Graphic Equalisation — Cosmology Grounding

Horizons, Measures, and What Has No Outside

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DRAFT — draft-2026-09-06.1r10 (6 September 2026). This document is under active revision and is circulated for comment, not as a finished result. It is a companion to *The Law of Graphic Equalisation — Theory* (referred to below as Graphic Equalisation) and to its physics companion *The Law of Graphic Equalisation — Physics Grounding* (the physics companion), and inherits their definitions, epistemic boundary, and level-of-claims. The other documents referred to below carry short names too, and those are the forms used: *Is* (the base paper), *Narrativium*, and the adaptability paper. Definitions, numbering and claims may change between drafts; cite the version string above if referring to it. Sections marked as falsifiability commitments are the intended points of attack.

Abstract

This companion develops the cosmological groundings of the substrate, and its work is mostly negative in a specific and useful way: it identifies which cosmological questions are ill-posed rather than merely hard, and says why on the account's own results. The spine is the measure problem of eternal inflation, which is the adaptability paper's no-prior-free proposition in another domain — a probability over pocket universes requires a frame-free denominator, and that paper shows no such thing is a member of the space, so the difficulty is not a missing regularisation but a request that cannot be met. Around that: the universe *as a whole* is one of the three degenerate readings *Is* already prices at zero, so the observable universe is the object rather than a sample of one; a particle horizon is an instantiated boundary relation, and what lies beyond it is neither absent nor concealed but NULL in this frame — a superframe dimension, real and related through the container we are a subframe of, and unreadable from here in the way an entangled partner's purity is unreadable, so that what is refused is the value and not the existence; and the cosmological principle divides cleanly into an observation that survives and an inference that does not, the second leg being modal reasoning of exactly the kind *Is* declines. *This paper derives no cosmological parameter, predicts no observation, and settles nothing empirical.* It says which questions have answers and which have none, which is a smaller thing, and it agrees with the field's own instincts more often than it corrects them — homogeneity is called an assumption and the measure problem is called unsolved, and both are correct in kind for reasons given here.

1 Scope, and what this adds

The physics companion already holds cosmology's in-frame half, and the division between them is principled rather than editorial. Questions asked *from inside* a frame — what the seed was, why these constants, where the arrow of time comes from — are physics questions, and that companion answers them: the Big Bang as a chosen entry rather than an intrinsic edge, the Past Hypothesis as a seed and therefore rightly an assumption, fine-tuning inverted by self-location. None of it is repeated here.

What is left is the boundary set, and this paper is short because that set is small: what the subject of cosmology is, what a horizon is, what may be said of what lies past one, and what becomes of probability when the sample space has no outside. The split follows the account's own line between what is in a frame and what is between frames — one companion for the questions with an answer inside, one for the questions about the edge. A reader who finds this document thin has found that division working rather than a gap in it, and the two are meant to be read in order.

Two disciplines carry over and are stated once. The account prices operations and does not license them, and it distinguishes what is *observed* from what is *modelled* — a distinction *Is* makes for its own object and which does most of the work below.

The result in one line, since the rest is the case for it. *You cannot have the ensemble and you cannot have a totality — and this paper can say why.* That is the whole of what is on offer. Cosmology already knows it cannot have them: the measure problem is called unsolved, homogeneity is called an assumption, and both are called that by people with no interest in this account. Those are correct instincts held without grounds, and the grounds are what is supplied here.

The difference is practical rather than decorative. An unsolved problem invites better regularisations and more of them; an ill-posed one redirects the effort spent on that, which is worth something to whoever would otherwise spend it. Knowing why you cannot have a thing is not the same as being told again that you cannot.

2 The universe is not an object

Cosmology's ordinary subject does not exist, and *Is* already says so. That paper gives three readings which each yield nothing (*Is*, Section 3 and Proposition 4): a single relatum with nothing to relate to, the empty case, and *everything at once read from outside, which has nothing left over to stand in relation to it.* The universe as a whole is the third.

Proposition 2.1 (The totality is a degenerate reading). *No frame has everything as its relatum: a frame is an instantiated boundary relation (Graphic Equalisation's Definition 6.2), a boundary requires something on the other side, and whatever frame is offered as the totality is individuated by something outside it.* The universe as a whole *names no object.*

The failure is not that the outside is empty but that there is always one more step outward, which is the unbounded frontier of Graphic Equalisation's Section 1, read in the extensive direction. This is a claim about *frames.* What *Is* posits — everything, with no container, modelled and not observed (its Section 5) — is not a frame and is not the object cosmology individuates; the proposition says that no *individuated* universe is the totality, which is the observed/modelled distinction of Section 1 doing the work it was announced for.

The consequence is a correction and not a limitation. It is usual to say that we observe only part of the universe and must infer the rest. On this account the observable universe is not a sample of the object — *it is the object*, being what stands in relation to the frame doing the cosmology. The horizon does not truncate a larger thing; it individuates the thing there is.

This is less revisionary than it sounds, and the practice already runs this way. The fits that determine cosmological parameters are made to what is inside the horizon. A quantity that made no difference to any fit was doing no work in the account, which is *Is*'s own test.

3 A horizon is a boundary relation

A particle horizon is the boundary relation itself, not a fence inside a larger space. Graphic Equalisation's frame is an instantiated boundary $\mathcal{B}_{W:G}$ (Definition 6.2), and individuation is performed by the container rather than by the thing (Graphic Equalisation's Remark 3.2). A horizon individuates a cosmological frame in exactly that sense, and its dependence on the observer's worldline is then expected rather than awkward: different worldlines instantiate different boundaries, so they have different frames, and there is no frame containing all of them from which to say which is right.

It does not follow that there is nothing outside, and the account says the opposite. A frame is individuated by its container, so a frame that is individuated *has* one — *the boundary relation is itself a relation to the outside*, and a cosmological frame could not be a frame without it. *There is an outside. We are not in it.*

Proposition 3.1 (The relation beyond a horizon runs up, not across)**.** *What lies past a horizon is related to us* through the superframe we are both subframes of *(the physics companion's Corollary 6.2); its content is a superframe dimension, first-class where it lives (Graphic Equalisation's Proposition 10.8) and* NULL *in our frame.*

A connection between subframes runs up rather than across, and NULL here is *not the same status as absent*: the value is unreadable from here, but it was never a dimension of this frame, so failing to read it discards nothing locally available. That distinction is the correction, and the entangled case already makes it. A traced-out partner is not information thrown away; the purity was never in the subframe. *So what lies beyond a horizon is real, related, and inaccessible* — three properties ordinary usage runs together and the account keeps apart.

What remains refused is only the reading. An extrapolation past the horizon is a model of a superframe dimension made from below, which is a legitimate thing to hold and an illegitimate thing to call measured. *The prohibition is on the value, not on the existence*, and it costs the practice nothing, since no measurement inside discriminates between competing values of a dimension that is NULL here.

Remark 3.2 (Where this could be wrong, and it is testable)*.* This is not idle, and on the corrected reading it is not awkward either. Searches for signatures of bubble collisions in the microwave background (Feeney et al., 2011; Planck Collaboration, 2016) are searches for a coupling to something past the horizon. A detection would refute nothing here. Measuring projects a superframe dimension into the subframe's aperture, which is the physics companion's standing description of what measuring does (its Corollary 6.2) — so a found signature is a dimension becoming accessible and not an outside coming into being. The aperture widens; the dimension was there. What it would refute is this paper's assumption about the present aperture, which is an assumption about us and not about the world.

4 The cosmological principle divides

Isotropy is observed. Homogeneity is inferred, and the inference has a modal leg. What is measured is that the sky looks the same in every direction to high precision. What is wanted is that the universe is the same everywhere, and the step between them is the Copernican principle: that our position is not special among positions. *Our position is not special* compares this position against positions we do not occupy, and *Is*'s commitment (its Section 6) is that what bears on a claim is a demonstration and not an imagining, since imagining a world costs nothing and settles nothing — so what follows is not the claim that nothing is out there.

Proposition 4.1 (The second leg is modal and is declined)**.** The inference from isotropy to homogeneity beyond the horizon is not available on this account*: the value it asserts is a superframe dimension, and the inference reads one from below. What survives is isotropy, which is measured, and homogeneity within the horizon, which is also measured.*

The standard derivation makes the point for us, inside its own hypothesis. The Ehlers–Geren–Sachs theorem (Ehlers et al., 1968) obtains Friedmann–Lemaître–Robertson–Walker geometry not from isotropy measured here but from isotropy measured *by a family of observers everywhere*; its realistic form (Stoeger et al., 1995) weakens exactness and not universality, and the observational programme built on it is explicit that what is being combined with the microwave measurements is the Copernican principle (Clarkson, 2012; Maartens, 2011). So the modal step is not appended to the derivation. It is the antecedent. The theorem is sound and the inference is valid; what it requires is a measurement over a domain no frame reaches, which is the one thing that cannot be supplied from inside.

This is the sharpest form of the section's claim and it is cosmology's own statement of it. The route from isotropy to homogeneity is not sloppy and is not naive — *it is exact, and it is conditional on a quantifier*, and the account's whole contribution here is to say why that quantifier has no referent.

The field's own vocabulary already concedes this. Homogeneity is called an assumption, not a result, and it is called that by people with no interest in this account. What is added here is not the suspicion but the reason: it is not an assumption because the measurement is hard, but because the quantity it asserts stands in no relation to the frame asserting it.

5 The measure problem is the no-prior-free proposition

This is the case where the account does real work, and it is the case cosmology already knows is broken.

Eternal inflation produces unboundedly many pocket universes (Guth, 2007). To extract a prediction — what a typical observer sees, how likely a given constant is — one needs a probability measure over them. The theory does not supply one. Different regularisations give different answers, some give absurd ones, and the difficulty is named and open (Freivogel, 2011): the youngness paradox and the Boltzmann-brain problem (Bousso and Freivogel, 2007) are what the disagreement looks like when a stipulation is pushed to its consequences.

Proposition 5.1 (The measure problem is ill-posed, not unsolved)**.** *A measure over all pockets requires a counting relation that represents every pocket in one comparison domain. Such a relation cannot be supplied by any pocket, because a pocket represents only the relations it instantiates; nor can it be supplied by a frame standing in no relation to the pockets, because it then distinguishes and counts none of them. The proposed frame-free denominator is therefore not an unconstructed member of the ensemble but no available relation at all.* The quantity being sought does not exist to be approximated.

This is the in-text argument to which the adaptability paper's no-prior-free proposition (Proposition 7.1) supplies an independently developed, credit-based formulation. A frame standing in no relation to what it counts draws no distinction and returns nothing, which is what makes the zero of such an axis no member of the space. The regularisations disagree because they are supplying, by stipulation, a denominator the theory cannot supply — and by *Narrativium*'s distinction between principled and stipulated conversions (Remark 8.3) a stipulated conversion carries exactly the authority of whoever stipulated it, which is why the answers track the stipulation rather than the physics.

The consequence is the same one the adaptability paper reaches about intelligence. The difficulty is not that the measurement is hard but that the control it needs is not constructible, and an account that kept looking for a better regularisation would be searching for a member of an empty set. This is a dissolution and not a solution, and it predicts that the disagreement between measures will not converge. The sharp form of that prediction is the falsifier of Section 9 (item 2): what would refute it is convergence on one measure *by an argument internal to the theory, requiring no stipulation from outside*, and that condition — internal convergence, not merely observed agreement — is what makes the prediction checkable rather than an open-ended claim about the literature's future.

Remark 5.2 (What this does not do to inflation). Nothing here bears on inflation as physics. Inflationary models make horizon-scale predictions that are tested inside a frame and stand or fall on those. What is refused is a specific inferential move — probability over an ensemble with no outside — and a theory can be entirely correct while one inference drawn from it is malformed. Conflating the two would be the error this paper is otherwise about.

6 Anthropic reasoning inherits the same defect

Typicality arguments are the measure problem wearing a different hat, and worse than that: the term they turn on names two different objects, and the argument survives only by sliding between them.

Read one way, *universe* means the ensemble — all of them, the population a typical member is typical of. Read the other, it means what the word ordinarily means: the observable, relative universe, the one a frame stands in relation to. Cosmological usage takes the second and infers with the first.

Proposition 6.1 (Typicality equivocates, and each reading fails separately)**.** *On the ensemble reading there is no population to be typical of (Proposition 5.1); on the relative reading there is exactly one universe — the frame's — and* typicality is undefined over a set a thing exhausts. Neither reading supports the inference.

They fail for unrelated reasons — the ensemble reading wants the counting standpoint Proposition 5.1 refuses, the relative reading a class its one member exhausts — which is why moving between them looks like an answer.

This is stronger than the usual complaint, which is that the reference class is hard to choose. The difficulty is not that the class is hard to pick but that on one reading there is no class and on the other the class has one member.

Is's care about *everything* is the same care and should be repeated exactly. It does not say that everything *is* nothing — it says the unqualified identity is asserted from a standpoint at which it does not hold, and that what is true is a claim about *readings*: everything at once, read from outside, has nothing left over to stand in relation to it and so yields nothing. So *everything* does not name a population whose members could be counted. It names an operation that returns nothing, and a distribution cannot be defined over the output of that operation.

Between the two zeros is where the distinctions live, which is *Is*'s own sentence and is the whole of what cosmology has to work with: not the ensemble, which reads as nothing, and not a totality, which does not close — but this frame, which is where everything measurable is.

The physics companion reaches the same place from the other direction and the two should be read together: there, fine-tuning is dissolved by self-location (Proposition 14.2), since a different seed is a different observer and there is no trans-seed standpoint from which to compare. Here the same absence removes the distribution. One prohibition, met twice.

7 Two measurements that disagree

A word on the Hubble tension, and it is a word of caution rather than a result. Early-universe and late-universe determinations of the expansion rate disagree beyond their stated errors, and the disagreement is the field's own open problem (Di Valentino et al., 2021).

The account says only what it says. By the adaptability paper's result a measurement is a property of a four-place arrangement (Remark 7.2), and two determinations made under different arrangements are two measurements rather than one measurement made twice — so comparing them requires an argument that the moved coordinate does not bear. That is exactly what the field is doing, at length and carefully, which is why this section claims nothing further. The account does not dissolve the tension, does not favour either value, and does not predict which coordinate is at fault. It says the comparison is the work, which cosmologists established without help.

8 What is not claimed

No cosmological parameter is derived here, and none could be. No observation is predicted. Nothing above distinguishes between inflationary models, settles the expansion tension, or bears on dark energy's equation of state.

Nor is any of the negative work a criticism of practice. Homogeneity is already called an assumption; the measure problem is already called unsolved; the tension is already treated as a comparison problem. The account agrees with the field's instincts and supplies reasons for them, which is worth less than a prediction and more than nothing.

9 Falsifiability commitments

On the tags. Each commitment below is marked [SHAPE] or [DETAIL]. A [DETAIL] failing is a revision: the account survives with that mechanism replaced. A [SHAPE] failing costs *range* rather than a mechanism, because what fails is something the substrate is claimed to require or to permit — so the account does not hold where it claimed to, which is the more serious of the two and is still a boundary rather than an annihilation.

1. [DETAIL] **An aperture wider than assumed.** A confirmed signature of a bubble collision, or of any structure causally beyond the particle horizon, would show a superframe dimension to be accessible from here. That refutes neither the account nor this paper's reading of what lies outside — both hold that it is there — but it refutes this paper's assumption about the *present aperture*, which is the load-bearing assumption of Section 3 and is about us rather than about the world. What changes on refutation is stateable: that section's claim that no measurement inside discriminates between competing values of a dimension that is NULL here would be false for that dimension, and the prohibition on reading its value would lift for that dimension alone. Marked [DETAIL] because what is replaced is an assumption about the present width of our aperture, not a claim about the substrate.

2. [SHAPE] **Convergence of measures.** If the regularisations of eternal inflation converge on one measure by an argument internal to the theory, requiring no stipulation from outside, then Proposition 5.1 is wrong and the problem was hard rather than ill-posed. Marked [SHAPE] because what would fail with it is the no-prior-free proposition (Proposition 7.1) in this domain, which is not a mechanism this paper could replace; it is this paper's real exposure.

3. [DETAIL] **Anisotropy that survives.** Isotropy is the leg this paper keeps. A large-scale anisotropy that survives scrutiny would remove the observed half of the cosmological principle. It does not touch Proposition 4.1, which declines the inference from isotropy to homogeneity and is left standing *a fortiori* if the antecedent fails; what it costs is this paper's sentence that isotropy is measured, and with it the surviving-leg framing of Section 4. Marked [DETAIL] for that reason, and listed rather than dropped because that framing is what the section is built on.

4. [DETAIL] **Typicality on a single reading.** Proposition 6.1 fails if a typicality argument can be stated on one reading of *universe* held throughout — either a countable ensemble carrying a frame-internal measure, which is item 2 again, or a relative universe whose reference class has more members than the one the frame exhausts — without sliding between the two. The claim is the equivocation, so exhibiting the argument without it is what refutes it.

5. [SHAPE] **Derivation of a seed** (inherited). If a cosmological initial condition is ever derived rather than installed — from within, with no boundary condition imported — then the physics companion's seed result (Proposition 14.1) and this paper's dependence on it both fail. The commitment belongs to that companion and is carried here because this paper leans on it.

6. [SHAPE] **No individuated totality.** Proposition 2.1 fails if a frame is exhibited that is individuated and has no container — a boundary relation with nothing on its other side — which would make the universe as a whole an object after all. Marked [SHAPE] because what fails with it is the substrate's requirement that individuation is performed by a container (Graphic Equalisation's Remark 3.2), which is not a mechanism this paper could replace.

Proposition 3.1 is split across the list rather than missing from it. Its inaccessibility half is item 1. Its *related through the superframe* half carries no separate exposure: it is the physics companion's nonlocality corollary (Corollary 6.2) applied at cosmological scale, inherited entire, and it fails where that fails and nowhere else. Proposition 4.1 is exposed through item 1: a dimension read from inside would be the inference made.

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