Cosmological Relativity: what the construction delivers, what it declines, and where its edge is

D. Janzen

Abstract

This paper states, in one place, what the Cosmological Relativity corpus establishes, at the weight each result is established at, together with what the construction declines to claim and where its open edge lies. Nothing here is new: every claim is drawn from one of seventeen papers or from the ledgers those papers cite, and is stated at the register its source gives it—a proposition as a proposition, a reading as a reading, a conjecture as a conjecture. What is new is the assembly, and the three things an assembly can supply that a set of papers cannot. *The joins*, where a result in one paper is load-bearing for a result in another, or where two papers reach one structure by arguments sharing no premise. *The bounds*, carried from each source to sit beside the claim they bound — *a distillation that drops them has not shortened the corpus but misreported it*, and several of the sharpest statements here are the limits their own papers place on their own results. And *the relative size of the frontier* against the body of work that surrounds it.

1 What forces the object, what it is, and the distinctions it forces

Cosmological Relativity is a construction on one geometric object, and almost everything below is that object read from somewhere. But the object is not where the argument starts, and presenting it first would ask a reader to grant the thing in question. It is reached: a cosmic foliation is forced, reading that foliation ontologically is the augmentation, and maximal symmetry then leaves exactly one manifold to carry it (Prop. 1). *The first of those steps is reached by three independent routes and the section gives them all*, because what a convergence of independent forcings establishes is different in kind from what any one of them does — *and the section is careful about which of them are independent, since a count that inflates itself would forfeit exactly that.* This section takes the steps in order, and closes on the distinction every later result depends on — what a *boundary* of such an object is.

1.1 What the measurement forces

The cosmological redshift is not a property an emitting source carries. It is the path integral of the expansion rate along the photon's own trajectory, accumulated continuously rather than fixed at emission [15]. That distinction is what makes the isotropy of the microwave background's monopole a measurement of something other than what it is usually taken to measure.

Grant the common reading its strongest form. Let last scattering be *perfectly* homogeneous. Then the observed temperature contrast is exactly the variation in the integrated expansion, with nothing left over, and *the entire observed isotropy is the statement that the integrated expansion was the same in every direction.* Homogeneity at the source does not *supply* the isotropy; granted perfectly, it removes one term and leaves the isotropy as a direct measurement of uniform expansion [15].

Under the alternative — that the large-scale expansion rate tracks the matter lumpiness region by region, with no single global scale factor — the accumulated redshift would scatter across the sky by $\sim 10^{-3}$, against an observed $\lesssim 3 \times 10^{-6}$: *an exclusion by three orders of magnitude. And every choice in the estimate biases it downward, so the number is a floor rather than an estimate* [15].

And the reason the two cases differ is mechanical rather than statistical, which is what makes the number a floor. Lumpiness clustering on a single background is carried by a potential, and the redshift acquired descending into a well is undone climbing out: the contributions *telescope*, and no $\sqrt{N}$ accumulation survives the journey. Differential expansion has nothing to cancel against, so it *accumulates. The isotropy is therefore a measurement selecting telescoping over accumulating*, and statistical homogeneity does not account for it — being fully consistent with the differential hypothesis, which would still deliver the scatter [15].

And the remaining evasion is self-defeating. A programme of locally differential rates escapes the floor only by requiring those rates to average to a common value in every direction — which *is* a global uniform expansion in cosmic time, reinstating the very rest frame and objective simultaneity it was introduced to avoid [15].

One escape is left, and it is closed on other grounds because no $\sqrt{N}$ argument touches it. A finely tuned, spherically symmetric inhomogeneity centred on the observer would give an isotropic redshift with no global uniform expansion at all — *structured rather than statistical*, so the floor says nothing about it. It is closed by the Copernican principle *together with* the independently measured isotropy of the expansion history itself. *With the statistical escape closed by the floor and the structured one closed here, the observed isotropy forces uniform cosmic expansion.*

And the floor constrains the rate and not the content, which is the misreading the result most invites. This construction's real space *is* locally curved and inhomogeneous — the matter density is precisely the bend of the spatial cut off the vacuum profile (§3). *Uniform expansion and lumpy matter are consistent*, and nothing here denies inhomogeneity; what is excluded is an expansion *rate* that tracks it [15].

What a single datum thereby establishes is worth stating exactly, because it is larger than a parameter bound. The rejected region is not a corner of parameter space but *the entire class of histories lacking a single global scale factor on a single global time.* To reject that class is to select a global, time-ordered expansion — the cosmic foliation, made dynamical. *And the foliation is logically prior to everything the standard model otherwise assumes*: "space" is one of its slices, "expansion" an ordered family of them, isotropy and homogeneity properties of a slice — none of them statable until the foliation is fixed.

So one datum establishes three things from the bottom up: the cosmic time on which the rest stands, the uniformity of its advance, and — *within the observable region and under the Copernican principle — the maximal symmetry of its slices* [15]. *Which is worth noticing against the order of this section*: the third step below reaches the substrate by maximal symmetry, and the measurement has already supplied that symmetry for the slices, at that scope. *The steps are therefore not as independent as their sequence suggests*, and the honest statement is that the datum reaches further into the construction than its position in the argument implies.

And the standard model's foundational kinematics are not idealisations the data tolerate: they are what the data force, the one coherent alternative having been excluded.

1.2 The augmentation that follows, and the routes that are not the measurement

Augmenting general relativity by fixing a physical foliation and reading it ontologically — the lapse the objective rate at which the existing world advances, the shift the relativity of synchrony — is *necessary and sufficient* for a coherent formal description of an existing, evolving world [16]. *Necessary*, because a description lacking the lapse part collapses existence into occurrence. *Sufficient*, because the two parts close the only coherent escapes. No field equation is altered.

The standard reading fills general relativity's silence about which foliation is physical by collapsing two distinctions at once: it reads the relativity of simultaneity as the absence of any objective present, and it reifies the four-manifold as a thing that exists [15]. §2 takes those apart; the augmentation is what remains when they are held apart.

A second collapse entered with the first cosmology and runs in the opposite direction from what the measurement establishes. Einstein's static solution fixes the cosmic scale from the content — with $\lambda = \kappa\rho/2$ the radius is $R = 1/\sqrt{\lambda}$, so *the density of the world-matter determines the size of the world* — and Friedmann's equations carry that direction of determination forward, the scale factor's evolution sourced by what the universe contains. *What the isotropy forces is the reverse ordering for the rate*: it is fixed independently of how the content is distributed, since a rate tracking the content is precisely what the measurement excludes. *Whether the same reversal extends from the rate to the scale is not settled by the measurement* [15].

And the structure the datum forces was posited, attacked, defended and abandoned within four years. Einstein assumed it in February 1917 in his own words "against the spirit of relativity", on the empirical ground that stellar proper motions are small compared with c. De Sitter countered a month later, placing the choice among candidate universes outside physical argument altogether and pressing as his sharpest objection that in Einstein's solution "time has a separate position". Eddington defended it in 1920 on geometric grounds, in the declared absence of any experimental knowledge on cosmical scales — *he names the absence of the discriminator and selects anyway.* Einstein then went nearly silent on cosmology and never addressed how the cosmic time his own assumption distinguished stands to the relativity of simultaneity [15]. *The assumption was correct, and the objection was correct as a description of the structure though not as a reason to reject it.*

And the measurement is not the only route to it. The event horizon of a collapsing body is a metric singularity met only at infinite exterior time, so no finite layer carries a completed horizon (§1.6) [2]: *a structural forcing, from general relativity alone. A third arrives from the dynamics, and it is of a third kind again — neither measured nor causal, but a breakdown of the alternative.* An internal clock is available and would serve at $\Lambda = 0$; at $\Lambda > 0$ it no longer separates the dynamics, and the absolute cosmic time is forced — *a necessity rather than a preference* [13]. *And it is shown twice, in settings that differ in what they carry*: the field-theoretic case repeats it with a local propagating degree of freedom, where the failure is explicit — the area clock *inconsistent* there, and the substrate's cosmic time replacing it *positively rather than by elimination*, earning its necessity exactly where the internal clock breaks down [10].

Three independent premises, and the third is established in two settings — a distinction this section has to make, since its whole argument is about independence. One route is measured, one is causal, and one is dynamical. The papers carrying the first two cite each other only to disclaim reliance, and the third turns on a fact about Λ that neither of them uses.

The two dynamical results are not two premises. Both turn on the same fact — that at $\Lambda > 0$ the internal clock fails — and they differ in setting rather than in ground. *And a premise that survives the addition of local dynamics is worth more than one shown only in the homogeneous sector* — which is why the second setting is a strengthening and not a second route. *That is one route strengthened across settings, and counting it twice would be the error this section exists to avoid* — the same error §9 keeps a row open against, where a derived and a measured value of one quantity must not be read as two confirmations. *A reader may take any one without the others*, and *that they converge is therefore evidence rather than construction* — where a dependency among them would have made the augmentation's necessity circular. *And the independence of the first pair is exhibited rather than asserted*: their only mutual citation is a disclaimer in each direction — the structural result *"stands on causal structure alone and needs none of the cosmological evidence"*, and *"nothing in the present argument draws on it"* [15, 2].

1.3 Three senses of "real", fixed before the word is used

The corpus uses *real* in three senses and keeps them apart; this paper does the same. They are not degrees of one thing.

Real in the arithmetic sense: a geometry has a real coordinate basis, with no imaginary coordinate doing any work. That is the sense in which the substrate below is a real manifold, and the claim is about coordinates and signature and nothing more.

Real by construction: a feature is built by a construction and really seen from the vantage that builds it. The perspectival mass is of this kind, and so is the compact face on which a continuous $\mathfrak{su}(3)$ could live.

Existent: the ontological sense, whose criterion in this framework is temporality. *The existent is the evolving three-dimensional layer, and the manifold is its record* [16]. By that criterion the compact face is real by construction but, being Riemannian and atemporal, *not a co-equal existent*—it holds no clock [17].

So nothing in this section claims that a five-dimensional object is what exists. The substrate is the geometric core the construction reads and cuts; what exists, on this framework's own criterion, is the layer. The higher-dimensional geometry is what the layer is a cut of, not a thing possessing the layer's kind of being, and the four-dimensional manifold is the record rather than the existent.

1.4 What maximal symmetry then selects

The foliation is forced; which manifold carries it is a separate question, and this is where the construction's one object arrives — as a selection rather than a premise. The maximally symmetric solutions of $R_{\mu\nu} = \Lambda g_{\mu\nu}$ form a one-parameter family with curvature radius $\alpha = \sqrt{3/|\Lambda|}$. They are usually met as hypersurfaces in a flat five-dimensional space, which is a convenient picture and not the manifold: solving that embedding for the fifth coordinate and substituting back returns an intrinsic four-dimensional line element in which the manifold is coordinatised by four *real* coordinates, real regardless of the sign of the curvature.

The imaginary fifth coordinate is a property of one embedding picture, not of the surface. *This is reality in the first of the three senses above, and in that one only.*

Reading the metric's eigenvalues off that real line element gives the result the programme's ontology stands on. Three eigenvalues are positive always, and the fourth's sign is fixed by real data alone.

Proposition 1 (The unique intrinsically Lorentzian maximally symmetric manifold)**.** *De Sitter space is the only real maximally symmetric manifold carrying an intrinsic Lorentzian signature. It has a real coordinate basis, satisfies the maximal-symmetry requirement, and is the only such manifold with the requisite causal structure [19, 1].*

Two ways the signature can turn are worth separating, because they are of different kinds. At fixed positive curvature the crossing occurs where the fourth eigenvalue passes through a *pole*: its magnitude diverges and its sign flips, the numerator being constant throughout. *So the metric does not degenerate at the crossing*—a signature change through zero would send the determinant to zero and leave no metric there, and that is not what happens. The one place the eigenvalue vanishes is the null cone: not a crossing within a member of the family, but the family's own singular leaf [19].

That the substrate is reached through imaginary instruments is therefore a fact about the instruments. The embedding coordinate, the equatorial seam's continuation, and the reassignment at the cosmogenesis are each places the construction uses an imaginary variable and lands on a real manifold; the geometry is intrinsically real at every point they land on [19]. In one case the instrument is not optional and the case is the construction's own central algebraic object: over the field of the mass parameter the horizon cubic is irreducible, and below the

Nariai mass its discriminant is positive, so its three roots are real and distinct. That is exactly the hypothesis pair of *casus irreducibilis*, whose conclusion is that no root lies in any real radical extension—*the three real horizon radii admit no expression in real radicals as functions of the mass*, and every radical route to them passes through $\mathbb{C}$ [19]. The imaginary is the only available road, and the roots it lands on are real.

1.5 One scale, and what that means

The substrate carries a single dimensionful scale. Read projectively it is a Cayley–Klein geometry[L17] whose *absolute* is the null cone, and its geodesic separation is the Cayley–Klein log-cross-ratio taken against that absolute, with the Cayley–Klein constant equal to α [19]. So α is not a length inserted into a metric but the constant of a projective geometry whose absolute is the light cone—which is the signature proposition above, read projectively rather than metrically.

The constants through which physics is written on it are unit gauges, each a nameable feature of the substrate: c is the null-ruling slope of the equilateral hyperboloid, Λ the waist, and G enters only as the offset-length GM/c^2, the mass being the offset of the cut from the central geodesic [19, 12, 4]. On this accounting the gravitational–cosmological–quantum sector spends no free dimensionless constant, and the reason is structural rather than counted: neither real form supplies a second invariant, and a dimensionless magnitude needs two [19].

One scope on that belongs with it, because the claim names the quantum sector and the quantum sector's own frontier bears on it. What the deparametrized tower leaves open is the definition of its mode sums, and a divergent sum over a discrete spectrum on a compact section is fixed by its spectral zeta function — *which carries exactly one ambiguity, a log-scale — whose coefficient is the function at zero for a functional determinant, and the residue at -1 for the zero-point sum, these being different numbers and the distinction worth keeping.* So the claim above, read across the sector it names, *makes a prediction about a computable number* — and *the number has been computed, and it does not vanish.* On the tower's own spectrum, which the quantum sector derives rather than imports, the spectral zeta at zero is 10 exactly, and the zero-point sum's log-scale coefficient is 39/4 [13]. *So the mode sums spend one dimensionless constant*, and the claim carries the scoping §9 already applies locally: the classical dynamics and the parameter-free closure stand independent of the definition's resolution, and *the ledger's own statement is about the geometric constants and not about the tower's regularisation.*

And the corpus has already named what a non-vanishing log costs, which is what makes this a located result rather than a bare negative. The quartic leader is field-independent and its counterterm is a cosmological-constant term, which the ledger does have. *The logarithmic successor goes with curvature-squared invariants* [13], so the constant the sums spend is one the geometric ledger does not carry, and where it would have to enter is stated rather than left to be found.

And two counterterms have to be kept apart here, because the number just computed is not the coefficient of the one the source names. The background is conformally flat, so the Weyl-squared invariant *vanishes identically on it — a background computation cannot see that counterterm at all.* What $\zeta(0)$ measures is the log on the degenerate combination that maximal symmetry makes proportional there. *The source's own entry — the one new counterterm the shear costs, which it identifies as the Weyl-squared one — lives at second order in the mode amplitude*, where the shear is the propagating content [13]. *So the vacuum log is costed and that entry is not*, and the two should not be read as one result.

The scope is the favourable case and is stated as such: free and static, on the instantaneous spectrum, and transverse-traceless only — *which is forced rather than chosen*, the constraint being solved before quantisation so there are no ghost or conformal towers to cancel against. *A coupled or non-adiabatic computation could still return zero*; what is excluded is the claim holding trivially, on the most favourable case the construction offers.

What the count leaves is not a constant but an initial condition, and the corpus carries it as measured content rather than as a derived quantity—as flat ΛCDM carries the baryon-to-photon ratio from a baryogenesis it does not model [14].

1.6 What a boundary of the substrate is

Here the corpus draws the distinction that everything downstream depends on, and it is a distinction between two kinds of singular locus rather than between a real one and an artefact.

A *metric* singularity is a locus at which a spatial extent contracts to zero while the curvature stays finite. *A curvature singularity* is a locus at which an invariant of the curvature diverges. *The event horizon of a collapsing body is the first kind*: a null hypersurface along whose generators the spatial extent also contracts to zero, occurring only as the null future boundary approached at infinite exterior time [2].

And what makes the first a category rather than a description is a theorem. Two events that are null-separated ($\Delta s^2 = 0$) and spatially coincident along the connection ($\Delta x = 0$) have $\Delta\tau = 0$ also, since $\Delta s^2 = \Delta x^2 - \Delta\tau^2$ leaves the third no freedom once two vanish. *Two of the three separations force the third.* The events stay topologically distinct and causally ordered — the affine parameter carries the order — while the metric assigns them no separation at all, spatial, temporal or spacetime [2]. *Null separation alone does not do this*: a past light cone gives $\Delta s^2 = 0$ with no coincidence, and it is the added vanishing of the spatial extent that collapses $\Delta\tau$.

Three consequences of the two-kind distinction follow immediately, and each is one a reader needs before meeting any application.

Observer-dependence is not the criterion. It is tempting to sort these loci by whether they are seen by every observer, and the sorting fails at once: the Rindler horizon is perspectival and carries a flux, so "perspectival, therefore no flux" is refuted before it starts. What sorts the four horizons the corpus treats is *completion*—whether the boundary is reached on any finite layer—and completion sorts all four [2].

And the finite-curvature case is the one the metric-singularity result treats. It is a different object from the locus standardly called the curvature singularity at $r = 0$, where the invariants computed on the areal radius diverge; the first is established with the event horizon as its exemplar, and nothing is said there about the second beyond noting that it is a different object [2]. *That the two admit a common treatment, and what becomes of the divergence at $r = 0$ under it, is established in the companion* [3, 4]. *No claim of necessity or sufficiency is made here in either direction*: the scope is what is stated, and reading it as a general criterion for when a boundary may be crossed would assert what the source declines to assert.

And formal likeness does not sort the two classes. A chart such as Eddington–Finkelstein parametrises approaches to a singular locus by a coordinate that degenerates there, so a single metric place is drawn spread out as an extended line — and Mercator draws the North Pole by the same projective mechanism, the visual appearance identical. *The reason for the appearance is opposite in the two cases*, which is why no argument from how a locus is drawn can sort them; §2 takes that pair apart, since the separation it turns on is one of the construction's own [3].

1.7 What follows for the reading, and what does not

Two guards belong here rather than later, because both are misread in the same direction.

Perspectival does not mean unreal. Where the corpus calls a feature perspectival it means built by a construction and really seen from the vantage that builds it—the curvature divergence of a perspectival metric is real as that metric's, and reading it as an artefact in the pejorative sense is the misreading the epistemology is written to defeat [6, 3].

And identifying a feature as perspectival is not a dismissal of the construction that carries it. Sweeping a radial curve to recover a spatial geometry is the legitimate and indeed the natural way to chart a geometry from a given vantage, and the result agrees with the standard geometry on every observable outside the horizon. What is identified is not an illegitimate operation but a misreading of its product: treating features the construction manufactures—the asymmetric labelling, and with it the curvature singularity at $r = 0$—as features of the geometry rather than of the chart. *The construction is faithful as a description from its vantage; the error is ontological* [3].

2 What the forcings pry apart

The forcings of §1 do their work by separating pairs of ideas the standard reading holds fused. *Each separation is a result rather than a clarification*: in every case the fused form is shown to make a claim the evidence refuses or the formalism cannot carry, and the separated form is what the rest of the construction is written on. This section states the pairs, because a reader who keeps any of them fused will read §§3–7 as claiming something other than what they claim.

2.1 Literal and perspectival

The appearances divide into components a projection images faithfully and components that are artefacts of the projection, and *both classes are non-empty* [6]. The Sun's annual path along the ecliptic is a perspectival illusion of the Earth's motion; the Moon's monthly circuit is a literal orbit. Because both occur, *no blanket reading is admissible* — and reading every appearance literally is the first thing a method must forbid.

A perspectival component need not be an illusion, and the corpus's own case is the sharp one. The metric's verdict that two null-separated horizon events share one place and one instant is a genuine fact about the measure — the separation truly collapses — *yet perspectival still*, a fact about the ruler and not about the identity of the events, which stay distinct on the point-set the ruler is laid over [2]. *So the perspectival class is not the class of false appearances but of those that image the projection rather than the world*, and some are entirely real as facts about the projection.

Nor does formal likeness sort the two, which is why the separation cannot be done by inspection — §1.6 gives the case, where two loci drawn identically arise for opposite reasons.

And in one case the separation is not inferred at all but read off, which the source calls the sharpest form the method affords. Where the projection is an exact involution, the partition appears as its two eigenspaces. The vacuum profile splits under the mass-reflection into the part it *fixes* — the de Sitter geometry $1 - r^2/\alpha^2$, *the literal content, imaging the substrate* — and the part it *reverses* — the Schwarzschild mass $-2M/r$, *the perspectival component the vantage carries* [9, 6]. *So the constraint that an admissible world exhibit its projection is met by writing the projection down rather than by inferring it from a spread of perspectives*, and an appearance is reclassified by reading which eigenspace it occupies. Parallax and the retrograde loops are the perspectival case identified *from* the appearances; this is the same case identified *within* a single exact description.

And the apparatus that makes "vantage" a definite notion rather than a manner of speaking is worth stating, because everything above presupposes it. The slicing curve is intrinsic: moving the charting observer changes the image and not the geometry. *So the descriptions form a groupoid, and the geometry is its single invariant* [9]. *Which fixes what a perspectival component is*: not an error and not a convention, but the part of a description that the morphism between two vantages moves, where the literal part is what it fixes.

And the groupoid has morphisms of two kinds, which is more than a bookkeeping distinction because the paper uses both. The first acts *within* one geometry, permuting the sky-angle labelling at fixed mass — and two separate results bear on it: the geometry carries *no continuous modulus* under change of charting vantage, and those morphisms are *discretely generated. So the* *vantages of one geometry are a finite structure rather than a continuum of equivalent retellings*, which is why a locus can be a seam from one vantage and the branch point from another (§3) without either being wrong. *The second kind moves between geometries*, changing the mass — and that is the reflection whose adjunction to the first gives the full discrete symmetry of the solution space, and which carries the mass reversal this paper reads as the conjugation [9]. *Rigidity is a statement about the first kind and not about the second*, and the two must not be run together.

2.2 Coordinate and metric, finite and infinite curvature

The separation the construction most depends on is one the standard classification never made, and it is a pair of axes read as a single binary. A singular locus can be a *coordinate* artefact — a chart manufacturing an extension that is not there — or a *metric* collapse that no chart removes. And separately, the curvature at it can be finite or divergent. *Those are two independent questions, and the received reading fuses them into one*: coordinate, therefore unreal, therefore crossable; real, therefore terminal.

Reading them apart fills a cell the fused version has no room for, and it is the cell this construction lives in. The event horizon is a metric collapse at *finite* curvature — real, no chart removes it, and nothing about it terminates anything [2]. The locus at $r = 0$ is a metric collapse at *divergent* curvature. A Mercator pole is the coordinate case at finite curvature. *So the horizon and $r = 0$ are not opposites but two species of one genus*, identical through first order and parted only at second by the value the chart's origin assigns each [3, 16].

And the fourth cell is empty, which is a claim and not an omission. A coordinate artefact at *divergent* curvature cannot occur: the invariants whose divergence defines the second axis are scalars, so no chart makes or removes one. *The axes are independent, and exactly one of their four combinations is excluded on principle* — which is why the fused reading survives as long as it does. It is right that coordinate implies finite curvature; what it adds, and what fails, is the converse.

And the received classification is one category error committed twice. It reads $r = 2M$ as a Mercator pole, removable, and $r = 0$ as the manifold tearing. Both are places drawn as lines by a degenerate coordinate, and *the reason for the appearance is opposite in the two cases* — at the pole the chart manufactures an extension, at the horizon it spreads out a collapse that is there [3]. *Which is why no argument from how a locus is drawn can sort them, in either direction*, and why the sorting criterion the corpus uses is completion rather than appearance (§1.6).

2.3 Saving an appearance and explaining it

An admissible world must *exhibit* the projection under which a perspectival appearance arises and show why it appears as it does — *not discard it, and not merely reproduce it* [6]. A model can reproduce the ecliptic path exactly while saying nothing true about why it appears. *The retrograde loops are not real reversals to be tracked by finer machinery but the parallax of the Earth's own motion*, and the right theory dissolves the puzzle by identifying what the appearance is.

And a dissolution can be entirely ontology-free, which is worth having before §5. The continuation through the curvature singularity undoes the standard verdict not by any claim about which manifold is fundamental but by exhibiting the continuation that carries the curve through — *the puzzle dissolved by identity, nothing assumed about the world beyond the appearance's own smoothness* [3].

2.4 Existence and occurrence

Events occur; the world exists. To deny the distinction — to hold the four-manifold itself the existent — is to treat occurrences as existents, which on analysis smuggles a fifth, meta-temporal dimension along which the block is supposed to "exist", and is incoherent as a basic description [15]. *The regress is the argument*: whatever endures does so through some time, so a four-manifold said to exist requires a further time it endures through.

This is the distinction §1's third sense of "real" turns on, and the lapse is its formal counterpart: *the rate of advance of the layer that exists, which is what a clock measures.*

And the regress has a formal address, which is worth giving because it shows the block reading paying the cost it was supposed to avoid. A block that endures needs a lapse on the product of the manifold with a further time — *a fifth dimension general relativity does not contain. So the block reading does not dispense with the lapse; it re-imports it one level up, informally* [16], and the frozen constraint of §5 is the canonical symptom of exactly that: a formalism correctly reporting that on the block's own premise there is nothing for a generator to do.

2.5 Simultaneity and synchrony

The relativity of synchrony is general — a feature of relative motion, the light postulate fixing only its magnitude — and it is the *shift*, the freedom of a moving observer to tilt the slices off the comoving normal. *Simultaneity is the separate question.*

To read the relativity of synchrony as the denial of an objective simultaneity is a modal fallacy [15, 6]. From the premise that the appearances contain no local discriminator between two candidate worlds, it does not follow that the worlds are identical, nor that the structure distinguishing them does not exist: *the absence of a local test is not the absence of the fact.*

The phrase is exact rather than figurative. Locally flat is the technical condition that every point of an embedding has a neighbourhood in which it is standard, and high-dimensional topology turns on locally flat against wild embeddings precisely because local standardness leaves the global invariant free: a submanifold can be locally indistinguishable from the trivial one at every point and globally knotted. *So the modal fallacy is the inference from local triviality to global triviality*, and that inference has a standing counterexample in every dimension where the question has been asked [6].

And the pair separated is not merely a fallacy named — it is two halves of the $3+1$ *split, one of which is now measured.* The shift is untouched: relative, conventional, exactly as it has always been. What the isotropy forces is the other half — the *lapse*, the objective rate at which the existing layer advances. *So synchrony is relative and simultaneity is absolute — and the second of those is a measured fact rather than a metaphysical preference* [15]. *The century-old reading that took the first for a denial of the second is not merely unsupported; the measurement falsifies it outright.*

The history is a record of the fallacy committed and corrected. No stellar parallax was detectable for two millennia and this was read as telling against the Earth's motion — though before the cosmos was given depth the relevant parallax was not a conceivable measurement at all. No local experiment distinguishes rest from uniform motion, and this was read as the non-existence of any preferred rest. *In each case the missing discriminator was mistaken for a missing fact, and a later non-local measurement supplied both* [6]. *An absent discriminator is not an absent fact*, and whether a discriminator is even available is a question about the picture in hand rather than about the world.

2.6 The map and the territory: a direction of construction

The separations above fix a direction, and running it backward is the standing error of which reading every appearance literally is the local symptom. *The valid order builds the ontology from* *the evidence, the kinematics from the ontology, and the coordinates from the kinematics* [6]. The reification error runs the chain backward: it takes the coordinate system as given and reads an ontology off it, treating the map as the territory and an apparent symmetry of the description as a fact about the world.

Applied to a mature mathematical theory the demand is sharper than it first appears, because there the appearances include the formal structures one has derived. *A four-dimensional manifold that organises the record of events is a coordinate scaffold of this kind*; granting it existence runs the chain backward, and the discipline forbids it on the same ground it forbids reading the ecliptic as a real solar orbit.

And the reification can hide in something smaller than a manifold — in a verb tense. The founding literature calls a black hole a "collapsed" object, the past participle quietly reading horizon formation into the causal past of an exterior observer, where the causal structure places it only at the infinite-future boundary. *The grammar must follow the geometry* [2].

2.7 Requiring a phenomenon and permitting it

The last pair is a criterion rather than a distinction between things, and it is the one the rest of this paper is weighed on. *Prefer the world that requires the observed phenomena as a consequence of its structure to the world that merely permits them through adjustable parameters* [6]. A framework on which the phenomenon could not have been otherwise is an explanation; one on which it is a tuned possibility among many is a description.

In the ontological register this has a sharp form. A structure carrying an unforced parameter — a modulus fixing how some symmetry is broken, which neither the appearances nor any deeper principle pins — *is not a single world but a family*, and answers "what is the world?" with a family rather than a world. *It is inadmissible as it stands rather than merely disfavoured.* The maximally symmetric structure is the unique one carrying no such modulus: every less symmetric structure requires a choice of how to break the symmetry, and maximal symmetry leaves nothing to choose [6].

That clause is a statement about a group action and it has an exact dynamical counterpart. What leaves nothing to choose is a group acting *transitively*: a modulus is a coordinate transverse to the orbits, so one exists precisely when the action is not transitive. *Read on the substrate's geodesics the same transitivity says the flow is maximally superintegrable* — the isometry group acts transitively on the unit tangent bundle, so every geodesic is every other seen from another vantage [19]. *Least-arbitrariness and superintegrability are one property read epistemically and dynamically*, and a modulus appearing is the same event as the action ceasing to be transitive.

This is why §1's selection of the substrate is a selection and not a preference: the alternatives are not worse worlds but families of worlds, and the criterion that excludes them is the same one by which any theory predicting a datum is preferred to one accommodating it.

One guard on that criterion is easily lost and would invert it if it were. What it selects is a symmetry *of the world* — a fact about the structure — and never a symmetry *of the description. A relabelling the world does not see grounds nothing*, and reifying one would be the constructive ordering above run backward [6]. It is the same discipline the description groupoid enforces from the other side, where the charts are many and the geometry is the invariant [9].

3 What is derived from the object

With the substrate fixed, the construction's working object is a *cut* of it, and one instrument generates the cuts. This section states what that instrument returns, what it cannot reach, and where its boundary falls — and it separates, at each step, the theorems from the reading they ground.

3.1 One swing, and the geometry that fixes its hinge

Before the instrument, the object it works on: the vacuum construction has a single moving part. One slicing plane swings about one fixed line, and the whole family of cuts is the single arc of that swing [4]. *So the angles the construction is written in — the observer's sky angle, the throat angle, the horizon angle — are three projections of one object and not three parameters that happen to be related*, and holding the one object fixed is what keeps the de Sitter and Schwarzschild forms from presenting as two spacetimes. *They are two vantages on the one swing. Each projection is blind to something different*, which is why reading one without its coupled complement is the characteristic error here; and *the scale is never sent to a limit* — reaching the Schwarzschild form by $\alpha \to \infty$ would dismantle the throat the construction lives on.

Before the hinge, where the parameter that indexes the family comes from — because it is not dialled by hand, and the act of fixing it is *the symmetry breaking.* An observer in the exterior does not share the hole's rotational symmetry: they sit at a definite radius along a definite direction. *And they cannot see the hole's centre.* What they have is the hole's image on their own celestial sphere — a small circle of some angular radius, which they can neither see around nor locate the true centre of [4]. *So an observer who takes the hole as reference is forced to break a further symmetry*, not by choice but because their reference is a sky image with the reticle off-centre.

And the chart is forced too. The hole's image lives on a curved sphere, so a planar chart requires a projection — and the line of sight is a straight radial line, so a faithful chart must carry it to a straight line. *The gnomonic projection is the unique one sending every great circle to a straight line*, so it is not chosen but compelled [4]. *The parametric radius is then the image radius times the sine of the genuine sky angle* — and *that image radius is itself forced*, to the one scale at which the horizon relation linearises to a pure triple angle, the residual harmonic vanishing nowhere else.

So the number the whole regime structure is read off — stated below — is not an input at all: it is what an observer at a given distance sees, on the one chart the geometry permits, at the one image scale that makes the horizon relation an angle.

The hinge is not placed, and this is the part worth following. The substrate carries three of them, 120° apart at transverse distance 2α, *and that distance is an output rather than a stipulation*: the hole determines exactly one circle without further choice, and 2α is where it ends [4]. The throat circle is then the *incircle* of the hinge triangle, whose three sides are *not imposed but found* — each a null generator of the doubly ruled substrate, tangent to the throat at its own midpoint — and their six ends, three per horn, close into one skew hexagon of null rulings.

And one identity in that geometry is worth stating for how little it costs. The power of a point with respect to the throat — Steiner's classical invariant, $|X|^2 - \alpha^2$ — is the same combination that the substrate's own equation sets equal to the square of the height. *So the tangent length from any point of the substrate to the throat equals that height, and the tangent is therefore a null line* [19]. *Euclid's tangent–secant relation and the null condition are the same equation*, and since the rulings *are* those tangents, "doubly ruled by straight null lines" and "every tangent to the throat is null" are one statement rather than two facts that agree. *The identity is a fact about one circle*, the waist, which bounds what the classical register can reach here — *and that bound is not a defect of the reading but the statement that the substrate has exactly one such circle.*

The bound is sharp in a way worth stating, because it is Euclid's own. The sightlines that *touch* the throat are light rays and the ones that *cut* it are not: the classical power theorem is about secants, and the null condition is its degenerate case, where the two intersection points merge [19]. *And the source is exact about where the nullity lives, which the planar statement obscures*: the equatorial plane carries a positive-definite restriction, so no displacement *within* the plane is null. What is null is the corresponding displacement *on the substrate*, from the vantage lifted to its own height to the point of tangency — *the planar figure is that null line's shadow*, which is why the power of a point reads the light cone at all. *Which is also why the overhead view of the hinge is not a diagram of the geometry but the hinge's light cone drawn* — the optics is the content rather than an illustration of it.

3.2 What the hinge carries: three roots that are one datum

The hinge placed, the structure it carries can be read — and the first thing to read is that the three horizon values are not three independent data. Because the mass is fixed by the parametric areal radius, the horizon cubic factors with that radius *as one of its own roots*, the remaining pair falling on a conic — and *the three roots sum to zero*, so the triple lies in the traceless plane, which is the Cartan subalgebra of the colour algebra in its standard realisation. *The conic is that root system's own circle*, and identifying it costs nothing beyond setting two facts already proved side by side [4]. *So the whole regime structure is read off the parametric radius and nothing else*: its discriminant is positive where the three roots are distinct, and vanishes exactly at the forced member's double root. *Which member one is on, and therefore where the lap's loci fall, is that one number's to say.*

The classical member makes that visible, and it is the companion paper's whole object. There the two loci sit at $z = 0$ and $z = \pi$ — *antipodal on one circle*, the horizon and the curvature singularity as its two poles, with the areal radius executing simple harmonic motion about the midpoint [3]. *So each sign of the radius covers a semicircle*, which is why the two signs are the two halves of one ring rather than two regions to be joined. *At the forced member the same three loci sit at a third and two thirds instead*, the double root having collapsed two of them together. *The split is the member's signature*, and reading one member's figure as the general case mistakes a signature for a structure.

And the number of horizons is itself a reading of the curvature. At zero curvature the horizon cubic degenerates and the cosmological root and its backward-radial partner run off to infinity, leaving the single finite horizon of the classical solution. *The two extra roots are present precisely because the substrate is de Sitter and not flat* [3], so horizon multiplicity — one against three — is not a feature of the black hole but of the vacuum it sits in. *Which is also what the pencil of §8 is a pencil over*: the three loci it parametrises exist because there are three roots to begin with.

And the swing's far end carries two readings of one curve, which is where the correspondence this construction rests on actually lives. Swing the plane to the end of its arc: the black-hole horizon shrinks until it merges with the origin at the back, the cosmological horizon swings to the polar-opposite point and becomes the horizon, and the interior region *wraps the half-equator* with the exterior opening beyond it [4]. *That single curve carries both readings, and the map between them is the backward-radial vantage-swap — the de Sitter–Schwarzschild correspondence, exact, at fixed scale, and neither a limit nor a mass relabelled to zero.*

And that curve is the one two paragraphs above, which the source says in as many words: the cut at the far end is the equator taken diametrically, *exactly the companion paper's Schwarzschild curve* [4]. *So the antipodal configuration and the half-equator are not two facts about two members but one configuration described from the two papers that reach it* — the cycloid's two poles read on the ring, and the swing's far end read on the arc.

Two routes to that same throat are declined because each breaks the construction reaching it, and they are named rather than left for a reader to try. *Schwarzschild is not the large-scale limit*: the scale is the fixed invariant the whole construction lives inside, and sending it to infinity dismantles the throat the curve turns on. *And the correspondence is not a mass set to zero*: the two readings are vantages on one curve, not two members of a family with a parameter dialled between them.

And the placement forces the member by the angles alone, which is a third route to it beyond the two of §4: the hinge's 2α makes the throat subtend exactly $60°$, so the sky angle's sine is one half, so the horizon relation's triple angle reaches unity — and unity is the merged root [4].

The hinge also makes the discrete symmetry physical rather than notational. Each hinge designates one root as *its own* black-hole horizon. *So exchanging two roots is a hop to a neighbouring vantage and the three-cycle is the tour around all three*: the Weyl group here is the relation among the three hinges, not an abstract relabelling of a solution's data [4, 9]. *Which is what makes a locus's identity vantage-dependent in a precise sense.* On the waist the three hinges generate an order-three rotation, and the lap's loci are its orbits: the branch point sits at phase zero and the seam at $120°$, *so the rotation carries one exactly onto the other. What one hinge reads as its branch point another reads as its seam*, and neither reading is wrong [4].

The mechanism is the rotation and not a permutation of one cubic's roots, and the distinction is load-bearing: the branch point is no root of the horizon cubic, and §8 shows the two loci carry covers whose branch sets are *disjoint. So the vantages exchange which locus they call which; they do not make the two loci one.*

The six hinge-ends carry the discrete skeleton directly. Three sit on the upper horn and three on the lower, and they are exchanged by the time reflection that swaps the two null generators — so the two triples are the fundamental and its conjugate, and the hexagon they close is the root system's own hexad [4]. *But the resonance with the matter sector's threefold is a resonance and not an identity, and the source proves it so rather than leaving it suggestive*: the reflection that preserves the horns and the one that flips them are *distinct*, so the two structures share the fundamental and complete differently. *The geometry poses the question of a Standard-Model bearing and does not settle it*, which is the same restraint §7 exercises on colour and for the same reason.

One further test on that geometry is worth reporting, because it is the discipline this paper argues for, applied by the source to itself. Five statements at the hinge are equivalent, and a reader may be tempted to count the number of them as evidence. *The source instead asked which survive a change of dimension.* Two do — the tangent length equalling the hinge's height, and the sides touching the throat at their midpoints — and those are the substrate's. Three do not, being the equilateral triangle's, the last of them because the nine-point circle is a theorem about triangles with no analogue at a square [4]. *So the load-bearing identity is on the dimension-independent side and what is dimension-specific is decoration*, which is a separation a count of coincidences could not have made.

3.3 The slicing closes, and the closed curve is the cosmogenesis

The areal radius is a signed coordinate — the angular part of the metric goes as its square and is insensitive to the sign — *and following that through changes what the slicing curve is.* It runs inward to the seam, around the throat, and *through* the branch point, which is passable: the substrate is smooth there, and the curvature divergence belongs to the areal reading rather than to the manifold. Beyond it the curve runs out onto the *real* conjugate branch — not a Euclidean excursion — and closes on the backward-radial root [4]. *So the slicing is one closed object on one manifold*, and *its turning points are the roots of the horizon cubic* — the seam, the cosmological horizon, and the backward-radial root — non-degenerate at simple roots and degenerate at the forced member [4]. *The branch point is not among them*, which is the same statement as the curve running through it rather than turning there.

Read forward as physics, that closed curve is the cosmogenesis. The conjugate branch is a previous universe's collapsed matter continued through the seam, its completion the expanding cosmology of §4, and the light-element abundances of that section a fossil of the collapse [4, 18]. *The geometry does not merely permit the continuation; the curve closes whether or not one reads physics onto it.*

And one guard travels with the closed curve, because the error it forbids is easy and consequential. At the forced member the two merging horizons stand *infinitely far apart in proper distance* — the length integral diverging logarithmically at the double zero — while the Gaussian curvature there is *finite* and the geometry regular. *A coordinate that runs to infinity where the invariant curvature is finite is reporting on the slicing and not on the manifold* [4]. The signed radius is the spine of the construction and proper distance is derived from it; *an l-divergence is never a geometric one.*

3.4 Straight cuts are vacuum

In the construction's gauge the vacuum condition $T_{\mu\nu} = 0$ is not a system to be solved but a single first-order linear ordinary differential equation, $rf' + f - 1 + \Lambda r^2 = 0$, whose *entire* solution space is

$$f = 1 - \frac{2M}{r} - \frac{\Lambda r^2}{3}, \tag{1}$$

the whole Schwarzschild–de Sitter family, with M the single constant of integration [12]. *The vacuum sector is exactly the kernel of the matter functional in* (1)*, derived rather than matched*: straight cuts are vacuum. Taken with the bend identity below — which shows every density is realised by some cut, so the functional is onto — the two give a kernel of dimension one over a vanishing cokernel, an index of 1, generated by that constant.

Two things follow that are worth having early. There is no room in the vacuum family for a third term: the solution space is the whole of it, so a rate written on this kernel carries Λ and the cut's offset and nothing else. And the question this answers is not a new one — it is the question the programme's own dissertation left open, asking what, if not the world-matter, fixes the geometry [1]; the kernel is the answer, and it is one the corpus states in the asking author's terms.

3.5 Matter is the bend of the cut

Writing any curve as a departure from the vacuum profile, $f = 1 - 2m(r)/r - \Lambda r^2/3$, gives $8\pi T^t{}_t = -2m'(r)/r^2$: the energy density $\rho = m'(r)/4\pi r^2$ *is the radial growth-rate of the enclosed mass*, the bend of the curve off the constant-M profile [12]. Checked on a non-vacuum member, Reissner–Nordström–de Sitter is the bend $2m(r) = 2M - q^2/r$, returning the electromagnetic stress-energy off its q^2/r^2 term.

And the reading is not an artefact of the symmetry, which is the objection it would otherwise invite. For a general leaf the density is the leaf's intrinsic-curvature departure from the substrate, $16\pi\rho = {}^3R + K^2 - K_{ij}K^{ij} - 2\Lambda$ — *which is the Hamiltonian constraint*, the spherical identity being its symmetric case [12].

What the identity states is what the bend ***is****, not why a leaf bends as it does.* That is the matter content's own generative law — a dynamics for the curve itself, as against the ordinary leaf evolution that carries it. *Two things stand under that one description, and they stand differently* [12]: *one of them the construction supplies.*

A dynamics for the curve, given content, is supplied. The operator's data are two free functions per symmetry class, and *the conservation law is not imposed but entailed by the cut's own geometry*, exactly as the contracted Bianchi identity entails it in general relativity; it fixes the angular component from the radial pair, so two independent stress components remain. A constitutive relation then closes the system into ordinary differential equations on the cut — *the Tolman–Oppenheimer–Volkoff system written in the operator's own variables*, with the density the leaf's half and the lapse equation the stacking's, reducing to Schwarzschild on the vacuum member [12]. *The companion states the same closure for the homogeneous and Weyl classes in its own voice* [9].

What is not supplied is the constitutive relation — and general relativity does not supply it either. Its contracted Bianchi identity gives conservation and not an equation of state, and a fluid needs one there too. *So being kinematic in that sense is not a property that distinguishes this construction from general relativity at all.* What genuinely differs is that the content is read leftward off the cut rather than fed into it, which is the whole of the bend identity.

A generative law for the content itself is not supplied, and that is the matter sector's declared boundary — carried on the frontier below rather than here.

3.6 What the instrument reaches, and the wall

The reach is a theorem: *the range of the operator is the symmetry-reducible sector of general relativity* [8]. The size of what is reachable is set by how much symmetry a class spends — a finite parameter family where the class reduces to ordinary differential equations, a functional family where it remains a partial differential equation problem — and the reachable sector is the constrained, non-radiative skeleton of the theory.

The boundary of that reach has a positive identity, and stating it the obvious way gets it wrong. The wall is the loss of isometry, and what lies past it is *the onset of free gravitational radiation*: the graviton's two propagating polarisations, read on the matter side as dynamical inhomogeneous sources [8].

And the sector past the wall is not merely named: the companion dynamics paper works a confined case there — a polarised wave on the de Sitter background, its unpolarised cut a wave map with a conserved handedness [10]. *That is what makes the handoff checkable rather than asserted: the far side has a worked member.*

Two things are settled at the wall itself, and the second is the one that matters to §1. The dynamics continues across it — so the wall bounds the operator's reach and not the physics. *And the wall is not a metric singularity in the sense §1.6 defines*: no measure collapses there, so it is a regular radiative boundary — *rather than a place at which a clock could be re-founded* [10].

That second clause is why the negative is load-bearing rather than tidy. The construction's cosmic time is selected once and holds throughout; a locus where a measure collapsed would be a locus where an internal clock could be founded afresh, and the selection would then be one choice among several rather than a forced one. *The wall's regularity is what forecloses that*, which makes a result about a radiative boundary a result about the foliation.

And in the nonlinear regime the background is an attractor and the first-class system is consistent to all orders [10], so the continuation past the wall is not a linearised statement waiting to fail at the next order.

And the worked member settles two further things, both sharper than the wall's own statement. The first is where handedness begins. It is natural to say the wall is its onset, and that is the coarser reading: the criterion bites *from the loss of the swept rotational symmetry onward.* A fixed polarization axis furnishes a reflection symmetry, parity identifies the two helicities, and there is no genuine chirality; so the polarized edge, retaining one fixed axis, *is still achiral*, the *turning* wave is the first chiral case, and the wall is where chirality becomes *generic* rather than where it starts [10]. *Which places the first chiral geometry inside the construction's own reach rather than past it.*

The second is why that handedness survives an obstruction the matter sector runs into. The wave's handedness is the sign of a conserved twist, and the substrate's orientation parity acts on it as a sign flip. *Because that parity is the disconnected component of the isometry group, no connected isometry identifies the two handednesses — and that is also why it lies beyond the reach of the index obstruction* which renders a connected-gauge fermion spectrum vector-like [10]. *The gravitational sector is chiral precisely through the component that obstruction cannot touch*, which is the same discrete parity §7 identifies as the single geometric opening.

And the source puts that agreement higher than a shared conclusion: the two are one mechanism read in two sectors. The index obstruction bites because a positive-dimensional *connected* group contains a circle whose action forces the equivariant index to vanish. The radiative criterion is achiral exactly while the swept rotation group supplies a continuous rotation that completes the reflection and identifies the two helicities. *In each case a connected isometry identifies the handednesses, and a chirality survives only on the component no connected action reaches* [10] *— which is the criterion, and it is worth saying that a reflection alone does not meet it.*

Applied to the quantum sector's own tower, that criterion is met, and met in the strongest form available. The closed layer is a group manifold, so its connected isometry group is a quotient of $SU(2) \times SU(2)$, and the transverse-traceless rank-two harmonics at each level sit in a pair of representations exchanged by swapping the two factors. *Their dimensions reproduce the tower's own degeneracy exactly at every level*, which is what ties the assignment to the tower the quantum sector carries rather than to a textbook one — ten at the floor, as the self-dual and anti-self-dual five-dimensional pair. *The two labels never coincide.* A connected group acts within an isotypic component and cannot carry a representation to an inequivalent one, so *the map between the handednesses lies exactly on the component no connected action reaches. The tower is a second place where geometric chirality can live*, and the sharper of the two, the handedness being a representation label rather than the sign of a conserved quantity. §3's five faces supply a $\mathbb{Z}_2$ that exchanges the graviton's two helicities and grades fermion chirality; *a map that exchanges two things is a grading, and every parity-even theory has one. What decides chirality is the second condition* — that no connected action completes the reflection — and that condition has been applied to the radiating sector and to no other object here — which is what §7 means by saying *where* geometric chirality can live at all. *The two are established independently and by different arguments*, which is why their agreement is evidence rather than restatement.

One guard travels with the handedness and its omission would misplace it. It is *not* one of the cubic-organised markers of the strata: it is the radiating-sector face of the single orientation $\mathbb{Z}_2$ — the diagram automorphism, the mass-reflection parity — and belongs with the reflection of this section rather than with the roots [10].

So the wall is a seam and not a defect — it is where generation by symmetry hands off to ordinary inhomogeneous evolution, and the handoff is a feature of the classification rather than a failure of the instrument.

And the wall is not the only boundary of the reach; it is one end of an axis with two. The reachable sector is laid out along the degeneracy of the null structure — the count of coincident principal null directions — and *its two ends are the seam and the wall* [8]. At the forced member two horizon null surfaces merge, a maximal but frozen symmetry that is still of the degenerate type: *the inner boundary.* At the wall all degeneracy is lost into the single propagating direction of the radiative type: *the outer one. So the forced member pins to the seam and not to the wall* [8] — and the two loci this paper has been treating in separate sections, *the merged horizon and the radiative handoff*, are the opposite ends of the one axis the operator's reach is laid out along.

And the inner end is the seam and not the branch point, which has to be said because the paper turns on both. The branch point is where the metric function *diverges*: it carries no surface gravity, is no Killing horizon, and sits on no rung of the null-degeneracy ordering at all. *They are the loci §4 separates for the transmission argument, and the same separation holds here.*

The reach also explains two things rather than accommodating them, and they are worth separating out. Rotation is neither the leaf nor the lapse but the shift. Every symmetric sweep makes its orbits orthogonal to the cut, so a block-diagonal cut cannot carry the cross term frame-dragging consists of; the shift is exactly what supplies it [8]. *And genuine angular momentum needs both the offset and the twist* — the offset alone is the static hole, and the twist alone, with no mass, is not a new geometry at all but a rotating slicing of the substrate itself, its curvature still constant.

The second is the sharper one, and the construction derives what general relativity carries as a gift. On the separable cut the vacuum condition *splits of its own accord* into a pure-radial and a pure-angular equation; nothing beyond the separable form is imposed. *So the hidden symmetry of the rotating family — the Killing tensor and the constant of motion that make its geodesics integrable, which general relativity carries without explanation — is the substrate's maximal symmetry surfacing in the separable corner* [8].

And the objection that reach raises is answered by a mechanism rather than by a survey. One would expect a substrate whose rulings are shear-free to force every cut into the algebraically special corner, since a special vacuum has a shear-free null geodesic congruence. *A cut need not inherit one.* The anisotropy of the general homogeneous cosmology, and of the static Weyl class, *is* shear; shear forbids a repeated principal null direction; and the substrate's congruences can be reassigned with shear [8]. *So nothing forces speciality and the operator climbs into the generic algebraic type* — with the reach persisting when the shift is on, *because the algebraic type is carried by the leaf and the shift moves angular momentum rather than type.*

Two members are excluded from the vacuum kernel on principle rather than by omission. A bare accelerating mass leaves a conical deficit its cosmological constant cannot remove, and a free mass follows a geodesic — *so a forced acceleration requires a source, and the strut is a line of matter, which is to say a bend.* And charge enters as a bend likewise, electrovac rather than vacuum; *the geometry carries charge conjugation as a symmetry rather than a blindness*, depending on the charge only through its square, with the sign living entirely in the potential [8].

One thing this section does not rest on is worth naming, because it is the part that looks like the result and is not. Within a reachable class the operator's four data — leaf, lapse, shift, vantage — supply exactly the functions the general invariant metric admits, so the cut spans the class. *The source says plainly that this surjectivity is not the content*: once the cut carries the class's function count, the cut ansatz is the general invariant metric and spanning is near-tautological. *The content is the identification of the vacuum members as the substrate's own family — the kernel — and of matter as the bend.*

3.7 The collapse boundary and the cosmological boundary are one layer

The construction's central result is not about cuts at all; it is about what a collapse becomes, and it rests on a correspondence between two boundaries. A map carries the collapse horizon to the oriented future cosmological horizon of a comoving geodesic, preserving the generator fibration, the affine ordering and the future orientation. *It is not an arbitrary isomorphism of like-typed boundaries*: both objects are the future horizon *of a worldline*, which constrains the map to a single causal type before anything is chosen [16].

And the clause that reorganises the picture is the one about counting. The assignment of a comoving geodesic to its oriented future cosmological horizon is a *bijection* — orientation being what distinguishes a point from its antipode — and the reassignment promotes each horizon's generators to that worldline. *So the sphere of comoving worldlines is the sphere of reassigned horizons, not merely covered by it*: no single horizon seeds the congruence, and *the family of horizons is the congruence* [16].

One apparent tension in that reading is settled rather than tolerated, and how it settles is the interesting part. Generically the map is causal and structural and *not* metric — the two horizons' areas and surface gravities differ, and a residual reframing freedom survives on the bifurcation two-sphere. *At the forced member the two horizons merge at a common areal radius with equal area, and the map reduces to the identity on that one coincident horizon: metric, and rigid.* The freedom cannot carry over, and the reason is structural rather than convenient — *the degenerate horizon carries no bifurcation two-sphere at all*, which is the very object the freedom was defined on. *So the seam is the map's metric coincidence and not a counterexample to its generic reading.*

What that yields is the result the rest of the cosmology stands on. On the augmentation, gravitational collapse cannot terminate: it continues as an expanding cosmology, and the corollary extends the conclusion past the spherical case [16]. *The progenitor sits on the conjugate branch*, so what issued as this construction's matter universe collapsed as antimatter — the standing conjugation across the bead rather than any baryogenesis event.

And the level at which that is settled is stated, along with what it leaves open. The conjugate branch is the areal reflection of the expansion leg, and under the mass-reflection — the same reflection worn five ways above, acting as the diagram automorphism — it is the *antifundamental* of the matter branch. *So the identity is fixed at the representation level*, as a consequence of the bead geometry and the theorem, and *independently of the sheet-to-ruling map* the synthesis closes separately. *What is not settled is the field-level charge structure* [16], which rides on the sector §7 declines — so the claim is about representations and not yet about charges.

One further thing the reassignment closes is the orientation itself, which is the tightest form of the correspondence. Every valid spacelike slicing reaches a collapse horizon only in the infinite limit of exterior time, so the horizon selects a null direction and an orientation with it. *Within this construction that very orientation becomes the timelike direction of cosmic evolution*, the reassignment being the mechanism that promotes it to the fundamental congruence [16]. *So the cosmology is not merely compatible with the horizon structure the causal result proves — its time is that structure's own selection*, which is what makes the two boundaries one layer rather than two that happen to match.

One guard travels with this and its neglect wrecks the cosmology. The areal radius read along a reassigned ruling obeys the $\sinh^{2/3}$ law and *not* the cosh of the closed *orthogonal* de Sitter slicing, whose comoving geodesics are a different family. *And the source states the guard positively, which is what makes it usable*: *it is the reassigned rulings, and not the closed-slicing geodesics, that are the fundamental worldlines of the cosmology* [16]. *Two distinct congruences*, and conflating them substitutes one cosmology for another.

One thing has to be added or the guard collides with the quantum sector below, where the same functional form appears with the opposite verdict. There the flat reading and a closed reading are *two synchronisations of one congruence*, and that congruence is *this* one — the source identifies it with the S^3 family of the correspondence in as many words [13]. The two papers therefore name the same fundamental worldlines and never disagree about which they are.

And there is only one cosh *in play, which is what makes the two statements consistent.* It is the hyperboloid's own foliation — the round three-sphere evolving as $a(T) = \alpha \cosh(T/\alpha)$, the waist at $T = 0$, which is simply de Sitter sliced at constant height. *The reassigned geometry shares that foliation*: the source marks it as a distinct Lorentzian metric on the same manifold with the same leaves [13]. *So the two papers are not naming two slicings.*

What the reassignment changes is which congruence is comoving with respect to those leaves. In the unreassigned metric it is the timelike geodesics orthogonal to them. In the reassigned metric the promoted rulings are timelike and those geodesics are not — *so the guard is against taking the old comoving family for the fundamental worldlines*, which is exactly what it says. And the $\sinh^{2/3}$ is a different quantity again: the areal radius read along a ruling in the cosmology that carries the bend, not a scale factor of the shared foliation. *One foliation, two metrics on it, and two quantities read along it* — and what separates the flat reading from the closed one is the bend the observer's accounting carries and the background has not.

3.8 General relativity's constraint algebra is the substrate's grading

At the symmetric cut the substrate's algebra splits as $\mathfrak{so}(5,1) = \mathfrak{h} \oplus \mathfrak{m}$ with $\mathfrak{h} = \mathfrak{so}(4,1)$, and all three symmetric-space inclusions hold, $\mathfrak{m}$ not being a subalgebra. Under the correspondence between $\mathfrak{m}$ and the normal deformations and between $\mathfrak{h}$ and the tangential ones, *these are the hypersurface-deformation brackets term for term* [11].

So the algebraic shape that makes the Dirac algebra puzzling — two normal deformations bracketing into a tangential one — is exactly the shape of a symmetric-space coset: two coset directions bracketing into the isotropy. They are the same grading. *The claim is a recognition rather than an addition*: no structure is added to general relativity, and what is exhibited is that a pattern the theory already carries is the substrate's.

And the grading is not only an algebraic fact about the constraints: it is the algebraic form of the split the cosmology computes on. The normal generator, sitting in the coset part, is smeared by the *lapse* — the metrical rate at which the layer advances, the foliation's own stacking rate. The tangential generators, sitting in the isotropy part, are smeared by the *shift* — the synchronisation convention through which that advance is coordinated and observed [11]. *So the pair §1 separates by measurement, and the pair §4 assigns its two rates by, are the two graded pieces of one symmetric-space decomposition. The lapse is the coset direction and the shift is the isotropy*, and what looked like three separate structures — an obstruction, a measurement, and a scoping rule — is one.

The coefficient that makes the algebra an algebroid rather than an algebra — the structure *function* standardly identified as the canonical root of the problem of time — is, on the symmetry-reducible reduction, the coset metric of that symmetric space [11]. *And the paper states at once that this is not a naive tensor equality*: the structure function is the Riemannian inverse spatial three-metric, the coset metric the Lorentzian five-dimensional form of signature $(1, 4)$, and what is identified is the *reduced* structure function on the symmetric-cut pattern with that coset form.

And what makes the identification more than dimensional bookkeeping is the signature. The coset metric carries an indefinite, Lorentzian sign, *supplied by the substrate's geometry rather than inserted by hand* — and it is the same indefiniteness standardly named as the "wrong sign" at the heart of the problem of time [11]. *So the obstruction is not merely paralleled by a geometric quantity; it is one.*

The rest follows from where that quantity is constant and where it varies. At the symmetric cut it is constant, and there the substrate's algebra is a genuine Lie algebra. Over the space of cuts it varies, and that is what makes the object a genuine algebroid — *so the problem-of-time obstruction is identified with a single geometric fact, the base-dependence of the substrate's symmetric-space metric, whose Lorentzian signature is the obstruction's own.* Read on the preferred foliation the same content deparametrizes to a true Hamiltonian (§5), which is the sharpest way to put it: *the obstruction and its resolution are one object under the static and the dynamic vantage* [11].

And the grading is exact in exactly two places, which turns the exceptions into content rather than caveats. The symmetric-space relations survive at the maximally symmetric stratum and at the forced member, those being the only admissible symmetric-pair dimensions. Everywhere else the coset bracket leaks back into the coset directions — *and that leak is the algebroid connection*, the genuine base-variation, vanishing exactly at the two strata where the grading is exact [11].

One further thing the algebra fixes is why different masses are not connected. The substrate's action on the space of cuts is not transitive, so the mass is a modulus transverse to the orbits — but the qualifier that matters is *connected.* No connected substrate isometry joins cuts of different mass; *an orientation-reversing one does*, and it is the reflection that swaps the substrate's two null rulings and, the mass relation being odd, reverses the mass across exactly the orbits the connected action cannot cross [11].

3.9 One reflection worn five ways, and the limit on what the threefold supplies

The reflection just named is not one of several discrete operations the construction happens to carry. The same $\mathbb{Z}_2$ appears five times and they are one map: the swap of the substrate's two null rulings, the orientation parity lying outside the connected isometry group, the diagram automorphism of the root system, the graviton's two helicities, and — *fermionically* — the chirality grading itself. The last of those is not an analogy. The substrate is spin with a *unique* spin structure, and the reflection, fixing all four spacetime legs, acts on the cut's natural spinor as γ^5; the alternative reading was excluded by computation rather than set aside [11]. *So the orientation parity **is** the chirality grading*, and the same reflection grades mass on both faces — the geometric mass reversal and the fermion mass term alike — *mass being its one odd datum in either register.*

And the graviton face can be exhibited on the same footing rather than asserted beside it. The closed layer is a group manifold, so its connected isometry group is a quotient of $SU(2) \times SU(2)$, and the transverse-traceless harmonics at each level fall into a pair of representations whose labels differ by two and never coincide — their dimensions reproducing the tower's own degeneracy at every level, ten at the floor as a self-dual and an anti-self-dual five [13]. *The map exchanging the two helicities is the swap of the two factors*, which is the outer automorphism and lies on the disconnected component. *So the reflection that grades chirality fermionically is, on the graviton face, the layer's own $L \leftrightarrow R$ swap* — and two of the five are now exhibited rather than named.

The threefold and the twofold act on independent structures, which is why they compose as a direct product: one permutes the three roots, the other exchanges the two rulings, and the inversion is central [11].

And here the construction declines the reading it is most tempted by, on its own criterion. The threefold furnishes a Cartan element and its Weyl group — *a necessary ingredient* — and it is natural to ask whether the colour algebra therefore lives on the substrate. It does not, and the answer is settled negatively rather than left open: that algebra is not a subalgebra of the relevant rotation group, its smallest faithful real representation being too large to fit [11]. *A substrate of one higher dimension would permit one — and permitting is exactly what the construction's own criterion of necessity refuses to count.* A structure a framework merely permits, as against one it requires, *is on that criterion no explanation but a description* (§2). *So neither the continuous algebra nor the dimensional rise is asserted*, and the resonance is recorded as necessary rather than sufficient.

And the negative is not allowed to overreach either, which the groupoid paper marks in its own voice: that the root system is not a realised colour isometry on this substrate is *not* the statement that its agreement with the colour algebra's own root system is a meaningless coincidence, and treating the one as the other would claim more than the argument supports [9]. *Whether the two coincide for a structural reason or by accident of abstract type is left open*, and it is the same question §7 leaves open one level up — the algebraic face of the identification whose discriminator is dynamics.

One item is a corollary and should not be mistaken for an open bracket. Because the normal–normal structure function is the inverse leaf metric — a momentum-independent tensor field, already fixed by the finite-mode identification — the smeared closure for arbitrary lapses holds on this sector as a consequence rather than as a further thing to prove. *What genuinely lies past the finite pattern is not a residual closure but the free transverse degrees of freedom beyond the wall*, and the algebroid hands off to them there [11, 10].

3.10 Four consequences of taking the layer as the existent

Four things follow from the layered reading that are easy to state and easy to miss, and each answers an objection the reading invites.

Flat spacetime does not imply flat space. A layer's own three-geometry is curved wherever matter bends the cut, and the spacetime assembled from the stack may nonetheless be flat; read the other way, *curved spacetime does not imply a curved existent* [16]. *The scope the companion* *papers mark is marked here too*: attributing the mass-curvature to the sweep rather than to a local source is the perspectival reading and not a result proved independently of it.

Gravitational waves are the layer's own transverse-traceless shear, evolving by a wave equation on the layer, and the wave's energy and momentum are carried entirely by the shear rate and the shear gradient — *so the carrier of wave energy is the evolving layer itself and not a field propagating through a block* [16]. *The account is exhibited rather than asserted*, which matters because a reading that denied the block would otherwise owe an explanation of the one phenomenon most naturally described in it.

Every finite layer is smooth, carrying no realized horizon and no realized singularity — and that single fact is what the black-hole family of §5 rests on. Censorship, the radiation, the information question and the laws of black-hole mechanics are not disposed of one at a time: *each supposes a completed horizon on a layer, and none is ever realized* [16].

Two things belong with that and neither is a caveat. The non-realisation is structural. The horizon is met only at infinite exterior time, and that is a statement that it is *never* met on any layer — not that it is met late. The forcing is not special to this geometry either: *it holds at any Killing horizon* [2]. *And what is dissolved is horizon-induced, and only that*: the mode-splitting that yields the radiation has no realised background to be computed on, while *local, non-horizon particle production is untouched. So the construction does not claim that a collapsing body radiates nothing* — what it claims is that the specifically horizon-derived channel has no realised horizon to derive from, which is a narrower statement and the one the source makes.

And each of these follows from the standard causal structure with no modification of general relativity, which is the register the whole family is disposed of in. *So the recovery of general relativity's sector is not the inheritance of its troubles*, and the dissolutions are one result read at several addresses rather than a list of separate escapes.

And there is no ontological time travel, for a reason of structure rather than of dynamics. The layers are totally ordered by the cosmic clock and no layer is prior to itself; with spacetime treated as a representational projection rather than as fundamental, *there exists no structure within which a trajectory could return to an earlier layer* [16]. *A closed timelike curve in the projection is therefore a feature of the projection*, which is what §5 disposes of it as.

3.11 Where $\hbar$ enters, and the one place it could have brought a parameter

The construction has one quantum result and it is worth stating exactly, because it closes rather than parametrises. The layer's propagating degree of freedom is the transverse-traceless shear, and on the closed synchronous slicing it decomposes into a *discrete* tower of oscillators, one per harmonic, each self-adjoint — *the closed topology entering as the discreteness of the tower* [13]. A fundamental observer reads the same tower on the expanding slicing with the index passing to a continuous wavenumber, *and what distinguishes the two readings is the bend*: the observer's own accounting carries a pressureless term the background's expansion has none of. *So the matter an observer attributes to the graviton's background is the bend of the slicing — a feature of the projection and not of the layer*, and the two are one congruence under two synchronisations rather than two frames.

The quantization has two freedoms, and the geometry closes one of them. Across the natural ordering family the inverse-square coefficient at the origin stays strictly below the threshold at which the operator would be essentially self-adjoint, so *the deficiency indices are the same whatever the ordering*: the ordering ambiguity cannot decide the quantization, and the residual reduces to one boundary condition [13]. *But that boundary is not a generic endpoint.* It is the de Sitter horizon — the same finite-curvature locus §5 identifies as the beginning — and a Killing horizon carries a unique state regular in the Euclidean continuation. *Euclidean regularity is the extension*: it keeps the regular branch and excludes the admixture whose presence would be a conical defect, an off-temperature state.

So that freedom is closed, and closed without a free parameter, because the horizon fixes one temperature — and closed not only for the free sector but for the coupled tower at every order of the coupling.

The second freedom is not closed, and the source is exact about what it is. The closure above is of the boundary ***condition****, and it holds for either operator ordering*; the ordering *itself* — which physical content the tower carries, whether its zero-point energy gravitates at the horizon — is not fixed by it. *And an exhaustion of the construction's candidate selectors finds that none selects it*: the thermal state and the seam act downstream of the ordering; the substrate isometry, positivity, the one-scale ledger and covariance respect both; and the deparametrization makes normal ordering available without making it mandatory, removing the anomaly-freedom lever by solving the constraint [16].

So the ordering is genuinely external — and what it is, is worth naming precisely, because it is a case of something §5 discharges wholesale. It is *a localized instance of the cosmological-constant problem*, reached from inside the boundary coefficient: *an epistemic gap of a single physical datum rather than a residual freedom of the quantization* [16]. *That the accounting of §5 dissolves the problem in general and the corpus locates a surviving instance of it here is a thing to state rather than to leave for a reader to notice. Which places $\hbar$ precisely*: the horizon that closes the freedom is *the seam where $\hbar$ enters gravity*, its period fixing the constant against the curvature alone — *the quantum instance of the constant ledger of §5*, in which the constants enter as unit gauges over the one scale, and the single place a free quantum parameter could have sat is closed by the horizon's own thermal state [13].

And the source draws a line here that this paper must not blur, having followed a curve above whose parameter runs imaginary over one stretch. The thermal register in which $\hbar$ is fixed by the horizon's period is not the register that curve's action belongs to. The lap's excursion is a real integral along a real curve of a real Lorentzian geometry, whose parameter happens to run imaginary over part of it — *not an exponent awaiting a quantum of action.* Dividing the one by the other would join two continuations the construction deliberately keeps apart [13].

Two things are open here and one is not, and they are easy to swap. Deparametrizability is not at risk at any order: the clock momentum enters the constraint linearly whatever the graviton content, so the constraint solves for a true Hamiltonian throughout and the coupling appears as interaction terms rather than as an obstruction. *Nor is the boundary condition open in the coupled sector*: the same thermal regularity supplies it fibre by fibre. *What is open is the definition of the interacting tower* — the spectrum of the operator that promotes the boundary coefficient, and the ultraviolet definition of the sums — *which is the standard problem of an interacting theory and not a residual freedom in the quantization* [13].

And one motive that usually attends this exercise is absent. There is no initial singularity to resolve here (§5), so the usual reason for quantizing the homogeneous sector does not arise. *The point is not singularity avoidance but that on the selected foliation the generator evolves rather than annihilates.*

3.12 What is a theorem here and what is the reading

The construction's covariance claim is that general relativity holds *a single geometry* invariant under change of chart, while this construction holds *the substrate* invariant under change of *geometry*, with the slicing curve as the gauge object: *"many line elements, one geometry" becomes "many geometries, one substrate."*

That is a reading, and the source labels it as one. The theorems — the vacuum kernel, the bend-density identity, the lapse split, the cosmological geodesic, the second-ruling embedding — are computed and verified; *the covariance reading is adopted on their strength and explicitly does not follow from them as a corollary follows from a theorem* [12]. It is stated here at that weight and at no other.

4 What is computed, and what it is confronted with

The construction meets data in three places: a rate, a set of light-element abundances, and the microwave background's angular structure. Each is stated here with the register its source gives it, and the third includes a measured disagreement for which no mechanism is in hand.

4.1 The rate: one parameter, and one epoch

The count is smaller than it first appears, and where the smaller count comes from is worth following, because it is easy to inherit the larger one. The vacuum family of §3 does carry two — the substrate scale and the offset of the cut, and no more [12]. *But the cosmology does not sit on a general member of that family.* It sits on the one where the two horizon roots merge, and there the mass is no longer free: it is fixed by the substrate scale, so *both* the amplitude and the rate of the expansion law are set by that one scale and the whole scale factor is a single function of it [14].

And which member is not fitted — it is forced, by routes that share no premise. Two are given here. Structurally, the limiting orientation a collapse selects is a null direction *grazing* its horizon, tangent and never transverse (§1.6). Classifying the family by how a null-generator congruence meets its horizon gives a trichotomy — transverse crossing at two distinct horizons, tangency at a merged double root, or no real horizon at all. *A collapse forms a horizon*, which excludes the horizonless case; *the limiting orientation is tangent*, which excludes the transverse one; and the unique member whose null-generator direction is tangent to its own horizon is the merged-root configuration [16]. *Algebraically*, the same member is the unique fixed point of the vantage involution: generic vantages fall into two-cycles that forbid the reassignment outright, so it selects that member and no other — *a fact about the group structure rather than about dynamics or fine-tuning* [9]. *Two independent routes, one configuration*, and neither is a fit to a mass. *A third arrives in §3 from the hinge's own placement*, by the angles alone and without reference to either of these.

And the flatness of the observed cosmology is not an input either. The comoving congruence is the *marginally bound* one — the energy of a particle at rest where the potential is trivial, the boundary between bound and unbound motion — and that congruence is the frame whose constant-time slices are flat. Read as a Friedmann model the family gives $-k = E^2 - 1$ exactly: bound is closed, marginal is flat, unbound is open, *with the mass and the curvature common to all three and only the congruence's energy differing* [12]. *So the flat cosmology is the marginal member of one family and not a separate construction*, and the same single congruence read inward is pressureless collapse — *the horizon being the seam it crosses rather than a wall between two regimes.*

Two scope lines belong with that trichotomy. The observed cosmology is the flat member; the other two are the substrate's other admissible slicings and not the physical universe. And the trichotomy is over the *spatial* curvature of the leaf, never over the signature of the spacetime — the open leaf being hyperbolic three-space, not a Lorentzian anti-de Sitter spacetime, which the one-time substrate admits no section of [12].

So the rate has one parameter and one epoch. What remains after the geometry is fixed is where the present sits on that one curve — and the quantity conventionally written as the offset carries exactly that: it is the present areal radius *in units of* the geometry's own fixed length, the two horizon roots' merged value. *The denominator is fixed by the substrate scale and the numerator is the moment*, so the number is a clock reading and not a second geometric datum. That is the same thing the construction says of the density ratio directly: it is a reading of cosmic epoch rather than a driver of the expansion [14].

And the distinction is worth the care, because the weaker phrasing understates the claim. Two parameters neither of which is a content of the universe is a good position; *one parameter, plus the time at which one happens to look, is a stronger one* — and the second of those is not a parameter of the theory at all, since any theory whatever must be told when it is being read. The epoch is measured directly and calibration-free — without a distance ladder, without the microwave background, and without any density.

The familiar cosmological form is then a coincidence of form, and the distinction matters more than it first appears. Written in the fitted pair, the same rate reads as the Friedmann one, with the density parameters following identically. *That is a translation between parameter sets and not a decomposition into components*: the two readings agree on the function and share nothing beneath it. A reader who takes the agreement as a decomposition has imported the very thing the construction declines to assume.

4.2 Three levels, and why a mis-assignment is fatal

Every rate-bearing quantity in the construction sits on one of three levels, and the assignment is not a convention [14]. *The foliation stacking rate* is read leftward — the cut is primary and a density is the name of its bend rather than its cause — and it is empirically forced rather than modelled. *The leaf-level local dynamics* is the ordinary Friedmann readout with radiation gravitating normally: the same single geodesic, read *inward* as dust collapse where the first reads it *outward* as cosmology. *The projection* is what an observer reads.

There is no boundary in time between the first two levels. The distinction is kinematic and holds at every epoch, the decomposition exact, the two rates differing by the radiation term alone. *A quantity assigned to the wrong level is not approximately right*; it is a different physical claim, and §4.6 turns on a case where the two levels give opposite answers.

And the split is forced by the kernel theorem rather than adopted for convenience. The vacuum kernel is the two-parameter family exactly — the curvature and the cut's offset, and no more — so the straight cut integrates to a rate both of whose terms are geometric. *Radiation is not in the kernel*: it requires a bend of the cut, hence content. *So the decomposition above is exact by the kernel's own content*, and not a modelling convenience that happens to hold [18, 12].

Each wrong extension is quantitatively fatal, in its own direction, which is what makes the scoping load-bearing rather than bookkeeping. Carrying the stacking law into the nucleosynthesis window gives a rate some three hundred times below standard at the deuterium bottleneck, *destroying the freeze-out.* Carrying the local radiation-sourced law past the seam pins the sound horizon to radiation and *re-manufactures the very tension the geometric rate dissolves* [18]. *So the two sectors stand together on exactly one reading*, and a reader who suspects the level assignment of being chosen to suit each case can check that no other assignment survives either test.

4.3 Why there is a hot era at all, and why its temperature does not depend on the mass

The turnaround exists; what has to be shown is that the matter is hotter than the deuterium bottleneck when it gets there. Two facts settle it and neither is assumed. *The compression is adiabatic*: the infalling plasma is optically thick by some twenty orders of magnitude in Thomson depth, the photon-diffusion time exceeding the free-fall time by nineteen, so the photon bath is trapped and compresses with the gas and the local temperature tracks the density [18]. *And the peak clears the bottleneck for every progenitor, with no mass condition* beyond the one that makes it a progenitor at all — a turnaround existing exactly when the interior's mass parameter sits at or below the forced member's. *And that threshold is not imported: it is obtained from whether the ball turns around, with no step in common with the derivation from the horizon cubic's double root — so a progenitor capable of seeding a universe is necessarily sub-critical,* which is the regime the construction already requires [18].

The reason the peak is mass-independent is worth following, because the natural estimate gives the wrong answer and the corpus says why. The compression does not stop at horizon crossing: the infalling worldline continues to the branch point in *finite proper time* (§3), so the mean density at horizon crossing is *a floor on the compression and not its peak* [18]. *And the distinction is not pedantic.* The progenitors this synthesis has are the collapses whose horizons occur, which by §1's causal structure are the end-states of the merger trees — cluster-scale and larger. For such masses the horizon-crossing average is orders of magnitude too dilute to reach the bottleneck, and for the largest it falls below the present cosmic density: *a peak pinned there would place the hot dense era in our future*, which is the reductio of reading the horizon-crossing average as the peak.

The physical peak is set by an M-independent scale instead — the infall energy. At the horizon the ratio of gravitational to rest energy is one half identically, so the kinetic energy the convergence delivers is of order the rest mass per nucleon, and *its thermalization is not a further assumption but what the convergence is*: worldlines arriving metrically coincident cannot remain cold coherent dust. That puts the peak some three and a half orders of magnitude above the deuterium bottleneck, at a temperature which lands on the hadronization scale to within the estimate's own accuracy [18]. *So a freeze-out exists for every progenitor, and the hot era is a feature of the collapse rather than of any particular collapse.*

One asymmetry makes the cooling leg the only leg that matters. Freeze-out is time-reversal violating, so it lives on the cooling side alone: *the heating infall cannot fix a surviving abundance, and the turnaround is what makes them* [18].

4.4 The abundances, and the miss that discriminates

The cooling leg *is* a standard big-bang nucleosynthesis — cooling through the window at the standard rate from a fully dissociated start — and a genuine multi-nuclide network integrated explicitly on that history returns $Y_p = 0.247$ against an observed 0.245, $D/H = 2.51 \times 10^{-5}$ against 2.53×10^{-5}, ^{3}He at 1.05×10^{-5}, and ^{7}Li at the standard several-fold over-prediction — *all jointly from the single inherited η*, at the baryon density the microwave background reads from the peak heights, with deuterium at -0.5σ and helium-4 at $+0.5\sigma$ [18].

And the lithium miss is the discriminating result rather than an embarrassment to be noted and passed over. It is the standard over-prediction, reproduced — which is to say the construction inherits the standard problem exactly, neither curing it nor worsening it. *A mechanism that changed the early history would have moved lithium*; this one does not, because the window and the rate through it are the standard ones.

4.5 The low-multipole floor, and why it does not discriminate

Because the distance slicing is exactly flat while the cosmological layers are a closed three-sphere, the photons are projected through the *flat* geometry while only the *source* modes carry the closed quantisation — *not the hyperspherical transfer of a literal closed universe*, which would deliver the lowest mode to the quadrupole and no deficit at all. The result is a *parameter-free* deficit below $\ell \approx 8$, bottoming at $\ell = 4$ and *not* at the quadrupole [14].

The register here is split and the split is the honest part: the existence, location and minimum are established; *the depth is open*, two transfers differing by up to a factor of two. *One thing that might have bled into that depth does not.* The projection across the lift is adiabatic for all but the lowest few harmonics and degrades to order unity exactly where the tower is coarsest — and the residual there is bounded rather than estimated, because the suppression falls monotonically with harmonic index and *the tower has no mode below the lowest, so its least-suppressed mode has no source beneath it.* Mixing can only carry amplitude into more-suppressed modes, and the ceiling on transmitted power sits at 7.9×10^{-8} [13]. And the feature does not discriminate between frameworks — it is a prediction the construction makes for free, not a test it passes and a rival fails.

And one other claim in this section is read at the same end of the spectrum, which is worth noting where both are stated rather than in only one of them. The coherence premise of §4.6 holds for the modes entering before the horizon maximum, so *its own weakest point is the low-wavenumber end* — this one. *Two claims of different kinds meeting where each is least secure* is not a defect in either, but a reader should know they are not independent there.

4.6 The acoustic comparison, and a rejection on the temperature spectrum

The acoustic *scale* is met, and the corpus records what meeting it cost: it is an accommodation, and it is spent. *The peak structure is a separate confrontation, and it goes against the construction.*

The transfer is validated on its control, which reproduces a standard code to 0.14% *in the configuration this construction's own number is taken in, and both arms are converged in the wavenumber integral.* On that footing the construction returns a first peak at $\ell_1 = 206$ with $\ell_1/\ell_A = 0.6830$ against the sky's 0.7312 — *a* 6.6% *deficit in position* — and height ratios of 1.759 and 1.612 against 2.217 and 2.277, with two wavenumber cutoffs agreeing to every digit [14]. *And the deficit is neither of the two instrument faults a reader would reasonably suspect*: the wavenumber truncation and the projection path are both removed there, and the polarisation source pulls both arms down by comparable amounts, landing the control on the sky because it was above it and carrying this arm further below because it was already there — *nothing about the operation differing between the arms.*

The seam datum's own freedoms are measured rather than left as an escape. Across the seventeen readings admitted by a four-peak criterion fixed before the numbers, the first peak spans 148 to 228 — a factor of 1.541, and 1.118 across the numeric-phase readings alone — so *the position is a statement of the construction and not a free choice*, and the sky's value lies inside that span. The same holds separately for the spacing, the phase intercept and the alternation ratio. *But a span containing the sky on each statistic one at a time is much weaker than a reading that reproduces the sky, and there is no such reading.*

What the readings do carry is a correlation, and it is the sharpest thing the scan returns. Position and alternation move against each other across the datum, at Spearman $\rho = +0.782$ and $p = 2.1 \times 10^{-4}$: as the datum carries the peak up toward the observed value, the second gap turns from contracting to expanding. Of the readings landing the first peak within one grid step of the sky's, none contracts; of those that contract, every one sits at $\ell_1 \leq 212$. *So the seam datum can buy the position or the alternation and not both, and no mechanism for that trade is in hand.*

This is where the level rule earns its statement, because the deficit's most natural explanation turns on it. It is tempting to say that the acoustic modes re-enter above the plasma's onset, so that none of them is driven and the comb should be uniform for that reason. *That census is taken on the stacking rate, and the rule assigns the perturbations to the leaf*, which carries a radiation term: on the leaf the band containing the first peak enters the horizon *while radiation dominates.* Those modes are driven, *and the driving is measured on both arms rather than argued* — with a result stated below that runs opposite to the word "deficit" [14].

So the confrontation does not end in a residual. The full-spectrum likelihood scores both arms on the same 133 bins of the temperature spectrum with the amplitude fitted, and the control returns 2.10 in χ^2 per bin against this construction's 118.4: *a rejection of this arm's acoustic spectrum on that statistic, and by a wide margin.*

And the absolute values are configuration-limited, which the source says rather than leaves to be found: the control's own χ^2 per bin is 2.10 and not one, the multipole ceiling cutting the damping tail on an unlensed spectrum. *What is not configuration-limited is the ratio* — the separation between the arms is 58 times the control's own distance from the data on the same bins — *and two independent measures agree to within* 5%, *so the verdict does not turn on which is used. Nor is it a truncation artefact*: at four-fifths of the ceiling the control reads 1.69 per bin against this arm's 82.05, so the disagreement is large at both cutoffs [14]. What produces the gap is the position deficit and the height ratios above, carried across every bin.

What is open is narrower than a mechanism, and sharper for it. The construction's own level assignment rules out the explanation that would have covered it, and the two instrument faults a reader would reasonably suspect are both removed: not the wavenumber truncation, and not the projection path, with the positions grid-converged. *A neighbouring reading is ruled out by a margin worth quoting, and its scope is stated rather than assumed.* One might expect the observed fluctuation amplitude to be the substrate's own vacuum — the natural analogue of the inflationary stretched-vacuum account. It is not: on the one scale, the substrate's vacuum metric-fluctuation power sits some hundred and thirteen orders of magnitude below the observed amplitude [14]. *So the fluctuations are inherited classical content and not a substrate vacuum. And the source immediately marks what that does not settle*: it rules out the *substrate's* vacuum, while the reading it supports locates the fluctuations in the progenitor, whose own vacuum is a different quantity normalised at a different scale and amplified across the branch point. *Neither effect is small and neither is disposed of by the margin above*; both are computed separately.

One further thing the boundary settles is what the construction does not *do to the primordial spectrum, and it is proved rather than assumed.* A mode approaching a horizon is governed by how the metric function vanishes there. At an ordinary horizon, with a non-zero surface gravity, the approach is exponential, and such a horizon *imprints* a scale-invariant spectrum — which is the mechanism the inflationary account relies on. *At the degenerate double root the surface gravity vanishes, the tortoise integral goes as the reciprocal of the separation, the approach is power-law and the boundary carries no scale at all* [14]. *So it transmits the progenitor's spectrum unaltered rather than manufacturing one.*

And the source is careful about which locus that is, which this paper must repeat because it discusses the other one at length. The transmission turns on the *front seam*, where the metric function and its derivative vanish together. *It is not the branch point*: there the function *diverges* rather than vanishing, so that locus carries no surface gravity and is not a Killing horizon at all [14]. *Two loci, two roles* — the seam transmits the spectrum, and the branch point is where the characteristic data below are set.

The consequence is a set of things this construction therefore does not have, and they are worth naming because their absence is a prediction rather than a gap: no inflationary scale-invariant attractor, no consistency relation, and no substrate-sourced primordial tensor signal. *The observed tilt is inherited, and the degeneracy is the proven reason. The collapse leg supplies the same conclusion independently*: horizon entry there occurs at one wavenumber-independent value for every mode, so the leg multiplies the spectrum by a constant and tilts nothing.

And the dichotomy has an operational form, which is what makes it testable rather than descriptive. A kernel carries a scale exactly when the tilt one fits to it *depends on which band one fits.* Fitted on disjoint bands the degenerate kernel returns one tilt to sixteen decimal places while the ordinary kernel spreads by several units, the spread shrinking as the surface gravity grows; restoring a scale to the degenerate kernel by hand destroys the agreement [14]. *So the scale-freedom is doing the work and not the arithmetic* — and the test can be run on a kernel without knowing where it came from.

One thing remains to be said, and it is the thing the construction supplies where the standard account supplies a mechanism — the premise everything above has been measuring against. The acoustic peaks are sharp because modes of a given wavenumber share a common phase at last scattering; inflation produces that coherence dynamically, by freezing modes while super-horizon, and this construction's modes are already sub-horizon at the seam, so that route is closed to it [14].

It obtains the coherence instead from the character of the boundary. The branch point is a *null* surface, so its initial-value problem is characteristic rather than Cauchy: the data are one free function per mode together with regularity along the generators, *not* a field and an independent momentum. *One datum per mode is one phase per mode, and there is no second, independently specifiable quantity available to randomise the relative phase.* So the coherence is not imposed — it is what regular characteristic data on a null surface *are*. Drawing the phase independently per mode, which is the second datum a Cauchy surface would admit, washes the comb out entirely.

The premise that the modes are already sub-horizon carries a qualification from its own receipt, and it is worth having because it names where the argument would fail: completeness holds for the modes whose entry precedes the horizon maximum, and entry is earlier the higher the wavenumber — *so the acoustic band sits on the safe side by construction, and the low-wavenumber end is where it would bite. Which is the same end this section's low-multipole floor is read at*, so the two claims meet at the one place each is least secure.

And the scope of that is stated by the source with unusual sharpness, so it is carried here in the same form. It establishes the mechanism and nothing about where the peaks fall. The demonstration writes the mode function down with the *standard* sound horizon as a literal and propagates no mode, so the spacing it returns is the arithmetic of an assumed expression on an imported ruler rather than an output. *What the peak spacing lacks is not agreement but a derivation*: it is asserted and computed nowhere in that paper [14]. *The heights are different* — those are carried structurally, the driven amplitude being a resonant Fourier magnitude exactly invariant under time reversal, and this cosmology's driving living on the contracting side whose potential evolution is that time-reverse, so the magnitude equals the standard one by structure rather than by tuning.

The direction of the failure is worth stating, because it is the opposite of the one the word "deficit" suggests. Removing the driving moves this arm's first peak from 206 to 340; the same subtraction on the control moves 276 to 220. *So the arm is not driven less than the control but* 2.4 *times as much*, and undriven its first peak already sits 23% higher than the control's. *The arm therefore overshoots rather than falls short*: the driving carries it from above the control's undriven position to below the control's driven one, past the sky [14].

And what the statistic scores is a computed spectrum, which is not the same object as the framework. The instrument it runs on is this cosmology's own — both arms on one set of equations, the control reproducing a standard code to 0.14%, both arms converged in the wavenumber integral — so the machinery is not what is in question. *What is in question is a specification the framework does not yet fix.* The end-to-end transfer the sequence names as its load-bearing debt requires first specifying *how the fluctuations gravitate on the geometrically fixed background*, a piece standard codes cannot supply because they tie radiation's gravity to its presence and so cannot represent the content-versus-rate split the layered reading rests on [14]. *So what stays owed is the specification and this arm, not the instrument.*

A second confrontation is run and it agrees, which matters because it is a different test. Fitting both arms to a binned likelihood over 215 multipole bins, with the same five parameters free in each and the published covariance, returns $\chi^2 = 397.13$ for this construction against 206.44 for the standard model — *a difference of* 190.7 *at equal fitted-parameter count*, so the freedom to refit does not absorb the gap [14]. *And the source states what that measures in the same breath: the five-parameter fit of the spectrum construction, not the geometry that motivates it, the two being joined by the transfer work rather than by identity. That distinction is the source's own and it is the one this section turns on.*

Which leaves the open question a question about a mechanism, and the candidates three rather than two. The deficit may be *physical*. It may be *numerical* — and the two faults a reader would first suspect, the wavenumber truncation and the projection path, are removed, with the positions grid-converged and two cutoffs agreeing to every digit. *Or the specification standing in for the owed one may not represent the construction*, which is a possibility about a model and not about the framework the model was built to represent. *The construction's own level assignment rules out the account that would have covered the first*, and the source states the residue exactly: a measured deficit with no mechanism.

5 What is dissolved

A dissolution is not a solution. Where a solution supplies a mechanism that answers a question, a dissolution shows the question rested on a premise the construction does not carry — so it is discharged rather than answered, and nothing is owed in its place. The cluster below is presented *graded*, because the tiers differ in what an objector must dispute, and a flat list would hand a reader the whole set to reject at once [16].

5.1 Tier one: what carries the layered reading's full weight

These stand or fall with the reading of §1, and an objector who declines that reading declines these with it.

The horizon–singularity family. The event horizon of a collapsing body is a metric singularity met only at infinite exterior time, so no completed horizon is realised on any finite layer. Four results follow, and each is discharged for a different reason.

Penrose's theorem is a correct mathematical result whose hypothesis is a *realised* closed trapped surface interior to the event horizon. With no completed horizon there is no trapped surface it would enclose. *Singularities are not avoided by new physics*; they are rendered physically irrelevant by causal structure alone, the curvature singularity remaining a feature of a global extension the realised worldtube never instantiates — and cosmic censorship is correspondingly unneeded rather than proved [2].

The Bogoliubov construction behind horizon radiation requires a globally defined horizon, a completed causal structure joining past to future null infinity across it, and permanent loss of causal contact rendering the two vacua inequivalent. *The third has an exact criterion*: two Fock representations are unitarily equivalent precisely when β is Hilbert–Schmidt, and a thermal β fails that test at the *infrared* end, its $1/\omega$ tail making the norm logarithmically divergent [2]. *This is not the claim that black holes do not radiate*; it is the claim that the construction's third premise is unmet on a realised worldtube.

The information paradox arises only if a completed horizon forms and subsequently evaporates. *Both premises fail together*: no completed horizon forms, and with no horizon-induced radiation there is no evaporation to carry the loss. The realised spacetime remains globally connected, with a global Cauchy surface, no hidden interior sector to trace over, and unitary evolution unobstructed. *The paradox is not resolved by a mechanism recovering information — it does not arise* [2].

And the laws of black-hole mechanics go with them, for the same reason and with the same register. The constancy of the surface gravity over the horizon, the first law relating a mass change to a change of area, and the area theorem are — like the singularity theorems — *correct results whose object is a realised event horizon carrying a definite area and surface gravity.* That object is never instantiated on a finite layer, so *no finite layer carries the area whose monotonicity the area theorem asserts* [16]. *Nothing here says the laws are wrong*; it says their subject is not among the things that occur.

And the apparatus splits at that point rather than falling whole, which is the part worth following. Area is a geometric property of a two-surface, and the completed four-manifold is a genuine record rather than a fiction — so the area theorem *keeps its subject*, and its subject is a representation and not an existent. *Entropy cannot make that move.* It is a state variable, a state needs a bearer, and on this reading the bearers are layers: *the collapse-face entropy has no bearer, which is not the same as having an unknown value.*

So the three premises §5 denies to the radiation are the same three the entropy's own routes require, and denying them once denies both. The Euclidean and Noether-charge derivations need the completed stationary geometry and regularity at the bifurcation surface, which a collapse spacetime does not have; the first-law route runs through the temperature already removed; and the information route needs matter to become permanently inaccessible, which is the third premise verbatim [2]. *There is accordingly no route to the area law's entropy on the collapse face whose premise this construction does not already deny.*

And the convention is therefore dispensable rather than adopted here. The one job it does elsewhere is to keep the second law from an entropy sink — and *this construction has no sink*: there is no permanently inaccessible region, and the central theorem says where the matter goes. *The entropy is not lost; it travels.*

And the criterion that sorts these is completion, not perspective. An argument of the form "the horizon is perspectival, therefore no thermal flux" is refuted before it starts and is not the argument made: the Rindler horizon is observer-dependent *and complete* — the boost field an exact Killing field of the whole spacetime — and the Unruh spectrum is thermal. Across the four horizons the programme names, one criterion sorts all four, and it is completion [2].

The problem of time, the hole argument, and closed timelike curves sit in this tier for the same reason: each turns on whether a foliation is a convention, and the augmentation of §1 makes it a physical structure. Where the foliation is physical, the canonical frozen-time problem is a question about a convention rather than about the world; the hole argument's two solutions are the same world read twice; and a closed timelike curve is not a trajectory an existing layer can carry.

The first of those is worth carrying out rather than merely asserting, because the shape of the dissolution is the point. The frozen constraint *is not a defect*: it is the faithful canonical image of the block, internally consistent, correctly reporting that if the block is what exists there is nothing for a Hamiltonian to do [13]. *The equations never change; what changes is the answer to what exists.* With the cosmic clock in hand the same constraint solves for a generator and gives unitary evolution in cosmic time. *So deparametrization here is not a trick restoring a time that was absent; it is the formal face of a time that was never lost.*

And the honest scoping of that is stated by the source and belongs here with it: no novelty is claimed in the mechanism. Deparametrization is standard once a clock is in hand — *the move is the selection, and everything after it is reading the textbook on it.* What the construction supplies is a *warrant.* The multiple-choice objection — many candidate internal times, inequivalent quantizations, no principle preferring one — *has force precisely when the choice of clock is a matter of formal convenience internal to the theory*, and loses it when the clock is fixed from outside by ontology and observation [13]. *The competing programmes are not charged with internal error*; what is claimed is that the premise they share, that there is no objective cosmic present, is the premise §4's measurement refuses.

One guard travels with the selection. The freedom among Lorentzian metrics *is* a genuine gauge symmetry, organised by the description groupoid of §2 — *but the cosmic foliation is not one of its orbits to be quotiented away*, being fixed by the ontology that freedom is defined over [13].

5.2 Tier two: what follows from the single scale alone

These require less. *An objector may reject the layered reading entirely and still owe an answer to them*, because they follow from the substrate carrying one scale and nothing further.

The fine-tuning pair — the cosmological constant problem and the coincidence problem — is discharged by the accounting of §1: Λ is the substrate's waist rather than a vacuum energy to be computed and matched, and the constants through which physics is written on it are unit gauges. *The question "why is the vacuum energy so small" presupposes that the quantity is an energy*, which is the premise the one-scale reading does not carry.

The local–cosmic boundary is the second: the locus where the local bend exactly cancels the substrate's cosmological term is derived rather than posited, so *the threshold separating what* *expands from what stays bound is a length the construction computes*, not a density it fits. *It is the subject of §6, which sets out why the same radius carries several unrelated readings.*

5.3 The cosmological puzzles

These are a separate family with a separate home, and they are not graded by the tiers above — they follow from the rate of §4 rather than from the layered reading.

The reckoning is drawn plainly at source: the standard account assembles dark energy, inflation for causal contact and flatness and coherence and scale invariance, and further physics for the tensions; *the construction reads each off* Λ [14]. *The flatness problem* is not solved by an early mechanism but does not arise on a rate whose uniformity is forced rather than assumed. *The horizon problem is discharged on other grounds and is taken below*, because the standard statement of it is not the one the construction answers. The big-bang singularity is a coordinate feature of the reading rather than a breakdown of the theory, the minimum radius being finite. The coincidence problem is discharged on the same accounting and is taken below, where the reading that carries it is given.

And the beginning is not merely a coordinate feature but a locus with an identity, which is worth giving because the correction is at the root. Along the comoving congruence the flat synchronous slices are horospheres normal to the substrate's *second* ruling — the past generator common to the whole congruence — and synchronising to that generator is what makes the slices flat, hence a flat cosmology rather than the closed one [12]. *As the synchronous coordinate runs to minus infinity the horospheres pile onto the null plane through that generator and the congruence converges on its common asymptote*: a single point in the reading. *But that point is a smooth null generator, and the substrate has no curvature singularity there.* Dressed with mass it becomes the origin the comoving reading reports as a beginning — *the same artefact dressed with mass. So the locus is not a point matter emerges from; it is a horizon the slicing is anchored to*, and reading the smooth common asymptote as a source inverts the geometry.

And that identification is scoped, which matters here more than in its own paper, because §3 argues the collapse boundary and the cosmological boundary are one layer. The reading requires the constant-time surfaces to be *normal* to the second ruling — not merely that a null ruling be available, but that the slices be orthogonal to it. *A collapse horizon's limiting causal direction is generically non-orthogonal to any spacelike slice*, meeting its horizon *tangentially* — *which is the very condition that picks the forced member, and the same condition that disfavours the synchronous identification there. So the account above is a statement about the cosmological face and does not extend to the collapse face*, and the two are separated by the horizon cubic's discriminant rather than by a modelling choice [12]. *The boundaries are one layer; the synchronous reading of one of them is not a reading of both.*

Two guards travel with that and each names a category error rather than a caveat. The minus infinity is the *synchronous coordinate* and not proper cosmic time: the elapsed proper time from the seam is the ordinary convergent age, and *taking the chart's infinity for the physical age is the time-face of the same error whose radius-face is taking the origin for the source.* And the beginning is a *finite*-curvature metric singularity — a horizon at which the comoving ruler collapses while the substrate's curvature stays finite, *the same species the event horizon was shown to be* (§2) — so the standard reading conflates the two species of the one genus.

Being that species, it is one. Read inward it is the future event horizon onto which a collapse in the antecedent universe asymptotes; read outward it is this universe's beginning. *The collapse's last event at the close of the antecedent cosmic time is the beginning of this one* [12] — which is §3's continuation stated in the one sentence that makes it a single object rather than two joined.

One puzzle in that family is older than the rest and is answered most directly, so it is taken on its own rather than folded into the list above. In any model whose expansion is driven by its contents, matter and radiation decelerate it, so such a universe expands at late times only because it was already expanding, and the expansion is an inertial legacy of an initial condition at which the description breaks down. *Eddington put the objection plainly and Hoyle shared it*: postulating that the velocities were there from the beginning can scarcely be called an explanation of them.

On this construction the acceleration is not a sector at all: it is the existent slice's own intrinsic curvature, so the expansion decelerates while that curvature is negative, turns over exactly where it vanishes, and accelerates thereafter — *with nothing added to make it do so* [14]. *The identity is set out in §6, together with the reason the locus of that turnover is also, for every mass, where a bound structure's hold gives way to the flow.*

And what discharges the cosmological-constant problem — the first of the fine-tuning pair named in this section's second tier — is an accounting rather than a cancellation. The Planck values are cross-register combinations, mixing a thermal constant with the geometric ones, so they are *gauge combinations and not physical scales. The one physical length is the substrate's curvature radius*, and the ratio of it to the Planck length is the size of the universe measured in gauge units — *a number, and not a tuning* [19]. There is accordingly no Planck scale for the observed curvature to be small against; and the curvature being geometrically primary, a constant vacuum energy is absorbed into the one observed curvature, so there is no split between a bare term and a vacuum energy for a large cancellation to act on.

The honest residue of that accounting is stated rather than left implicit: the curvature's value is the ledger's one input, and it is not predicted.

And the ledger settles a number a reader arriving from horizon thermodynamics will compute, so the source takes it rather than leaving it to be raised. The horizon whose thermal state fixes $\hbar$ (§3) has area $4\pi\alpha^2$, so the Bekenstein–Hawking value carried on it is $\pi(\alpha/\ell_P)^2 = 3\pi/\Lambda\ell_P^2$, of order 10^{122} [19]. *Which is the gauge count of the paragraph above, squared, and nothing further — so the number that is usually the cosmological-constant problem's headline is here a restatement of the ledger rather than a quantity in need of cancelling. And the source is careful about what that does and does not assert*: it does not claim a de Sitter entropy, but states what the number *is* if the standard expression is taken, leaving whether $S = A/4$ carries to a cosmological horizon on this reading unsettled — *and marking that a failure to carry would be a result rather than a gap*, a one-scale ledger forbidding a thermodynamic relation rather than accommodating one [19].

The same standard discharges a third puzzle, and the source's first move on it is to say the usual statement is posed the wrong way round. Standardly the horizon problem asks why the microwave background is uniform across regions never in causal contact — which demands a *mechanism* to communicate a common condition, and inflation supplies one. *The deeper form of the question is not about temperature at all*: it is why the electrons and photons at last scattering are the *same* electrons and photons, obeying the same physics, as those here — *how a causally distant patch knows how to be what our patch is* [19].

Put that way it has an answer with nothing to communicate. A specified material structure is the same structure everywhere because there is *one intrinsic standard* everywhere — which is what maximal symmetry says. The curvature length, the null cone locked to it, the real temporal extent: *present at every point by the symmetry itself*, not conditions that had to propagate and could therefore fall foul of a horizon. *And the argument is Eddington's, sharpened.* He read Einstein's vacuum law as saying the radius of curvature of empty space is a constant length in every direction at every point — then made the move that matters: *length is not absolute, so "constant length" can only mean constant relative to the material standards of measurement.* Inverted, the law reads that *the length of a specified material structure bears a constant ratio to the radius of curvature of the world where it lies.* In his own phrase, an electron could never decide how large it ought to be unless there existed some length independent of itself for it to compare itself with [19]. *So a positive curvature is not optional*: without a finite intrinsic radius there is no standard against which a material structure could be what it is.

That is why the deeper horizon question answers itself here. The patch at last scattering does not need to be told how to be what it is; *it is measured against the same standard we are*, because the standard is the substrate's own curvature and is present at every point by the symmetry rather than propagated to it. *So the uniformity is not the residue of early causal contact but the very fact that makes physics universal*, and the problem is dissolved by locating the standard rather than solved by finding a faster channel.

The coincidence problem goes with the same accounting. The present matter density and the dark-energy fraction are *readings of one cosmic clock rather than drivers of the expansion*, so the coincidence of the two dissolves into our observing at a time of order the geometry's one timescale [14].

A caution belongs with all three, of exactly the kind §8 raises for threefolds. This paper reads one radius seven ways, and the geometric core separately reads maximal symmetry seven ways. *Those are not the same seven and the coincidence of number carries nothing*: the first is a list of quantities that coincide at one length, the second a list of results that share one root, and comparing the two lists item by item finds no correspondence. *The check was run because the numbers matched*, which is the only reason to run it and not a reason to expect an answer.

And the Hubble tension is placed in a different category from the rest, which is the honest part. It is carried not as a dissolution but as a *discriminating datum* — the standing here being theory-choice-favoured rather than settled [14]. *A reader should not count it with the others.*

5.4 The unification divides, and the matter sector

Two further families are carried at lower altitude than anything above, and the corpus says so.

The gravity–gauge and general-relativity–quantum divides are addressed where the boundary paper draws its synthesis: the pieces are established, and what is not discharged is *the identification* — that the substrate's two real forms are physics' actual quantum and gauge sectors rather than a structural rhyme with them [17]. *That is a located question and not a want of confirmation*, because its discriminator is named: a rhyme predicts nothing further, an actual gauge sector carries a field strength and a coupling, and the flat bundle of §7 is exactly what cannot supply one.

The matter-sector family — generation replication, the origin of colour, the family-by-chirality structure, the mass hierarchy, matter and antimatter, CPT — is addressed in the matter sector's own scope section: generation replication read as the three hinges, the family symmetry as the substrate's own Weyl group, gauged chirality against global flavour — which two independent routes reach, the matter sector's on-versus-tangent distinction and, from the algebra alone, the fact that one factor *is* a substrate isometry and so grades as a gauge symmetry while the other is not and so grades a global one [9, 11] —, and matter against antimatter as the conjugation [7]. *These are held at forced-within-CR coherence with the content external, and the corpus records this as the lowest altitude it carries.* §7 states what the same sector declines, and the two should be read together.

5.5 Tier three: what stands on the bare analytic structure

This tier is untouched by any verdict about what exists, which is what makes it the most robust and the least often noticed. It requires neither the layered reading nor the one-scale accounting — only the analytic structure of the solutions.

The continuation through the curvature singularity is of this kind, as is the identical analytic type of the two critical points. *And the Kretschmann divergence is a pole of finite order* — twelfth in the cycloid parameter, raised from sixth by the chain rule — *which is the whole of why the continuation is available*: a pole is continuable where an essential singularity would not be [3]. The overcritical regime is reached by the same continuation that joins the seam.

And the scope the source keeps on that continuation travels with it here, because without it the claim is larger than what was shown. What fails is the *inference* from a curvature divergence to an inextendible boundary — not the divergence, and not geodesic incompleteness, both of which stand. The locus remains a real infinite-curvature metric singularity at which the constructed manifold is legitimately singular, reached in finite proper time. *And the distinction the source draws there is the one that carries the whole result*: *the swept worldline ends at the singular endpoint; the underlying curve passes through it* [3]. What the locus is *not* is the absolute terminus the standard reading takes it for. *So the two poles are identical through first order and parted at second*, and flattening the inner one into unreality would be the same error as calling the horizon removable, committed at the other end.

And the refutation is more robust than the reading this paper gives it, which is worth saying because the paper does give it one. *The counterexample does not require deciding whether the residual curvature divergence belongs to the geometry or to the chart* — that is a separable question and the inference fails either way [3]. *A reader who rejects §1's ontology entirely still owes an answer to it.*

And the separable question does get an answer, from the substrate rather than from this locus, which is the sharpest thing the layered reading says about it. The divergence is the *swept* geometry's: it is where the infalling family's own construction terminates. *On the substrate the same locus is an ordinary point of the equatorial throat*, and the manifold is smooth across it — a single smooth manifold, finite at the equator, with the curvature divergence belonging to the areal reading rather than to the geometry [4]. *So the substrate does not distinguish that point from any other on the waist*, which is why the curve runs through it, and why §3's hinges can read it as a branch point from one vantage and a seam from another. *A locus can be a real terminus of one construction and an unremarkable point of the manifold that construction is drawn on, and both statements can be exactly true.*

The source also volunteers the theorem that bounds it, which is worth repeating rather than leaving to an objector to supply. The C^0-inextendibility of maximal Schwarzschild is established on causal-geometric grounds that never invoke the curvature divergence at all, and *that theorem is left untouched*: continuing the *curve* through the critical point is not a C^0 extension of the Lorentzian manifold across the locus. *Whether the spacetime extends is a further question, and it is not asserted* [3]. *What is refuted is one inference, and only that.*

Nor is the chart at fault. The swept chart is legitimate and agrees on every exterior observable; the error is ontological — promoting one of its artefacts to a fact about the geometry.

An objector who grants nothing else still faces this tier, and that is the reason the cluster is graded rather than listed. Rejecting the reading of §1 costs tier one and leaves tiers two and three standing; rejecting the one-scale accounting costs tier two and leaves tier three. *There is no single objection that takes all three.*

5.6 The closure: one substrate read many ways

The meta-collector, where the rest close. The substrate's maximal symmetry is worn seven ways, and the physics is read as broken-symmetry shadows of one object [19]. *Its status is stated in §1's terms*: the seven results are each established, and *their unification is the thesis rather than a further theorem* — a conjecture decidable by a named test, and carried here at that weight.

6 One radius, read seven ways

This is the corpus's clearest convergence, and it is worth setting out whole because no single paper contains it. A boundary observed around every bound structure, and the epoch at which the universe stops decelerating, are on this construction *the same fact at different masses* — and the geometry that makes them one is visible on the substrate itself.

6.1 The locus

For the marginally-bound congruence that *is* this cosmology, $(\mathrm{d}r/\mathrm{d}\tilde{\tau})^2 = E^2 - f$, so

$$\frac{\mathrm{d}^2 r}{\mathrm{d}\tilde{\tau}^2} = -\frac{f'}{2} = r\,K_G, \tag{2}$$

with $K_G = 1/\alpha^2 - M/r^3$ the slicing surface's Gaussian curvature: *the comoving acceleration is the slice's own intrinsic curvature*, up to the positive factor r [4, 16]. Both sides vanish at

$$r^3 = M\alpha^2, \tag{3}$$

generally in the mass. That radius is the Hubble–Eddington radius, $r_{\mathrm{HE}} = (3GM/\Lambda c^2)^{1/3}$.

So one equation says two things that are not obviously about each other. The expansion decelerates while the slice is negatively curved, turns over exactly where the slice is flat, and accelerates thereafter. And that same flat locus is *the boundary within which local structure stays bound against the cosmic flow and beyond which it is carried off* — the radius the largest bound structures are observed not to exceed [14].

6.2 Why this is a convergence and not a restatement

Two independent quantities change sign at that radius, and the construction does not relate them. The slice's intrinsic curvature is geometric; the acceleration of the areal radius is dynamical; *nothing connects them beyond their both being read off the same curve* [6]. A geometric identity restated in dynamical words would be one fact twice. This is not that.

And the corpus reads the radius seven distinct ways, in papers written for unrelated ends: the Hubble–Eddington radius proper; the flat locus of the slice's own curvature; the handover from the sub-marginal bound orbits to the marginally-bound congruence that is this cosmology; the local range of the substrate's single scale, the one Λ that also sets the global expansion; the acceleration turn; the unique fixed point of the vantage involution [9]; and a consequence of the layered closure itself [6, 16]. *No single paper lists them all* — five are gathered in one place and five in another, three of them shared — *and the convergence is visible only from outside any one of them.*

6.3 The picture on the substrate

Drawn on the hyperboloid the two behaviours are one curve. The substrate is finite at its equatorial throat and opens toward the poles. A slicing line at offset r_0 meets the throat circle rather than passing through it — the manifold is not there at the centre — so the only continuation available is around the circle, and the chart's $r = 0$ sits on the throat at the back, diametrically opposite the hinge [4]. *The lap runs around the throat and then out along the horn.*

The rate along it separates the loci exactly. Since $(\mathrm{d}r/\mathrm{d}\tilde{\tau})^2 = 2M/r + r^2/\alpha^2$, the rate vanishes at the comoving turnaround, diverges as $r \to 0$, and *passes a minimum at* $r = (M\alpha^2)^{1/3}$ — the locus of (3) [16]. *So the re-expansion is slowest exactly there*, and what (2) adds is that the same point is where deceleration becomes acceleration.

On the forced member the locus coincides with the front seam, where the horizon cubic's double root makes f and f' vanish together; there the bead attains $\mathrm{d}r/\mathrm{d}s = 1$ with $\mathrm{d}^2 r/\mathrm{d}s^2 = 0$, its unique inflection. *On other masses the two separate with the roots* [16, 4] — *which is why the radius is a statement about every structure and the seam is a statement about one.*

6.4 What this dissolves, and what the standard account has instead

The observed phenomenon has a name and a long-standing awkwardness. A galaxy at the edge of its cluster is said to "enter the Hubble flow" and be carried off, and the cluster to evaporate at its boundary. *In an account where the expansion is driven by the contents, there is no mechanism for that edge* — only a balance between an attractive term and a repulsive one, meeting at a radius where their magnitudes happen to agree. *A coincidence of forces is a place, not a reason*, and the picture of a structure shedding its outskirts across a threshold has had no better ground than that for a century.

The radius itself is not new and the corpus does not claim it. It is derived in the standard framework and proposed there as an independent local test of Λ [5], with the same $M^{1/3}$ scaling. *That literature calls it a maximum "turnaround" radius, and the word is used here only in reporting their result. In this construction* turnaround *is a different locus and the two must not be run together*: the comoving turnaround is where the *worldline* turns, the radial kinetic term vanishing and the collapse dynamically reversing, at $r = -(2M\alpha^2)^{1/3}$ on the conjugate leg [16]. *The radius of this section is where the* acceleration *changes sign, at* $r^3 = +M\alpha^2$, and it is called the Hubble–Eddington radius throughout. *What differs is what the radius is.* On this construction it is not where two terms balance but *where one quantity changes sign* — the slice's own intrinsic curvature, whose sign *is* the boundedness–expansion dichotomy. *So the threshold is sharp because a sign is sharp*, and the structure does not shed its outskirts against a competing pull; the curve those outskirts are carried along simply turns.

6.5 What the appearance is a shadow of

Nothing accelerates anything at that radius. The sign of $\mathrm{d}^2 r/\mathrm{d}\tilde{\tau}^2$ is a property of a fixed curve, read where f' passes through zero, and the deceleration and the acceleration are what continuous motion along that curve looks like from within [6].

So the boundary's appearance — a coincidence of forces, a structure's hold giving way to a flow — is shown what it is a shadow of, and not merely declared to be one: a curve whose second derivative changes sign, seen by an observer carried along it. *That is the reading of §2 carried out on an observed phenomenon*, and the phenomenon it explains is the local–cosmic boundary itself.

One further reading marks what the coincidence is not. On the forced member that radius is the front seam, which the stratification marks as the one locus crossed at unit speed *without* dividing two causal regions — f touching zero without changing sign. *So the areal acceleration changes sign there and the causal character does not*: two independent sign-questions answered oppositely at one radius, and an observer crossing it records a change in their expansion history and none in the character of their own radial coordinate [6].

7 What it declines to claim

The declines below are not gaps awaiting work. Each is a place where the construction has an argument for why the thing it does not deliver *cannot* be delivered on the structure it has — and stating them with their registers is what keeps the deliveries of §§3–5 legible as deliveries.

7.1 Colour is not a geometric isometry, and the obstruction is complete

The substrate's continuous symmetry cannot carry the strong force, and the reason is exact: $\mathfrak{su}(3)$ is not a subalgebra of $\mathfrak{so}(5,1)$, *precisely because the isometry is exhausted* [17]. *Every candidate substrate bundle falls with it*: the algebra needs a complex rank-three module, and a real bundle's complexification carries a parallel conjugation whose holonomy lands back in the real form.

So the question was never which real bundle, but where the complex structure is — and it is at the branch point. Taking the wall's definition literally there are three branch loci, one per vantage, and the three wall monodromies with the hinge three-cycle generate $SU(3)$ itself, a full lap being the centre [7].

What that delivers is colour's discrete content, and it is delivered. What it does not deliver is a force. *The flatness is a complete obstruction rather than a stage not yet reached, and it is derived rather than stipulated.* The holonomy group generated by the three wall monodromies with the hinge three-cycle is *finite* — necessarily so, a branch structure having finitely many sheets. *A finite group is zero-dimensional, and the holonomy theorem makes the holonomy algebra the span of the curvature, so the curvature vanishes identically* [7]. *So the absence of a force follows from the branching itself*, not from a stage not yet reached. *And the same theorem carries the algebroid's reading in the other direction* — one holonomy result, read forward giving the coset structure and read backward forbidding the coupling. *A reader should not expect a later section to supply the gauge dynamics; there is an argument here that it cannot be supplied on this structure.*

And the antisymmetry that makes the baryon work comes from the same discipline: it is supplied *not by a gauge datum* but by the three modes being the kernel of one Dirac operator — hence identical particles, so a three-fermion state lives in Λ^3 and *the surplus invariants do not exist. The diquark is then a prediction rather than a fit*, nothing having asked that the two-fold carry no invariant.

7.2 The count is computed; the hierarchy is not

The generation number is three, as a γ^5-graded index of wall-localised zero modes [7]. *The count is computed rather than traced*, and it is the sector's strongest single result.

The wall those modes localise on is not put in by hand. Because the areal radius is signed (§3), the radial problem's superpotential *changes sign* where the radius does — so the branch point the curve passes through is a domain wall, and the zero mode is an exact normalisable solution bound to it, its conjugate branch growing instead of decaying and being rejected [7]. *The signed radius that closes the lap and the wall that binds the fermion are the same fact.*

And the norm the mode is normalisable in is the one the ontology selects, which the source calls load-bearing and scopes carefully in the same breath. The fermion is a field on the evolving leaf — the existent, of which the spacetime is a projection — so its norm is the induced proper-distance measure on the cut. In that measure the turning points lie at finite distance and the crossing is an integrable singularity, and the bound state is genuinely normalisable; in the conserved spacetime norm the same *static* mode is not [7].

Two things the source says next bound that, and both cut against the reading it invites. The leaf norm is strictly the weaker condition — on the static region the two measures are related by a bounded factor, so everything the spacetime norm admits the leaf norm admits too. *And the selection is performed on the static region itself and not at the horizons*, where the leaf-measure amplitude runs as a power of the radius so that one chirality decays and is bound while its conjugate grows and is rejected; *at the horizons the two norms disagree about every bounded mode alike*, and so select nothing [7].

And the static mode's failure in the spacetime norm is a statement about that mode rather than about the sector: a modulus tending to a constant at infinite tortoise distance is the plane-wave asymptotic — *the normalisation condition of a continuum state, not an obstruction to one. So the ontology selects the norm, and the count follows on the leaf; what does not follow is that the sector is unavailable otherwise*, and claiming so would overstate what the source establishes.

What the sector delivers and what it does not is stated by the source at the outset, and the boundary is sharp on both sides. Delivered: the generation count, the chirality of each, and the family symmetry — *the discrete flavour structure. Not delivered*: the gauge representations, which remain the ordinary route — a matter bundle placed by hand, untouched by the decline above — and the mass spectrum, the zero modes being massless and their splitting external to the geometry [7].

The mass hierarchy is not delivered, and the corpus states the boundary rather than blurring it. A cubic supplies the *count* and not the spacing: three roots are three, and nothing in the count fixes the ratios between them. *So a reader who takes the generation result as a step toward the mass spectrum has crossed a line the source draws explicitly.*

7.3 What is held open, and at what altitude

The identification of the substrate's two real forms with physics' own quantum and gauge sectors is not discharged, and this is the decline that matters most for how the rest is read [17]. *It is declined for a stated reason rather than pending evidence*: what separates an identification from a structural rhyme is dynamics, and the flatness obstruction above is precisely what denies the compact face a field strength. *So the decline names its own blocker*, which is what distinguishes it from a promise to confirm later. The matter-sector family of §5 is carried at *forced-within-CR* coherence with the content external — the corpus's own description, and the lowest altitude it assigns to anything.

And the closure of §5 is a conjecture and is labelled one. The seven ways the substrate wears its symmetry are each established; *their unification is the thesis*, decidable by a named test and not established by the seven results individually [19]. *Asserting the unification on the strength of its parts would be the one over-claim this corpus is most exposed to*, and the grading of §5 exists partly to prevent it.

7.4 What licenses the word "forced", and the limit on it

Every claim above that a structure is forced leans on one criterion, and it is worth saying plainly what that criterion is and what it is worth. It is the preference of §2: a world that *requires* the observed phenomena is preferred to one that merely permits them through an adjustable parameter.

That preference is one of four rules, and the other three are at work here too, so they are named rather than left implicit. Against naïve realism: do not privilege the world that maps the appearances most directly onto what seems to be happening, since directness of fit is not evidence of truth — *which is the rule that licenses the whole literal-and-perspectival apparatus of §2*, and without it the perspectival readings would be perverse rather than disciplined. *Consolidation*: prefer the world that unifies many phenomena under one structure to the world treating them as separate patterns each fixed by its own hand. *And against ad hoc modification*: reject the framework that survives only by accumulating modifications to reconcile prediction with observation, serial patching being the signature of a foundation that is wrong [6].

The four license judgement precisely where rival frameworks fit the same data and the decisive evidence is not in hand — which is the situation theory-choice actually occurs in, and the situation this paper is in on most of what it claims.

And the first of the four — the preference for requiring over permitting — has a track record, which is the reason it is taken seriously. When a direct, non-local discriminator becomes available it has confirmed the structure the criterion selected ahead of it — the heliocentric arc being the cleanest instance, favoured on symmetry a century before parallax measured it, the standing objection answered not from parallax but from symmetry, and the decisive complaint being against a device introduced to save the very uniformity it violated [6].

And the limit on that is stated by the source rather than left for an objector to find. The record is assembled from celebrated successes, and *a reliability estimated only from successes is survivorship rather than measurement.* The cases where the same criteria misled — the luminiferous ether, caloric, Kepler's nested solids — have not been sampled and no base rate has been computed. *So what the criterion has is a compelling hypothesis with confirming instances and not a calibrated reliability*, and establishing the base rate is set as the discipline's own first programme rather than presumed [6].

That fixes the altitude of every "forced" in this paper exactly. It is a claim that the criterion of necessity favours the structure, made at the strength a criterion with a track record and no base rate can carry — *not a claim that a measurement has confirmed it*, except where §4 says a measurement has. *Which is why the independent routes of §1 matter more than any one of them does*: a convergence of independent forcings is worth more than the criterion that licenses each, because the routes can be checked against each other where the criterion cannot yet be checked against a rate.

7.5 Why the chirality is forced to be non-geometric, and how far that reaches

The register comes first, because a negative result is as easy to overstate as a positive one. What is established is that colour does not arise as a continuous internal gauge symmetry through any examined geometric-isometry route. *What is not established, and is claimed nowhere, is the universal statement that no construction whatever could yield the Standard Model from this geometry* [17]. *Colour by the ordinary route — a matter bundle placed by hand — is in no jeopardy and is not the subject.*

Within that scope the closure is a mechanism rather than a wall, and the mechanism says where geometric chirality can live at all. A theorem fifty years old forbids a chiral spectrum on a compact spin manifold carrying a continuous isometry action: a positive-dimensional *connected* group contains a circle, and it is the circle action that forces the equivariant index to vanish [17]. *The construction's own gravitational handedness is not such an action.* It is a single reflection lying outside the connected isometry group — *a discrete datum, which triggers no circle.*

So the two occupy complementary parts of one group: the obstruction on the identity component and its connected subgroups, the gravitational chirality on the disconnected complement. *And the Standard Model's chiral fermions are charged under a connected gauge group*, so a geometric-isometry realisation of their chirality falls squarely under the obstruction's hypothesis and is rendered vector-like. *Observed fermion chirality is therefore not merely found to be non-geometric but forced to be*, by the very part of the group structure in which chirality can and cannot be carried [17]. *That is the conclusion of a mechanism and not the report of a wall*, and it is the same fact §3 states from the radiative side.

And the argument above is not the securest one the source has, which a synthesis leading with it would misreport. Colour-closure for the matter sector rests on the causal structure rather than on the wall at all. The cosmogenesis is a *signature-preserving* reassignment on the real Lorentzian substrate — so the matter rides that horn, while the colour algebra lives across the signature seam. *The algebra is therefore not a symmetry of the world the matter inhabits whatever the compact face's status*, and that conclusion depends on no claim about the compact face and no index theorem [17]. *The source ranks it first and this paper carries the ranking*: the index route is the mechanism, and the causal route is the one that would survive the mechanism failing.

One escape is closed at proof level and it is worth saying how, because the obvious way would not work. The substrate is non-compact, and the theorem's hypotheses require compactness — so one expects the obstruction simply not to apply. *But the escape presupposes the colour algebra acting by isometry on that non-compact substrate, and it does not act there at all*; where it acts, the manifold *is* compact. *So the route's own premise fails, rather than the theorem being stretched to a manifold it does not cover — and the closure is for that route*, which is the scope the source states [17].

And what the parity supplies is worth separating from what it does not. It reflects only the transverse leg, fixing all four spacetime legs, so it *grades* the two chirality eigenspaces rather than *exchanging* them — which is why a projection by it would yield a chiral spectrum rather than the vector-like one an exchange would force. *So that route is gated rather than closed*, on the one prerequisite the substrate does not supply: a propagating spinor sector to project [17]. *The geometry supplies the chirality arena together with its grading operator; it does not supply the chiral content*, the unequal population of the two gradings, which remains the ordinary route.

A second boundary runs alongside and is stated because its absence would otherwise be read as a claim. Charge conjugation is not among the substrate's discrete isometries and cannot be: it acts antilinearly, on the field's charge structure, while every substrate isometry acts linearly. *And the reason is that charge is a bend* — the metric depends on it only through its square, so the geometry carries charge conjugation as a *symmetry* rather than as a blindness, and the sign lives in the potential [17, 8]. *So the charge sign closes from the matter field and not from the geometry.*

But that boundary is a perimeter, and the source is emphatic that it has an inside — not an isometry is not not geometric. The reality involution on complexified cosmic time, $\tilde{\tau} \mapsto \bar{\tilde{\tau}}$, is antilinear *and* geometric: complex-analytic, fixing the real axis and exchanging the two imaginary readings that are the bead's lift and collapse legs [17]. *So the antilinearity that puts C outside the isometries does not put it outside the geometry*, and the substrate carries an antilinear face after all.

With that face restored the closure is a factorisation, and it is proved rather than gestured at: charge conjugation is the field-level charge sign composed with the geometric pair — the mass-reflection and the reality involution — *with the substrate supplying every kinematic datum of C, its whole CPT and Feynman–Stückelberg content, and only the electric-charge sign closing from the field* [17]. *So the earlier statement understates*: what is geometric is not merely C's spacetime part but all of its kinematics.

And the geometric factor is not an abstract composite — it is the bead's own crossing. The mass-reflection's sole fixed point is $r = 0$, the branch point itself, and it exchanges the two species regions bijectively while carrying the mass across, so the bead's halves carry conjugate species and conjugate mass-sign [17]. *The seam between the two factors of C is the cosmogenesis. That is a drawn connection between charge conjugation and the cosmology*, and the source marks it as a positive result the negatives alone could not reach.

7.6 Why the declines are discipline rather than modesty

Each decline above buys something. The colour obstruction is what makes the discrete residue the single geometric opening — had the continuous symmetry been available, the residue would be one route among several rather than the only one. The hierarchy boundary is what lets the generation count be read as an index rather than as a fit. And holding the identification undischarged is what lets the structural results be stated at all without asserting more than the construction shows.

These are not places the corpus stopped; they are places it drew a line and then used the line.

8 The joins

The convergence of §6 is one kind of join: several papers describing what turns out to be one fact. There is a second kind, and it is what an assembly can supply that a set of papers cannot. Twenty-three mathematical fields were put against all seventeen papers — what bit, what bounced, and where the boundary lies — and the identities below are ones *the papers state separately.*

8.1 Identities the papers state separately

The Nariai condition and Petrov type D are the same algebraic event. The eigenvalues in the classification result are the self-dual Weyl operator's, and its degeneracy condition is Nariai's own algebra: *a depressed cubic's discriminant vanishing*, on two different cubics[L2].

The ellipse of the slicing construction has the Killing form's eigenvalues[L18], its axis ratio the A_2 root-to-weight ratio, and its shorter semi-axis the slicing scale itself.

The S_3 is worn three ways: as the monodromy group of a three-sheeted cover, as the Weyl group of A_2, and as the Galois group of the horizon equation over $\mathbb{C}(2M)$ [9].

Colourlessness has two halves and they come from different places: the trivial Fourier summand on the deck $\mathbb{Z}_3$ supplies the *necessary* half, the antisymmetry in the triple tensor product the *sufficient* one[L12].

Matter is the obstruction to integrating a connection, not a quantity standing beside it[L12] — which is the bend of §3 read in the language of the field that owns obstructions.

And the peak of the crossing is an erasure channel[L21], so what it returns is exactly what a conservation law protects: the inherited datum survives where the composition does not, in one sentence.

8.2 Two relations to one circle

The discrete residue's two factors act on independent structures, and on the waist those structures are the two relations a figure can bear to a circle. The three roots are the special points *on* it; the two rulings are the lines *tangent* to it (§3) [7]. *What that supplies is which factor is which, and that they differ in kind — and the source is explicit that the directness of the product is not itself the evidence and must not be cited as though it were*: every automorphism of S_3 is inner, so a semidirect product by one is isomorphic to the direct product, and there is no semidirect alternative to rule out.

The kinds then sort themselves by the same distinction, without any further input. A ruling is a line *of* the substrate, so exchanging the pair is a *motion* of it — an isometry, acting on the cut's spinor as the chirality operator: *so that grading descends gauged.* A root labels a different *cut*, so permuting the triple moves through the space of solutions and is no motion at all: *so a family symmetry it graded would be global. The Standard Model's arrangement of a gauged chirality against a global flavour is that difference* [7] *— and the source marks its own altitude here: a reading of established structure rather than a further result.*

One caution the corpus supplies against its own statement belongs with it. Every orientation-reversing isometry swaps the two rulings, so *the swap does not characterise the reflection* — the claim is about the group acting on the two structures, never about identifying a map by what it exchanges. *What does the work is what the swapped structure is*: a line of the substrate, or a label on a cut.

8.3 Three loci, one pencil, and two ways a threefold is carried

The lap's three critical loci are not three separate facts. Writing the structure function's level set $f(r) = c$ and clearing the pole gives

$$r^3 + \alpha^2(c-1)\,r + 2M\alpha^2 = 0, \tag{4}$$

a single pencil, linear in c: the seam at $c = 0$ is the horizon cubic, the Euclidean null at $c = 2$ its reflected partner, and the turnaround at $c = 1$ is the *depressed* member, whose linear term vanishes identically. So the three causal characters $1 - f \in \{+1, 0, -1\}$ are the linear coefficient running $-\alpha^2, 0, +\alpha^2$, and the family is symmetric about the marginal member — which is why the turnaround separates the two null passes rather than joining them [16]. *Read on the energy* *family,* (4)*'s three are the curvature classes* $k' = +1, 0, -1$ *taken at their own turning radii*, the marginal congruence crossing each at speed $\sqrt{k'}$ exactly.

And the threefold that pencil carries is carried in two different ways at its two ends, which is worth stating because the two are easy to fuse. At $E < 1$ the roots are colinear and real and carry no symmetry *as a figure*, while the cover of the mass line has full monodromy S_3; at $E = 1$ the position reverses — the roots are the equilateral A_2 weight triangle and carry S_3 as their own symmetry, while the monodromy drops to the rotation subgroup $\mathbb{Z}/3$. *Neither end lacks the* S_3*; the deformation exchanges the manner in which it is carried*, and the exchange is governed by $p = 0$ alone [16]. That is the same group the groupoid paper obtains as the deck symmetry of the three-sheeted cover [9].

And the corpus does better than caution here: it proves the two threefolds are not related, in a form stronger than the obvious one, in a line. Read the horizon turning as a cover of the mass plane whose fibre is the horizon cubic's roots, with monodromy S_3; read the comoving turning as a cover whose deck is the cube-root rotation, which *fixes* the mass. Applying that rotation to a root of the horizon cubic returns $r(1-\omega)$, *which vanishes only at the branch point. So the turnaround deck carries a root of the horizon cubic to a root of the same cubic nowhere except there: it fixes the root cover's base and does not permute its fibre at all* [16]. *That is strictly stronger than saying no change of variable identifies the two root sets*, which rules out one family of maps; this rules out any covering-space relation between them.

And a fact at lower weight gives the paper's own naming guard an analytic cause. The two covers' branch sets are $\{\pm\alpha/\sqrt{3}\}$ and $\{0\}$, *and they are disjoint* — which are exactly the two loci §3 insists on holding apart. *So conflating the seam with the branch point identifies a point where one cover is branched with a point where the other is not*, and the guard is not a matter of careful naming but of the covers' own structure.

What none of this says is that the two share no structure: they share the radius and the mass, and both count three because the structure function has the degree it does [16]. *The negative is about a relation, not about kinship.*

A caution the two ends make necessary. A threefold appearing twice in this construction may be one group carried two ways, as here, or it may be one locus read from three vantages — and those are different in kind. The first is a group acting on a root set: the horizon cubic's roots *are* the seam radii, and the Weyl exchange permutes them. The second is the description groupoid acting on the vantages — *which is the waist rotation of §3*, carrying the branch point onto the seam, so that which of the two a given hinge calls its own is a fact about the hinge. *That is a relation between two loci and not their identification*: the covers above branch at disjoint sets, and the rotation moves points between them rather than making them one.

And the distinction has a geometric statement read off the null structure alone, by a route mentioning neither spinors nor the colour algebra. The sky-angle periodicity is two steps along a null ruling of the substrate — so it is a closed path of light, and its third power being the identity *is* that path closing. *The Weyl reflection admits no such path*: it is a loop in the complex mass plane about the forced member, and the mass *labels the family* rather than pointing along the manifold [11, 9]. *So the rulings walk exactly the isometries and nothing else*, which is the difference in kind read off the light cone. *So the rulings realise exactly that part of the discrete structure which is a substrate isometry, and nothing else* — which is the same partition §5 reaches from the algebra — one factor a substrate isometry and the other not — legible here in the light cone before any field is put on the cut. *Counting the two as one threefold would assert a coincidence of number as a structural identity*, which is the inference §7 declines in the colour sector for the same reason.

The rule those refusals follow is worth stating, and it is this paper's own practice rather than a result of any of the seventeen. A structural identity requires a *derivation* — one object from whose own equation both quantities follow with no further input. A shared abstract type requires a *proof of inequivalence*. *Neither is undecided, and undecided is an honest verdict rather* *than a failure to reach one. And the asymmetry that makes it a rule is that a negative must be earned*: "no link found" is undecided, and reading it as "two unrelated numbers" rigs the question sceptically exactly as reading it as "one thing" rigs it credulously.

The verdict also belongs to the claim rather than to the pair, so the same two objects can carry a proved negative to one question and an open verdict to another, simultaneously and without inconsistency. *Which is why the negative results of this paper are stated as results*: an earned negative and an unearned one look identical in a summary and are not the same thing.

8.4 Two halves of one index, neither of them in the papers

The generation count of §7 needed two things established that no paper had established. That the wall index is well *defined* — the leaf compactness surviving the limit[L10] — came from one field bake, *which the corpus's own receipt had never tested.* That it is *stable*, and that a spectral gap is why, came from another[L19]. *Two bakes, two halves, and neither half was in the papers.*

An open join is named with them: the construction relies on two spectral gaps[L19] doing two different jobs, with neither referencing the other. *That is carried as an open join rather than assumed to be one gap.*

8.5 What the instrument's negatives are worth

A field that bounces cleanly is a measurement, and most of the recent bakes bounced. The apparent probabilistic footprint of the corpus resolves, on inspection, into a curvature, an invariance and a substring[L24]; *congruence* is geodesic throughout and never arithmetic[L16]. *Reporting that is what makes the joins above worth anything* — an instrument that only ever finds connections is not measuring.

And the instrument checks itself, which is the strongest evidence it works. A spectral enquiry asked whether a mode degeneracy used elsewhere matched the corpus's own and found that they differed[L19][L12]: *the papers derive one expression where the textbook supplies another, and the papers' is the one this construction requires. The disagreement was found by one field bake reading another*, which is a check no single bake can run on itself.

8.6 A debt that is presentational and not scientific

One class of finding is worth stating because it cuts in exactly one direction. A method can be used correctly throughout a corpus and named nowhere — and *a reader searching for the standard name finds nothing and concludes the method is absent, when it is present and correct.* Five such were carried; four proved already named on re-measurement, and the fifth — *matched-procedure differencing*, where a control is run through the identical extraction so the procedure's own bias cancels in the difference — is named now.

The class closes silently, which is why it goes stale: someone writes the name while doing something else and nothing records it. *A naming debt wants re-measuring rather than re-reading*, and that distinction is the reason this one shrank from five to one when it was finally measured rather than recalled.

9 The frontier, at its true relative size

What follows is complete and unfiltered. Ten items stand open, each with what would discharge it, and none is omitted for being awkward or small. *The list is given whole because a filtered frontier is worth nothing*: a reader cannot weigh a programme against a selection of its own open problems, and an item that leaves a list by reclassification rather than by being worked has not been closed.

The relative size is a number rather than an adjective. Ten open items stand against roughly seventy-four results carrying a hard register — theorem, proposition, derived, computed, receipt-anchored. *The ratio is not the argument*, and it is given because the alternative is an adjective, and an adjective about one's own frontier is the thing a reader is right to distrust.

Assembling this paper opened three items and closed all three, which is worth stating because it cuts both ways. Each was raised where the construction seemed to state an opening and no instrument was tracking it; each turned out, on being read at source, to be answered in the paper it came from or by material the corpus already held unjoined. *A frontier that moves when a corpus is read whole is the reading working* — in both directions, and a list that only ever shortens is no more trustworthy than one that only ever grows.

9.1 The matter sector

The deepest item the construction opens onto is the matter content's own generative law: a dynamics for the curve itself, as against the ordinary leaf evolution that carries it. §3's identity says what the bend *is* and not why a leaf bends as it does. *Discharged by* a generative law exhibited.

Whether a fermion sector can be built on the compact face stands with it, and it is well posed in a way few unbuilt things are: bounded by a structural result fixing where an admissible mechanism may live and by measured ratios fixing what it must produce, *with its motivation settled and no ontological claim riding on the outcome* [17].

And one question this sector might be expected to settle is one it demonstrably cannot. The per-generation content is fifteen Weyl fermions, or sixteen with a right-handed neutrino. *Both of the construction's handles on matter content are blind to that state*: the generation count is a graded index of wall-localised zero modes and counts generations rather than the content within one, and the anomaly condition returns the identical verdict for fifteen and sixteen, the singlet carrying no colour, isospin or hypercharge and contributing exactly zero on every channel [7]. *So a preference between them must come from outside the construction*, which is the representation-content step §7 records it as declining.

9.2 The quantum sector

The ultraviolet definition of the mode sums is open and has never been attempted; the corpus records two of its three parts as settled and names the third. *And its standing is worth stating with it, because it bounds what an unresolved item costs*: it is the same wall any interacting quantum field theory meets, and the classical dynamics, the deparametrized unitary evolution and the parameter-free closure of the quantization ambiguity *stand independent of its resolution* [13].

And the propagating nonlinear residual is worth reading closely, because it shows what an exact result not reaching something does and does not mean. The ghost and zero-mode runaways are closed *exactly*, and this is the one structure those results do not reach — *but it is not therefore open.* It is the future stability of de Sitter, and the small-data theorem covers precisely the perturbative regime the propagating graviton lives in, with the all-data extension in the same symmetry class corroborating and the one non-generic exception falling exactly on the locus the range classification already isolates. *And the reason no energy instrument was ever going to settle it is given*: the method trades the global-in-time problem for a local one at future null infinity, so *the failure of any monotone energy is the expected shape of that fact rather than a sign of openness.*

9.3 The cosmology

The acoustic rejection of §4.6 is the largest open item in the paper, and it is open in the strongest sense. *The transfer that measures the deficit and the likelihood that scores it are both run, and the likelihood goes against the construction* — the numbers are given at the confrontation rather than repeated here. *So what this list carries is not a residual awaiting a mechanism*: it is the question that section leaves standing — *and the object rejected is a computed spectrum rather than the framework*. The instrument is built, controlled against a known answer and converged; what the sequence names as owed is the specification of how the fluctuations gravitate on the fixed background, and this arm run against it.

One item here is a test rather than a gap. The Hubble–Eddington radius of §6 is degenerate between this construction and the standard one, and *the circularity is in how the test has been run*: the calibrations are dark-matter-only and the mass estimates dynamical, so which mass the radius tracks is assumed rather than measured. *Discharged by* the radius compared against independently measured baryonic mass.

And one thing stood here as a numerical curiosity and turns out to be a consequence. The normalisation of the standard linear growth factor crosses unity once, at the concordance matter density — an observation recorded from inside the standard model, with no explanation attached. *Written on this construction's rate the growth equation loses its parameters altogether*: the substrate scale cancels, because on the forced member the source is fixed by that scale while the time variable carries it too, and what is left is a single equation in the clock with nothing free in it. *The decaying mode is the expansion rate itself*, and the matter fraction is not a parameter but sech^2 of the clock [14].

On those variables the condition that the normalisation equal unity reduces to a balance: the growth-weighted history of the matter fraction, taken about the value 2/3, integrates to zero. *The pivot is the deceleration-to-acceleration turnover*, $\rho_m/\rho_\Lambda = 2$, and the balance is solved at the observed density [14].

Two things narrow that, and both are worth having. The turnover is not this construction's property — any flat matter-and-Λ rate has one. What *is* this construction's is that the turnover sits at a geometric locus, the radius of §6: *the balance pivots on the turnover, and the geometry is what makes the turnover a place.* And the rate the derivation runs on is the stacking one, which is right for the object — the published normalisation is a matter-and-Λ integral and the stacking rate written in the fitted pair *is* that rate — but the construction assigns perturbations to the leaf, so *what is derived is the root of the standard normalisation rather than this construction's own growth root.*

So a number recorded from inside the standard model as a curiosity is, on these variables, fixed by an equation with nothing free in it, and what stays contingent is that the present epoch lies near it — a question about when we look rather than about what the world contains.

9.4 The substrate geometry

The identification of the flat synchronous space with the substrate's second ruling is the sharpest statement in the corpus's $r = 0$ chain, and it is bounded to the cosmological face by the orthogonality it requires — a collapse horizon's limiting direction being generically non-orthogonal to any spacelike slice [12]. *Whether a charged collapse forms the Cauchy horizon* is open, and it is a question about general relativity's own dynamical interior rather than about this construction — *the eternal geometry's obstruction is stated exactly, and a collapse is a dynamical thing. What is at stake in it is bounded*: the closed-loop reading of the charged case, and not the result that collapse continues as a cosmology, whose hypotheses name no charge and which a sub-extremal charged collapse satisfies [4]. *Whether* $-M/r^3$ *is a forced pivot or a mass* awaits an adjudication. *What survives for a perpetually collapsing body is not on this list, and the reason is that it is answered*: the horizon-thermodynamic apparatus has no realised horizon to be defined on, and what the area law and the entropy are *of* there is settled at §5 rather than owed — the area transferring to the record and the entropy having no bearer. What the collapse produces is the central theorem's, and what content crosses is the erasure channel's of §4.

9.5 The nine, with what would discharge each

Stated as a list so it can be worked rather than read.

open item	*what would discharge it*
the matter content's generative law	a generative law for the *content* — the curve's own dynamics *given* content is supplied, the conservation law being entailed by the cut's own geometry and an equation of state closing the system into ordinary differential equations on the cut; what is not supplied is the equation of state, which general relativity does not supply either
a fermion sector on the compact face	*first, what such a construction would be* — the usual specification is a reduction over an internal space, and that is unavailable here; on the reading available an isometry-realised sector on the round face is not vector-like but *empty*, the five-sphere carrying no Dirac zero modes at all
the mode sums beyond the free static case	the *coupled* computation, and only that — for the free tower the scale factor factors out of the whole sum identically, so a non-adiabatic free calculation cannot move the coefficient
the Weyl-squared coefficient at second order in the shear	*stated, and reversible on its scoping*: the tower is two minimally coupled scalar degrees of freedom, so the coefficient is twice a real scalar's, $\frac{1}{60}$ in units of $(4\pi)^{-2}$ — on the physical-mode count, the constraints here being solved rather than gauge-fixed
the last convention in the two-arm comparison	both arms' acoustic scales set the same way — the apparent split being dominated by a start-and-convention mismatch, since the peak-to-scale ratio has the distance cancel out of it and so was never a projection quantity
the progenitor spectrum	a progenitor interior modelled — and reaching the *head* of a bounded genealogy, a stationary recursion being excluded by the entropy monotone that makes the chain finite
which mass the Hubble–Eddington radius tracks	the radius measured against independently measured baryonic mass — worth 1.85 in the radius and 6.4 in an inferred Λ, and *discriminating the dark fraction rather than the framework*, both readings taking the same $m(r)$
the charged collapse and the Cauchy horizon	*what stands in the horizon's place* — the eternal inner horizon is not formed, in both readings of a residual charge, so the stationary obstruction is not reached; but inextendibility is not a spacelike origin, so the charged case is not thereby rejoined
whether the tilt displacement is a tension	a joint fit — the signature is absorbed in shape at 0.26 per bin and relocated into the inferred tilt at -0.0304 against $\sigma = 0.00323$, and whether a displacement of that size is a tension is what remains

9.6 What is not on this list, and why that matters

Two kinds of thing are deliberately absent. Items closed by impossibility are not carried as open, and there are now two of them, dual to each other. *The onset ratio changes along the leg*, so a quantity with no single value has no handover to transmit it [19]. *The inherited datum is the mirror*: it enters the progenitor from the ambient universe and leaves the branch point unchanged to one part in 2×10^9, so the handover fixes nothing about it [18]. *What a lap determines it cannot transmit; what it transmits it cannot determine.* In neither case is a derivation owed. *An impossibility is a result and belongs in §5, not here.*

And the declines of §7 are not frontier items. The colour obstruction is complete rather than a stage not yet reached; the mass hierarchy is a boundary the construction draws rather than a gap it has failed to close. *Listing a decline as an open problem would misreport both*: it would promise work the construction has argued cannot be done on this structure, and it would inflate the frontier with items nobody owes.

And the list is not the weighing. What a frontier of this size is worth against the register that surrounds it, and what would actually retire the framework, are separate questions and are taken separately in §10.

10 What would displace it

The verdict this licenses has to be drawn on the right axis and confined to it, and the cosmology paper draws it in two. On the axis of theory-choice — the requiring rather than the permitting of the phenomena, the consolidation of many results under one structure, the absence of a device added per problem, which are three of the four rules above — *the comparison is decidable now, from the structural record. On the axis of data-discrimination it is not*, and §4.6 is where that shows most sharply [14]. *Two axes, two verdicts, and neither is evidence for the other.*

One thing about the matter density is worth stating plainly, since the construction's matter sector invites the question. The dust the rate carries exceeds the baryons by about a factor of six, so most of it is non-baryonic. *That is not a component this cosmology introduces, and it is not one it derives* [14]: the matter sector fixes the number of families, their chirality and the symmetry relating them, and nothing about what any of them weighs. *So the construction is neutral on the question rather than in tension with it* — the density enters as boundary data, on the same footing as the baryon-to-photon ratio, which the standard account also measures rather than derives.

And a framework is credited for requiring the structure it explains and not faulted for measuring the boundary data it does not [14]. *Nor is the sector silent on a candidate*: the sixteenth Weyl fermion of §9 is a total singlet, carrying no colour, isospin or hypercharge — *which is what a candidate of that kind is required to be*, and it arrives here as a state the construction's own count cannot see rather than as a component added to fit.

Two questions are asked of a framework carrying a measured disagreement of this size, and they are not the same question. The narrow one asks whether the disagreement is an instrument defect. The wide one asks what would disqualify the framework, and it is not a question about that disagreement at all.

10.1 The narrow answer, kept short so it is not mistaken for the wide one

For the acoustic rejection of §4.6 to be a fact about the framework rather than about the instrument, there would have to be a physical defect that suppresses the third peak's ratio several-fold, leaves the peak positions right to within a few per cent, leaves the acoustic angle right to within two standard deviations and free of the Hubble constant, *and produces the identical failure on the standard model, where the answer is independently measured. The last* *requirement is very nearly a contradiction.* Every candidate examined so far that moved a number was an instrument fact, and none required a physical claim to give way.

10.2 The wide question

What retires a physical framework is a better or equivalent account of what it explains. Nothing else ever has. So the price of disqualifying this one is the register in full — and the register is not an illustration but a count: nine structural recoveries, the dissolutions of §5, the cross-field joins, a formal spine of some two hundred environments with fourteen named theorems on six axioms, an evidence rail of several hundred receipts of which the overwhelming majority are shown able to fail, and forty-four proved classical-geometry identities.

Every one of those is a thing a competitor must also explain. The Carter constant is one: general relativity carries it as a coincidence of the Kerr solution and this construction derives it, with a separate result supplying why the derivation is not circular [8]. *It is an illustration of the class and not the case* — the same paragraph could be written for the provable absence of the radiative types, the generation index, the group obstruction, or the index-one vacuum.

10.3 On parameters, where a deficit is easily manufactured

It is tempting to list the framework's measured quantities — the inherited datum, the amplitude, the tilt — as unpaid debts because they are measured rather than derived. That is not a debt: it is what a physical theory does with parameters, and the comparison class does the same. The standard model fits six; this construction fits one, with the background otherwise two numbers, one of them measured calibration-free (§1).

A framework that fits fewer parameters than the model it competes with does not owe a debt for fitting any, and presenting that discipline as backlog is an error worth naming rather than quietly avoiding.

10.4 What is genuinely unpaid, at its actual size

Two real builds: the full-spectrum likelihood, and the end-to-end transfer — both of which the cosmology names itself. *The second is not an unbuilt instrument*: the two-arm line-of-sight machinery is built, controlled against a known answer and converged, and what stays owed is *the specification of how the fluctuations gravitate on the geometrically fixed background* — which standard codes cannot supply, tying radiation's gravity to its presence — together with this arm run against it [14]. *One unresolved observational question*: the high-multipole damping signature, established as real and non-reabsorbable but not established in what it does to the observable. *Its degeneracy with the spectral tilt is window-local rather than general*—the signature is a Gaussian in ℓ and a tilt a power law, so the tilt it locally mimics runs by a factor of $(\ell_{\max}/\ell_{\min})^2$ across the likelihood's own range—*so a joint fit meets a shape residual and not a shifted tilt*, which is where the question properly sits [14]. *One item that belongs to the field rather than to this framework*: the lithium over-prediction, which is standard nucleosynthesis's and is recorded because it sits in the sector rather than because it is owed.

And one that is sharper here than in the field, which is why it is carried as this construction's own rather than as an inherited convention. The horizon-entropy convention is adopted rather than derived throughout black-hole thermodynamics — *but elsewhere it is adopted on a horizon that exists*, and here no finite layer carries a completed one (§1.6). *So the question of what the area law and the entropy are* ***of*** *is this construction's to answer or to dissolve*, and it is carried on the frontier at §9 rather than filed as somebody else's.

That is the honest unpaid column, and it is short because the register is long — not because anything has been left out. §9 lists the nine open items in full, and this section is the weighing rather than the list.

10.5 The claim this supports, stated exactly

A framework with this register is not immune to disqualification. It is expensive to disqualify. The two builds above are where a competitor would start, and they are named here at the same weight as the recoveries — because a register offered as a defence, with its own weakest points withheld, would not be worth the counting.

References

[1] D. Janzen, *A Solution to the Cosmological Problem of Relativity Theory* (PhD dissertation, University of Saskatchewan, 2012), ch. 3.

[2] D. Janzen, *The causal structure of gravitational collapse: the event horizon as a metric singularity.*

[3] D. Janzen, *The Schwarzschild circle: one cycloid, two metric singularities.*

[4] D. Janzen, *The Schwarzschild–de Sitter slicing curve.*

[5] V. Pavlidou and T. N. Tomaras, *Where the world stands still: turnaround as a strong test of ΛCDM in the local universe*, JCAP **09** (2014) 020.

[6] D. Janzen, *The shadow of existence: inferring the world that casts the appearances.*

[7] D. Janzen, *The fermion sector of Cosmological Relativity: three chiral generations from the maximally-symmetric slicing structure.*

[8] D. Janzen, *The range of the slicing operator: the symmetry-reducible sector and its wall.*

[9] D. Janzen, *The description groupoid: vantages, the root exchange, and the discrete symmetry of the solution space.*

[10] D. Janzen, *The dynamics past the wall: the confined bend, the wave map, and chirality as the turning of the polarization plane.*

[11] D. Janzen, *The constraint algebroid: the Dirac algebra as a symmetric-space grading.*

[12] D. Janzen, *The slicing operator: straight cuts are vacuum, matter is the bend of the cut.*

[13] D. Janzen, *Canonical time: the deparametrized tower and the lock.*

[14] D. Janzen, *The cosmology of Cosmological Relativity and its scalar perturbation sector.*

[15] D. Janzen, *A modern parallax: the redshift-isotropy floor and the augmentation it forces.*

[16] D. Janzen, *Cosmological Relativity: the framework.*

[17] D. Janzen, *The matter boundary: what the substrate's symmetry can and cannot carry.*

[18] D. Janzen, *Cosmogenesis: the branch point, the abundances, and what the crossing carries.*

[19] D. Janzen, *The geometric core: the substrate as a real object, and maximal symmetry worn seven ways.*

Appendix L The Knowledge Ledgers

Each claim marked L in the text rests on a field bake or the figure–theorem bake recorded in the named ledger, which ships with this work and carries the probes, the receipts, and the three registers kept apart — what bit, what bounced, and where the boundary is. A ledger is working apparatus, not a publication, and is cited here rather than in the bibliography. This appendix is generated from the ledger index, not maintained by hand.

L2 `ALGEBRAIC_GEOMETRY_LEDGER.md` [field bake]
The algebraic-geometry field-bake ledger — what bit, what bounced, and the boundary. One of the three fields listed but never thrown (the overnight order: algebraic geometry $\times 57$, discriminant $\times 28$ / genus $\times 21$). 'OWED' 622

L10 `FUNCTIONAL_ANALYSIS_LEDGER.md` [field bake]
The functional-analysis / unitarity field-bake ledger — the field that bounced, and the one routing fact it returned. Third of the four fields 'L-272''s re-survey left outstanding. 'OWED' 622

L12 `HARMONIC_ANALYSIS_LEDGER.md` [field bake]
The harmonic-analysis field-bake ledger — what bit, what bounced, and the boundary. Second of the four fields 'L-272''s re-survey left outstanding. 'OWED' 622

L17 `QUADRIC_GEOMETRY_LEDGER.md` [field bake]
projective geometry of quadrics against the CR substrate — the CK metric identification, and the ladder gap it exposes

L18 `REPRESENTATION_THEORY_LEDGER.md` [field bake]
The representation-theory field bake — what bit, what bounced, and the boundary. The largest unbaked vocabulary in the corpus ($\times 241$ tight), thrown after the Phase 4 survey named it the standing first pick on measured usage

L19 `SPECTRAL_THEORY_LEDGER.md` [field bake]
The spectral-theory field bake — what bit, what bounced, and the boundary. Tier B's largest never-thrown field ($\times 189$ on the reach measure), verified as NOT covered by the harmonic ledger, which mentions spectral, self-adjoint and deficiency zero times

L21 `INFORMATION_THEORY_LEDGER.md` [field bake]
The information-theory field-bake ledger — what bit, what bounced, and where the boundary is

L16 `NUMBER_THEORY_LEDGER.md` [field bake]
The number-theory field-bake ledger — what bit, what bounced, and where the boundary is

L24 `PROBABILITY_LEDGER.md` [field bake]
The probability and stochastic-processes field-bake ledger — what bit, what bounced, and where the boundary is