assessment.

Notation

ε — the break. Minimum viable splinter. Always Axiom B.

\mathbf{a}_0 — acceleration floor. $a_0 \approx cH_0/(2\pi)$. Derived in AP18.

\mathbf{T} — tension of a field line. Energy per unit length. $T = \lambda$ (substrate stiffness, AP15), proved by the Energy-Measure Bridge (Lemma, §5.1).

λ — substrate stiffness. $\lambda \approx 2.15 \times 10^{46}$. Established in AP15 (The Connection) and Edition 04. The unique constant with dimensions energy/length in the argument.

μ — additive measure on the record monoid (AP18 Lemma 1). $\mu(m_1 \cdot m_2) = \mu(m_1) + \mu(m_2)$.

\mathbf{l}, \mathbf{l}_i — field line length.

\mathbf{M}_j — Jeans mass.

\mathbf{c}_s — sound speed.

ρ — gas density.

σ — involution (Axiom S). Not velocity dispersion.

γ — dimensionless coefficient in quantum gravity correction (AP14).

α — dimensionless apex-symmetry factor, $\alpha \approx 1.05$ (AP18 Prop 1). Not fine-structure constant.

\mathbf{k} — universal proportionality constant between energy and measure. $k = T = \lambda$.

Axiom Mapping

Axiom S \rightarrow Field-line closure. The involution σ connects sectors. Disconnection violates σ . Every field line must close (+ AP06 Thm 3.1). The vacuum IS the tension field.

Axiom B \rightarrow Source structure. ε defines the 1-pole (matter, propagation). Virtual records in the path sum.

Axiom R \rightarrow Expansion. The monoid accumulates irreversibly. The manifold expands (H_0). Finite extent $R_H = c/H_0$. Monoid homomorphism (AP18 Lemma 1) gives linear measure \rightarrow energy bridge.

Axiom C \rightarrow Causal bound. Finite propagation speed c . Forces compactification at extreme density (direct vacuums, §6).

Kill Switches

KS-41 (Structure formation): LIVE — EMPIRICAL. Structurally addressed; quantitative confrontation pending (D1).

KS-51 (Filament topology): LIVE — EMPIRICAL. Gas velocity alignment along filaments.

KS-52 (Primordial anchor sequence): LIVE — EMPIRICAL. SMBHs before or with galaxies.

Here is how to destroy this paper. Reproduce the CMB acoustic peaks, the matter power spectrum, and the BAO signal without the tension field — using only visible matter and Newtonian gravity.

If that works, nothing here is needed. Or show that gas kinematics in the intergalactic medium are fully explained by visible-matter gravitational dynamics with no residual coherent alignment along filaments.

Or prove that every supermassive black hole formed after its host galaxy. Any of these kills the argument cleanly.

§1 – The Crisis of Structure

Look at the night sky through a telescope powerful enough. You will not see galaxies scattered randomly. You will see a web — galaxies strung along filaments, clustered at nodes, separated by vast empty voids.

The structure is unmistakable. The question is how it got there.

The standard cosmological model (Λ CDM) faces a structural problem: ordinary matter cannot form galaxies fast enough on its own. In the early universe, baryonic gas is too hot, too smooth, and expanding too rapidly.

The standard model resolves this by inserting Cold Dark Matter — invisible, non-interacting particles that collapse first under gravity, creating deep potential wells for the baryonic gas to fall into.

Without CDM, the standard model cannot reproduce the cosmic web.

CDM is extraordinarily successful empirically. It reproduces the CMB temperature power spectrum to sub-percent precision, the matter power spectrum $P(k)$, the baryon acoustic oscillation signal, and the large-scale distribution of galaxies with six free parameters.

Any alternative must either match these successes or explain precisely where and why it diverges.

This paper proposes a structural alternative: the tension field derived in AP17 and AP18 provides a global confining potential that replaces CDM's role in structure formation. The structural mechanism is presented here.

The quantitative confrontation with precision cosmological data remains an open debt.

§2 – The Tension Field: A Standalone

Summary

For readers without AP17 and AP18, the essential claims are summarised here.

What the tension field is. Gravity is the condition of the \emptyset -pole (the fold) and propagation at c is the condition of the 1-pole.

The break ε sits between them: the wave function collapsing from probability to actuality.

The tension field is the field of ε between \emptyset and 1. It is the substrate under tension between its two conditions.

What closure means. Field lines of the tension field must close. This follows from Axiom S (the two sectors are connected by σ) and AP06 Theorem 3.1 (leakage is nonzero: the sectors cannot fully disconnect).

A field line that leaves the 1-pole must return to a \emptyset -pole. Disconnection violates the involution.

What a_0 claims. The acceleration floor a_0 is the minimum gravitational acceleration that the tension field enforces.

AP18 derives the scale: $a_0 = \alpha H_0 / (2\pi)$, where $\alpha \approx 1.05$ is the apex-symmetry factor from AP18 Proposition 1. Below this floor, Newtonian gravity would predict zero acceleration, but the topological closure of field lines prevents this.

The widest field line extends to the Hubble radius $R_h = c/H_0$; its curvature at the apex gives the floor.

What is still open. The 2π geometric factor in $a_0 = \alpha H_0 / (2\pi)$ is derived from dipolar loop geometry (AP18 §4).

With $\alpha \approx 1.0445$ (AP18 v6, Z_2 symmetry bound) and $H_0 = 74$ km/s/Mpc, the numerical result matches the empirical MOND scale ($1.20 \pm 0.02 \times 10^{-10}$ m/s²) to approximately 0.3%.

The residual is within measurement uncertainty. KS-39 (numerical value) remains LIVE — EMPIRICAL. This paper inherits this uncertainty.

§3 — The Vacuum Is the Covering

You have held a ball wrapped in cling film. Pull any point of the film and the entire surface responds. The film is not on the ball. The film is what makes the ball coherent.

Standard physics treats the vacuum as empty space containing fields. The axioms say the vacuum IS the field. This is not metaphor. By AP20, AS = manifold (identity, zero gap).

The tension field is not a field on the manifold; it IS the manifold's coherence.

From AP17 and AP18: the tension field of ε exists between 1 (propagation, matter) and \emptyset (fold, collapse). Field lines must close (Axiom S, AP06 Theorem 3.1).

At the cosmological scale, the universe is expanding (Axiom R — the monoid grows). As matter separates, the field lines connecting all 1-poles to all \emptyset -poles stretch. But they cannot break. Disconnection violates σ .

The entire vacuum of the universe is under tension.

Not metaphorically. Structurally. The vacuum is the global envelope of field lines striving for closure against the expansion.

What Λ CDM attributes to an invisible particle species, the axioms attribute to the topological structure of the vacuum itself.

You are inside the covering right now. The tension that holds the cosmic web together passes through the space between your hand and this page.

§4 — Fractal Scaling

The tension field operates at every scale. The mechanism is the same; only the geometry changes.

Micro level. The tension is ε itself. The single break. Quantum gravity resisting the perfect 1:1. The correction $\delta G/G = \gamma \ell_p^2/L^2$ (AP14).

Galactic level. The tension is the Room (AP17). Field lines anchoring to a central black hole, flattening rotation curves at the floor a_0 (AP18).

Cosmic level. The tension is the global covering. The entire vacuum under tension from the expansion. Field lines bundling into filaments to minimise stretching energy (§5).

One mechanism. Three scales. Not by analogy but by the same axioms operating at different densities. You have seen this pattern before — the same equation governing systems that differ by forty orders of magnitude.

That is not coincidence. That is architecture.

§5 – The Formation of the Web

§5.1 – Stretching energy

Every rubber band you have ever stretched stores energy in proportion to how far you pull it. Not in how hard it resists at one point — in how far the stretch extends.

The tension field has this same property.

The proof follows from the axioms in two steps: first, that physical energy is proportional to the record measure; second, that this proportionality yields $E = Tl$ for a field line of length l .

Background. A tension field line connecting a 1-pole to a \emptyset -pole has a length l in the manifold. As the universe expands, that length grows.

An inverse-square field stores energy in the field strength at each point (energy density \propto field²). A tension field stores energy in the extent of the line itself.

A rubber band stores energy in how far it is stretched, not in how hard it pulls at one end.

Lemma (Energy–Measure Bridge). Let E be the physical energy associated with a record m , and let μ be the additive measure on the record monoid (AP18 Lemma 1).

Then $E(m) = k\mu(m)$ for a universal constant k .

Proof. The argument proceeds in five steps.

Step 1 (All energy from the break). The state of the universe is $1:1 + 1 \times \varepsilon$ (the axiom). The perfect symmetry $1:1$ is the zero-energy ground state.

The unpaired splinter ε (Axiom B) is what gives the universe non-zero energy content. All energy is a manifestation of the break.

Step 2 (A record traces the break). A record m is the irreversible trace left on the manifold when ε actualises (Axiom R). Each record is fundamentally a record of the break manifesting.

Step 3 (The measure is additive). By AP18 Lemma 1, the record measure is a monoid homomorphism: $\mu(m_1 \cdot m_2) = \mu(m_1) + \mu(m_2)$.

Step 4 (Energy is additive). Energy conservation follows from the spacetime symmetries derived in AP05 and AP08 (via Noether's theorem, which is itself a consequence of the derived Lagrangian structure).

The total energy of two independent events is the sum of their individual energies: $E(m_1 \cdot m_2) = E(m_1) + E(m_2)$. Energy is a homomorphism from records to \mathbb{R} .

Step 5 (Single generator forces proportionality). Axiom B says the break is ONE element ε . Every actualization event is the same break manifesting. Every elementary record is a trace of the same ε .

The record monoid is generated by copies of a single generator. On a monoid with a single generator, any two homomorphisms to \mathbb{R} are determined by their value on the generator and are therefore proportional.

Since both E and μ are additive functions on the same single-generator monoid, $E(m) = k\mu(m)$ where $k = E(\varepsilon)/\mu(\varepsilon)$. \square

Step 5 is where Axiom B does critical work.

Without the single-generator property, two additive functions on the same domain need not be proportional (e.g. on \mathbb{R}^2 , $f(x,y) = x$ and $g(x,y) = y$ are both additive but independent).

The one-ness of the break forces the one-dimensionality of the monoid, which forces the proportionality.

You just watched a single axiom — one break, one ε — force every form of energy into a single measuring tape. That is not an assumption.

It is a consequence of the architecture having exactly one crack.

Proposition 1 (Energy-length proportionality). Let a tension field line of length l connect a 1-pole to a \emptyset -pole through the manifold.

Then the stretching energy stored in the line is $E = Tl$, where $T = \lambda$ (substrate stiffness from AP15).

Proof. The argument proceeds in four steps.

Step 1 (Field lines exist). By Axiom S, the involution σ connects every element in sector \mathcal{L} to a corresponding element in sector \mathcal{P} . A field line is the manifold expression of this σ -correspondence (AP17).

Its length l is a well-defined geometric quantity because AS = manifold (AP20, EH proved).

Step 2 (Measures are additive). By AP18 Lemma 1, the record measure is a monoid homomorphism: $\mu(m_1 \cdot m_2) = \mu(m_1) + \mu(m_2)$.

A field line of length l can be decomposed into N segments of length dl_i with $l = \sum dl_i$.

The total measure (and hence energy, by the Lemma) of the line is the sum of the measures of its segments: $E = \sum dE_i$.

Step 3 (Constant energy per unit length). By AP08, the substrate is homogeneous and isotropic. By the Lemma, $E = k\mu$.

Since μ is a measure on the manifold and the substrate is homogeneous, the energy cost to sustain a segment dl of σ -correspondence is the same everywhere: $dE_i = T \cdot dl_i$, where $T = k\mu(\varepsilon)/l(\varepsilon)$ per unit length.

Step 4 (Combine and identify T). By Step 2, $E = \sum dE_i = \sum(T \cdot dl_i) = T \cdot \sum dl_i = Tl$. The constant T has dimensions of energy per unit length.

The argument contains exactly one such constant: the substrate stiffness $\lambda \approx 2.15 \times 10^{46}$ (AP15, Edition 04). λ measures the substrate's resistance to deformation; T measures the energy cost of maintaining a field line per unit length.

Both characterise the same substrate. By uniqueness, $T = \lambda$. \square

The stretching energy of the vacuum is therefore $E_{\text{tot}} = T\sum l_i$, summed over all field lines.

The vacuum configuration that minimises E_{tot} is the one that minimises the total length of all field lines, subject to the constraint that every line must close.

The vacuum wants to be short. The expansion forces it to be long. The compromise between these two pressures builds the web.

§5.2 — Why bundling reduces stretching energy

You have watched water drain from a flat surface. It does not flow as a uniform sheet. It gathers into streams. The streams merge into channels. The channels converge to a point.

This is energy minimisation in action. The tension field does the same thing — for the same reason.

Proposition 2 (Filament formation). A configuration of N tension field lines connecting distributed 1-poles to distributed 0-poles in the manifold has lower total stretching energy when the lines bundle into shared corridors (filaments) than when they run independently.

Proof. By Proposition 1, the system minimises $E_{\text{tot}} = Tl_{\text{tot}}$. This is equivalent to minimising the total length l_{tot} of all field lines. The manifold is a metric space (AP20, EH proved).

The problem of finding the minimum total length of connections among N points in a metric space is the Euclidean Steiner Tree Problem. The solution is a well-known mathematical result:

- For $N = 2$ points, the minimum is a straight geodesic.
- For $N = 3$ points forming a triangle, the minimum-length connection is not two sides of the triangle.

It is achieved by introducing a Steiner point inside the triangle and connecting all three vertices to it, forming a Y-junction. This is strictly shorter than any pair of direct connections.

- For $N > 3$, the minimum-length network introduces multiple Steiner points (nodes) connected by 1-dimensional edges (corridors). The result is a branching tree, not N independent lines.

The Steiner Tree is 1-dimensional (a graph of edges and nodes), not 2-dimensional.

A 2D sheet connecting the same points would add surface area without reducing the total edge length; extra dimensionality costs stretching energy without improving point-to-point connectivity.

The corridors of the Steiner Tree are the filaments. The Steiner points are the nodes. Bundling into shared corridors is the minimum-energy solution. \square

You have seen this in every city you have driven through. The highway system is not a grid of point-to-point roads. It is a branching tree — shared corridors converging at interchanges.

The same geometry, the same reason: minimise total length under connectivity constraints.

Corollary (scaling estimate). Consider N masses in a cube of side L . Independent lines: $E_1 \sim NTL$. Bundled into k corridors: $E_2 \sim NT(L/k^{1/3}) + TkL$. For N large, $E_2 < E_1$.

This confirms the Steiner Tree result in the scaling regime.

Epistemic note. Propositions 1 and 2 establish that bundling is energetically favoured and that the minimum-energy network is 1-dimensional (filaments, not sheets).

However, the actual cosmic matter distribution is continuous, not a finite set of points.

For continuous distributions, the full variational minimisation of E_{tot} over the expanding manifold would produce the complete cosmic web topology — voids, sheets (walls), filaments, and nodes.

The Steiner Tree result captures the dominant 1D structure (filaments and nodes). The 2D structures (sheets/walls) arise from the continuous limit and are not addressed here.

The paper claims the qualitative result: filamentary bundling is the dominant energy-minimisation mechanism.

§5.3 — Filaments from topology

In the early universe, as the manifold expands, the primordial gas tries to disperse. To disperse evenly, the gas would have to drag the tension field lines apart equally in all directions.

But this maximises the total stretching energy (Proposition 1).

The field lines seek the configuration of minimum stretching energy. By Proposition 2, this means bundling into shared corridors. The primordial gas, caught in the covering, is forced to flow along these bundled tension lines.

The filaments are not made of dark matter particles. They are the bundled lines of the substrate's own topological tension. The gas pools where the tension guides it.

You have watched a river carve a valley. The water does not choose the path. The terrain chooses it. The tension field is the terrain of the cosmos. The gas is the water.

The web is the valley system — carved not by flow, but by the topology of the vacuum itself.

§5.4 — The confining potential and the Jeans threshold

In standard physics, a gas cloud collapses under gravity when its mass exceeds the Jeans mass M_j . Below M_j , thermal pressure prevents collapse.

The standard Jeans mass depends on the gravitational acceleration: stronger gravity \rightarrow lower $M_j \rightarrow$ easier collapse.

From AP18, the tension field provides a baseline acceleration floor a_0 . At the cosmic scale, the effective gravitational acceleration of a mass M does not drop to zero as $r \rightarrow \infty$.

It approaches the tension floor: $a(r) = GM/r^2 + a_0$ for r beyond the Newtonian regime.

Illustrative scaling argument for Jeans mass modification. The standard Jeans mass scales as $M_j \propto c_s^3/(G(3/2)\rho(1/2))$ where c_s is the sound speed, G is the gravitational constant, and ρ is the density.

Adding a constant floor acceleration a_0 modifies the effective gravitational confinement. The illustrative scaling $G\rho \rightarrow G\rho + a_0/R$ (where R is the cloud radius) shows the direction of the effect, not its magnitude.

For large clouds (R large, ρ small), the a_0/R term dominates over $G\rho$. This is the low-acceleration regime where the tension floor matters most.

The Jeans mass is reduced because the effective gravitational confinement is stronger than Newtonian gravity alone predicts.

Gas that would be too hot to collapse under Newtonian gravity can collapse under the additional confinement of the tension floor.

You know this from experience: a tent in a windstorm collapses more easily when you anchor the ropes tighter. The tension floor tightens the ropes on the cosmic gas. The gas collapses sooner.

The galaxies form faster.

Epistemic note. This scaling argument is illustrative, not quantitative.

In MOND-type theories, the modified gravity enters through a nonlinear Poisson equation, and linearised perturbation theory in an expanding background with a floor acceleration is significantly more complex than the simple $G\rho \rightarrow G\rho + a_0/R$ substitution suggests.

The direction of the effect (M_j decreases) is robust. The magnitude is unknown and requires the full calculation (D1).

Debt D1. The effective Jeans mass under the tension floor must be computed explicitly from the modified Poisson equation and compared to the Λ CDM prediction at relevant cosmological scales.

The minimum deliverable: solve the linearised perturbation equations with the a_0 floor and compute the modified power spectrum.

§6 — The Direct Vacuum

You have seen a drain form in water. The flow concentrates, the surface dimples, and once the vortex locks in, everything nearby spirals toward it. The drain was not placed there. The flow created it.

Where the filaments intersect, the gas pools. The tension lines cross. At these intersections, the local density of records spikes. The tension becomes extreme. The fabric is forced to fold.

This creates a local \emptyset -pole — a primordial supermassive black hole. The direct vacuum.

Before this moment, the gravity of the global covering is weak and distributed. But when the direct vacuum forms, it drops a deep anchor into the manifold. It captures the local tension field.

It pulls the covering tight around itself. This deepens the potential well, pulling in the surrounding gas and igniting the galaxy.

The mechanism. At a filament intersection, the record density (Axiom R) exceeds a threshold where the manifold's boundedness (Axiom C) forces compactification. The 1-pole field collapses into a \emptyset -pole.

This is not gravitational collapse in the Newtonian sense — it is the axiom of closure (C) operating at extreme record density. The fold is the manifold closing on itself locally, creating a topological anchor.

Debt D2. The compactification threshold — the record density at which Axiom C forces a local fold — is not derived in this paper. It is an open question.

A future paper must specify this threshold and derive it from {S, B, R, C}, or flag it as a free parameter.

The supermassive black hole does not form after the galaxy. It forms first, at the intersection of the tension lines, as the topological anchor that forces the galaxy to exist.

Observational signature. Direct vacuums form before their host galaxies and are more massive at high redshift than conventional accretion models predict.

If SMBHs are observed at $z > 10$ with masses exceeding $10^8 M_{\odot}$ — too massive to have grown by accretion since the Big Bang — the direct vacuum mechanism is supported.

JWST observations are already finding supermassive black holes at redshifts earlier than Λ CDM comfortably predicts. If the pattern holds, the argument gains empirical support.

You live in a galaxy that exists because a topological anchor dropped into the manifold thirteen billion years ago. The Milky Way did not attract its central black hole.

Its central black hole summoned the Milky Way.

§7 — What This Paper Does and Does Not Do

This paper provides the structural mechanism for structure formation without CDM.

The qualitative picture follows from the axioms: the vacuum is under tension, the tension bundles into filaments (Propositions 1 and 2), gas flows along filaments, nodes collapse into direct vacuums, galaxies form.

This paper does not provide:

- A quantitative fit to the CMB temperature power spectrum. Λ CDM fits the acoustic peaks with six parameters to extraordinary precision. The tension field must either reproduce this fit or explain the discrepancy.

This is the hardest test.

- A quantitative matter power spectrum $P(k)$. The distribution of galaxies at different scales must be reproduced.

- Baryon acoustic oscillation predictions. The BAO signal is a clean geometric measurement. The tension field must predict the correct scale.

These are not structural gaps — they are computational debts. The mechanism is derived. The confrontation with precision data requires solving the linearised perturbation equations with the a_0 floor and computing the resulting power spectra.

KS-41 remains LIVE until this confrontation is complete. Honest assessment: this is where MOND-type alternatives have historically struggled. The argument must do better.

§8 — Derivation Chain

AP06 Thm 3.1 → field lines must close (leakage nonzero).

AP17 → tension field between 0 and 1.

AP18 → acceleration floor $a_0 \approx \alpha c H_0 / (2\pi)$ + Lemma 1 (monoid additivity).

AP08 → substrate homogeneity.

Lemma (Energy–Measure Bridge) (Axioms B + R, AP18 Lemma 1, AP05/AP08 Noether) → $E = k\mu$ → energy proportional to measure.

Proposition 1 (Lemma + AP08 + AP15 + AP20) → $E = Tl$, $T = \lambda$ → stretching energy proportional to length.

Axiom S + expansion (R) → field lines stretch but cannot break → vacuum under tension.

Proposition 2 (Steiner Tree on metric manifold) → tension lines bundle into shared corridors → filaments.

Filament intersections → density spike → fold (Axiom C) → direct vacuum (primordial SMBH).

Direct vacuum → deep anchor → gas capture → galaxy.

§9 — Kill Switches

Global numbering note: Kill switch numbers are globally unique across the corpus. This paper inherits KS-41 and introduces KS-51 and KS-52.

KS-41 — Structure formation. Previously LIVE — EMPIRICAL (AP17, untouched). The structural mechanism is now derived but the quantitative confrontation with CMB, $P(k)$, and BAO data is not complete.

Status: LIVE — EMPIRICAL (upgraded from untouched to structurally addressed). This is the hardest empirical test in the corpus. If the tension field cannot reproduce the CMB acoustic peaks without CDM, the mechanism fails.

The argument hands you this weapon. Use it.

KS-51 — Filament topology. The argument predicts that gas in the cosmic web flows along tension filaments, not purely under gravitational free-fall toward mass concentrations.

Observable signature: gas velocity fields in the intergalactic medium should show coherent alignment along filament axes that is stronger than predicted by the gravitational potential of the visible matter alone.

The velocity dispersion of gas perpendicular to a filament axis should be suppressed relative to the parallel component by more than a purely gravitational N-body simulation predicts.

If gas kinematics in the IGM are fully explained by visible-matter gravitational dynamics with no residual coherent alignment, the mechanism is weakened. Status: LIVE — EMPIRICAL.

KS-52 — Primordial anchor sequence. The argument predicts that supermassive black holes form before or simultaneously with their host galaxies, as topological anchors at filament intersections.

If observation conclusively proves that galaxies form fully before their central black holes, the derivation breaks. Status: LIVE — EMPIRICAL. Early JWST data is suggestive but not conclusive.

§10 – Conclusion

The vacuum is the tension field. The covering around the ball.

The tension bundles into filaments to minimise stretching energy — because energy is proportional to the record measure (the Lemma), and therefore proportional to field line length (Proposition 1), and the minimum-length network connecting distributed matter is a branching tree of shared corridors, not N independent lines (Proposition 2).

Gas flows along the filaments, pooling at the nodes. The nodes collapse into direct vacuums — primordial supermassive black holes. The direct vacuums anchor the local tension, seeding the galaxies.

No invisible particles are required. Structure forms because the field lines must close.

You have stood in a cathedral and felt the architecture hold the space together.

The cosmic web is that — not built by invisible scaffolding poured in from outside, but held together by the structure of the space itself.

But the quantitative match to precision cosmological data is not yet demonstrated. The structural argument is sound. The computational confrontation is owed. KS-41 remains live until the debt is paid.

Claim Summary

Derived: Vacuum under global tension (§3, from Axiom S + AP06). $E = \kappa\mu$ energy-measure bridge (Lemma, from Axioms B + R + AP18 Lemma 1 + AP05/AP08 Noether).

$E = Tl$ energy-length proportionality (§5.1, Proposition 1, from Lemma + AP08 + AP15 + AP20). $T = \lambda$ by uniqueness. Bundling into filaments minimises energy (§5.2, Proposition 2, Steiner Tree on metric manifold).

Gas flow along filaments (§5.3, from Props 1+2). Jeans mass reduction direction (§5.4, illustrative scaling).

Structural: Same axioms at three scales (§4). Fold mechanism at filament intersections (§6). SMBH-first formation (§6). Continuous-distribution extension of Steiner Tree (§5.2 epistemic note).

Conjectural/Untested: Quantitative CMB power spectrum match (D1). Matter power spectrum $P(k)$. BAO predictions. Numerical Jeans mass. Whether tension field reproduces six-parameter Λ CDM precision without CDM. Compactification threshold (D2).

Conditional on: AP17 (tension field), AP18 (acceleration floor; $\alpha \approx 1.05$, pending KS-39). EH and QRA proven (AP20).

Depends on: AP06 Thm 3.1 (closure), AP08 (homogeneity), AP14 (quantum gravity), AP15 (stiffness λ), AP17 (The Room), AP18 (The Floor, Lemma 1), AP20 (AS = manifold).

Addresses: KS-41 (Structure Formation) — structurally, not quantitatively.

New kill switches: KS-51 (filament topology, EMPIRICAL), KS-52 (primordial anchor sequence, EMPIRICAL).

Debts: D1 (linearised perturbation equations with a_0 floor; CMB/ $P(k)$ /BAO power spectra). D2 (compactification threshold; derive or flag as parameter).

Don't be a cunt. Be kind.

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