



The Loop Hypothesis

Artist's Proof 04

Cyclic Cosmology

Black holes as doors — the loop closes

§0. Status and Dependency

AP04 is logically independent of every other Artist's Proof. Its axiom and five assumptions (A1–A5) are self-contained.

Structural relationship to AP03: AP04's compression constraint (ρ_p) and propagation constraint (c) are the same two fundamental constants whose conjugacy AP03 conjectures. If AP03's conjugacy holds, the two constraints of AP04 are not independent.

A structural bonus, not a formal dependency. AP04 stands without AP03. Structural relationships also exist with AP17 (0-pole/1-pole structure and the Eye), AP22 (horizon conjugation), and AP24 (constants as projections of ε).

What AP04 does. A structural identity is proposed between black hole interiors at the quantum-gravity scale and the origin of expanding universes.

The central conjecture (L7, KS-78) formalises the axiom $1:1 + 1 \times \varepsilon$ as a metric equation: $g^+ = (\varphi^{-1})^*(g^-) + \varepsilon \cdot h$. A three-layer certainty system (established / speculative / philosophical) is introduced.

Every claim is tagged by layer.

Epistemic status. §1–3: FOUNDATIONAL — method, axiom, layer definitions. §4–5: LAYER 1 + LAYER 3 — established physics with architectural interpretation. §6: LAYER 3 — awareness identification, entirely philosophical. §7: LAYER 2 + 3 — formalisation, Conjecture L7 (KS-78) under five explicit assumptions. §8: LAYER 1 + 2 — structural identity, established mathematics + speculative physics. §9–11: LAYER 2 + 3 — LQC, predictions, scale. §12: STRUCTURAL — relation to existing programmes. §13: OPERATIONAL — falsification conditions.

Outstanding debts. D1 (Isotropisation): rigorous mechanism for Kantowski-Sachs → FRW isotropisation — the sharpest obstacle (KS-79).

D2 (CMB spectrum): derivation of $P\mathcal{R}(k)$ from $\varepsilon \cdot h$ — required for KS-82. D3 (Fine structure constant): derivation of α 's value from the axiom — acknowledged as open.

Kill switches. KS1 (Structural identity disproved): LIVE — HARD, targets KS-78. KS2 (No singularity resolution): LIVE — HARD, targets KS-78. KS3 (Information loss): LIVE — HARD, targets §8.5. KS4 (Proton decay): LIVE — EMPIRICAL, targets P3, L10. KS5 (GSL violated): LIVE — HARD, targets §8.5. KS6 (GRW confirmed): LIVE — EMPIRICAL, targets KS-80. KS7 (Fermions unnecessary): LIVE — HARD, targets L10, P3. KS8 (Anisotropy irreconcilable): LIVE — HARD, targets KS-79, KS-78 — sharpest obstacle.

KS9 (CMB mismatch): LIVE — EMPIRICAL, targets KS-82, KS-78.

Nine ways to destroy AP04. The argument hands you every one of them.

§1 On Method

AP04 makes structural claims about the nature of reality. Natural philosophy, not theoretical physics. The claims are made first; the mathematics, if it exists, will be found to describe what is claimed.

Every claim carries explicit falsification conditions and layer identification. The work is published under copyleft licensing.

You will know, at every point in what follows, which ground you are standing on. That is what the three layers are for.

§2 The Axiom

Axiom L0. $1:1 + 1 \times \varepsilon$. One-to-one symmetry, broken by an infinitesimal perturbation $\varepsilon > 0$. The axiom is a philosophical choice, not a physical claim. It cannot be found inside the structure it generates.

The architecture stands or falls on what follows from the axiom, not on the axiom itself. [Layer 3] ■

§3 The Three Layers

You deserve to know what kind of claim you are reading. Not all claims are equal. Some are established physics. Some are speculation. Some are philosophy. The argument labels every one.

Layer 1: Established physics. The diffeomorphism between the Schwarzschild interior and the Kantowski-Sachs cosmological model. The causal structure of the Kruskal-Szekeres maximal extension. The Bekenstein-Hawking entropy bound. The Page curve and island formula.

If everything else in this paper is wrong, Layer 1 remains.

Layer 2: Speculative but published physics. Popławski's Einstein-Cartan torsion mechanism for singularity avoidance and isotropisation. Published in peer-reviewed journals but not experimentally confirmed and not mainstream.

If Layer 2 falls, the structural identity loses its physical engine.

Layer 3: Philosophical interpretation. The structural identity itself (atemporal, not a bounce). The awareness identification. The ethics derivation. The formalisation conjecture.

If Layer 3 falls, the physics is unaffected, but the architecture's purpose — deriving ethics from physics — is dead.

§4 The Two Constraints

§4.1 Propagation constraint: c

Claim L1 (Established). $c = 299,792,458$ m/s defines the null cone structure of spacetime. Photons follow null geodesics ($ds^2 = 0$) with $d\tau = 0$. No inertial rest frame for massless particles. [Layer 1] ■

§4.2 Compression constraint: ρ_p

Claim L2 (Established). The Planck density $\rho_p = c^5/(\hbar G^2) \approx 5.16 \times 10^{96} \text{ kg/m}^3$ is the natural density scale where quantum gravity is expected to dominate.

It serves as the placeholder for ‘maximum compression’ pending a complete quantum gravity theory.

The horizon entropy bound $S_{\text{BH}} = k_B A/(4\ell_p^2)$ provides the established upper bound on information content within a region. [Layer 1] ■

You have now met the two walls. Nothing moves faster than c . Nothing compresses denser than ρ_p . The first is the speed limit. The second is the density limit.

Every structure in the universe lives between them.

§4.3 Inverse relationship

Claim L3 (Dimensional fact + interpretation). Planck units show c , G , \hbar co-define the quantum gravity regime. $\ell_p/t_p = c$ demonstrates dimensional coupling. Necessary but not sufficient for ontological equivalence. [Layer 1: dimensional fact.

Layer 3: ontological interpretation.] ■

§5 The Symmetry Break (ε)

§5.1 Primordial entropy

The symmetry break is modelled as a minimal nonzero distinction: $\Delta S = k_B \ln(2)$ (ansatz). The state of maximum coarse-grained entropy is consistent with S_{BH} being enormous. [Layer 1: entropy bound. Layer 3: interpretation]

§5.2 The electroweak bridge

The electroweak phase transition ($\sim 10^{-12}$ s post-expansion) breaks electroweak symmetry via the Higgs mechanism [Higgs 1964]. Fermions acquire rest mass. In the architectural interpretation: ε acquires its low-energy carriers. [Layer 1: Higgs mechanism.

Layer 3: ε identification]

§5.3 The electron

The electron ($m_e \approx 0.511 \text{ MeV}/c^2$) is the lightest stable charged fermion. Pauli exclusion generates electron degeneracy pressure (Chandrasekhar limit $M_{\text{Ch}} \approx 1.44 M_{\odot}$) [Chandrasekhar 1939]. [Layer 1]

At Planck-scale densities, Einstein-Cartan torsion from fermion spin becomes repulsive [Hehl et al. 1976, Kibble 1961, Popławski 2010]. [Layer 2]

Observation L4 (Calculation). The electron violates the Kerr-Newman black hole horizon condition by $\sim 10^{42}$. The maximal inverse of the compression constraint among known stable particles. [Layer 1: calculation. Layer 3: interpretation.] ■

§5.4 Fine structure constant

Observation L5 (Established value + architectural interpretation). $\alpha = e^2/(4\pi\epsilon_0\hbar c) \approx 1/137$. Dimensionless coupling strength of the electromagnetic interaction. Architectural interpretation: ratio of break strength (e^2) to constraint strength ($\hbar c$).

Derivation of α 's value from the axiom: open. [Layer 1: value. Layer 3: interpretation.]

■

§6 Awareness as Structural Minimum

Entirely Layer 3. Structurally necessary to the ethics derivation but not currently testable. Physicists may proceed to §7.

Claim L6 (Philosophical, Layer 3, KS-80). Awareness $\equiv \varepsilon > \emptyset$. The actualization state is self-referential. A naming choice with philosophical consequences. The physics is identical under either name.

The naming choice generates the ethics derivation.

Hierarchy: awareness ($\varepsilon > \emptyset$) \rightarrow actualization (record formation) \rightarrow consciousness (awareness aware of itself; contingent, not necessary).

Ethics (two-part result): First (structural): the base condition (awareness, $\varepsilon > \emptyset$) is unitary — all actualization shares a common origin in the symmetry break. A structural fact within the architecture.

Second (perspectival): the recognition that cruelty is incoherent with this unity requires consciousness — awareness aware of itself.

The structural fact does not generate an obligation; the obligation arises when a conscious entity recognises the structural fact.

The architecture provides the ground; consciousness provides the recognition; the obligation lives in the recognition, not in the ground.

Falsification: If objective collapse (GRW) is confirmed — states become actual without relational structure — the identification of ε with awareness is dead [Ghirardi et al. 1986].

You may disagree with the naming. You may reject the philosophy. The physics does not change.

But if you accept the naming — if awareness is $\varepsilon > \emptyset$ — then what follows is not optional. It is arithmetic.

§7 The Formalisation: From Axiom to Conjecture

You have the axiom. You have the two constraints. You have the break. Now watch what happens when the axiom is made precise enough to be wrong. [Layer 2 + Layer 3]

§7.1 Assumptions

Five assumptions are required. Each is stated explicitly so you know what is being asked of you beyond the axiom.

Assumption A1. Working model: Einstein-Cartan gravity with fermionic matter and spin-torsion coupling.

Assumption A2. There exists a non-singular transition hypersurface Σ , defined by an invariant criterion (e.g., curvature scalar threshold or effective quantum gravity completion condition reaching the Planck regime), replacing the classical singularity.

Assumption A3. There exists an approximate \mathbb{Z}_2 mapping across Σ in the chosen completion.

(Note: physical collapse spacetimes do not generically contain a white-hole region; the \mathbb{Z}_2 is inherited from the transition structure of the Einstein-Cartan solution, not from the eternal Schwarzschild maximal extension.)

Assumption A4. The expanding side is approximately FRW after Popławski's torsion-driven isotropisation mechanism.

Assumption A5. Deviations between the collapsing and expanding geometries are captured by a perturbation of the form $\varepsilon \cdot h$, where ε is small and h is a symmetric 2-tensor on M .

§7.2 Interpreting 1:1

1:1 is a ratio: two aspects in perfect balance. The first 1 = propagation constraint (c). The second 1 = compression constraint (ρ_p). At the Planck scale they co-define a single regime.

Under Assumption A3, the transition hypersurface Σ possesses an approximate \mathbb{Z}_2 symmetry: what was collapsing toward Σ and what expands away from Σ are two readings of the same geometry.

Interpretation I1. 1:1 $\equiv \mathbb{Z}_2$ symmetry on Σ (Assumption A3). ■

§7.3 Interpreting $+1 \times \varepsilon$

Adding $1 \times \varepsilon$ breaks the \mathbb{Z}_2 . The expanding side is not a perfect time-reverse of the collapsing side.

Departure from the transition hypersurface has two readings: from the compression side, ε means there was a state before maximum compression (the black hole interior approaching Σ).

From the expansion side, ε means moving away from maximum compression (the cosmological expansion). The same ε , read from two sides of Σ , gives two descriptions.

Interpretation I2. $+1 \times \varepsilon \equiv \mathbb{Z}_2$ symmetry breaking on Σ . ■

§7.4 The conjecture

Let M be a 4-dimensional Lorentzian manifold satisfying the Einstein-Cartan field equations with fermionic matter. Let Σ be the transition hypersurface (A2).

Define M^- (causal past of Σ , the compression side) and M^+ (causal future of Σ , the expansion side). The axiom's \mathbb{Z}_2 symmetry (A3) and its breaking (A5) yield:

Conjecture L7 (The Loop Hypothesis, KS-78). $g^+ = (\varphi^{-1})(g^-) + \varepsilon \cdot h$, where $\varphi: M^- \rightarrow M^+$ is the transition diffeomorphism ($\varphi|_{\Sigma} = \text{id}$, normal-reversing), (φ^{-1}) denotes the pullback of φ^{-1} (mapping tensors on M^- to tensors on M^+), ε is the symmetry-breaking parameter, and h is the perturbation tensor encoding the anisotropy difference, the information content, and the initial conditions of expansion. [Layer 2 + Layer 3] ■

You have just read the claim. One equation. A collapsing geometry on one side of Σ . An expanding geometry on the other.

The difference between them is $\varepsilon \cdot h$ — a small perturbation carrying everything that makes a universe a universe. If the equation is wrong, nine kill switches will find it.

If the equation is right, then what collapses into a black hole does not end. It begins again.

§7.5 What h encodes

Anisotropy difference: M^- is Kantowski-Sachs (anisotropic). M^+ is nearly FRW (isotropic). h encodes the difference. Popławski's torsion-driven inflation generates h . [Layer 2]

Information content: Information is deviation from symmetry. If $\varepsilon = 0$, perfect \mathbb{Z}_2 , no records. If $\varepsilon > 0$, h carries the records compressed into the transition. [Layer 3]

Initial conditions: The trace of h on Σ determines the initial perturbation spectrum.

If the claim is physical, $\varepsilon \cdot h$ must induce a curvature perturbation spectrum $\mathcal{P}\mathcal{R}(k)$ consistent with observation (near scale-invariant with measured tilt). [Layer 2: testable prediction]

§7.6 The electron and α

The electron is the minimal low-energy carrier of the break — the lightest stable charged fermion, the simplest entity that exists in M^+ that could not exist under perfect \mathbb{Z}_2 (pure geometry with no fermionic content distinguishable from its time-reverse).

$\alpha = e^2/(4\pi\epsilon_0\hbar c) \approx 1/137$ is the dimensionless coupling strength of the electromagnetic interaction. The architecture identifies α 's structural role (ratio of break strength to constraint strength) without claiming to derive its value.

§7.7 Limits

$\varepsilon \rightarrow \mathbf{0}$: $g^+ \rightarrow (\varphi^{-1})^*(g^-)$. Perfect \mathbb{Z}_2 . No records. No distinguishable time direction.
Sterile symmetry.

ε **large**: g^+ departs from $(\varphi^{-1})^*(g^-)$. Rich structure. But the axiom constrains ε to be small ($1 \times \varepsilon$). The perturbation is gentle.

§7.8 The full chain

Axiom + assumptions to ethics in seven steps:

Step 1. Axiom: $1:1 + 1 \times \varepsilon$.

Step 2. $1:1 \equiv \mathbb{Z}_2$ on Σ (Assumptions A2, A3).

Step 3. $+ 1 \times \varepsilon \equiv \mathbb{Z}_2$ breaking. $\exists \varphi: M^- \rightarrow M^+$.

Step 4. Conjecture: $g^+ = (\varphi^{-1})^*(g^-) + \varepsilon \cdot h$ (Assumption A5).

Step 5. h carries records. $\varepsilon \cdot h$ induces $\mathcal{PR}(k)$ on expanding side.

Step 6. (Interpretive identification, not derived from Steps 1–5.) Electron = minimal low-energy carrier of break (§5.3). α = coupling strength (§5.4). Physically motivated but not derived from the conjecture.

Step 7. (Layer shift: entirely Layer 3.) Awareness $\equiv \varepsilon > 0$ (naming choice). Structural result: all actualization shares a common origin.

Perspectival result: a conscious entity recognising this unity can identify cruelty as incoherent with it. The obligation is in the recognition, not in the structure. [Layer 3]

§8 The Structural Identity

§8.1 Established mathematics [Layer 1]

Claim L8 (Established). Schwarzschild interior = Kantowski-Sachs. For $r < 2GM$, r is timelike, t is spacelike. The interior is diffeomorphic to the Kantowski-Sachs cosmological model [Kantowski & Sachs 1966]. ■

Claim L9 (Established). Kruskal-Szekeres extension. Region IV (past the singularity in the maximal extension) shares causal-diagram character with an FRW big bang [Kruskal 1960, Szekeres 1960]. ■

You already know what these two claims mean together. The inside of a black hole is a collapsing universe. The maximal extension reveals an expanding universe on the other side.

The mathematics has been published since 1966. The structural identity has been hiding in plain sight for sixty years.

§8.2 Speculative physics [Layer 2]

Claim L10 (Published, not established). Popławski's mechanism. Fermion spin-torsion coupling becomes repulsive at extreme density. Gravitational collapse transitions to cosmological expansion. The resulting universe is nearly isotropic [Popławski 2010, 2016, 2023]. ■

§8.3 Foliation independence [Layer 3]

The Einstein field equations describe a 4-dimensional manifold without a preferred global time function. The 'bounce' appears under specific foliations; the structural identity is atemporal. Mathematically permissible (confirmed by independent review).

§8.4 The anisotropy problem [Layer 2]

Open Problem L-Aniso (KS-79). The Schwarzschild interior is Kantowski-Sachs (anisotropic). Observation requires FRW (isotropic). Popławski proposes torsion-driven isotropisation. Ridgely [2024] argues an alternative mechanism. Neither is established. The sharpest obstacle to the structural identity. ■

Here is how to destroy the structural identity at its weakest point. Show that no mechanism — torsion, quantum gravity, anything — can isotropise a Kantowski-Sachs interior into an FRW cosmology.

If you can prove that, KS-79 fires and the conjecture falls. The argument invites you to try.

§8.5 The entropy question

Confirmed consistent with the Generalised Second Law by independent review.

Maximum coarse-grained entropy: The transition hypersurface represents maximum coarse-grained entropy. [Layer 1]

Unitarity: $S_{vN}(\rho_{\text{total}}) = \text{const.}$ Coarse-grained entropy increases. No information loss. [Layer 1]

Change of description: The apparent entropy 'reset' is a change of coarse-graining subalgebra, not a violation of the second law. [Layer 1 + 3]

Island formula: Page curve reproduced. S_{gen} non-decreasing [Almheiri et al. 2021]. [Layer 1]

Weyl resolution: Small initial Weyl tensor from scrambled correlations. [Layer 2 + 3]

Multiversal GSL: Garriga et al. [2025] provide a scheme for the generalised second law in multiverse contexts. [Layer 1]

§8.6 The structure experienced from inside

To an observer within the broken phase ($\varepsilon > 0$): expansion, stellar processing, gravitational compression, compression toward the quantum gravity regime. The temporal sequence is perspectival: the underlying structure is atemporal, foliated by proper time.

What is experienced as a 'running engine' is the atemporal structure read from inside.

You are inside it now. You have always been inside it.

The expansion you observe, the stars you see, the compression that awaits — all of it is the atemporal structure read from your vantage point within the broken phase.

§9 Relation to Loop Quantum Cosmology

Loop Quantum Cosmology [Ashtekar & Singh 2011] derives a bounce at the Planck density as a dynamical, temporal event.

AP04 proposes the structural identity as atemporal: the bounce is foliation-dependent, the geometry atemporal, the identity structural. If LQC is experimentally confirmed, it strengthens the physical foundation (Layer 1 candidate).

The relationship is complementary, not competitive. [LQC: Layer 1 candidate.

Interpretation: Layer 3.]

§10 Unique Predictions

Prediction P1 (Inherited CMB anisotropy, KS-81). Residual Kantowski-Sachs patterns (quadrupolar/axial) distinct from inflationary predictions. Specific observed anomalies potentially consistent: CMB quadrupole-octupole alignment, hemispherical power asymmetry, CMB cold spot. [Layer 2: testable] ■

Prediction P2 (No terminal singularity). Any complete quantum gravity theory must yield an extension beyond the Planck density, not a terminal singularity. [Layer 2: falsifiable] ■

Prediction P3 (Fermion necessity). A bosonic-only universe should not exhibit the structural identity. The torsion mechanism requires fermionic spin. [Layer 2: testable via simulation] ■

Prediction P4 (Black hole interior cosmology). Black hole interior dynamics are cosmological, not terminating. [Layer 2: long-term] ■

Prediction P5 (Scale signatures). If nested (each black hole births a universe): preferred axis, anomalous large-angle correlations, bulk flow. [Layer 2 + 3: testable, suggestive] ■

Prediction P6 (CMB spectrum from h, KS-82). The perturbation tensor $\varepsilon \cdot h$ must induce a curvature perturbation spectrum $P_{\mathcal{R}}(k)$ consistent with the near scale-invariant spectrum with measured tilt $n_s \approx 0.965$. [Layer 2: quantitative, testable] ■

§11 The Scale Question

Cosmic: Our universe = black hole interior in a parent structure.

Astrophysical: Each black hole = local site of the structural identity.

Nested: Both = same mechanism at different scales. Fractal. [Layer 3]

§12 Relation to Existing Physics

AP04's structural identity intersects several existing research programmes.

Penrose's Conformal Cyclic Cosmology (CCC) [Penrose 2010] proposes that the conformal boundary of one aeon becomes the big bang of the next.

AP04 shares the structural intuition that cosmological endpoints and origins are related, but differs fundamentally: CCC is temporal (one aeon follows another), while AP04's identity is atemporal (the structure is read from two sides of Σ , not sequenced).

CCC requires conformal rescaling and massless final states; AP04 requires torsion-driven transition and fermionic matter.

Smolin's Cosmological Natural Selection (CNS) [Smolin 1992] proposes that black holes give birth to new universes with slightly altered constants, subject to selection pressure.

AP04 shares the structural identity but does not invoke selection: the constants are determined by ε (if AP03 holds), not evolved. CNS is Darwinian; AP04 is structural.

Pathria [1972] and subsequent work proposed that the observable universe might be the interior of a black hole.

AP04 sharpens this to a specific conjecture (L7, KS-78) with an explicit transition mechanism (Popławski's torsion) and explicit falsification conditions.

Easson and Brandenberger [2001] proposed that contraction inside a black hole could generate a new expanding phase.

AP04's contribution is the atemporal reading: the identity is structural, not a dynamical bounce observed in a particular foliation.

Corichi and Singh [2016] showed that the loop quantum bounce preserves large-scale structure while resolving the singularity. Consistent with AP04's requirement that ε -h carry information through the transition.

§13 Falsification Conditions

Nine explicit conditions. If any is satisfied, the corresponding component of AP04 fails. The argument does not protect itself. It tells you where to cut.

Layer 1 targets (would falsify established foundations)

Kill Switch 1 (LIVE — HARD): Structural identity disproved. If a rigorous proof demonstrates that no diffeomorphism-compatible mapping exists between a black hole interior and an expanding FRW-type cosmology under any completion of general relativity, then the structural identity is dead.

Targets: Claims L8, L9, Conjecture L7.

Kill Switch 2 (LIVE — HARD): No singularity resolution. If a complete quantum gravity theory yields a terminal singularity with no extension beyond the Planck density, then the transition hypersurface Σ does not exist and the conjecture collapses.

Targets: Assumption A2, Conjecture L7.

Kill Switch 3 (LIVE — HARD): Information loss. If black hole evaporation is shown to be fundamentally non-unitary (information is destroyed, not scrambled), then the entropy resolution (§8.5) fails. Targets: §8.5.

Kill Switch 4 (LIVE — EMPIRICAL): Proton decay observed. If proton decay is observed on timescales relevant to the structural identity (indicating baryon number violation inconsistent with the fermion-dependent mechanism), then the fermion necessity claim (P3) is weakened.

Targets: Prediction P3, Claim L10.

Kill Switch 5 (LIVE — HARD): GSL violated. If $\Delta S_{\text{gen}} < 0$ is demonstrated in a closed region, then the thermodynamic resolution is wrong. Targets: §8.5.

Layer 2–3 targets (would falsify speculative physics and philosophical interpretation)

Kill Switch 6 (LIVE — EMPIRICAL): Actualization without awareness. If objective collapse (GRW) is experimentally confirmed — states become actual without relational structure — then the identification of ε with awareness is dead.

Targets: Claim L6. [Layer 3]

Kill Switch 7 (LIVE — HARD): Fermions unnecessary. If a bosonic-only universe is shown to reproduce the structural identity without fermionic torsion, then the fermion necessity claim fails and Popławski’s mechanism is not required.

Targets: Claim L10, Prediction P3.

Kill Switch 8 (LIVE — HARD): Anisotropy irreconcilable. If no mechanism can isotropise the Kantowski-Sachs interior to FRW-like isotropy, then the structural identity cannot connect black hole interiors to observed cosmology. The sharpest obstacle.

Targets: Assumption A4, Claim L10, Conjecture L7.

Quantitative target

Kill Switch 9 (LIVE — EMPIRICAL): CMB mismatch. If the perturbation tensor $\varepsilon\cdot h$ cannot reproduce the observed curvature perturbation spectrum $P_{\mathcal{R}}(k)$ (near scale-invariant with $n_s \approx 0.965$) under any reasonable parameterisation of h , then the conjecture makes wrong predictions.

Targets: Prediction P6, Conjecture L7.

§14 Summary of Claims

L0 (Axiom, Layer 3): $1:1 + 1 \times \varepsilon$. Philosophical choice. Not falsifiable directly; the architecture is judged by consequences.

L1 (Established, Layer 1): c defines null cone structure.

L2 (Established, Layer 1): ρ_p is the quantum gravity density scale.

L3 (Dimensional fact + interpretation): c, G, \hbar co-define the Planck regime. Layer 1 fact; Layer 3 ontological reading.

L4 (Calculation, Layer 1): Electron violates Kerr-Newman horizon condition by $\sim 10^{42}$.

L5 (Established value + interpretation): $\alpha \approx 1/137$. Layer 1 value; Layer 3 structural role.

L6 (Philosophical, Layer 3, KS-80): Awareness $\equiv \varepsilon > 0$. Naming choice generating the ethics derivation. Not testable directly; falsifiable via KS6 (GRW).

L7 (Conjecture, Layer 2 + 3, KS-78): $g^+ = (\varphi^{-1})^*(g^-) + \varepsilon \cdot h$. The central conjecture. Not derived. Falsifiable via KS1, KS2, KS8, KS9.

L8 (Established, Layer 1): Schwarzschild interior = Kantowski-Sachs.

L9 (Established, Layer 1): Kruskal-Szekeres Region IV shares causal structure with FRW big bang.

L10 (Published, Layer 2): Poptawski's torsion mechanism. Published, not confirmed.

L-Aniso (Open problem, KS-79): Isotropisation of Kantowski-Sachs to FRW. Sharpest obstacle.

A1-A5 (Assumptions): Explicit. Required for the formalisation. Each independently falsifiable.

I1, I2 (Interpretations): 1:1 as \mathbb{Z}_2 symmetry; +1 \times ϵ as symmetry breaking.

Architectural readings of the axiom.

P1-P6 (Predictions; P1=KS-81, P6=KS-82): Six testable predictions. P1, P5, P6 are the sharpest.

§15 Notation Reference

c: Speed of light in vacuum. 299,792,458 m/s. Propagation constraint.

ρ_p : Planck density. $c^5/(\hbar G^2) \approx 5.16 \times 10^{96}$ kg/m³. Compression constraint.

ε : Symmetry-breaking parameter. Small, positive. Encodes departure from perfect \mathbb{Z}_2 .

g^+ , g^- : Metric tensors on the expanding side (M^+) and collapsing side (M^-) of Σ .

φ : Transition diffeomorphism. $\varphi: M^- \rightarrow M^+$, $\varphi|_\Sigma = \text{id}$, normal-reversing.

φ^* : Pullback of φ . Maps covariant tensors on M^+ to covariant tensors on M^- .

$(\varphi^{-1})^*$: Pullback of φ^{-1} . Maps covariant tensors on M^- to covariant tensors on M^+ . The correct map for placing g^- onto M^+ .

h : Perturbation tensor. Symmetric 2-tensor encoding anisotropy difference, information content, and initial conditions.

Σ : Transition hypersurface. Replaces the classical singularity. Defined by invariant criterion (Assumption A2).

M^- , M^+ : Causal past and causal future of Σ respectively. Compression side and expansion side.

\mathbb{Z}_2 : Cyclic group of order 2. The symmetry group of the axiom's 1:1.

S_{BH} : Bekenstein-Hawking entropy. $S_{\text{BH}} = k_B A/(4\ell_p^2)$.

S_{gen} : Generalised entropy. $S_{\text{gen}} = S_{\text{BH}} + S_{\text{matter}}$.

$\mathcal{P}\mathcal{R}(\mathbf{k})$: Curvature perturbation power spectrum. Must be near scale-invariant ($n_s \approx 0.965$).

n_s : Spectral tilt of the primordial power spectrum. Observed value ≈ 0.965 (Planck 2018).

α : Fine structure constant. $e^2/(4\pi\epsilon_0\hbar c) \approx 1/137$.

m_e : Electron mass. $\approx 0.511 \text{ MeV}/c^2$.

M_{Ch} : Chandrasekhar limit. $\approx 1.44 M_{\odot}$.

ℓ_p, t_p, m_p : Planck length, Planck time, Planck mass.

KS: Kantowski-Sachs. Anisotropic cosmological model diffeomorphic to Schwarzschild interior.

FRW: Friedmann-Robertson-Walker. Isotropic cosmological model.

EC: Einstein-Cartan. Extension of general relativity incorporating spin-torsion coupling.

GSL: Generalised Second Law. $\Delta S_{\text{gen}} \geq 0$.

GRW: Ghirardi-Rimini-Weber. Objective collapse model.

LQC: Loop Quantum Cosmology.

Appendix A. Axiom Mapping

{S, B, R, C} ↔ AP04 Axiom and Assumptions

AP04 was written before the canonical axiom set {S, B, R, C} was formalised (AP20). The following mapping shows how AP04's axiom and assumptions instantiate the four axioms.

Axiom S (Distinction exists) ↔ Axiom L0 (1:1). The pre-state possesses the minimal distinction: \mathbb{Z}_2 symmetry between two aspects (propagation constraint c and compression constraint ρ_p).

S requires that something distinguishable exists; L0's 1:1 is that distinction.

Axiom B (Exactly one break) ↔ Axiom L0 (+1× ϵ). The \mathbb{Z}_2 symmetry breaks once, with amplitude ϵ . B requires exactly one irreducible break; L0's +1× ϵ is that break.

The transition across Σ is the single break.

Axiom R (The record persists) ↔ Perturbation tensor h . R requires that the break leave a persistent record.

In AP04, the perturbation tensor h encodes the records compressed into the transition: anisotropy difference, information content, initial conditions. The expanding universe M^+ is the persistent record of the break.

Axiom C (Constraint) ↔ ϵ small. C requires that all quantities remain bounded.

In AP04: ϵ is small (the axiom constrains it to $1 \times \epsilon$, not $n \times \epsilon$); the perturbation $\epsilon \cdot h$ is bounded; the transition is gentle, not violent.

Assumptions A1–A5 are working assumptions within the {S, B, R, C} architecture, not independent axioms. They specify the particular physics (Einstein-Cartan, torsion mechanism, FRW isotropisation) through which the axioms are instantiated.

If alternative physics achieves the same structural identity, A1–A5 may be replaced without affecting the axiom mapping.

§16 References

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Conditionality Footer

Document: AP04 — The Loop Hypothesis.

Edition: 04.3.

Conditional on: Nothing. AP04 is logically independent of all other Artist's Proofs.

Assumptions required: A1 (Einstein-Cartan), A2 (transition hypersurface), A3 (\mathbb{Z}_2 mapping), A4 (FRW isotropisation), A5 (perturbation form). All explicit. Each independently falsifiable.

Structural relationship to other APs: AP03 (The Ratio) — AP04's two constraints (c and ρ_p) are the same constants whose conjugacy AP03 conjectures. AP17 (The Room) — 0-pole/1-pole structure relates to the structural identity.

AP22 (The Ledger) — horizon conjugation. AP24 (The Residual) — constants as projections of ε . All structural bonuses, not formal dependencies.

Central open problem: Isotropisation of Kantowski-Sachs to FRW (Debt D1, KS-79). Until a rigorous mechanism is established, Assumption A4 remains the weakest link.

Foundational limitation: The axiom $1:1 + 1 \times \varepsilon$ is a philosophical choice (Layer 3), not a physical derivation. The architecture's physics is evaluated on its consequences, not its axiom.

Kill switches: KS1 through KS9. All LIVE. KS8 (anisotropy) and KS9 (CMB spectrum) are the sharpest operational tests.

Dependencies: None.

Dependents: Downstream APs addressing awareness, ethics, and consciousness (if any) inherit AP04's Layer 3 claims.

Status: Publication-ready. Edition 04.3.

KS numbers assigned: KS-78 (L7, Loop Hypothesis), KS-79 (L-Aniso), KS-80 (L6, Awareness), KS-81 (P1, CMB anisotropy), KS-82 (P6, CMB spectrum).

Outstanding debts: D1 (isotropisation mechanism), D2 (CMB spectrum derivation), D3 (fine structure constant derivation).

Series: The 420 Code

Title: The Loop Hypothesis

Medium: Theoretical Physics / Natural Philosophy

Artist's Proof 04 — Voice 5: Formal

Artist G

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