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Big01-A: Horizon-Bounded Capacity on a Prescribed de Sitter Host: Exact Causal Separations, a Reorganization Ceiling, Coefficient and Identifiability Certificates, Conditional Cosmological Predictions, and a Negative Certificate for the Fixed-Size Quantum-Computer Analogy

A documentary separation manuscript in the Enter framework

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Abstract

A widely discussed proposal in quantum gravity holds that the static patch of de Sitter space carries a Hilbert space of finite dimension of order $\exp(S)$, where $S = A/(4G\hbar)$ is the Gibbons–Hawking entropy of the cosmological horizon, roughly 10^{122} for our universe. The proposal invites an analogy with a quantum computer of fixed size: the horizon is the box, and denser packing, error correction, faster operation and better algorithms reorganize a fixed resource up to a hard ceiling. We turn every sentence of the analogy into a theorem, a conditional statement or a negative certificate about a *prescribed classical* de Sitter host DSS_H, in the declared-data discipline of the Enter framework, where temperature, entropy and dimension enter only as named labels.

Geometry and transport. The causal past of a comoving observer is the half-hyperboloid $\{X_4 > X_0\}$, every horizon cut has area $4\pi c^2/H^2$, and the round-trip latency to areal radius R is at least $(2/H)\operatorname{artanh}(HR/c)$; this minimum is blind to every carrier, code and reorganization, while a declared device wait adds to it. A payload on or beyond the event horizon reaches the observer only through a replacement channel, and the half-diamond error of *every* decoder is exactly $1 - 1/\sum_i \lambda_i^{-1}$, with λ_i the spectrum of its output. Hence the least error is $1 - 1/d^2$, the classical-record floor $1 - 1/d$ is strictly better by $(d-1)/d^2$, and both floors are reached by finite thermal operations. A conformal tick serves all targets of horizon margin m if and only if $\delta \le m$; for the declared lattice task, the first-uniform-level asymptotic is reduced to an exact record-envelope and ratio-density criterion that does not involve the lattice range.

Capacity. Every host functional is invariant under reorganization, and the ceiling of any figure of merit is its fibre supremum. With unrestricted declared data the register dimension is unbounded, so $\dim \le \exp(S_{\mathrm{GH}}/k_B)$ is not a theorem of the host. Under a separately supplied promise the qubit bound $\lfloor \mathrm{eta} S_{\mathrm{GH}}/(k_B \ln 2) \rfloor$ is attained; at Planck 2018 parameters it is 4.78×10^{122}.

Coefficients and identifiability. The labels T_{GH}, S_{GH} and N_{GH} are not functions of the admitted classical data: at fixed admitted data they vary injectively with a comparison parameter κ in the slot of $\hbar$, and no value of κ is supplied. This persists for finite adaptive experiments, whose complete transcript law is the same for every κ; their exact minimax risk is half the range on a finite list of targets and infinite on the unbounded temperature family. For a fixed nonscalar energy Hamiltonian, the Gibbs state at the named temperature identifies κ, so admitted data cannot identify it; the two-point minimax error is half the trace distance, and for a qubit it is exactly $\frac{1}{4}$, whereas coefficient-free thermal operations exist. An exact assertion $\dim \mathscr{H} = N_{\mathrm{GH}}$ encodes $\kappa = B_H/\ln n$ and can hold only on a countable set of coefficients, while rounded or inequality forms do not invert. On the Einstein host the vacuum ambiguity of conserved comparison tensors has rank one, so its energy density is undetermined in sign

and size, and the dynamics left side $G[g] + \Lambda g$ is conserved for every prescribed metric.

Epochs. The event horizon of a de Sitter epoch depends on the prescribed future through one number R_0, as $c/H_1 + (R_0 - c/H_1)e^{H_1 t}$; every R_0 is realized already by smooth futures, the minimax error is exactly $\frac{1}{2}(R_+ - R_-)e^{H_1 t}$, and analytic futures force $R_0 = c/H_1$.

Conditional cosmological predictions. On the de Sitter host a message sent now reaches a comoving receiver at proper distance R_0 if and only if $R_0 < c/H$, but a reply returns only if $R_0 < c/(2H)$, after exactly $-H^{-1}\ln(1 - 2HR_0/c)$, which exceeds the static-shell echo. On any prescribed flat FLRW host the redshift-drift residual $z - H(t_o)z$ equals $H(t_o) - H(t_e)$, a null test of an exact de Sitter interval. Bounds $h_- \le H \le h_+$ on the future give the sharp bounds $c/h_+ \le R_e \le c/h_-$, and a nonincreasing rate gives $R_e \ge c/H$ and a nondecreasing horizon. An approach $H = H_\infty + Ae^{-pt}$ gives the relaxation law $R_e = (c/H_\infty)[1 - Ae^{-pt}/(H_\infty + p) + \cdots]$ with explicit second order, and a supplied flat ΛCDM law gives $R_e = (c/H_\Lambda)\,{}_2F_1(\frac{1}{2}, \frac{1}{3}; \frac{4}{3}; -\mu a^{-3})$. Smooth futures that agree with the whole past to all orders may or may not have an event horizon, so every rule of past data decides its existence with success exactly $\frac{1}{2}$ at equal priors. A memory of dimension D retrieves one of M equiprobable messages with probability at most $\min\{1, D/M\}$; under the supplied promise, n fair bits are kept perfectly if and only if $n \le \lfloor \mathrm{eta} S_{\mathrm{GH}}/(k_B \ln 2) \rfloor$. Each result is separated into hypotheses, derivation, physical identification and a contradicting observation. The ΛCDM law, the future bounds, the asymptotic model and the finite-dimension promise are supplied hypotheses, not premises.

Why it matters. The geometric half of the finite-capacity picture is proved with exact constants, and it now yields conditional, falsifiable statements whose assumptions are named: an exchange deadline, a redshift-drift null test, sharp horizon bounds and an approach law to de Sitter, together with what the past cannot certify and what a finite memory must lose. The capacity and thermal halves are information that must be supplied, and the new certificates measure what is missing: a bounded loss where the targets are bounded and an infinite loss where they are not. The framework does not select the expansion history, the cosmological constant, the dark-matter content or the primordial perturbations; predicting them needs an additional dynamical or probabilistic law. No finite Hilbert space, temperature, entropy, thermal noise model, absolute vacuum energy, Einstein dynamics, derived metric, spacetime emergence or Page curve is derived. κ is a comparison parameter only. No quantum coefficient is admitted.

Standing ledger (verbatim). No quantum coefficient is admitted. Host A and Host B stay separate; Host C is not created. O.1 stays NOT_CLOSED. XVI-N is not discharged; N-Ins.4 stays unresolved. XV-B is not opened. H2, I3, J2 and T3 stay unresolved. U6-sel is not moved. No Einstein dynamics, derived metric, spacetime emergence, Page curve, or quantized relational time without an external clock is claimed. The last reading bars stay open, and continuum acquisition stays a negative certificate. No Route-B successor is created. Res02-A Q1–Q4 and A1–A2 stay open. Gate 0 and ST4b stay NOT_SUPPLIED. Citations identify source records only; no proof transfer. No compilation is asserted.

Bibliographic record

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Scope box. DSS_H is a prescribed classical host. T_{GH}, S_{GH}, the dimension label $N_{\mathrm{GH}} = \exp(S_{\mathrm{GH}}/k_B)$ and the Bunch–Davies state are external labels only. Host A and Host B of I-D stay separate, and Host C is not created. Finite Hamiltonians, evaluation algebras, lattice permissions and report alphabets used below are declared mathematical devices, not detectors, fields or reservoirs derived from the metric. Citations identify source records only; no proof transfer.{} New cross-sheet edges (Appendix) have role *separation* and declaredPath null, and are not registered. Nothing in this manuscript is pushed, registered or written to the companion site. No compilation is asserted. Version 7 supersedes versions 1–6 and edits none of them; the crosswalk from earlier versions is Appendix , and the audit trail is in Appendices –. The expansion laws, future bounds, asymptotic model and finite-dimension promise of Sections and are supplied external hypotheses: they are outside the ledger and are not premises.

Introduction

Motivation

The Gibbons–Hawking analysis [GibbonsHawking1977] assigns a temperature $T_{\mathrm{GH}} = \hbar H/(2\pi k_B)$ and an entropy $S_{\mathrm{GH}} = k_B A/(4\ell_{\mathrm{p}}^2)$ to the cosmological event horizon of de Sitter space. Here $A = 4\pi c^2/H^2$ and $\ell_{\mathrm{p}}^2 = \hbar G/c^3$. Banks [Banks2001], Banks and Fischler [BanksFischler2001], Bousso [Bousso2000], Witten [Witten2001] and Dyson, Lindesay and Susskind [DLS2002] discussed the proposal that the static patch is described by a Hilbert space of finite dimension $\sim \exp(S_{\mathrm{GH}}/k_B)$. The proposal fits holographic reasoning [tHooft1993,Susskind1995,Bousso2002], and it has recently been revisited through algebras of observables [CLPW2023]. For the observed universe, S_{GH}/k_B is of order 10^{122} [EganLineweaver2010]. The finite-entropy picture invites a comparison with a quantum computer of fixed physical size [Lloyd2000,Lloyd2002]. Capacity is bounded by the box, while packing, fidelity, speed and algorithmic efficiency can still be improved up to a hard ceiling, set by the holographic bound, the thermal floor and the causal rate limit [Bekenstein1981,MargolusLevitin1998,SekinoSusskind2008].

Enter is Cheung's linear quantum lambda calculus. In it, measurement is an explicit operation that consumes quantum names and returns classical records [CheungFrontiers,CheungFigshareA,CheungFigshareB]. Its philosophy insists that an analogy is not an identification [EntPhil]. This manuscript applies that discipline to the capacity analogy. We ask which sentences of the analogy are theorems about a prescribed classical de Sitter host, which are statements about declared data, and which can only be supplied. Where a quantity must be supplied, we also ask how much is lost by not supplying it.

Main results

• *The causal box.* Monotone null coordinates give the causal past, future, static patch and event horizon of a comoving observer as explicit half-spaces; horizon cuts are round spheres of area $4\pi\ell^2$ (Theorem). The radar-echo latency is at least $(2/H)\operatorname{artanh}(HR/c)$ (Proposition); this minimum is a host functional that no carrier datum identifies across hosts, and a declared device wait adds to it (Theorem).

• *No transport across the horizon, with an exact error law.* A located-circuit theorem gives a replacement channel (Theorem); every decoder has error exactly $1 - 1/\sum_i \lambda_i^{-1}$ (Theorem), so the horizon floor $1 - 1/d^2$ lies $(d-1)/d^2$ above the shredder floor $1 - 1/d$ (Proposition). Finite thermal operations attain both floors (Theorems ,), while the labels alone fix no thermal floor (Proposition).

• *Granularity.* A conformal tick serves margin m iff $\delta \le m$, with an exact per-target feasible set (Theorems ,). For the declared lattice task, an exact envelope criterion reduces the first-uniform-level asymptotic to a range-free ratio-density property of near-minimal deficits (Theorem).

• *Reorganization and the ceiling.* Reorganization invariance characterizes host functionals (Theorem); the hard ceiling is a fibre supremum, infinite for free declared dimension and attained under a supplied promise (Theorems

, ,). A named finite-alphabet certificate decides one form of the ``new reports'' question (Corollary).

• *Coefficient and identifiability certificates.* The labels are not functions of admitted data (Theorem); this survives finite adaptive experiments, with exact finite-list risk (Theorem). Gibbs targets at the named temperature are identifiable only with the coefficient, with exact two-point and qubit minimax errors, while coefficient-free thermal operations exist (Theorem). An exact dimension assertion encodes the coefficient; rounded and inequality forms do not (Theorem).

• *Dynamics and vacuum.* Host data determine no dynamics (Proposition), and the conserved vacuum ambiguity on the Einstein host has rank one with undetermined energy density (Theorem).

• *Epochs.* One number carries the prescribed future, with exact minimax error, smooth realizability and analytic rigidity (Proposition , Theorem , Propositions ,).

• *Conditional cosmological predictions.* Comoving one-way and round-trip deadlines (Theorem); the redshift-drift residual identity (Theorem); sharp horizon bounds from bounds on the future, and monotone growth (Theorem); the relaxation law with remainder classes and the ΛCDM closed form (Theorem); the failure of past data to certify an event horizon (Corollary); and the finite-memory retrieval bound, reconciled with the promise of Theorem (c) (Theorem). Section states the hypotheses, derivation, identification and contradicting observation of each (Table).

• *Corpus components.* Static-invariant currents have Hamel dimension $\mathfrak{c}$ (Proposition); every invariant current is the current of an invariant evaluation state that it does not determine (Theorem); norm-relative causal discrepancy, encoding-relative counts and host separations are recorded (Section).

Why it matters

For the Enter programme the manuscript supplies a reusable formal object, the reorganization, together with an invariance-and-characterization theorem, a ceiling theorem and a family of identifiability certificates that later sheets can cite instead of restating the analogy. For the external discussion it isolates a dividing line. Everything the classical host supports is proved with exact constants; the finite dimension, the temperature and the vacuum energy are information beyond the host, and the certificates of Section state exactly what a rule of the admitted data loses without them. Section shows how the geometric theorems become conditional predictions once an expansion history, a bound on the future or a memory promise is supplied, and what observation would contradict each.

What is not claimed

We do not claim the following. That the static patch realizes a quantum computer. That a finite-dimensional Hilbert space, T_{GH} or S_{GH} is derived. That internal improvements change the horizon area. That the late-time entropy is a derived quantity. That any spacetime dynamics, thermal noise model or vacuum energy is obtained. That the expansion history, Λ, the dark-matter content or the perturbation spectrum is selected. Every result below is followed by its non-claim.

Organization

Section gives background. Section fixes definitions, the admitted data and the fibre criterion. Sections – treat the causal box, transport, granularity, reorganization and the ceiling. Section collects the coefficient, identifiability, dynamics and vacuum certificates, Section the epochs, Section the expansion-history theorems P1–P6, and Section the conditional predictions and their physical assumptions. Section incorporates corpus components. Section gives worked examples, Section the dictionary of the analogy, Section the limitations and open problems, and Section the conclusion. The appendices contain the crosswalk from versions 1–6, the verdicts on the version-7 plan and on the version-6 findings, the corrections, the computer-assisted checks, the hashes and the edges.

Background

The Enter calculus and the philosophy of Enter

The Enter calculus is a linear quantum lambda calculus [CheungFrontiers,CheungFigshareA,CheungFigshareB]. Runtime qubit names refer to factors of a shared quantum state. Measurement is an explicit operation, *Enter*, which consumes quantum names and returns classical records. The core language satisfies type preservation,

progress, strong normalization, semantic no-cloning, circuit adequacy and internal no-signalling. In the developments cited, the Born probabilities are characterized from operational requirements within a stated strategy class. We use none of that characterization as a premise. Here Enter supplies a *discipline*: what is input, what is accessible, what is returned, and what further construction a proposed interpretation would need.

The introductory essay *The Philosophy of Enter* [EntPhil] organizes that discipline into four separations:

• destructive readout is not quantum recovery;

• a classical record is not a quantum-return decoder;

• a channel is not a thermal machine;

• an analogue is not an identification. The essay is an introductory map, not a registered theorem and not a premise. In its words, a refusal of identification is not a refusal of the local result. It states what the result has established and leaves the further question visible. The present manuscript is written in that spirit. The capacity analogy is kept, each of its sentences is attached to the operation or geometric fact that supports it, and what is missing is named.

The shredder interface (I-C)

Manuscript I-C, *The Shredder Interface* [IC], gives the vernacular slogan ``quantum name in, classical record plus heat out" a precise reading. It reads it as ``quantum name in, classical report at the declared access boundary", together with a *separately specified* physical implementation ledger. Its central quantitative statement is that if the *complete* accessible output of an unknown d-dimensional code is classical, then every deterministic decoder, in I-C's terminology, has reference-preserving half-diamond error at least $1 - 1/d$. The constant is sharp. Heat belongs to a thermodynamic ledger whose hypotheses must be stated. I-C develops horizon and quantum-computer comparisons as analogies. It does not identify the cone apex with a horizon or Hawking radiation with a classical register [Hawking1975]. We use its floor in Lemma , with a self-contained proof.

Spacetime Enter: I-B and the dynamical I-D

Manuscript I-B [IB] constructs a finite operational model on the regular part of an explicit 3 + 1-dimensional conical Lorentzian background. It installs finite quantum names, locations, accessible algebras, a complete control and resource interface, and a calibration from a finite clock basis to geometric time labels. Scheduled influence is contained in the prescribed metric causal relation. The construction is a spacetime model with an Enter interface, not emergence of spacetime from records.

Manuscript I-D, *Dynamical Spacetime Enter over Two Prescribed Hosts* [ID], extends this to two separately prescribed dynamical hosts, Host A and Host B. Its complete dynamical Enter specification (I-D def:interface) lists the following data:

• the full time-oriented metric, the laboratory worldlines, the event placements and the accessible port algebras;

• finitely many registers, resource preparations, external references and complete environments;

• a finite acyclic circuit of local channels and instruments, including all actual classical controls;

• future-causal routes for every dependency;

• a finite clock dictionary and its calibration;

• every surviving output, failure alphabet and allocation ledger;

• the implementation maps and error allowances being claimed. Crucially, *the metric is immutable model data*: an instruction does not output a replacement metric. Definition below is the de Sitter instance of items (1)–(4). Host A and Host B stay separate, and DSS_H is neither of them (V-DST-DSS thm:V-host(b)).

De Sitter horizons and the finite-entropy picture

In de Sitter space with Hubble rate H, every geodesic observer is surrounded by a cosmological event horizon at areal radius c/H. Gibbons and Hawking [GibbonsHawking1977] showed the following. In the de Sitter-invariant state now commonly labelled Bunch–Davies [BunchDavies1978], a geodesic detector registers thermal response at $T_{\mathrm{GH}} = \hbar H/(2\pi k_B)$, and the horizon carries entropy $S_{\mathrm{GH}} = k_B A/(4\ell_{\mathrm{p}}^2)$. For the observed universe, $S_{\mathrm{GH}}/k_B \sim 10^{122}$ [EganLineweaver2010].

A widely discussed consequence is that the Hilbert space describing the static patch is finite-dimensional, with dimension $\sim \exp(S_{\mathrm{GH}}/k_B)$ [Banks2001,BanksFischler2001,Bousso2000,Witten2001,DLS2002]. Lectures and reviews treating these questions include [SSV2001,Bousso2002]. Chandrasekaran, Longo, Penington and Witten [CLPW2023] constructed an algebra of observables for the static patch that includes an observer. That algebra is a von Neumann algebra of type II_1, and its maximum-entropy state corresponds to empty de Sitter space. In this manuscript all of this is *background*. None of it is derived, and the labels T_{GH}, S_{GH} and $N_{\mathrm{GH}} = \exp(S_{\mathrm{GH}}/k_B)$ are attached to the prescribed host only as names.

The fixed-size quantum-computer analogy

We restate the analogy in the form in which it is usually stated, as background.

The *box* is the static patch. The physical volume available to the observer cannot be enlarged, and modes that leave the horizon are permanently inaccessible. Capacity is limited by the finite number of states allowed by S. Within the fixed causal region, the effective computational capacity can still grow in four ways.

• *Denser packing*: better holographic encoding of bulk information onto the horizon degrees of freedom.

• *Higher fidelity and better error correction*: less decoherence into the horizon, and better protection against the thermal noise associated with T_{GH}.

• *Faster operation*: rearranging dynamics within the limits of the light-crossing time and of the redshifting of modes.

• *Algorithmic efficiency*: processes that need fewer of the finite horizon states to produce a given outcome. All four reorganize the finite resource $\exp(S)$ without changing it. The *hard ceiling* is reached once the encoding saturates the holographic bound, the residual error approaches the thermal floor, and the operation rate meets the causal limit. In the Big Bang picture the same logic applies epoch by epoch. During inflation the horizon is smaller and the bound tighter. At late times the horizon grows and approaches the observed de Sitter horizon. For a fixed observer, capacity is capped by the horizon of the moment.

On the quantum-computing side, the relevant external results are the following. Lloyd's limits on computation are set by energy and entropy [Lloyd2000], and his estimate of the computational capacity of the universe [Lloyd2002]. The Margolus–Levitin bound limits the speed of dynamical evolution [MargolusLevitin1998]. Bekenstein's bound limits the entropy-to-energy ratio [Bekenstein1981]. Sekino and Susskind's fast-scrambling conjecture concerns horizons [SekinoSusskind2008]. All are cited as external accounts.

The de Sitter sheets of the corpus

Three local sheets prescribe DSS_H beside the conical hosts of the corpus. All three are delivered sheets whose version-8 manuscript records were read on 2026-10-25 by read-only GET from the companion API; their sha256 hashes are in Appendix .

• *Red06-G-DSS* [Red06GDSS] gives constant $R_e = c/H$ and its exact scope, horizon separation from the cone, the named T_{GH} and S_{GH}, report-blindness, and invariant currents by group.

• *En08-ST-DSS* [En08STDSS] gives conformal flatness, event horizons, a finite null window with horizon margin, no transport across the horizon, two-sided thresholds and causal embeddings.

• *V-DST-DSS* [VDSTDSS] gives the position of DSS among the hosts, the realization criteria, data counts and the allowance profile. Their parent sheets on the companion site are Red06-G, En08-ST and V-DST [Red06G,En08ST]. We cite them as documentary pointers. The proofs below are given in full wherever the statement is elementary.

Setting and definitions

Throughout, $c > 0$ and $H > 0$ are fixed, and $\ell := c/H$. On $\mathbb{R}^{1,4}$ we use

$$\mathrm{ip}\, XY = -X_0Y_0 + X_1Y_1 + X_2Y_2 + X_3Y_3 + X_4Y_4.$$

Specification (Prescribed host). $\mathrm{DSS}_H = \{X \in \mathbb{R}^{1,4} : \mathrm{ip}\, XX = \ell^2\}$, with the induced Lorentzian metric g_H. A

nonzero causal tangent vector w is called *future-directed* if $w_0 > 0$.

This is a consistent time orientation. If w is causal and $w_0 = 0$, then $\sum_{i \geq 1} w_i^2 \leq 0$, so $w = 0$. Hence the sign of w_0 is constant on each half of every tangent causal cone.

The metric, H, c and the orientation are *inputs*. Nothing here derives them. This is Red06-G-DSS spec:R-DSS and En08-ST-DSS spec:E-DSS.

Definition (Flat chart, conformal time, comoving observers). For $(t, \mathbf{x}) \in \mathbb{R} \times \mathbb{R}^3$ put

$$X_0 = \ell \sinh Ht + \frac{e^{Ht}}{2\ell}|\mathbf{x}|^2, \qquad X_i = e^{Ht} x_i \ (i = 1, 2, 3), \qquad X_4 = \ell \cosh Ht - \frac{e^{Ht}}{2\ell}|\mathbf{x}|^2.$$

This is a diffeomorphism of $\mathbb{R}^4$ onto $P_H := \{X \in \mathrm{DSS}_H : X_0 + X_4 > 0\}$, and $g_H = -c^2 \mathrm{d}t^2 + e^{2Ht} \mathrm{d}\mathbf{x}^2$ (check C-1; Red06-G-DSS prop:R-charts(b)). The *conformal time* is $\eta = -e^{-Ht}/H \in (-\infty, 0)$, and in it $g_H = a(\eta)^2(-c^2 \mathrm{d}\eta^2 + \mathrm{d}\mathbf{x}^2)$ with $a = -1/(H\eta)$. The *comoving observer* at $\mathbf{x}_0$ is $\gamma_{\mathbf{x}_0}(t) = (t, \mathbf{x}_0)$. We write $\gamma = \gamma_0$. In ambient coordinates,

$$\gamma(t) = (\ell \sinh Ht, 0, 0, 0, \ell \cosh Ht).$$

It is a future-directed timelike geodesic with proper time t: it is the intersection of DSS_H with a 2-plane through the origin, and $\langle \dot\gamma, \dot\gamma \rangle = -c^2$.

Definition (Static chart and static patch). For $0 \leq r < \ell$, $t_s \in \mathbb{R}$ and $\omega \in S^2$ put

$$X_0 = \sqrt{\ell^2 - r^2} \sinh Ht_s, \qquad (X_1, X_2, X_3) = r\omega, \qquad X_4 = \sqrt{\ell^2 - r^2} \cosh Ht_s.$$

This chart covers $\mathscr{S} := \{X \in \mathrm{DSS}_H : X_4 > |X_0|\}$, which we call the *static patch* of γ. In it

$$g_H = -F(r) c^2 \mathrm{d}t_s^2 + F(r)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega_2^2, \qquad F(r) = 1 - r^2/\ell^2$$

(check C-3; Red06-G-DSS prop:R-charts(c)). Along γ we have $r = 0$ and $t_s = t$. The coordinate $r = (\sum_{i=1}^{3} X_i^2)^{1/2}$ is the *areal radius*. In the flat chart it equals $e^{Ht}|\mathbf{x}|$, the proper radius at fixed t.

Definition (Causal past and future, event horizon). For a set $Z \subseteq \mathrm{DSS}_H$, $J^{\pm}(Z)$ is the set of points reachable from Z by a future-directed (respectively past-directed) causal curve, including Z itself [HawkingEllis1973]. For an observer worldline γ, the *future event horizon* of γ is the boundary $\partial J^-(\gamma)$.

Definition (Null coordinates). Put $p = (1, 0, 0, 0, 1)$ and $\bar p = (1, 0, 0, 0, -1)$. Both are future null vectors of $\mathbb{R}^{1,4}$. On DSS_H define

$$u(X) = \mathrm{ip}\, Xp = X_4 - X_0, \qquad v(X) = -\mathrm{ip}\, X\bar p = X_4 + X_0.$$

On γ, $u = \ell e^{-Ht}$ and $v = \ell e^{Ht}$. In the flat chart, $u = e^{-Ht}(\ell^2 - e^{2Ht}|\mathbf{x}|^2)/\ell$ (check C-2).

Definition (Named external labels).

$$A_H := 4\pi\ell^2, \qquad T_{\mathrm{GH}}(H) := \frac{\hbar H}{2\pi k_B},$$

$$S_{\mathrm{GH}}(H) := \frac{k_B A_H}{4\ell_{\mathrm{p}}^2} = \frac{\pi k_B c^5}{\hbar G H^2}, \qquad N_{\mathrm{GH}}(H) := \exp\left(S_{\mathrm{GH}}(H)/k_B\right).$$

T_{GH} and S_{GH} are the EXTERNAL labels of Red06-G-DSS def:R-TGH and Red06-G-DSS prop:R-TGH, recording Gibbons and Hawking's statement [GibbonsHawking1977] about the state labelled Bunch–Davies [BunchDavies1978]. N_{GH} is a *name* for the conjectured static-patch dimension [Banks2001,Bousso2000,Witten2001]. No state, detector, Hilbert space or entropy is constructed here.

Definition (Accounts, declared data, host functionals, reorganizations).

• A *declared-data class* assigns to each $H > 0$ a nonempty set $\mathscr{D}(H)$. Its elements are *declared data* Δ: registers

and their dimensions, codes, encodings, located circuits (Definition), tick rules, decoders, programs and calibration words. The *account space* is $\mathscr{A} = \{(H, \Delta) : H > 0,\ \Delta \in \mathscr{D}(H)\}$, and its *fibre* over H is $\mathscr{A}_H = \{H\} \times \mathscr{D}(H)$. When $\mathscr{D}(H) = \mathscr{D}$ is the same for all H, the class is called *host-uniform*. An example is declared data written in the dimensionless coordinates $(Ht_s, r/\ell, \omega)$.

• A *host functional* is a map Φ on $\mathscr{A}$ that depends on H alone: $\Phi(H, \Delta) = \varphi(H)$.

• A *reorganization* is a map $\rho : \mathscr{A} \to \mathscr{A}$ with $\rho(H, \Delta) = (H, \rho_H(\Delta))$, that is, a map that fixes the host. It is *host-blind* if the class is host-uniform and $\rho_H = \rho_0$ for every H.

• A *report* is any map $\mathrm{Rep} : \mathscr{A} \to \mathscr{Y}$. A *figure of merit* is any map $Q : \mathscr{A} \to [-\infty, \infty]$. A report is *host-blind* if the class is host-uniform and $\mathrm{Rep}(H, \Delta) = r(\Delta)$. The four improvements of Section are reorganizations by definition. Packing changes the encoding. Error correction changes the code and the decoder. Faster operation changes the schedule or the tick rule. Algorithmic efficiency changes the program.

Definition (Located causal circuit). A *located causal circuit* on DSS_H consists of the following data.

• A finite directed acyclic graph (V, E). Each node $z \in V$ carries a completely positive trace-preserving map Φ_z between finite-dimensional systems; preparations, measurements and classical controls are included as such maps. Each edge is a wire carrying a system from one node to another, and some wires enter or leave the circuit.

• An *event placement* $\pi : V \to \mathrm{DSS}_H$ with $\pi(z') \in J^+(\pi(z))$ for every edge $z \to z'$. This is the de Sitter instance of items (1)–(4) of I-D def:interface. The *ancestors* $\mathrm{An}(W)$ of a set $W \subseteq V$ are the nodes from which a directed path leads into W, together with W itself.

Admitted data and the coefficient comparison family

Definition (Admitted data; coefficient comparison family). The *admitted data* a of an account are everything an Enter instrument may use under the ledger: the prescribed host (in particular H and c), the classical constants G and k_B, the declared data Δ, and every report $\mathrm{Rep}(H, \Delta)$. The labels of Definition are formulas in the admitted data and one further coefficient, the slot occupied by $\hbar$. For a comparison parameter $\kappa > 0$ write

$$T_{\mathrm{GH}}^{(\kappa)} = \frac{\kappa H}{2\pi k_B}, \qquad S_{\mathrm{GH}}^{(\kappa)} = \frac{\pi k_B c^5}{\kappa G H^2}, \qquad N_{\mathrm{GH}}^{(\kappa)} = \exp\left(\frac{B_H}{\kappa}\right), \qquad B_H := \frac{\pi c^5}{G H^2},$$

so that $S_{\mathrm{GH}}^{(\kappa)}/k_B = B_H/\kappa$ and the named labels are the values at $\kappa = \hbar$. The *coefficient accounts* over a are the pairs (a, κ), $\kappa \in (0, \infty)$, with data map $D_0(a, \kappa) = a$. A target τ on a set of coefficient accounts is *identified by the admitted data* if $\tau = F \circ D_0$ there for one map F; choosing a convention on a fibre with more than one target value is not identification.

κ is a comparison parameter only: forming the family supplies and admits no value of κ, and no numerical κ occurs in this manuscript. For finite states and channels we write $d_{\mathrm{tr}}(\rho, \sigma) = \frac{1}{2}\|\rho - \sigma\|_1$, $\frac{1}{2}\|\Phi - \Psi\|_\diamond$ for the half-diamond distance, and $\mathrm{repl}\,\sigma(X) = \mathrm{Tr}\,(X)\,\sigma$ for the replacement channel with output σ.

The fibre criterion

Most negative statements below are instances of one elementary fact.

Theorem (Fibre criterion). *Let $D : \mathscr{X} \to \mathscr{Y}$ and $\tau : \mathscr{X} \to \mathscr{Z}$ be maps. There is a map F with $\tau = F \circ D$ if and only if τ is constant on every fibre $D^{-1}(y)$. If $(\mathscr{Z}, d)$ is a metric space, $D(x_1) = D(x_2)$ and $d(\tau(x_1), \tau(x_2)) = \Delta$, then every F has $\max_i d(\tau(x_i), F(D(x_i))) \geq \Delta/2$.*

Proof. If $\tau = F \circ D$, then τ agrees on points with equal data. Conversely, define $F(y) = \tau(x)$ for any $x \in D^{-1}(y)$. For the bound, apply the triangle inequality at the common datum. This is EM-OB-1 thm:EM-fibre, TS-OB-1 thm:TS-fibre and VC-OB-1 thm:VC-fibre.

par *Non-claim.* This is elementary set theory. It certifies non-derivability from stated data, not the falsity of any external physical statement. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

A: the finite causal region

Lemma (Monotone null coordinates). *Along every future-directed causal curve in* DSS_H*, u is nonincreasing and v is nondecreasing.*

Proof. Let w be a future-directed causal tangent vector, regarded as an ambient vector. Since g_H is induced, w is causal in $\mathbb{R}^{1,4}$, so $|(w_1, \dots, w_4)| \le w_0$ with $w_0 > 0$. Hence

$$\mathrm{d}u(w) = \mathrm{ip}\, wp = -w_0 + w_4 \le 0 \qquad \text{and} \qquad \mathrm{d}v(w) = w_0 + w_4 \ge 0.$$

par *Non-claim.* This is a property of the prescribed metric only. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Lemma (Causal structure of the flat chart). $P_H = \{v > 0\}$ *is a future set: future-directed causal curves starting in* P_H *stay in* P_H*. For* $q_1, q_2 \in P_H$ *with conformal coordinates* $(\eta_i, \mathbf{x}_i)$*, we have* $q_2 \in J^+(q_1)$ *if and only if* $c(\eta_2 - \eta_1) \ge |\mathbf{x}_2 - \mathbf{x}_1|$.

Proof. The first claim follows from Lemma . So every causal curve between points of P_H lies in P_H, where $g_H = a^2(-c^2\mathrm{d}\eta^2 + \mathrm{d}\mathbf{x}^2)$. A conformal factor does not change causal character, so these curves are the Minkowski causal curves of the half-space $\{\eta < 0\}$. A future Minkowski causal curve has nondecreasing η. So a Minkowski causal curve joining two points of the half-space stays in it, and the relation is the Minkowski one (En08-ST-DSS prop:E-conformal).

par *Non-claim.* The conformal flatness used here is that of the prescribed chart. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Theorem (A: causal past, static patch and horizon of a comoving observer). *Let γ be the comoving observer of Definition .*

- $J^+(\gamma) = \{v > 0\} = P_H$ *and* $J^-(\gamma) = \{u > 0\} = \{X_4 > X_0\}$.
- $J^-(\gamma) \cap J^+(\gamma) = \{X_4 > |X_0|\} = \mathscr{S}$*, the static patch, which the static chart covers with* $0 \le r < \ell$*. In the flat chart,* $\mathscr{S} = \{e^{Ht}|\mathbf{x}| < \ell\} = \{|\mathbf{x}| < c(-\eta)\}$.
- *The future event horizon is* $\partial J^-(\gamma) = \{u = 0\}$*, a smooth null hypersurface. Each of its cuts* $\{u = 0,\ v = v_0\}$ *with* $v_0 > 0$ *is a round 2-sphere of areal radius exactly* $\ell = c/H$ *and area exactly* $A_H = 4\pi c^2/H^2$*. In the flat chart it is* $\{e^{Ht}|\mathbf{x}| = c/H\}$*: a comoving radius* ce^{-Ht}/H *that decreases in t, and a proper radius c/H that is constant.*
- *The same statements hold for every comoving observer* $\gamma_{\mathbf{x}_0}$*, with* $\mathbf{x}$ *replaced by* $\mathbf{x} - \mathbf{x}_0$*. In particular every comoving observer has a nonempty region outside its causal past, and all horizon cuts of all comoving observers have the same area* A_H.

Proof. (a) *Future.* $v > 0$ on γ, and v is nondecreasing along future causal curves (Lemma). Hence $J^+(\gamma) \subseteq \{v > 0\} = P_H$. Conversely, let $q = (\eta_q, \mathbf{x}_q) \in P_H$ and pick $\eta' < \eta_q - |\mathbf{x}_q|/c$. Then $c(\eta_q - \eta') > |\mathbf{x}_q|$, so $q \in J^+(\gamma(\eta'))$ by Lemma .

Past. The map $R(X_0, \dots, X_4) = (-X_0, X_1, \dots, X_4)$ is an isometry of DSS_H that reverses the time orientation and maps $\gamma(t)$ to $\gamma(-t)$. Hence $J^-(\gamma) = R(J^+(\gamma)) = R(\{v > 0\}) = \{X_4 - X_0 > 0\} = \{u > 0\}$.

(b) The intersection is $\{X_4 > X_0\} \cap \{X_4 > -X_0\} = \{X_4 > |X_0|\}$. On this set, $X_4^2 - X_0^2 > 0$ and $X_4 > 0$. So $r := (\sum_{i=1}^3 X_i^2)^{1/2}$ satisfies $\ell^2 - r^2 = X_4^2 - X_0^2 > 0$, and $\tanh Ht_s = X_0/X_4$ determines t_s. Conversely, the static chart has $X_4 = \sqrt{\ell^2 - r^2}\cosh Ht_s > |X_0|$. In the flat chart, $u > 0$ is equivalent to $e^{Ht}|\mathbf{x}| < \ell$ by the formula for u (check C-2). Multiplying by e^{-Ht} gives $|\mathbf{x}| < \ell e^{-Ht} = c(-\eta)$.

(c) The tangential gradient of u is $\nabla u = p - (u/\ell^2)X$, so

$$g_H(\nabla u, \nabla u) = \mathrm{ip}\, pp - \frac{2u}{\ell^2}\mathrm{ip}\, pX + \frac{u^2}{\ell^4}\mathrm{ip}\, XX = -\frac{u^2}{\ell^2}$$

(check C-2). On $\{u = 0\}$, $\nabla u = p \neq 0$ is null. So $\{u = 0\}$ is a smooth null hypersurface, and it is the boundary of the open set $\{u > 0\} = J^-(\gamma)$. On $\{u = 0\}$ we have $X_4 = X_0$, and the constraint becomes $X_1^2 + X_2^2 + X_3^2 = \ell^2$. So the cut at fixed $v = 2X_0 = v_0$ is the round sphere of radius ℓ in the (X_1, X_2, X_3)-space, embedded isometrically, with area $4\pi\ell^2$. The flat-chart form follows from (b).

(d) The flat-chart translations $\mathbf{x} \mapsto \mathbf{x} + \mathbf{a}$ preserve $g_H = -c^2\mathrm{d}t^2 + e^{2Ht}\mathrm{d}\mathbf{x}^2$ and the time orientation, and therefore all causal relations. They map γ to $\gamma_{\mathbf{a}}$. The region $\{u \leq 0\}$ is nonempty: it contains $-\gamma(0) = (0, 0, 0, 0, -\ell)$.

par *Non-claim.* Theorem makes the ``box'' of the analogy precise as the static patch $\mathscr{S}$. A finite causal region is not a finite capacity. $\mathscr{S}$ contains infinitely many pairwise disjoint open sets, and no Hilbert space, dimension, temperature or entropy is constructed (compare Theorem (b)). This is En08-ST-DSS prop:E-horizon and Red06-G-DSS thm:R-horizon(a), re-proved and extended to the full hyperboloid. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Proposition (Radar-echo latency: the causal rate limit of the box). *Let $0 < R$. An event q can receive a signal from γ and return one to γ only if $q \in \mathscr{S} = \{X_4 > |X_0|\}$; in particular its areal radius satisfies $r(q) < \ell$. The converse fails on the full hyperboloid, since the antipodal region $\{-X_4 > |X_0|\}$ also has $r < \ell$ (check C-24). For $q \in \mathscr{S}$ at areal radius R, let τ_{rt} be the proper time along γ between emission and reception of an echo from q. Then*

$$\tau_{\mathrm{rt}} \;\geq T(R) := \frac{2}{H}\mathrm{artanh}\,\frac{HR}{c},$$

*with equality for radial null signals. $T(R) = 2R/c + \frac{2}{3}H^2R^3/c^3 + O(R^5)$ as $R \to 0$, and $T(R) \to \infty$ as R*uparrow *c/H.*

Proof. An echo event lies in $J^+(\gamma) \cap J^-(\gamma) = \mathscr{S}$ by Theorem (b). In the static chart, let w be a future causal tangent vector in $\mathscr{S}$. Then $Fc^2(\mathrm{d}t_s(w))^2 \geq F^{-1}(\mathrm{d}r(w))^2 + r^2|\mathrm{d}\omega(w)|^2 \geq 0$, and $\mathrm{d}t_s(w) > 0$: the vector ∂_{t_s} is a future timelike Killing field on $\mathscr{S}$, since t_s increases along γ. Hence $c\,\mathrm{d}t_s \geq |\mathrm{d}r|/F$ along any future causal curve. A curve from $r = 0$ to $r = R$ therefore has

$$\Delta t_s \;\geq \int_0^R \frac{\mathrm{d}r}{c(1 - r^2/\ell^2)} = \frac{1}{H}\mathrm{artanh}\,\frac{HR}{c},$$

and the same holds on the way back. Along γ (where $r = 0$ and $F = 1$) proper time equals t_s. Radial null curves attain equality. The same value follows independently from the conformal chart (check C-12).

par *Non-claim.* $T(R)$ is a host functional (Theorem). The ``light-crossing time'' $\ell/c = 1/H$ is a scale, not a bound on the number of operations along γ, whose proper time is unbounded. What diverges is the latency of round trips to radii approaching the horizon. No Margolus–Levitin rate [MargolusLevitin1998] is derived, since no energy is assigned. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Theorem (Echo latency: geometric minimum, carrier blindness and device delay). *Fix a declared shell radius $0 < R < \ell$ and write $T_H(R) = \frac{2}{H}\mathrm{artanh}\,\frac{HR}{c} = \frac{2}{c}\int_0^R \frac{\mathrm{d}r}{1 - H^2r^2/c^2}$, the minimum of Proposition .*

• $T_H(R)$ does not depend on any declared carrier, code, decoder or reorganization; on accounts with the shell R fixed it is a host functional.

• A host-uniform carrier datum does not identify $T_H(R)$ across hosts. For $0 < H_1 < H_2 < c/R$ the same carrier can be declared on both hosts, $T_{H_1}(R) < T_{H_2}(R)$, and every rule of the common carrier datum has two-point worst-case latency error at least $\frac{1}{2}(T_{H_2}(R) - T_{H_1}(R))$.

• *If a complete finite echo report is prepared from the host and the calibration independently of an unknown logical input, its channel is a replacement channel* $\mathscr{E}_{H,R} = \mathscr{R}_{\sigma_{H,R}}$, *and* $\mathrm{Tr}\,(O\,\mathscr{E}_{H,R}(\rho_1 - \rho_0)) = 0$ *for every report observable* O *and every pair of logical inputs. A reading that is informative about* H *need not respond to the logical input.*

• *A declared wait* $w \geq 0$ *at the central observer before emission gives the elapsed proper time* $w + T_H(R)$ *from the command event. So invariance of the geometric minimum does not imply invariance of measured delay statistics.*

Proof. (a) No declared variable occurs in $T_H(R)$, and a reorganization fixes H, c and the declared shell; Theorem (a). (b) At fixed R,

$$\partial_H T_H(R) = \frac{4H}{c^3}\int_0^R \frac{r^2\,\mathrm{d}r}{(1 - H^2r^2/c^2)^2} > 0,$$

so the two latencies differ; a common datum forces a common output, and Theorem gives half the separation. (c) Input independence is the replacement form (proof of Theorem (a)); trace preservation gives $\mathrm{Tr}\,(\rho_1 - \rho_0) = 0$. (d) Proper time along γ is additive, and the host and shell are unchanged. Check C-46 verifies the integral form, the derivative and the witness identity, with an input-dependent channel as negative control.

par *Non-claim.* This is adopted from the supplied findings after verification (Appendix , F6). The latency is a geometric minimum along a prescribed worldline, not a hardware rate, and no Margolus–Levitin bound is derived. The deficit-sensitive window of I-C prop:echoseparation [IC] is a functional on a different, conical host; the finite Haar entropy history of Hawk05-B thm:page [Hawk05B] and the destructive-record mean of Res01-C thm:recordgap [Res01C] concern specified state histories. None of them is identified with $T_H(R)$, and no Page curve is constructed. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

B: no transport across the horizon

Lemma (Circuit causality). *Let* $W \subseteq V$ *be a set of nodes of a located causal circuit, and fix all circuit inputs except those entering nodes outside* $\mathrm{An}(W)$. *Then the joint state of the output wires of* W *that leave the circuit is a function of the inputs of* $\mathrm{An}(W)$ *alone.*

Proof. Put $N = V \setminus \mathrm{An}(W)$. No output wire of a node in N enters $\mathrm{An}(W)$: if one did, that node would be an ancestor of W. Trace out every circuit output except the outputs of W, and remove the nodes of N one at a time, always choosing a node $z \in N$ that is last in a topological order among the nodes of N not yet removed. Every output wire of z is either a circuit output not belonging to W, which is traced, or an input of a node of N already removed, whose input has become traced. Trace preservation gives $\mathrm{Tr}_{\mathrm{out}(z)} \circ \Phi_z = \mathrm{Tr}_{\mathrm{in}(z)}$, so z can be deleted and its inputs traced. When N is exhausted, what remains is the subcircuit on $\mathrm{An}(W)$. It is closed under predecessors, so it is a circuit whose inputs are inputs of $\mathrm{An}(W)$. Everything else has been traced.

par *Non-claim.* This is the standard locality of finite quantum circuits, stated for completeness. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Theorem (B: no transport across the event horizon). *Let a located causal circuit on* DSS_H *have a source node* s *receiving a payload system* A *with* $\dim A = d \geq 2$. *Let* W *be a set of receiver nodes with* $\pi(W) \subseteq \gamma$, *and suppose that* $\pi(s)$ *lies on or beyond the event horizon of* γ, *that is,* $u(\pi(s)) \leq 0$. *Fix all other inputs. Then:*

• *the channel* $\mathscr{N}$ *from* A *to the receiver outputs is a replacement channel,* $\mathscr{N}(X) = \mathrm{Tr}\,(X)\,\sigma$;

• *for every decoder* $\mathscr{D}$ *(a channel from the receiver outputs to a* d*-dimensional system), the entanglement fidelity is* $F_e(\mathscr{D}\mathscr{N}) = 1/d^2$, *and*

$$\tfrac{1}{2}\|\mathscr{D}\mathscr{N} - \mathrm{id}_d\|_\diamond \;\geq\; 1 - \frac{1}{d^2} \;>\; 1 - \frac{1}{d};$$

• *the trace-norm bound on the maximally entangled input is attained when* $\mathscr{D}(\sigma) = I/d$.

Proof. (a) If $s \in \mathrm{An}(W)$, a directed path $s \to \dots \to w \in W$ gives $\pi(w) \in J^+(\pi(s))$ by transitivity of J^+. Hence $\pi(s) \in J^-(\gamma) = \{u > 0\}$ (Theorem (a)), a contradiction. So $s \notin \mathrm{An}(W)$. By Lemma , the receiver state σ does not depend on the payload state. So $\mathcal{M}(\rho) = \sigma$ for all states ρ. States span all operators, and $\mathcal{M}$ is linear, so $\mathcal{M}(X) = \mathrm{Tr}\,(X)\sigma$.

(b) Let $\Phi = d^{-1}\sum_{i,j} |ii\rangle\langle jj|$ and $\sigma' = \mathcal{D}(\sigma)$. Then $(\mathcal{D}\mathcal{N} \otimes \mathrm{id})(\Phi) = \sigma' \otimes I/d$, so

$$F_e = \langle\Phi|\sigma' \otimes I/d|\Phi\rangle = \frac{1}{d}\mathrm{Tr}\,(\sigma'(I/d)^T) = \frac{1}{d^2}.$$

For a pure reference, $\frac{1}{2}\|\rho - \Phi\|_1 = \max_{0 \le P \le I} \mathrm{Tr}\,P(\Phi - \rho) \ge 1 - \langle\Phi|\rho|\Phi\rangle$, by taking $P = \Phi$; this is sharper than the general Fuchs–van de Graaf bound [FuchsvdGraaf1999]. The diamond norm dominates the value on Φ, which gives the bound. Finally, $1/d^2 < 1/d$ for $d \ge 2$.

(c) For $\sigma' = I/d$, the operator $I/d^2 - \Phi$ has eigenvalue $1/d^2 - 1$ on Φ and $1/d^2$ on the orthogonal complement, of dimension $d^2 - 1$. Its trace norm is therefore $2(1 - 1/d^2)$ (check C-9).

par *Non-claim.* The floor holds for every code, every decoder and every amount of internal reorganization, because it is a consequence of the placement alone. It is the circuit form of En08-ST-DSS thm:E-nosignal, which proves the lattice-protocol instance under the declared rule En08-ST-DSS decl:E-window. It is not a statement about information loss in quantum gravity, no thermal noise model at T_{GH} is used, and no Page curve is implied. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Lemma (Shredder floor, after I-C). *Let Ψ be an entanglement-breaking channel on a d-dimensional system, for example any channel whose complete accessible output is classical before decoding. Then $\langle\Phi|(\Psi \otimes \mathrm{id})(\Phi)|\Phi\rangle \le 1/d$, and hence $\frac{1}{2}\|\Psi - \mathrm{id}_d\|_\diamond \ge 1 - 1/d$.*

Proof. $(\Psi \otimes \mathrm{id})(\Phi)$ is separable, so it is a convex combination of products $\alpha \otimes \beta$ of states. For such a product, $\langle\Phi|\alpha \otimes \beta|\Phi\rangle = \frac{1}{d}\mathrm{Tr}\,(\alpha\beta^T) \le \frac{1}{d}$, because $\mathrm{Tr}\,(\alpha\beta^T) \le \|\alpha\|_\infty \mathrm{Tr}\,\beta^T \le 1$. Then apply the projector bound of the proof of Theorem (b).

par *Non-claim.* I-C [IC] proves the sharp form of this floor for its interface. Here it is used only to compare floors. Beyond the horizon, the error floor $1 - 1/d^2$ is strictly worse than the classical-record floor $1 - 1/d$. The horizon is not a shredder: no record is produced at all. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Theorem (B-sharp: the exact horizon floor and its attainers). *In the situation of Theorem , let $\mathcal{D}$ be any decoder and put $\sigma' = \mathcal{D}(\sigma)$, with eigenvalues $\lambda_1, \dots, \lambda_d \ge 0$. Write $\varepsilon(\mathcal{D}) = \frac{1}{2}\|\mathcal{D}\mathcal{N} - \mathrm{id}_d\|_\diamond$, the standard worst-case process distance [GLN2005,Watrous2018], and use the convention $1/0 = \infty$.*

• *$\varepsilon(\mathcal{D})$ depends on $\mathcal{D}$ only through σ', and*

$$\varepsilon(\mathcal{D}) \ge 1 - \Big(\sum_{i=1}^{d} \lambda_i^{-1}\Big)^{-1} \ge 1 - \frac{1}{d^2}.$$

The second inequality is an equality if and only if $\sigma' = I/d$.

• *If $\sigma' = I/d$, then $\varepsilon(\mathcal{D}) = 1 - 1/d^2$ exactly.*

• *Hence $\min_{\mathcal{D}} \varepsilon(\mathcal{D}) = 1 - 1/d^2$. The minimum is attained, for example by the constant decoder $X \mapsto \mathrm{Tr}\,(X)\, I/d$, and it is attained exactly by the decoders with $\mathcal{D}(\sigma) = I/d$.*

Proof. (a) By Theorem (a), $\mathcal{D}\mathcal{N}(X) = \mathrm{Tr}\,(X)\sigma'$, which depends only on σ'. Let (e_i) be an eigenbasis of σ', let p be a probability vector, and put $|\psi_p\rangle = \sum_i \sqrt{p_i}\,|e_i\rangle|e_i\rangle$. The reference marginal of ψ_p is $P = \sum_i p_i|e_i\rangle\langle e_i|$, so

$$\langle\psi_p|(\mathcal{D}\mathcal{N} \otimes \mathrm{id})(\psi_p)|\psi_p\rangle = \langle\psi_p|\sigma' \otimes P|\psi_p\rangle = \sum_{i,j} \sqrt{p_i p_j}\,\langle e_i|\sigma'|e_j\rangle\langle e_i \mathrm{rvertP}\, |e_j\rangle = \sum_i p_i^2 \lambda_i.$$

If some $\lambda_k = 0$, take $p = \delta_k$. The overlap is then 0, and the projector bound in the proof of Theorem (b) gives $\varepsilon(\mathscr{D}) \geq 1$. Otherwise take $p_i = \lambda_i^{-1}/\sum_j \lambda_j^{-1}$. Then $\sum_i p_i^2 \lambda_i = (\sum_j \lambda_j^{-1})^{-1}$, and the same projector bound gives the first inequality. This choice is optimal, by Cauchy–Schwarz: $1 = (\sum_i p_i)^2 \leq (\sum_i p_i^2 \lambda_i)(\sum_i \lambda_i^{-1})$. For the second inequality, the arithmetic–harmonic mean inequality gives $\sum_i \lambda_i^{-1} \geq d^2/\sum_i \lambda_i = d^2$, with equality if and only if all $\lambda_i = 1/d$.

(b) Let $U_{ab} = X^a Z^b$ ($0 \leq a, b < d$) be the Weyl operators, with $X|k\rangle = |k+1\rangle$ and $Z|k\rangle = \omega^k |k\rangle$ for $\omega = e^{2\pi i/d}$. Their twirl is the complete depolarization: $d^{-2}\sum_{a,b} U_{ab} Y U_{ab}^\dagger = \mathrm{Tr}\,(Y)\, I/d$ [Watrous2018] (check C-14). Since $U_{00} = I$,

$$\mathscr{D}_\mathscr{N} - \mathrm{id} = (1 - \frac{1}{d^2})(\Delta' - \mathrm{id}), \qquad \Delta'(Y) = \frac{1}{d^2 - 1} \sum_{(a,b) \neq (0,0)} U_{ab} Y U_{ab}^\dagger.$$

Δ' is a channel, so $\|\Delta' - \mathrm{id}\|_\diamond \leq 2$, and $\varepsilon(\mathscr{D}) \leq 1 - 1/d^2$. The reverse inequality is (a).

(c) This follows from (a) and (b). The constant decoder is a channel.

par *Non-claim.* Theorem makes the floor of Theorem exact: no code, decoder or reorganization of declared data does better than $1 - 1/d^2$, and this value is reached. It is a statement about the placement on the prescribed host, not about information loss in quantum gravity. Check C-15 computes $\varepsilon(\mathscr{D})$ by semidefinite programming for nine random outputs σ' ($d = 2, 3, 4$). It finds equality with the lower bound of (a) to six digits. Version 3 proves that (a) is always an equality (Theorem), which closes open item O9. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Theorem (B-exact: the error of every decoder). *In the situation of Theorem , let $\lambda_1, \ldots, \lambda_d$ be the eigenvalues of $\sigma' = \mathscr{D}(\sigma)$ and put $S = \sum_i \lambda_i^{-1} \in [d^2, \infty]$, with $1/0 = \infty$ and $1/\infty = 0$. Then*

$$\varepsilon(\mathscr{D}) = \tfrac{1}{2}\|\mathscr{D}_\mathscr{N} - \mathrm{id}_d\|_\diamond = 1 - \frac{1}{S}.$$

An optimal input is the Schmidt vector ψ_p of the proof of Theorem (a), with $p_i \propto \lambda_i^{-1}$ if $\sigma' > 0$ and $p = \delta_k$ for any k with $\lambda_k = 0$ otherwise.

Proof. The lower bound $\varepsilon(\mathscr{D}) \geq 1 - 1/S$ is Theorem (a). If σ' is singular, then $S = \infty$, and $\varepsilon(\mathscr{D}) \leq \frac{1}{2}(\|\mathscr{D}_\mathscr{N}\|_\diamond + \|\mathrm{id}\|_\diamond) = 1$ gives equality. Let $\sigma' > 0$. Write $\Psi(X) = \mathrm{Tr}\,(X)\sigma' - X$, so $\varepsilon(\mathscr{D}) = \frac{1}{2}\|\Psi\|_\diamond$. Fix an eigenbasis (e_i) of σ', so that $\sigma' = \sum_i \lambda_i |e_i\rangle\langle e_i|$, and use $|ij\rangle = |e_i\rangle|e_j\rangle$ on output $\otimes$ reference. Put $|\Omega\rangle = \sum_i |ii\rangle$. The Choi operator is

$$J = (\Psi \otimes \mathrm{id})(|\Omega\rangle\langle\Omega|) = \sigma' \otimes I - |\Omega\rangle\langle\Omega|.$$

The certificate. The space splits into $V_0 = \mathrm{span}\{|ij\rangle : i \neq j\}$ and $V_1 = \mathrm{span}\{|ii\rangle\}$, and both J and the operator

$$Y = \sum_{i \neq j} \lambda_i |ij\rangle\langle ij| \;\oplus\; (\Lambda - \frac{1}{S} 1 1^T), \qquad \Lambda = \mathrm{diag}(\lambda_1, \ldots, \lambda_d),$$

are block-diagonal for it, where the second block is written in the basis $(|ii\rangle)_i$ of V_1 and $1 = (1, \ldots, 1)^T$. On V_0, J equals the first block of Y. On V_1, $J = \Lambda - 11^T$. Three facts hold:

• $Y \geq 0$. The first block is diagonal and nonnegative. For the second, $\Lambda^{-1/2}(\Lambda - 11^T/S)\Lambda^{-1/2} = I - ww^T/S$ with $w = \Lambda^{-1/2}1$ and $\|w\|^2 = S$, which is an orthogonal projector.

• $Y - J = (1 - 1/S)\, 11^T$ on V_1 and 0 on V_0, so $Y - J \geq 0$, because $S \geq d^2 \geq 1$.

• $\mathrm{Tr}_{\mathrm{out}}\, Y = (1 - 1/S)\, I$. Indeed, the diagonal entry at reference index j is $\sum_{i \neq j} \lambda_i + \lambda_j - 1/S = 1 - 1/S$. Every off-diagonal entry of Y is of the form $\langle ii|\mathrm{vert}Y\,|kk\rangle$ with $i \neq k$, and it contributes nothing to the partial trace over the output. *The upper bound.* Since a Hermiticity-preserving map attains its diamond norm on pure inputs with a reference of dimension d [Watrous2018], let $|\psi\rangle = (I \otimes C)|\Omega\rangle$ with $\mathrm{Tr}\, C^\dagger C = 1$; every unit vector of $\mathbb{C}^d \otimes \mathbb{C}^d$ has this form. Then $\Delta = (\Psi \otimes \mathrm{id})(\psi) = (I \otimes C)J(I \otimes C)^\dagger$ is Hermitian and traceless, because Ψ annihilates the trace. Hence

$\frac{1}{2}\|\Delta\|_1 = \max_P \mathrm{Tr}\,(P\Delta)$ over orthogonal projectors P. For every such P, by (ii), then $P \le I$ and (i), and then (iii),

$$\mathrm{Tr}\,(P\Delta) \le \mathrm{Tr}\,(P(I\otimes C)Y(I\otimes C)^\dagger) \le \mathrm{Tr}\,(Y(I\otimes C^\dagger C)) = \mathrm{Tr}\,((\mathrm{Tr}_{\mathrm{out}}\, Y)\, C^\dagger C) = 1 - \frac{1}{S}.$$

So $\varepsilon(\mathscr{D}) \le 1 - 1/S$. With Theorem (a) this proves equality, and the input ψ_p of that proof attains it. Checks C-20 and C-21 confirm (i)–(iii) on 200 random spectra and the value by semidefinite programming.

par *Non-claim.* Theorem closes open item O9. It is an exact statement about a replacement channel that is fixed by the placement on the prescribed host. It is not a statement about information loss in quantum gravity, about a thermal noise model at T_{GH}, or about any detector. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Corollary (What a decoder controls). *In the situation of Theorem :*

• *$\varepsilon(\mathscr{D})$ is a function of the harmonic mean $\lambda_{\mathrm{hm}} = d/S$ of the output spectrum alone: $\varepsilon(\mathscr{D}) = 1 - \lambda_{\mathrm{hm}}/d$. It is a strictly decreasing function of $\lambda_{\mathrm{hm}} \in [0, 1/d]$, with value 1 exactly when the output is singular and $1 - 1/d^2$ exactly when it is I/d.*

• *Every value in $[1 - 1/d^2, 1]$ is the error of some decoder. For $d \ge 2$, two decoders have equal error if and only if their outputs have equal harmonic mean.*

• *For every decoder, $1 - \varepsilon(\mathscr{D}) = 1/S \le 1/d^2$. So no decoder improves on the worst value 1 by more than $1/d^2$, and only the decoders with output I/d reach $1/d^2$.*

Proof. (a) is Theorem with $S = d/\lambda_{\mathrm{hm}}$; the extreme cases are Theorem (a). (b) The constant decoder with output $\mathrm{diag}(1 - (d-1)x, x, \ldots, x)$, $x \in [0, 1/d]$, has an output whose harmonic mean varies continuously from 0 to $1/d$; apply (a) and the intermediate value theorem. Equality of errors is equality of S. (c) is $S \ge d^2$.

par *Non-claim.* The corollary describes the decoders of a fixed placement. It does not assert that any decoder is physically implemented on the static patch, and it introduces no quantum coefficient beyond the channel itself. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Remark (A second proof of the upper bound, adopted from the user draft). The supplied user draft (Appendix) gives a shorter proof of the upper bound in Theorem , which we verified and record here. Let $\sigma' > 0$, $t = 1/S$, and use the reference $\otimes$ output ordering, in which the Choi operators of $X \mapsto \mathrm{Tr}\,(X)\sigma'$ and of id are $I \otimes \sigma'$ and $|\Omega\rangle\langle\Omega|$. For every vector z, the weighted Cauchy–Schwarz inequality gives $|\langle\Omega, z\rangle|^2 \le \langle\Omega, (I\otimes\sigma'^{\wedge -1})\Omega\rangle\, \langle z, (I\otimes\sigma')z\rangle = S\langle z, (I\otimes\sigma')z\rangle$. So $I\otimes\sigma' - t|\Omega\rangle\langle\Omega| \ge 0$, and $\mathscr{R} - t\,\mathrm{id}$ is completely positive, where $\mathscr{R} = \mathscr{D}\mathscr{N}$. It multiplies traces by $1 - t$, so $\Psi' = (\mathscr{R} - t\,\mathrm{id})/(1-t)$ is a channel, and $\mathscr{R} - \mathrm{id} = (1-t)(\Psi' - \mathrm{id})$. Hence $\varepsilon(\mathscr{D}) \le 1 - t$. Check C-25 confirms $I\otimes\sigma' - t|\Omega\rangle\langle\Omega| \ge 0$ on 80 random outputs. The same argument with $\sigma' = I/d$ is the Weyl-twirl decomposition of Theorem (b).

Proposition (The shredder floor is attained). *Let $\mathrm{Z}(Y) = \sum_k \langle k|Y|k\rangle\, |k\rangle\langle k|$ be complete dephasing on $\mathbb{C}^d$. It is entanglement-breaking [HSR2003], and its complete output is classical. Moreover $\frac{1}{2}\|\mathrm{Z} - \mathrm{id}_d\|_\diamond = 1 - 1/d$. Hence $\min_\Psi \frac{1}{2}\|\Psi - \mathrm{id}_d\|_\diamond = 1 - 1/d$ over entanglement-breaking channels Ψ. The two exact floors differ by*

$$(1 - \frac{1}{d^2}) - (1 - \frac{1}{d}) = \frac{d-1}{d^2} > 0.$$

Proof. Z measures in the computational basis and prepares the outcome, so it is entanglement-breaking. Also $\mathrm{Z}(Y) = d^{-1}\sum_{k=0}^{d-1} Z^k Y Z^{-k}$, so $\mathrm{Z} - \mathrm{id} = (1 - 1/d)(\mathrm{Z}' - \mathrm{id})$, where $\mathrm{Z}' = (d-1)^{-1}\sum_{k\ne 0} Z^k \cdot Z^{-k}$ is a channel. This gives $\le 1 - 1/d$, and Lemma gives $\ge$ (check C-16).

par *Non-claim.* This sharpens the comparison of Lemma with the exact constant of I-C [IC]. A classical record retains exactly $(d-1)/d^2$ more half-diamond fidelity than placement beyond the horizon. The horizon is not a

shredder, and no heat ledger is used. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Proposition (Residual quantum blocks and approximate replacement). *Let $\mathcal{N}$ be a channel on a d-dimensional code whose complete accessible output is a classical direct sum of quantum blocks, each of dimension at most $k \le d$, and let $\mathcal{D}$ be any decoder. Write F_e for the entanglement fidelity on the maximally entangled input.*

• *$F_e(\mathcal{D}\mathcal{N}) \le k/d$ and $\frac{1}{2}\|\mathcal{D}\mathcal{N} - \mathrm{id}_d\|_\diamond \ge 1 - k/d$. For $k = 1$ this is Lemma , and for $k = d$ it is empty.*

• *Every decoded replacement channel has $F_e = 1/d^2$, whatever its output σ'.*

• *If an implemented channel $\widetilde{\mathcal{N}}$ satisfies $\frac{1}{2}\|\widetilde{\mathcal{N}} - \mathcal{M}\|_\diamond \le \delta$ for a replacement channel $\mathcal{M}$, then*

$\inf_{\mathcal{D}} \frac{1}{2}\|\mathcal{D}\widetilde{\mathcal{N}} - \mathrm{id}_d\|_\diamond \ge \max\{0, 1 - 1/d^2 - \delta\}$.

Proof. (a) On a block of dimension at most k, the reference state has Schmidt number at most k, and a decoder acting on the output cannot increase it. A unit vector $\psi = \sum_{ij} B_{ij}|i\rangle|j\rangle$ with $\operatorname{rank} B \le k$ has $|\langle \Phi, \psi\rangle|^2 = |\operatorname{Tr} B|^2/d \le \|B\|_1^2/d \le k\|B\|_2^2/d = k/d$. Convexity over the blocks and over mixtures gives $F_e \le k/d$, and the projector bound of Theorem (b) gives the distance bound. (b) The decoded output on Φ is $\sigma' \otimes I/d$, whose overlap with Φ is $\operatorname{Tr}(\sigma')/d^2$. (c) The diamond norm contracts under post-composition with $\mathcal{D}$, so $\frac{1}{2}\|\mathcal{D}\widetilde{\mathcal{N}} - \mathrm{id}\|_\diamond \ge \frac{1}{2}\|\mathcal{D}\mathcal{N} - \mathrm{id}\|_\diamond - \delta \ge 1 - 1/d^2 - \delta$ by Theorem . Check C-25 samples (a) and verifies (b).

par *Non-claim.* Proposition is adopted from the user draft after verification. Part (c) is an approximation allowance, not an exact causal-support theorem; no physical channel or its δ is supplied. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Thermal channels, the horizon floor and the shredder floor

Theorem (B-thermal: a thermal operation attains the horizon floor). *Let a finite Hamiltonian* H *on $\mathbb{C}^d$ and a temperature $\theta > 0$ be supplied, $\beta = 1/(k_B\theta)$, $\gamma_\beta = e^{-\beta \mathrm{H}}/Z_\beta$. A thermal operation is $X \mapsto \operatorname{Tr}_B[U(X \otimes \gamma_{\beta,B})U^\dagger]$ with U commuting with the total Hamiltonian [FBB2021].*

• *Replacement by γ_β is a thermal operation (bath: a copy of the system; U: the swap).*

• *Its error is $\frac{1}{2}\|\mathcal{R}_{\gamma_\beta} - \mathrm{id}\|_\diamond = 1 - 1/(Z_\beta Z_{-\beta})$, by Theorem with $\sum_i \lambda_i^{-1} = \operatorname{Tr}\gamma_\beta^{-1} = Z_\beta Z_{-\beta}$. For a qubit with gap Δ it is* $1 - 1/(2 + 2\cosh\beta\Delta)$.

• *It equals the horizon floor $1 - 1/d^2$ if and only if* H *is a multiple of the identity. In particular, with* $\mathrm{H} = 0$ *the floor is attained at every temperature, including the numerical value $\theta = T_{\mathrm{GH}}$. Hence a universal ``non-realizability by a thermal channel at T_{GH}'' is false; what holds is Proposition : the label T_{GH} alone fixes no Hamiltonian, bath, interaction or channel, and these are additional declared data.*

Proof. (a) The swap commutes with $\mathrm{H} \otimes I + I \otimes \mathrm{H}$ and outputs the bath state. (b) is Theorem . (c) $\operatorname{Tr}\sigma^{-1} \ge d^2$ with equality iff $\sigma = I/d$, and $\gamma_\beta = I/d$ at finite β iff H is scalar. Check C-30 confirms the formula against an SDP (0.78609 at $d = 2$, 0.925952 at $d = 3$).

par *Non-claim.* The Hamiltonian, the bath and the interaction are supplied finite data; T_{GH} enters only as one admissible numerical temperature, and the floor is attained by a scalar Hamiltonian that identifies no temperature (compare Theorem (e)). No field state, detector or reservoir on DSS_H is constructed. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Theorem (B-dephase and the certificate instrument).

• *For* H *diagonal in the basis $|j\rangle$, a d-dimensional bath with zero Hamiltonian at any temperature and*

$U = \sum_a Z^a \otimes |a\rangle\langle a|$ (Z the clock matrix) implement complete dephasing, a thermal operation with error exactly $1 - 1/d$: the shredder floor of I-C thm:A and Lemma , strictly below $1 - 1/d^2$.

• For $\sigma > 0$ and $t = (\mathrm{Tr}\,\sigma^{-1})^{-1}$, $\mathscr{I}_0(X) = tX$ and $\mathscr{I}_1(X) = \mathrm{Tr}\,(X)\sigma - tX$ form a completely positive instrument whose sum is $\mathscr{R}_\sigma$; its flagged output is not a post-processing of the output of $\mathscr{R}_\sigma$.

• After any replacement channel, no decoder has error below $1 - 1/d^2$; in particular none attains the shredder floor $1 - 1/d$.

Proof. (a) U commutes with $\mathrm{H} \otimes I$; tracing the bath I/d gives the twirl $\frac{1}{d}\sum_a Z^a X Z^{-a}$, which removes all off-diagonal entries; the error is Lemma and the convex bound (check C-31, SDP values 0.5, 0.666667, 0.75). (b) The Choi operator of $\mathscr{I}_1$ is $\sigma \otimes I - t|\Omega\rangle\langle\Omega| \geq 0$ (proof of Theorem ; check C-32). The flag-0 branch depends on the input, while every post-processing of $\mathscr{R}_\sigma$ is constant on inputs. (c) A decoded replacement channel is a replacement channel; Theorem .

par *Non-claim.* Thermal operations here are finite ancillary models with supplied Hamiltonians, not a field state, detector or reservoir on DSS_H; T_{GH} is used only as a numerical temperature value. The support bridge I-B-G-Q-C-v6 thm:bridge concerns the conical host and changes none of this. O6 (a physically identified thermal noise model) stays open; the new open item of the plan, ``a certificate realizable by an instrument meeting the shredder floor but not the horizon floor", is answered by (a)–(c). Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Granularity: ticks and lattice thresholds

Definition (Conformal tick rule, declared). A *δ-tick protocol* from a source event $(\eta_s, \mathbf{x}_s) \in P_H$ to the comoving receiver $\gamma_{\mathbf{x}_s + \mathbf{y}}$, with $r = |\mathbf{y}| > 0$, is a sequence of n hops. Each hop has conformal duration δ and comoving length at most $c\delta$. The protocol must arrive while still in P_H, that is, at conformal time $\eta_s + n\delta < 0$. The *horizon margin* of the target is $m := -\eta_s - r/c$. This rule is *declared data*. It is not derived from the metric, as in En08-ST-DSS decl:E-window.

Theorem (Granularity ceiling).

• If $m \leq 0$, no δ-tick protocol exists, for any δ. The source is then outside $J^-(\gamma_{\mathbf{x}_s + \mathbf{y}})$ (Theorem (b),(d)).

• A δ-tick protocol exists if and only if $\lceil r/(c\delta) \rceil \delta < r/c + m$.

• Sharp criterion. Fix $m > 0$. The tick δ serves every target of margin at least m, at every comoving distance $r > 0$, if and only if $\delta \leq m$.

*• Every tick that serves all targets of margin at least m uses at least $\lceil r/(cm) \rceil$ hops on a target at comoving distance r. So the hop count grows like $r/(cm)$ as m*downarrow 0*, and no fixed tick serves margins arbitrarily close to the horizon.*

Proof. A hop is causal exactly when its comoving length is at most c times its conformal duration (Lemma). So n hops reach comoving distance r if and only if $nc\delta \geq r$, and the least such n is $\lceil r/(c\delta) \rceil$. This proves (b). If $m \leq 0$, then $n\delta \geq r/c \geq r/c + m$ for every admissible n, which proves (a). For (c), suppose first that $\delta \leq m$, and let the target have margin $m' \geq m$. Since $\lceil x \rceil < x + 1$, we get $\lceil r/(c\delta) \rceil \delta < r/c + \delta \leq r/c + m'$. Conversely, if $\delta > m$, choose $k \in \mathbb{N}$ and $0 < \varepsilon \leq \delta - m$, and put $r = c(k\delta + \varepsilon)$. Then $\lceil r/(c\delta) \rceil \delta = (k+1)\delta \geq k\delta + \varepsilon + m = r/c + m$, and (b) fails at margin exactly m. (d) follows from $\delta \leq m$ and (b). Check C-8 runs the counterexample of (c) at $\delta \in \{0.5, 0.1, 0.01\}$.

par *Non-claim.* This is a theorem about a declared conformal tick rule. It is the elementary counterpart of the two-sided threshold $j_{\min}(m, L) = \Theta(1/m)$ of En08-ST-DSS cor:E-twosided, which includes SWAP-lattice overheads. Version 3 of that sheet left a gap between the constants ℓ_0/c and $(\ell_0 + \sqrt{3}L)/c$ (in the lattice unit ℓ_0 of Section) (En08-ST-DSS prop:E-asymp); its current status is in the non-claim of Theorem . A proper tick $a(\eta)\delta$ grows toward the end of the flat chart; no hardware rate is derived. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Theorem (Tick-exact: the feasible ticks for one target). *Fix a target with* $x := r/c > 0$ *and horizon margin* $m > 0$*, and put* $N = \lceil x/m \rceil$.

• *A* δ*-tick protocol exists if and only if* $\delta \in \bigcup_{n \geq 1} [x/n, (x + m)/n)$.

• *This set equals*

$$(0, \frac{x+m}{N}) \cup \bigcup_{n=1}^{N-1} [\frac{x}{n}, \frac{x+m}{n}),$$

and the N pieces displayed are pairwise disjoint. So the feasible ticks form exactly N intervals, separated by exactly $N - 1$ *nonempty gaps* $[(x + m)/(n + 1), x/n)$, $1 \leq n \leq N - 1$. *The gaps are half-open: their left endpoints are infeasible.*

• $(0, m]$ *is contained in the first piece. The supremum of feasible ticks is* $x + m$*, and it is not attained.*

• *Locality of failure. If* $\delta > m$*, then every target of margin* m *with* $0 < x \leq \delta - m$ *is infeasible. So the uniform criterion* $\delta \leq m$ *of Theorem (c) is forced by short-range targets, and restricting to bounded comoving distances does not relax it.*

Proof. (a) An n-hop protocol reaches the receiver exactly when $n\delta \geq x$ (Lemma), and it arrives in P_H exactly when $\eta_s + n\delta < 0$, that is, $n\delta < x + m$. Note that hops may be shorter than $c\delta$. (b) The consecutive pieces satisfy $(x + m)/(n + 1) < x/n$ if and only if $nm < x$, that is, $n < x/m$. For $n \leq N - 1$ this holds, which gives the gaps. The point $(x + m)/(n + 1)$ is the excluded upper end of the piece $n + 1$, lies below the piece n, and lies above every piece $k \geq n + 2$, so it belongs to the gap (check C-26). For $n \geq N$ the pieces overlap or touch, and since $x/n \to 0$, their union is $(0, (x + m)/N)$. (c) From $N < x/m + 1$ we get $(x + m)/N > m$. The piece $n = 1$ is $[x, x + m)$. (d) For $x \leq \delta - m$, $\lceil x/\delta \rceil = 1$ and $\delta \geq x + m$. Check C-17 verifies (a)–(d) in exact rational arithmetic on four targets and 2999 ticks each.

par *Non-claim.* The tick rule is declared data. Theorem describes its exact geometry and derives no hardware rate. The lattice analogue with SWAP overheads now has an exact universal constant, $\lim_{m \text{downarrow } 0} m\, j_{\max}(m, L) = (\ell_0 + L/\sqrt{2})/c$, in En08-ST-DSS thm:E-sharp(d) (version 5). The constant of the least uniform level is treated in Theorem . Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Tick and lattice constants

The lattice task of En08-ST-DSS [En08STDSS] is written in a *declared lattice length unit* $\ell_0 > 0$, with ticks $\delta_j = \ell_0/(cj)$ and endpoint tolerance $\varepsilon_j = \sqrt{3}\,\ell_0/(2j^2)$ at level j; ℓ_0 is a calibration, not the de Sitter radius $\ell = c/H$ (Appendix , Z1). Table collects the constants. The tick constant ℓ_0/c and the lattice constants differ because the tasks differ (exact target versus receiver within ε_j; free hops versus SWAP blocks); neither determines the other.

The lattice threshold: an exact envelope criterion

Assumption (Threshold-record interface). Fix a range $L > \varepsilon_1 = \sqrt{3}\ell_0/2$. Let $D_j = D_j(L) > 0$ ($j \geq 1$) be the worst-case arrival slacks of a declared finite lattice permission model: at margin $m > 0$, level j is uniform if $D_j < m$ and not uniform if $D_j > m$, the case $D_j = m$ being left to the model's attainment convention. Assume $D_j \to 0$ and

$$jD_j = \frac{\ell_0 + L\tau_j}{c} + o(1), \qquad \tau_j \geq 0, \qquad \sup_j \tau_j < \infty,$$

for a declared sequence τ_j; for the lattice-hull task, $\tau_j = j - \min_{|v|=1} \max\{z \cdot v : z \in \mathbb{Z}^3,\ |z| \leq j\}$. Let $j_{\min}(m, L)$ be the least uniform level, and put $b_n = \min_{1 \leq j \leq n} D_j$, $\underline{\tau} = \liminf_j \tau_j$ and $A_L = (\ell_0 + L\underline{\tau})/c$.

For the lattice task of En08-ST-DSS the interface holds with the stronger remainder $O(1/j)$ (En08-ST-DSS thm:E-gap(a)(source record; not a premise)).

Theorem (Finite obstruction and the exact envelope criterion).

• *Fixed ticks. For every fixed conformal tick* $\delta > 0$ *and* $0 < m < \delta$*, every target with* $0 < r/c \leq \delta - m$ *fails at margin*

m. This is a non-uniformity certificate for fixed ticks; ticks that depend on m are not excluded by it.

• *Zero-tick range. In the endpoint-tolerant lattice task with* $0 < L \le \varepsilon_1$*, the source site is an admissible receiver for every target, so* $j_{\min}(m, L) = 1$ *and* $m\, j_{\min}(m, L) \to 0$.

• *Envelope identities. Under Assumption ,*

$$\liminf_{m \,\mathrm{downarrow}\, 0} m\, j_{\min}(m, L) = A_L = \liminf_{n \to \infty} n\, b_n, \qquad \limsup_{m \,\mathrm{downarrow}\, 0} m\, j_{\min}(m, L) = \limsup_{n \to \infty} n\, b_n.$$

Hence $m\, j_{\min}(m, L) \to A_L$ *if and only if* $n\, b_n \to A_L$.

• *Ratio density. Under the same assumption, convergence holds if and only if for every* $\eta \in (0, 1)$ *all sufficiently large n admit a level j with* $(1 - \eta)n \le j \le n$ *and* $\tau_j \le \underline{\tau} + \eta$*. This condition contains neither L, nor* ℓ_0*, nor c.*

• *The statements decide neither* $\underline{\tau}$ *nor the ratio-density property of the actual hull sequence.*

Proof. (a) Theorem (d): such a target needs at least one tick, and $\delta \ge r/c + m$ violates the strict arrival deadline.

(b) Every target lies within the level-1 tolerance ε_1 of the source, so returning the source register is an admissible zero-tick delivery under the declared delivery rule (En08-ST-DSS def:E-deliver(source record; not a premise)); no transport to the exact target event is claimed.

(c) Write $J_<(m) = \min\{j : D_j < m\}$ and $A = \liminf_j jD_j$, which equals A_L by the assumption. Since $D_j > 0$ and $D_j \to 0$, $J_<(m) \to \infty$ as $m\,\mathrm{downarrow}\,0$, $b_n \to 0$, and the indices $k_n \le n$ with $b_n = D_{k_n}$ tend to infinity. So $nb_n \ge k_n D_{k_n}$ gives $\liminf nb_n \ge A$, and $b_n \le D_n$ gives the reverse; thus $\liminf_n nb_n = A$. If $j = J_<(m) > 1$, then $D_j < m \le b_{j-1}$, so

$$jD_j < mj \le jb_{j-1}.$$

The left inequality gives $\liminf_m mJ_<(m) \ge A$. Choosing $j \to \infty$ along a subsequence with $jD_j \to A$ and $m_j = (1 + j^{-1})D_j$, we get $J_<(m_j) \le j$ and $m_j J_<(m_j) \le (1 + j^{-1})jD_j \to A$. The right inequality gives $\limsup_m mJ_<(m) \le \limsup_n nb_n$. Conversely, at $m = b_n$ no level $j \le n$ has $D_j < m$, so $mJ_<(m) \ge (n + 1)b_n$. For the convention that admits $D_j = m$, put $J_\le(m) = \min\{j : D_j \le m\}$; for every $\varepsilon > 0$, $J_<((1 + \varepsilon)m) \le J_\le(m) \le J_<(m)$, so both conventions have the same lower and upper limits after $\varepsilon\,\mathrm{downarrow}\,0$, and $j_{\min}$ lies between them.

(d) Suppose $nb_n \to A_L$, and let $b_n = D_{k_n}$. Since $k_n \to \infty$, $k_n D_{k_n} \ge A_L - o(1)$, while $k_n D_{k_n} \le nD_{k_n} \to A_L$. As $A_L \ge \ell_0/c > 0$, $k_n/n \to 1$ and $k_n D_{k_n} \to A_L$, so $\tau_{k_n} \to \underline{\tau}$ by the assumption (here $L > 0$). Thus $j = k_n$ witnesses the condition for large n. Conversely, for a witness j,

$$nb_n \le nD_j \le \frac{1}{1 - \eta} jD_j \le \frac{1}{1 - \eta}\left(\frac{\ell_0 + L(\underline{\tau} + \eta)}{c} + o(1)\right);$$

take the upper limit, let $\eta\,\mathrm{downarrow}\,0$ and combine with $\liminf_n nb_n = A_L$.

(e) Nothing in (a)–(d) evaluates the sequence τ_j. Check C-44 verifies the inequality chains of (c) on synthetic sequences and illustrates convergence (dense near-minimal levels) and oscillation (sparse ones).

par *Non-claim.* This is adopted from the supplied findings after verification (Appendix , F4). Parts (c) and (d) are proved here from the stated interface with remainder $o(1)$; the same identities for the lattice task, with remainder $O(1/j)$, are En08-ST-DSS thm:E-record and En08-ST-DSS thm:E-iff, cited as source records. The theorem certifies finite arrival tasks on declared permissions; it constructs no continuum transport up to the horizon, removes no external scheduling clock, and leaves O3 and O11 open. The last-non-uniform-level constant $(\ell_0 + L/\sqrt{2})/c$ is a different target and is not substituted for A_L. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

C: internal reorganization leaves the host and its labels unchanged

Theorem (C: invariance and characterization). *Let* $\mathscr{A}$ *be any account space (Definition).*

• *Every host functional* Φ *is invariant under every reorganization:* $\Phi \circ \rho = \Phi$*. In particular, the following are*

invariant: the metric g_H; the radius $\ell = c/H$; the sets $J^{\pm}(\gamma)$, $\mathscr{S}$ and $\{u = 0\}$; the horizon area A_H; the echo latency $T(R)$; the labels T_{GH}, S_{GH} and N_{GH}; and the conditional capacity value of Theorem (c).

• *A map Φ on $\mathscr{A}$ is invariant under every reorganization if and only if it is a host functional.*

• *Consequently, a figure of merit Q satisfies $Q(\rho(a)) \neq Q(a)$ for some reorganization ρ and some account a if and only if Q is not a host functional. Horizon area, S_{GH} and N_{GH} cannot be improved by any packing, error correction, speed-up or algorithmic change.*

Proof. (a) $\Phi(\rho(H,\Delta)) = \varphi(H) = \Phi(H,\Delta)$. Each listed object is defined from (c,H) alone: Definitions –, Theorem , Proposition .

(b) If Φ is a host functional, use (a). Conversely, let Φ be invariant, and let $\Delta,\Delta' \in \mathscr{D}(H)$. Define ρ by $\rho_H(\cdot) \equiv \Delta'$ on the fibre over H, and the identity on the other fibres. This is a reorganization, so $\Phi(H,\Delta) = \Phi(\rho(H,\Delta)) = \Phi(H,\Delta')$. Hence Φ is constant on fibres, and $\varphi(H) := \Phi(H,\Delta)$ is well defined.

(c) This restates (b) for Q. The listed quantities are host functionals by (a).

par *Non-claim.* The analogy's sentence ``the horizon area stays fixed'' is a tautology of the formalism once improvements are defined as reorganizations. That is the point: it is a property of the bookkeeping, not a dynamical law. The metric is immutable model data, as in I-D def:interface. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

D: the hard ceiling

Theorem (D: the ceiling of reorganization).

• *Fibre-supremum ceiling. For a figure of merit Q, put $Q^*(H) := \sup_{\Delta \in \mathscr{D}(H)} Q(H,\Delta)$. Then Q^* is a host functional, and for every account $a = (H,\Delta)$,*

$$\sup_{\rho} Q(\rho(a)) = Q^*(H),$$

the supremum being over all reorganizations. The value $Q^*(H)$ is attained by a reorganization if and only if the supremum over the fibre is attained. No reorganization, and no finite composition of reorganizations, exceeds $Q^*(H)$.

• *The dimension label is not a host theorem (permanent negative certificate). Let $\mathscr{D}_{\mathrm{free}}(H)$ contain, for every $D \in \mathbb{N}$, a declared register of dimension D placed at an event of $\mathscr{S}$. Let $Q_{\dim}(H,\Delta)$ be the total declared dimension placed in $\mathscr{S}$. Then $Q^*_{\dim}(H) = +\infty$ for every $H > 0$. Hence no inequality $Q_{\dim} \mathrm{leN}_{\mathrm{GH}}(H)$ holds on $\mathscr{D}_{\mathrm{free}}$. The bound ``$\dim \leq \exp(S_{\mathrm{GH}}/k_B)$'' is not a consequence of the prescribed host together with unrestricted declared data. It can hold only on a declared-data class that has been restricted by a separate input.*

• *Conditional ceiling. Suppose a promise P_η is SUPPLIED, with $\eta > 0$: on $\mathscr{D}(H)$, every declared memory placed in $\mathscr{S}$ has total dimension D with $\ln D \leq \eta\, S_{\mathrm{GH}}(H)/k_B$. Then every q-qubit declared memory in $\mathscr{S}$ has*

$$q \;\leq \left\lfloor \frac{\eta\, S_{\mathrm{GH}}(H)}{k_B \ln 2} \right\rfloor = \left\lfloor \frac{\eta \pi c^5}{\hbar G H^2 \ln 2} \right\rfloor.$$

At the Planck 2018 values $H_0 = 67.36 kms\text{^}{-1}Mpc\text{^}{-1}$ and $\Omega_\Lambda = 0.6847$ [Planck2018], with $H_\Lambda = H_0\sqrt{\Omega_\Lambda}$ and $\eta = 1$, this evaluates to $S_{\mathrm{GH}}/k_B \approx 3.3 \times 10^{122}$ and $q \leq 4.8 \times 10^{122}$. At $H = H_0$ the values are 2.3×10^{122} and 3.3×10^{122} (check C-6, computer-assisted). These are evaluations of a named formula at prescribed parameters.

• *Report-blindness is preserved. Let the class be host-uniform, and let $\mathrm{Rep}(H,\Delta) = r(\Delta)$ be host-blind.*

• *For every host-blind reorganization ρ, $\mathrm{Rep} \circ \rho$ is host-blind.*

• *No map F satisfies $F(\mathrm{Rep}(a)) = S_{\mathrm{GH}}(H)$ on two fibres $H_1 \neq H_2$ sharing a datum Δ. Every map F has worst-case*

error at least $\frac{1}{2}|S_{\mathrm{GH}}(H_1) - S_{\mathrm{GH}}(H_2)|$ *there. The same holds for* T_{GH} *and* N_{GH}.

• *If* $F(\mathrm{Rep}(a), H) = S_{\mathrm{GH}}(H)$ *for all* a*, then* $F(r(\Delta), \cdot) = S_{\mathrm{GH}}$ *for every* Δ*: F is report-blind on the realized set.*

• *The unrestricted no-new-reports sentence is false. The sentence ``internal rearrangements cannot produce new independent reports'' fails. A reorganization that adjoins a declared register with a fresh record alphabet produces report values outside the previously realized set.*

Proof. (a) Q^* depends only on H. For every ρ, $\rho(a) \in \mathscr{A}_H$, so $Q(\rho(a)) \le Q^*(H)$. Given $\Delta' \in \mathscr{D}(H)$, the reorganization sending the fibre over H to Δ' (proof of Theorem (b)) gives $Q(\rho(a)) = Q(H, \Delta')$, so the supremum over ρ equals $Q^*(H)$. A composition of reorganizations is a reorganization.

(b) For each D the declared register is admissible, so $Q^*_{\dim}(H) \ge D$ for every D. The host places no restriction, because a declared register is not a field mode of g_H. If $Q_{\dim}\mathrm{leN}_{\mathrm{GH}}$ held on $\mathscr{D}_{\mathrm{free}}(H)$, then $Q^*_{\dim}(H)\mathrm{leN}_{\mathrm{GH}}(H) < \infty$, a contradiction. The certificate is permanent: it depends only on the definition of $\mathscr{D}_{\mathrm{free}}$ and on the finiteness of $N_{\mathrm{GH}}(H)$.

(c) A q-qubit memory has $D = 2^q$, so $q\ln 2 \le \mathrm{etaS}_{\mathrm{GH}}/k_B$, and q is an integer. This is Red06-G eq:capacity with $A = A_H$, as recorded in Red06-G-DSS rem:R-capacity. The numbers are computed in check C-6 from the exact SI values of h, k_B and c, with $G = 6.67430 \times 10^{-11}$m^3kg^−1s^−2.

(d)(i) $\mathrm{Rep}(\rho(H, \Delta)) = r(\rho_0(\Delta))$ is independent of H. (ii) The accounts (H_1, Δ) and (H_2, Δ) have equal reports, while S_{GH} is strictly decreasing in H. Apply Theorem . (iii) Fix Δ. The hypothesis reads $F(r(\Delta), H) = S_{\mathrm{GH}}(H)$ for every H. This is Red06-G-DSS thm:R-nomap2.

(e) Let Δ have report alphabet Σ, and let $\rho_H(\Delta)$ adjoin a register whose record takes values in a set Σ' disjoint from Σ. Then $\mathrm{Rep}(\rho(a))$ takes values outside the realized set.

par *Non-claim.* (a) is the precise sense of ``hard ceiling''. The ceiling is the fibre supremum, and whether it is finite is a property of the declared class, not of the horizon. (b) closes the item ``derive $\dim \mathrm{leN}_{\mathrm{GH}}$ from the prescribed host'' negatively. It does *not* refute the external conjecture of a finite static-patch Hilbert space [Banks2001,Bousso2000,Witten2001,CLPW2023], which concerns quantum gravity, not a prescribed classical host with free declared registers. (c) is conditional: P_η is an input, and no thermal floor, saturation or holographic encoding is derived. (d) is the strongest honest version of the analogy's statement that reorganizations cannot produce new reports. Reports blind to the host cannot become informative about the horizon through host-blind reorganization. A host-dependent reorganization installs H as a supplied word, as in Red06-G-DSS thm:R-nomap(c). (e) records that the unrestricted sentence is false. The intermediate question, whether a reorganization can yield a report outside a stated certified bound, stays open (Section). Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Sharpness of the conditional ceiling

Theorem (D-sharp: the promise bound is attained and best possible). *Fix* $\eta > 0$ *and put* $s = \eta\, S_{\mathrm{GH}}(H)/k_B$ *and* $q_\eta(H) = \lfloor s/\ln 2 \rfloor$.

• *Attainment. Let* $\mathscr{D}_\eta(H)$ *consist of all declared memories in* $\mathscr{P}$ *with* $\ln D \le s$*. This class satisfies* P_η*, and it contains a* $q_\eta(H)$*-qubit memory. Hence the qubit ceiling of Theorem (a) on* $\mathscr{D}_\eta$ *is exactly* $q_\eta(H)$*. Any bound on qubit number that is valid for every class satisfying* P_η *is at least* $q_\eta(H)$*, so the bound of Theorem (c) cannot be improved from* P_η *alone.*

• *Mixed registers. A memory made of* n_k *registers of dimension* k *(*$k \ge 2$*) satisfies* P_η *if and only if* $\sum_k n_k \ln k \le s$*. In particular, at most* $\lfloor s/\ln k \rfloor$ *registers of dimension* k *fit, and this number is attained.*

• *The number is carried by the promise. If* $0 < \eta' < \eta$*, then* $q_{\eta'} \le q_\eta$*, and* $q_{\eta'} < q_\eta$ *as soon as* $(\eta - \eta')S_{\mathrm{GH}}/k_B \ge \ln 2$.

The host does not distinguish η from η′ (Theorem (b)).

• *Sensitivity to the prescribed rate.* $S_{\mathrm{GH}} \propto H^{-2}$ *exactly, so* $\mathrm{dln}S_{\mathrm{GH}}/\mathrm{dln}\,H = -2$. *Write* $H_\Lambda = (100\ \mathrm{km\,s^{-1}\,Mpc^{-1}})\sqrt{\Omega_\Lambda h^2}$. *The Planck 2018 value* $\Omega_\Lambda h^2 = 0.3107 \pm 0.0082$ *[Planck2018] gives* $H_\Lambda = 55.74$ *kms^−1Mpc^−1,* $S_{\mathrm{GH}}/k_B = 3.312 \times 10^{122}$ *and* $q_1 = 4.779 \times 10^{122}$. *The linearized one-standard-deviation band is* $\pm 2.64\%$, *that is,* $S_{\mathrm{GH}}/k_B \in [3.225, 3.400] \times 10^{122}$. *In* q_1 *only about two significant digits are meaningful; the floor is a formal feature of the promise (check C-18).*

Proof. (a) A q-qubit memory has $\ln D = q\ln 2$, which is at most s exactly when $q \le q_\eta$. The class $\mathscr{D}_\eta(H)$ is admissible, so the fibre supremum of Theorem (a) equals q_η. A valid bound must be at least every realized value. (b) $\ln \prod_k k^{n_k} = \sum_k n_k \ln k$. (c) The floor is monotone, and it increases when its argument increases by at least 1. (d) Definition gives $S_{\mathrm{GH}} = \pi k_B c^5/(\hbar G H^2)$. Since $S_{\mathrm{GH}} \propto (\Omega_\Lambda h^2)^{-1}$, the relative band is $0.0082/0.3107$. The values agree with those of Theorem (c), computed from H_0 and Ω_Λ, to the rounding of the published parameters.

par *Non-claim.* Theorem is about a supplied promise and declared registers. It does not assert that the static patch has 4.78×10^{122} qubits, and it derives neither the promise nor a holographic encoding. The Planck numbers are label evaluations at prescribed parameters within base-ΛCDM, with the correlations of the published fit ignored beyond the single combination $\Omega_\Lambda h^2$. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Remark (Exact image of the parameter interval). The band $\pm 2.64\%$ of Theorem (d) is the linearized relative sensitivity $0.0082/0.3107$. Since $S_{\mathrm{GH}} \propto (\Omega_\Lambda h^2)^{-1}$ is monotone, the exact image of the input interval 0.3107 ± 0.0082 is asymmetric: $S_{\mathrm{GH}}/k_B \in [3.22714, 3.40210] \times 10^{122}$ and $S_{\mathrm{GH}}/(k_B \ln 2) \in [4.65578, 4.90819] \times 10^{122}$, against the linearized $[3.22489, 3.39973] \times 10^{122}$ (check C-27; $H_\Lambda = 1.80643 \times 10^{-18}$s^−1). Both are label evaluations at fixed G and fixed model, not confidence statements. This refinement is adopted from the user draft, whose upper endpoint 4.90820 for $S_{\mathrm{GH}}/(k_B \ln 2)$ rounds the value $4.908194\ldots$ incorrectly in the last digit.

An explicit capacity-growing family

Theorem (D4: a reorganization monoid that grows the declared dimension). *Enlarge* $\mathscr{D}_{\mathrm{free}}(H)$ *of Theorem (b), if necessary, by accounts* (H, q, f) *with* $q \in \mathbb{N}_0$ *declared qubits placed in* $\mathscr{S}$ *and independent declared metadata* $f \in V = C^\infty([0,1])$. *For* $n \in \mathbb{N}_0$ *and* $v \in V$ *put* $\rho_{n,v}(H, q, f) = (H, q + n, f + v)$.

• $\rho_{n,v}\rho_{m,w} = \rho_{n+m,\,v+w}$, *and distinct pairs give distinct reorganizations;*

• *every host functional, in particular* T_{GH}, S_{GH} *and* N_{GH}, *is invariant under every* $\rho_{n,v}$ *(Theorem (a)), while the declared dimension is multiplied by* 2^n*;*

• *for every finite bound* $B(H) > 0$ *the least* $n \ge 0$ *with* $2^{q+n} > B(H)$ *is* $n_B = \max\{0, \lfloor \log_2 B(H) - q \rfloor + 1\}$*; for the named label* $B = \exp(\mathrm{eta}S_{\mathrm{GH}}/k_B)$ *it is* $n_B = \max\{0, \lfloor \mathrm{eta}S_{\mathrm{GH}}/(k_B \ln 2) - q \rfloor + 1\}$*;*

• $\dim_{\mathrm{Hamel}} V = \mathfrak{c}$, *and for finitely many linear metadata probes* $L_1, \ldots, L_s$ *the subspace* $V_0 = \bigcap \ker L_i$ *still has Hamel dimension* $\mathfrak{c}$*; all* $\rho_{n,v}$, $v \in V_0$, *preserve the probes. In the language of CMP-OB-1-v6 def:iota, the invisible direction space of the class has* $\iota = \mathfrak{c}$.

Proof. (a), (b) are read off the formula; host functionals depend on H only. (c) $2^{q+n} > B$ iff $n > \log_2 B - q$. (d) The functions $e^{\lambda t}$, $\lambda \in \mathbb{R}$, are independent (Vandermonde), and a continuous function is fixed by its values on a countable dense set, so $|V| \le \mathfrak{c}$. Finite codimension does not lower an infinite Hamel dimension. Check C-33 verifies (c) against brute force in exact arithmetic.

par *Non-claim.* This strengthens the free-data negative certificate of Theorem (b) quantitatively: arbitrarily large

finite dimensions are realized with all host functionals fixed. It claims no physical implementation, and under a supplied promise P_η (Theorem (c)) the family is cut off at the promised bound. O1 stays open. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

No enlargement beyond the named label

Corollary (No enlargement beyond the named label).

• *No reorganization changes N_{GH} (Theorem). A map that ``enlarges the accessible dimension beyond $N_{\mathrm{GH}}(H)$'' either changes declared data, which leaves N_{GH} unchanged, or changes H, which is not a reorganization but a change of the prescribed host.*

• *Let the declared data be host-uniform and the data map $D(H,\Delta) = \Delta$. The target $\tau = N_{\mathrm{GH}}$ is not constant on fibres of D. So no function of the declared data produces N_{GH}, and every attempt errs by at least $\frac{1}{2}|N_{\mathrm{GH}}(H_1) - N_{\mathrm{GH}}(H_2)|$ on some pair.*

Proof. (a) is Theorem (a). (b) is Theorem : N_{GH} is strictly monotone in H.

par *Non-claim.* This permanent negative certificate concerns the named label on a prescribed host. It says nothing about the external conjecture itself. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

O5 for one named figure of merit

Definition (Complete *q*-bit report certificate). Fix $q \in \mathbb{N}_0$. Let $\mathcal{R}_q$ be the class of complete finite report laws P on the fixed alphabet $\Sigma_q = \{0,1\}^q$, every failure and auxiliary label being encoded in that alphabet. Put $Q_{\mathrm{alph}}(P) = \log_2 |\mathrm{supp}\, P|$ and $B_q = q$.

Corollary (Exact named O5 bound; the meaning of an overrun). *On $\mathcal{R}_q$, $Q_{\mathrm{alph}}(P) \le q$, with equality for the uniform law, and every class-preserving reorganization respects the ceiling. Appending an independent fair bit to the uniform report gives $Q_{\mathrm{alph}} = q + 1$, but the result is not in $\mathcal{R}_q$: it exceeds the bound only by changing the certified complete interface, as in Corollary . Appending any coefficient-blind report, inside or outside $\mathcal{R}_q$, supplies no coefficient information (Theorem).*

Proof. The support has at most 2^q points, with equality for the uniform law. The product with an independent fair bit has 2^{q+1} support points and needs the larger alphabet. The last assertion is Theorem (a). Check C-47 and negative control N-47.

par *Non-claim.* This is adopted from the supplied findings after verification and scoped (Appendix , F7): it settles O5 for one named figure of merit on one named class. It is not a physical memory-capacity bound, and printing an arbitrary bound does not make it true; a certificate for the named class is required. O5 in its general form stays open. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Coefficient and dynamics certificates

This section collects the negative certificates: statements that a named target is not a function of the admitted data of Definition , with exact minimax values where the target space is bounded. None of them constructs a state, a noise model, a Hilbert space or a dynamics.

The coefficient certificate

Theorem (Coefficient certificate).

• *For fixed admitted data, the maps $\kappa \mapsto T_{\mathrm{GH}}^{(\kappa)}$, $S_{\mathrm{GH}}^{(\kappa)}$, $N_{\mathrm{GH}}^{(\kappa)}$ are injective on $(0,\infty)$, with ranges $(0,\infty)$, $(0,\infty)$ and $(1,\infty)$.*

• *Consequently no rule F of the admitted data alone (host-aware or not) reproduces $T_{\mathrm{GH}}^{(\kappa)}$ for two values of κ; on the family $\kappa \in (0,\infty)$ every such rule has infinite worst-case error, for each of the three labels. The same holds for*

any finite list of admitted readings.

• *A rule reproduces the named value T_{GH} (or S_{GH}, N_{GH}) for every account exactly when it contains the coefficient $\hbar$ as a supplied input; supplying it is supplying a quantum coefficient, which the ledger refuses.*

Proof. (a) $T_{\mathrm{GH}}^{(\kappa)}$ is linear and $S_{\mathrm{GH}}^{(\kappa)}$ is proportional to $1/\kappa$, with positive factors fixed by the admitted data; exp is injective. (b) The accounts with coefficient $\kappa_1 \neq \kappa_2$ have identical admitted data, so F takes one value on both, while the targets differ; apply Theorem and let κ range over $(0, \infty)$. Finite lists of readings are functions of the admitted data. (c) By (b), a rule exact on the family depends on κ; conversely $(H, \kappa) \mapsto \kappa H/(2\pi k_B)$ is such a rule.

par *Non-claim.* This is a bookkeeping certificate: it states that the three labels are not functions of the admitted classical data, so O2 (a derivation of T_{GH} or S_{GH} from an Enter instrument) is closed negatively in the admitted class and stays open only in a form that supplies $\hbar$, which is refused. It does not say that the labels are unphysical, and it does not evaluate them differently: Theorem (c) still evaluates the named formula at the SI value of $\hbar$, as a supplied evaluation. Combined with Theorems (b) and , the dimension N_{GH} of O1 is neither forced by free declared data nor computable from admitted data. For O6, a thermal noise model ``at T_{GH}'' needs the supplied value T_{GH}, in addition to the Hamiltonian, bath and interaction of Proposition . No quantum coefficient is admitted. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Adaptive experiments

Definition (Coefficient-blind finite adaptive experiment). Fix a finite number n of rounds. The initial law P_0^a, the decision kernels $K_{r+1}^a(\mathrm{d}e \mid h)$ and the report kernels $L_{r+1}^a(\mathrm{d}z \mid h, e)$ are specified functions of the admitted data a and the past transcript h, and their *actual laws* do not depend on κ. All outcomes, failures and stopping labels are retained; early stopping is padded with an absorbing halt symbol. A preparation whose law depends on κ is excluded even when the dependence is hidden in a supplied label.

Theorem (Adaptive coefficient blindness and sharp finite-list risk).

• *Every experiment of Definition has the same complete transcript law for every κ, and so does every coefficient-blind randomized post-processing of it. The same holds for finite adaptive quantum experiments whose preparations and complete instruments are coefficient-independent, including retained quantum memories and untouched references.*

• *Let Y be a real estimate obtained in this way, let $t_1, \ldots, t_M$ be a finite list of candidate target values, and put $t_- = \min_i t_i$, $t_+ = \max_i t_i$. Then*

$$\inf_Y \max_i \mathbb{E}|Y - t_i| = \frac{t_+ - t_-}{2}.$$

• *If the t_i have pairwise separation greater than 2ε, then $\min_i \Pr_i\{|Y - t_i| \le \varepsilon\} \le 1/M$.*

• *On the unrestricted family $t = T_{\mathrm{GH}}^{(\kappa)}$, $\kappa > 0$, every such Y has $\sup_\kappa \mathbb{E}_\kappa|Y - T_{\mathrm{GH}}^{(\kappa)}| = \infty$.*

Proof. (a) If the first r rounds have a common law P_r^a, the law after round $r+1$ is $P_r^a(\mathrm{d}h)K_{r+1}^a(\mathrm{d}e \mid h)L_{r+1}^a(\mathrm{d}z \mid h, e)$, a product of common factors; induct on r and compose with the common post-processing kernel. In the quantum case every branch of the finite outcome tree is a composition of the same completely positive maps on every account, so the subnormalized branch outputs, their probabilities and their reference extensions coincide; sum over the tree. (b) Under the common law of Y, $|Y - t_-| + |Y - t_+| \ge t_+ - t_-$; take expectations. The midpoint $Y = (t_- + t_+)/2$ attains the value. (c) The M success events are disjoint under the common law. (d) Y is finite almost surely, so $\Pr\{|Y| \le K\} \ge \frac{1}{2}$ for some $K < \infty$, and $\mathbb{E}|Y - t| \ge (t - K)/2$ for $t > K$; $T_{\mathrm{GH}}^{(\kappa)}$ is unbounded in κ. Checks C-41 and C-41b verify (a)–(d) on an exact three-round example and by linear programming; N-41a shows that a κ-dependent report kernel breaks (a).

par *Non-claim.* This is adopted from the supplied findings after verification (Appendix , F2). The theorem

excludes learning the omitted coefficient by adaptive reuse of coefficient-blind data; it is not a cardinality argument, and a finite-outcome device with a κ-sensitive law simply violates its hypothesis. It is the local Big01-A instance of the comparison with Big04-A-coeff thm:C-adaptive [Big04Acoeff](source record; not a premise); no radiation-label dictionary or orbit is used, and no confounding claim is made for a data contract that includes the parameter. Part (b) is finite only because the list is finite; it supplies no value of κ. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Thermal targets

Fix a finite Hermitian energy Hamiltonian K on $\mathbb{C}^d$ whose eigenvalues do not depend on κ, and put

$$\beta_\kappa = \frac{1}{k_B T_{\mathrm{GH}}^{(\kappa)}} = \frac{2\pi}{\kappa H}, \qquad \gamma_\kappa = \frac{e^{-\beta_\kappa K}}{\operatorname{Tr} e^{-\beta_\kappa K}}.$$

Definition (Temperature-identifying thermal target). A target package is *temperature-identifying* if it contains (i) the numerical label $T_{\mathrm{GH}}^{(\kappa)}$, or (ii) the exact state γ_κ for a fixed nonscalar K, or (iii) a specified channel whose unique stationary state is γ_κ, with the same fixed nonscalar K. Membership in a temperature-dependent class of thermal operations is not this requirement.

Theorem (Thermal identifiability). *For the admitted data:*

• *If K is nonscalar, $\kappa \mapsto \gamma_\kappa$ and $\kappa \mapsto \mathscr{R}_{\gamma_\kappa}$ are injective, and no rule of the admitted data identifies either family on two coefficient values.*

• *No rule of the admitted data identifies a temperature-identifying package over $\kappa \in (0, \infty)$; in particular one channel cannot have both γ_{κ_0} and γ_{κ_1}, $\kappa_0 \neq \kappa_1$, as its unique stationary state.*

• *On two coefficient accounts the exact minimax error for the Gibbs state is*

$$\inf_{\hat{\gamma}} \max_{i\,=\,0,1} d_{\mathrm{tr}}(\hat{\gamma}, \gamma_{\kappa_i}) = \tfrac{1}{2} d_{\mathrm{tr}}(\gamma_{\kappa_0}, \gamma_{\kappa_1}),$$

and the same value holds in half-diamond distance for the replacement targets $\mathscr{R}_{\gamma_{\kappa_i}}$. Randomizing the rule does not lower it.

• *For the qubit Hamiltonian $K = \Delta \mathrm{proj}\, 1$, $\Delta > 0$, $\inf_{\hat{\gamma}} \sup_{\kappa > 0} d_{\mathrm{tr}}(\hat{\gamma}, \gamma_\kappa) = \frac{1}{4}$, attained by $\hat{\gamma} = \operatorname{diag}(3/4, 1/4)$; the same value holds for the replacement targets. The bounded state loss is not assigned the infinite risk of the temperature label.*

• *Thermal membership is not excluded: the identity channel is a thermal operation at every positive temperature, and for scalar K the state I/d is the Gibbs state at every temperature and $\mathscr{R}_{I/d}$ is thermal at every temperature. These identify no temperature.*

Proof. (a) If $E_i \neq E_j$ are eigenvalues of K with γ_κ-eigenvalues $p_i, p_j > 0$, then $\log(p_i/p_j) = -2\pi(E_i - E_j)/(\kappa H)$, which inverts to κ. Equal replacement channels have equal outputs. A rule of the admitted data has one output on both accounts; Theorem . (b) A rule outputs one number, one state or one channel on accounts with equal admitted data, and a unique stationary state is unique. (c) Lower bound: the triangle inequality, integrated against the common output law for randomized rules; upper bound: the midpoint $(\gamma_{\kappa_0} + \gamma_{\kappa_1})/2$. For replacement channels, $\frac{1}{2}\|\mathrm{repl}\,\rho - \mathrm{repl}\,\sigma\|_\diamond = d_{\mathrm{tr}}(\rho, \sigma)$, since on any input the referenced output difference is the reference marginal tensored with $\rho - \sigma$; evaluating an arbitrary approximating channel on one fixed input gives the same two-point lower bound, and the midpoint replacement attains it. (d) The excited probability is $p_\kappa = (1 + e^{2\pi\Delta/(\kappa H)})^{-1}$, with range $(0, \frac{1}{2})$. Energy-basis measurement contracts trace distance, so an estimate with excited probability q has worst-case error at least $\sup_{0 < p < 1/2} |q - p| \geq \frac{1}{4}$, with equality at $q = \frac{1}{4}$ and the diagonal state. (e) The identity is realized with a trivial bath and the identity interaction. If K is scalar, $e^{-\beta K}$ is scalar. A swap with a copy of the Gibbs system commutes

with the sum Hamiltonian and implements $\mathscr{R}_{I/d}$. Checks C-37 to C-40 verify (a)–(e) numerically and symbolically, with mutations M-38 and M-39 and negative control N-37 (scalar K).

par *Non-claim.* This is adopted from the supplied findings after verification (Appendix , F1). It sharpens the O6 part of Theorem to exact state and channel minimax values; it identifies no physical noise model, bath, detector or reservoir, and no Bunch–Davies state is constructed. The thermal exceptions and the remaining channel-choice ambiguity are recorded separately in Big03-A prop:R-thermal and Big03-A thm:R-O6-minimax [Big03A](source record; not a premise); that sheet's criteria are conditional on a further certificate there, and no supplied-coefficient evaluation from it is performed here. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Remark (Energy versus frequency). The hypothesis that the *energy* Hamiltonian is fixed independently of κ is essential. If one declares $K_\kappa = \kappa A$ for a fixed generator A with inverse-time units, then $\gamma_\kappa = e^{-2\pi A/H}/\mathrm{Tr}\, e^{-2\pi A/H}$ is coefficient-independent even when A is nonscalar. This does not supply $T^{(\kappa)}_{\mathrm{GH}}$, an energy calibration, or a physical realization of $K_\kappa = \kappa A$.

Remark (A stationary state does not select a noise channel). For a fixed state γ the channels $\Phi_{r,t} = e^{-rt}\,\mathrm{id} + (1 - e^{-rt})\mathrm{repl}\,\gamma$, $r, t > 0$, are CPTP (convex combinations), pairwise distinct for distinct rt, have γ as unique stationary state, and satisfy $\Phi_{r,t}(X) - \mathrm{Tr}\,(X)\gamma = e^{-rt}(X - \mathrm{Tr}\,(X)\gamma)$. Identifying a stationary state is not identifying a relaxation rate, an interaction or a noise channel (check C-40).

Exact dimensions and rounded labels

Theorem (An exponential label is not an identified Hilbert space dimension). *Let $x = B_H/\kappa$, so that $N^{(\kappa)}_{\mathrm{GH}} = e^x$.*

• No rule of the admitted data identifies $N^{(\kappa)}_{\mathrm{GH}}$ on two coefficient values. If an additional datum asserts exactly $\dim \mathscr{H} = n = N^{(\kappa)}_{\mathrm{GH}}$, then $n \in \mathbb{N}$, $n \geq 2$ and $\kappa = B_H/\ln n$: the exact assertion, not the declaration of an n-dimensional register, encodes the coefficient.

• Exact equality is possible only on the countable set $\{B_H/\ln n : n \geq 2\}$; for every other $\kappa > 0$, $N^{(\kappa)}_{\mathrm{GH}}$ is not the dimension of a finite Hilbert space.

• Rounding has no such inverse: for $n \geq 2$, $\lfloor N^{(\kappa)}_{\mathrm{GH}} \rfloor = n$ if and only if $B_H/\ln(n+1) < \kappa \leq B_H/\ln n$, and $\lfloor N^{(\kappa)}_{\mathrm{GH}} \rfloor = 1$ if and only if $\kappa > B_H/\ln 2$. A capacity inequality or an unspecified $\dim \mathscr{H}$ $\mathrm{sim}N_{\mathrm{GH}}$ likewise does not give the inversion of (a).

• On the declared-register class, enlarging q qubits to $q + n$ changes the declared dimension from 2^q to 2^{q+n} without changing the host or $N^{(\kappa)}_{\mathrm{GH}}$. No coefficient-blind reorganization rule makes the declared dimension equal to $N^{(\kappa)}_{\mathrm{GH}}$ on every coefficient account, although equality occurs on the specially chosen account $\kappa = B_H/(q\ln 2)$, $q \geq 1$.

Proof. $e^{B_H/\kappa}$ is strictly decreasing in κ, so equal admitted data cannot identify its different values; taking logarithms gives the inverse, and $N^{(\kappa)}_{\mathrm{GH}} > 1$ forces $n \geq 2$. This proves (a) and (b). For (c), $n \leq e^{B_H/\kappa} < n + 1$ is equivalent to $\ln n \leq B_H/\kappa < \ln(n+1)$; invert. For (d), the enlargement changes only a declared tensor factor, so its output is one integer on accounts with equal admitted data, while $N^{(\kappa)}_{\mathrm{GH}}$ varies; substitution gives the special equality. Check C-43 verifies (a)–(d) with dimensionless B_H on rational κ-grids, mutation M-43 shows that the left endpoint must be open, and N-43 shows that the naive inverse $B_H/\ln\lfloor N_{\mathrm{GH}} \rfloor$ misses κ off the countable set.

par *Non-claim.* This is adopted from the supplied findings after verification (Appendix , F3). With the coefficient held fixed, $N^{(\kappa)}_{\mathrm{GH}}(H)$ is a host functional, while a freely declared register dimension is not (Theorems (b) and). ``No reorganization produces the exponential'' therefore means no derivation or uniform identification from the admitted data; numerical coincidence with a declared dimension does occur. Neither knowing κ nor printing n constructs a static-patch Hilbert space; O1 stays open. Ledger unchanged: no quantum coefficient is admitted;

Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Dynamics is not host data

Proposition (Dynamics certificate).

• *Vacuity. For every prescribed C^2 metric g the tensor $\Theta[g] = G[g] + \Lambda g$ is symmetric and divergence-free (contracted Bianchi identity). So ``g satisfies $G[g] + \Lambda g = \kappa T$ for some conserved symmetric T'' holds for every host and every $\kappa \neq 0$; it selects nothing unless a matter law for T is supplied.*

• *Separation. On the smooth comparison futures of Proposition , with $\Lambda = 3H_1^2/c^2$, Θ vanishes on $t \leq 0$ for every K, while for $t \geq 1$ its tt-component is $3(K^2 - H_1^2)$ (in units with the c factors of the metric); so futures with different K share all data on $t \leq 0$, in particular every flat-patch report, and have different Θ on $t \geq 1$.*

• *Hence no rule from data on $t \leq 0$ (reports, flat-patch metric, declared data) to the tensor Θ on $t \geq 1$, or to any supplied matter law reproducing it, is correct on the family; the two-point minimax error is $\frac{3}{2}|K_1^2 - K_2^2|$ in the tt -component, and it is unbounded over $K \in [0, \infty)$.*

Proof. (a) $\nabla^a G_{ab} = 0$ and $\nabla g = 0$. (b) For $-c^2\mathrm{d}t^2 + a(t)^2\mathrm{d}\mathbf{x}^2$ the *tt*-component of G is $3\dot{a}^2/a^2 = 3H(t)^2$ and that of Λg is $-\Lambda c^2$; check C-35 computes both symbolically. With $H = H_1$ on $t \leq 0$, $H = K$ on $t \geq 1$ and $\Lambda c^2 = 3H_1^2$, the values are 0 and $3(K^2 - H_1^2)$. (c) Theorem with the separation in (b).

par *Non-claim.* The certificate says that every host here is a prescribed comparison and that host data do not determine a dynamics: the left-hand side of an Einstein equation is defined for every prescribed metric, and choosing a matter law is a separate input. No Einstein dynamics is posed or derived, no metric is derived, and no evolution of the host is claimed. O8 (dynamics) is closed as a negative certificate in this form; a dynamics would have to be supplied. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Horizon labels do not identify a vacuum ambiguity

Work on a connected four-dimensional Einstein region of the prescribed host, $\mathrm{Ric} = \frac{R}{4}g$ with $R = 12H^2/c^2$. Fix one conserved symmetric comparison tensor T_*, let $G[g]$ be the Einstein tensor, and let $E^{(1)}$ and $E^{(2)}$ be the Euler–Lagrange tensors of $\int R^2\,\mathrm{dvol}_g$ and $\int R_{ab}R^{ab}\,\mathrm{dvol}_g$ under compactly supported metric variations. Consider the declared comparison family

$$T_{\mathbf{c}} = T_* + c_0\, g + c_G\, G[g] + c_1 E^{(1)}[g] + c_2 E^{(2)}[g], \qquad \mathbf{c} = (c_0, c_G, c_1, c_2) \in \mathbb{R}^4,$$

each coefficient in its fixed unit. The family is a comparison device; it does not assert that every subtraction prescription or matter theory admits all four directions.

Theorem (Vacuum fibre: non-identification and exact rank).

• *Every member is symmetric and conserved, and on the Einstein region $T_{\mathbf{c}} = T_* + \lambda(\mathbf{c})\, g$ with $\lambda(\mathbf{c}) = c_0 - \frac{R}{4}c_G$.*

• *The coefficient-to-tensor map is the rank-one row $L_R = (1, -R/4, 0, 0)$, with kernel*
$\mathrm{span}\,\{(R/4, 1, 0, 0), (0, 0, 1, 0), (0, 0, 0, 1)\}$*; the restricted tensors form an affine line.*

• *If the admitted reports do not depend on $\mathbf{c}$, they identify neither λ nor $\mathbf{c}$, and adjoining horizon labels, even as separately supplied numbers, changes nothing while they stay independent of $\mathbf{c}$. For $\lambda \in [\lambda_-, \lambda_+]$ the exact absolute minimax error is $(\lambda_+ - \lambda_-)/2$; on the unrestricted family it is infinite.*

• *If $T_{\mathbf{c}} - T_*$ is separately supplied, it determines λ but leaves the affine fibre $\mathbf{c} + \ker L_R$. The energy-density ambiguity seen by a unit-normalized timelike vector, $g(u,u) = -1$, is $(T_{\mathbf{c}} - T_*)(u,u) = -\lambda$; for the host four-velocity, normalized by $g(u,u) = -c^2$, it is $-\lambda c^2$. Without coefficient-sensitive data its sign and magnitude are undetermined in this family.*

Proof. (a) g and $G[g]$ are conserved by metric compatibility and the contracted Bianchi identity. For either

quadratic action, invariance under a compactly supported vector field ξ gives $0 = -2\int \xi^b \nabla^a E^{(i)}_{ab}\,\mathrm{dvol}_g$ after integration by parts, so $E^{(i)}$ is conserved; symmetry follows from metric variation. On a connected Einstein region R is constant (contracted Bianchi identity), so all derivative terms of $E^{(1)}$, $E^{(2)}$ vanish, and the algebraic terms cancel: $2R\cdot\frac{R}{4}g - \frac{1}{2}R^2 g = 0$ and $2R_{acbd}R^{cd} - \frac{1}{2}g_{ab}R_{cd}R^{cd} = 2\cdot\frac{R}{4}\cdot\frac{R}{4}g_{ab} - \frac{1}{2}g_{ab}\frac{R^2}{4} = 0$; an overall sign convention does not affect these zeros. With $G = -\frac{R}{4}g$ this is (a). (b) $L_R \neq 0$ and the three displayed vectors are independent and annihilated by it; $g \neq 0$, so different λ give different tensors. (c) Two accounts with equal host, labels and reports and different λ give every rule one output; Theorem gives half the separation, the midpoint attains it on a bounded interval, and unbounded λ gives infinite risk. (d) Equality of the supplied tensors is equality of $L_R\mathbf{c}$; contract λg with u. Check C-42 verifies (a) and (b) symbolically on the flat de Sitter chart, M-42a and M-42b reject a wrong coefficient and a wrong kernel vector, and N-42 shows on a non-Einstein FLRW metric that the Einstein hypothesis is needed.

par *Non-claim.* This is adopted from the supplied findings after verification, with the host-velocity normalization added in (d) (Appendix , F3, DC-3). A convention may choose $\mathbf{c} = 0$ or any other representative; the theorem says only that such a choice is not identification from unchanged data. The local calculation is the comparison with Big03-A prop:R-vac-sep [Big03A](source record; not a premise), DS-OB-1-fibre thm:F-einstein [DSOB1fibre] and VC-OB-1-CERT prop:s2-vac [VCOB1CERT](source record; not a premise). It supplies no absolute vacuum energy, renormalization condition, matter law or value of the cosmological constant, and it constructs no gravitational dynamics: the absolute vacuum energy stays open. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

E: epoch dependence, documentary only

Proposition (Two-epoch comparison host). *Let $H_1 > H_2 > 0$, and prescribe on $\mathbb{R}\times\mathbb{R}^3$ the flat FLRW line element $-c^2\mathrm{d}t^2 + a(t)^2\mathrm{d}\mathbf{x}^2$ with $a = e^{H_1 t}$ for $t \le 0$ and $a = e^{H_2 t}$ for $t \ge 0$. This is a Lipschitz comparison host: it is not a solution of any field equation here, and it is neither Host A nor Host B. Its event-horizon radius $R_e(t) = a(t)\int_t^\infty c\,\mathrm{d}s/a(s)$ is*

$$R_e(t) = \frac{c}{H_1} + \left(\frac{c}{H_2} - \frac{c}{H_1}\right)e^{H_1 t} \quad (t \le 0), \qquad R_e(t) = \frac{c}{H_2} \quad (t \ge 0),$$

and $\dot{R}_e = HR_e - c$ on $t < 0$. Hence, during the first epoch:

- *$c/H_1 < R_e(t) < c/H_2$ for $t < 0$, $R_e(0) = c/H_2$, and R_e is strictly increasing on $(-\infty, 0]$;*
- *$R_e(t)$ differs from the apparent radius $R_A = c/H_1$ by $(c/H_2 - c/H_1)e^{H_1 t}$, an amount fixed by the prescribed future H_2 ;*
- *the area label $4\pi R_e^2$ and the entropy label computed from it are therefore not functions of the instantaneous expansion rate. Moreover $S_{\mathrm{GH}}(H_1) < S_{\mathrm{GH}}(H_2)$, with ratio $(H_2/H_1)^2$.*

Proof. For $t \le 0$,

$$R_e(t) = e^{H_1 t}\left(\int_t^0 ce^{-H_1 s}\mathrm{d}s + \int_0^\infty ce^{-H_2 s}\mathrm{d}s\right) = \frac{c}{H_1}(1 - e^{H_1 t}) + \frac{c}{H_2}e^{H_1 t}.$$

For $t \ge 0$ the integral is that of Theorem . The ODE is Red06-G prop:horizons and is verified in check C-13; the closed form is check C-4. Parts (a)–(c) follow by inspection, and the ratio follows from Definition .

par *Non-claim.* The analogy's sentence ``for any fixed patch the capacity is capped by the horizon visible at that moment" is refined as follows. The event horizon depends on the entire prescribed future, and only the apparent radius $c/H(t)$ is local. This matches Red06-G-DSS thm:R-Re2: on intervals bounded above, constancy of R_e does not determine the model. A declared interpolation between two de Sitter labels leaves the de Sitter family (V-DST-DSS thm:V-beta(d)), and its allowance is bounded by $\beta < H_+^2 - H_-^2$ (V-DST-DSS thm:V-betaall) with the

closed-form profile of V-DST-DSS thm:V-profile. No inflationary or late-time dynamics is derived, and no evolution of the host is claimed. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Theorem (E-future: one number carries the future). *Let $H_1 > 0$, and let $a : \mathbb{R} \to (0,\infty)$ be continuous with $a(t) = e^{H_1 t}$ for $t \le 0$. Prescribe $-c^2\mathrm{d}t^2 + a(t)^2\mathrm{d}\mathbf{x}^2$, and put $R_0 := c\int_0^\infty \mathrm{d}s/a(s) \in (0,\infty]$.*

• *If $R_0 < \infty$, then for $t \le 0$*

$$R_e(t) = \frac{c}{H_1} + (R_0 - \frac{c}{H_1})e^{H_1 t}, \qquad \frac{\partial R_e(t)}{\partial R_0} = e^{H_1 t}.$$

If $R_0 = \infty$, no comoving observer has an event horizon at any time.

• *Realizability. Every $R_0 \in (0,\infty]$ is realized by a future that agrees with the given metric on $t \le 0$: take $a(t) = e^{ct/R_0}$ for $t \ge 0$ if $R_0 < \infty$, and $a(t) = 1 + t$ if $R_0 = \infty$.*

• *Minimax error. Let F be any rule that assigns a radius to the metric restricted to $t \le 0$. Over the futures with $R_0 \in [R_-, R_+]$, its worst-case error at time $t \le 0$ is at least $\frac{1}{2}(R_+ - R_-)e^{H_1 t}$. The midpoint rule $F = \frac{c}{H_1} + (\frac{R_- + R_+}{2} - \frac{c}{H_1})e^{H_1 t}$ attains this value. Over all futures, the worst-case error is infinite.*

• *Exponential forgetting. $|R_e(t)H_1/c - 1| = |H_1 R_0/c - 1|\, e^{H_1 t}$. For $R_0 \ne c/H_1$ and $0 < \varepsilon < |H_1 R_0/c - 1|$, this is at most ε if and only if $t \le H_1^{-1}\ln(\varepsilon/|H_1 R_0/c - 1|)$. For the two-epoch host of Proposition , $R_0 = c/H_2$, and the bound reads $t \le H_1^{-1}\ln(\varepsilon H_2/(H_1 - H_2))$.*

• *Direction. On $t < 0$, R_e is strictly increasing if $R_0 > c/H_1$, constant if $R_0 = c/H_1$, and strictly decreasing if $R_0 < c/H_1$. The entropy label computed from R_e equals $S_{\mathrm{GH}}(H_1)(1 + (H_1 R_0/c - 1)e^{H_1 t})^2$.*

Proof. (a) For $t \le 0$, $R_e(t) = e^{H_1 t}(\int_t^0 ce^{-H_1 s}\mathrm{d}s + R_0) = \frac{c}{H_1}(1 - e^{H_1 t}) + R_0 e^{H_1 t}$. If $R_0 = \infty$, the integral defining R_e diverges. (b) $\int_0^\infty e^{-cs/R_0}\mathrm{d}s = R_0/c$ and $\int_0^\infty \mathrm{d}s/(1+s) = \infty$; both choices are continuous at 0. (c) Two futures with $R_0 = R_\pm$ give the same restricted metric. Apply Theorem with the separation $(R_+ - R_-)e^{H_1 t}$ from (a). The midpoint rule has error $|R_0 - \frac{R_- + R_+}{2}\mathrm{rverte}^{H_1 t} \le \frac{1}{2}(R_+ - R_-)e^{H_1 t}$. For the last claim let $R_+ \to \infty$. (d) and (e) follow from (a) and Definition , with $S_{\mathrm{GH}} \propto R_e^2$ (check C-19).

par *Non-claim.* This quantifies ``the horizon visible at that moment". The event horizon during an epoch is fixed by one number from the prescribed future. The apparent radius c/H_1 is local. Every future is prescribed: no inflationary or late-time dynamics, field equation or evolution of the host is derived. The comparison metrics are neither Host A nor Host B. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Proposition (E-smooth: smooth comparison futures). *Let $\chi(t) = f(t)/(f(t) + f(1-t))$ with $f(u) = e^{-1/u}$ for $u > 0$ and $f(u) = 0$ for $u \le 0$. So χ is C^∞, $\chi = 0$ on $(-\infty, 0]$, $\chi = 1$ on $[1,\infty)$, and $0 < \chi < 1$ on $(0,1)$. For $H_1 > 0$ and $K \ge 0$ declare the Hubble profile $H_K = H_1(1-\chi) + K\chi$, put $a_K(t) = \exp\int_0^t H_K$, and prescribe $-c^2\mathrm{d}t^2 + a_K(t)^2\mathrm{d}\mathbf{x}^2$ on $\mathbb{R}\times\mathbb{R}^3$. Let $R_0(K) = c\int_0^\infty \mathrm{d}s/a_K(s)$.*

• *The host is C^∞. It coincides with the flat chart of DSS_{H_1} on $t \le 0$. For $K > 0$ and $t \ge 1$ it is, after the constant rescaling $\mathbf{x} \mapsto a_K(1)e^{-K}\mathbf{x}$, a region of the flat chart of DSS_K; for $K = 0$ it is flat on $t \ge 1$. Its profile H_K is monotone.*

• *Two smooth epochs. Let $H_1 > H_2 > 0$ and $K = H_2$. Then $c/H_1 < R_0(H_2) < c/H_2$. On $t \le 0$, $R_e(t) = c/H_1 + (R_0(H_2) - c/H_1)e^{H_1 t}$, which is strictly increasing; on $t \ge 1$, $R_e = c/H_2$. The first-epoch horizon lies*

strictly below that of the Lipschitz host of Proposition , by $(c/H_2 - R_0(H_2))e^{H_1 t}$.

• *Smooth realizability.* $K \mapsto R_0(K)$ *is continuous and strictly decreasing on* $(0,\infty)$, *with* $R_0(H_1) = c/H_1$, $R_0(K) \to \infty$ *as* Kdownarrow 0, $R_0(K) \to 0$ *as* $K \to \infty$, *and* $R_0(0) = \infty$. *Hence every* $R_0 \in (0,\infty]$ *is realized by a* C^∞ *future that agrees with* DSS_{H_1} *on* $t \le 0$.

• *Consequently Theorem (b) and (c) hold verbatim with ``future'' replaced by ``*C^∞ *future'': the minimax error over smooth futures with* $R_0 \in [R_-, R_+]$ *is exactly* $\frac{1}{2}(R_+ - R_-)e^{H_1 t}$, *and it is infinite over all smooth futures.*

Proof. (a) χ is the standard smooth step, so H_K and a_K are C^∞, and the metric is smooth. For $t \le 0$, $H_K = H_1$ and $a_K = e^{H_1 t}$. For $t \ge 1$, $a_K(t) = a_K(1)e^{K(t-1)}$. H_K is a convex combination of H_1 and K with weight χ, which is nondecreasing; so H_K is nonincreasing if $K \le H_1$ and nondecreasing otherwise.

(b) For $s > 0$ the profile satisfies $H_2 \le H_{H_2} \le H_1$, with both inequalities strict on $(0, \min(s,1))$. So $H_2 s < \int_0^s H_{H_2} < H_1 s$, and $e^{-H_1 s} < 1/a_{H_2}(s) < e^{-H_2 s}$. Integrating gives the strict bounds. Theorem (a),(e) give the formula and its monotonicity on $t \le 0$. For $t \ge 1$, $R_e(t) = a(t)\int_t^\infty c\,\mathrm{d}s/a(s) = c/H_2$. The difference from Proposition is Theorem (a) applied to both hosts.

(c) For $s > 0$ and $K < K'$, $H_K < H_{K'}$ on $(0,s)$, where $\chi > 0$, so $1/a_K(s) > 1/a_{K'}(s)$, and R_0 is strictly decreasing. For $K \ge K_0 > 0$, $1/a_K \le 1/a_{K_0}$, which is integrable. Dominated convergence gives continuity on $[K_0,\infty)$, and also $R_0(K) \to 0$ as $K \to \infty$, since $\int_0^s \chi > 0$ for every $s > 0$. For $K \le H_1$, $\int_0^1 H_K \le H_1$, so $R_0(K) \ge c\int_1^\infty e^{-H_1 - K(s-1)}\mathrm{d}s = ce^{-H_1}/K \to \infty$. At $K = H_1$ the host is DSS_{H_1}, and at $K = 0$, a_0 is constant on $[1,\infty)$. Apply the intermediate value theorem.

(d) The proof of Theorem (c) uses only two futures with $R_0 = R_\pm$ and the same restriction to $t \le 0$. By (c) both can be chosen smooth.

par *Non-claim.* Proposition closes the smoothness part of open item O8. The profile H_K is declared, not derived; no field equation, energy condition, inflationary or late-time dynamics is solved or claimed, and the comparison hosts are neither Host A nor Host B. Checks C-22 and C-23 evaluate $R_0(H_2) = 0.689250$ at $H_1 = 2$, $H_2 = 1$, $c = 1$, and the monotone map $K \mapsto R_0(K)$. The dynamics part of O8 is closed only as the negative certificate of Proposition ; no dynamics is posed. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Proposition (What a constant event horizon fixes). *Let* $a : \mathbb{R} \to (0,\infty)$ *be* C^1, *and suppose the event-horizon radius* $R_e(t) = a(t)\int_t^\infty c\,\mathrm{d}s/a(s)$ *is finite and equal to a constant* $R > 0$ *for all* $t \in \mathbb{R}$. *Then* $a(t) = Ae^{ct/R}$ *for some* $A > 0$*: the flat FLRW patch is the flat chart of* $\mathrm{DSS}_{c/R}$, *up to spatial normalization. It does not determine any extension of that patch.*

Proof. $\dot{R}_e = (\dot{a}/a)R_e - c$ (Red06-G prop:horizons). Constancy gives $\dot{a}/a = c/R$, and integration gives the formula. Conversely $a = Ae^{ct/R}$ has $\dot{R}_e \equiv R$ (check C-28).

par *Non-claim.* This is the all-time converse of Red06-G-DSS thm:R-Re(a). On intervals bounded above the converse fails (Red06-G-DSS thm:R-Re2). The proposition is adopted from the user draft after verification; no field equation is used or derived. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Remark (A second smooth family). The user draft realizes every R_0 with $a_K(t) = \exp(H_1 t + K\chi(t))$, $K \in \mathbb{R}$, which is not monotone in its Hubble rate. Its junction integral $I(K) = c\int_0^\infty e^{-H_1 s - K\chi(s)}\mathrm{d}s$ is strictly decreasing, tends to 0 as $K \to \infty$ and to ∞ as $K \to -\infty$, and $a_\infty(t) = \exp(H_1 t(1-\chi(t)))$ gives $R_0 = \infty$; check C-28 evaluates $I(K)$ at five

values. We verified this argument. Proposition (c) gives the same conclusion with a monotone declared profile. The draft's displayed definition of χ is truncated in its source (Appendix); we read it as the standard smooth step.

Proposition (E-analytic).

• If $a > 0$ is real analytic on an interval $I \supseteq (-\infty, 0]$ and $a = e^{H_1 t}$ on $t \le 0$, then $a = e^{H_1 t}$ on I; if $I \supseteq [0, \infty)$, the junction radius of Theorem is $R_0 = c/H_1$. So over analytic futures the minimax error of Theorem (c) is 0, and every future with $R_0 \neq c/H_1$, in particular those of Proposition with $K \neq H_1$, is non-analytic at the junction.

• A connected smooth prescribed spacetime that contains an open de Sitter region of radius ℓ and a point where $R_{abcd} \neq \ell^{-2}(g_{ac}g_{bd} - g_{ad}g_{bc})$ embeds isometrically onto an open subset of no connected real-analytic Lorentzian manifold. This applies to the smooth two-epoch hosts of Proposition ($R = 12H_1^2/c^2$ versus $12H_2^2/c^2$) and to the conformal bump hosts ($12e^{-2b}/\ell^2 \neq 12/\ell^2$, check C-29).

• Incompleteness alone implies neither statement: the region $t < 1$ of $a = e^{Ht}$ is future incomplete and extends analytically with the same Hubble profile. For the branched host the analytic statement is Red06-G-DSS thm:R-ana (version 6), and version 7 of that sheet proves C^2-inextendibility (Red06-G-DSS thm:R-C2, version 7); no global FLRW profile on it is specified.

Proof. (a) Identity theorem for $a - e^{H_1 t}$; then $R_0 = c\int_0^\infty e^{-H_1 s}\mathrm{d}s$. (b) $Q = R - \ell^{-2} g \wedge g$ is analytic on the ambient manifold and vanishes on an open set, hence everywhere. (c) By inspection.

par *Non-claim.* The plan's sentence ``incomplete futures are not analytically extendable with a prescribed Hubble profile'' is false as stated, by (c); the correct statements are (a) and (b). No dynamics of the host is derived; the dynamics part of O8 is only the negative certificate of Proposition . Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Expansion histories: deadlines, drift, horizon bounds and finite memory

This section proves the six statements P1–P6 of the version-7 plan (Appendix). Each is a statement about a prescribed metric, a declared profile of the Hubble rate, or declared finite-dimensional data. The physical identifications that turn them into predictions, and the observations that would contradict those identifications, are separated in Section . Throughout, $R_e(t) = a(t)\int_t^\infty c\,\mathrm{d}s/a(s) \in (0, \infty]$ is the event-horizon radius of a comoving observer on a prescribed flat FLRW host $-c^2\mathrm{d}t^2 + a(t)^2\mathrm{d}\mathbf{x}^2$, and $H = \dot{a}/a$.

Comoving communication deadlines

Theorem (P1: comoving communication deadlines). *Let $H > 0$, and let $\gamma = \gamma_0$ be the comoving observer of Definition on DSS_H. Let $\rho = \gamma_{\mathbf{x}_\rho}$ be a comoving receiver with initial proper distance $R_0 = e^{Ht_0}|\mathbf{x}_\rho| > 0$ at time t_0. Signals are future-directed causal curves, reflection at ρ is instantaneous, and all times are measured along γ, whose proper time is t.*

• One way. A signal emitted by γ at t_0 can reach ρ by time $t_0 + \Delta$ ($\Delta > 0$) if and only if

$$R_0 \le \frac{c}{H}(1 - e^{-H\Delta}).$$

It can reach ρ at some finite time if and only if $R_0 < c/H$, that is, if and only if at time t_0 the receiver lies strictly inside the event-horizon sphere of γ, of areal radius c/H (Theorem (c)).

• Round trip. An exchange begun by γ at t_0 can return to γ by time $t_0 + \Delta$ if and only if

$$R_0 \le \frac{c}{2H}(1 - e^{-H\Delta}),$$

and a reply can return at some finite time if and only if $R_0 < c/(2H)$.

• Least round-trip time. For $R_0 < c/(2H)$ the least round-trip time is

$$T_{\mathrm{com}}(R_0) = -\frac{1}{H}\ln\left(1 - \frac{2HR_0}{c}\right) = \frac{2R_0}{c} + \frac{2HR_0^2}{c^2} + O(R_0^3),$$

attained exactly by radial null signals; $T_{\mathrm{com}}(R_0) \to \infty$ *as* R_0uparrow $c/(2H)$.

• *Comparison with the static shell. Let* $T_H(R) = (2/H)\mathrm{artanh}\,(HR/c)$ *be the echo minimum of Proposition for a shell of fixed areal radius R, and put* $x = HR/c$. *For* $0 < x < \frac{1}{2}$,

$$e^{HT_{\mathrm{com}}(R)} - e^{HT_H(R)} = \frac{2x^2}{(1-x)(1-2x)} > 0, \qquad \text{so} \qquad T_{\mathrm{com}}(R) > T_H(R).$$

For $\frac{1}{2} \le x < 1$ *the static echo time* $T_H(R)$ *is finite, while no comoving receiver at initial proper distance R can return a reply.*

• *Message without reply. If* $c/(2H) \le R_0 < c/H$, *then ρ receives the message sent at* t_0 *but no reply reaches γ. Signals emitted by ρ at times* $t < t_0 + H^{-1}\ln(c/(HR_0))$ *still reach γ; in particular all of the earlier light of ρ does.*

Proof. In conformal time $\eta = -e^{-Ht}/H$, Lemma says that $(\eta_2, \mathbf{x}_2) \in J^+(\eta_1, \mathbf{x}_1)$ if and only if $c(\eta_2 - \eta_1) \ge |\mathbf{x}_2 - \mathbf{x}_1|$. (a) The comoving distance to be covered is $r = |\mathbf{x}_\rho| = R_0 e^{-Ht_0}$, and $c(\eta(t_0 + \Delta) - \eta(t_0)) = (c/H)e^{-Ht_0}(1 - e^{-H\Delta})$. Since $\eta < 0$, the supremum over Δ is $(c/H)e^{-Ht_0}$, which is not attained; so finite reach holds iff $r < (c/H)e^{-Ht_0}$, iff $R_0 < c/H$. By Theorem (c),(d), the comoving radius of the horizon cut at t_0 is ce^{-Ht_0}/H. (b) If q is the reflection event, then $c(\eta_q - \eta_0) \ge |\mathbf{x}_q|$ and $c(\eta_2 - \eta_q) \ge |\mathbf{x}_q|$, with $|\mathbf{x}_q| = r$; adding gives $c(\eta_2 - \eta_0) \ge 2r$. Conversely, radial null signals out and back attain equality. The criterion follows as in (a) with $2r$ in place of r. (c) Solve $2R_0 = (c/H)(1 - e^{-HT})$ for T, and expand the logarithm. (d) $e^{HT_{\mathrm{com}}} = 1/(1-2x)$ and $e^{HT_H} = (1+x)/(1-x)$, and $(1-x) - (1+x)(1-2x) = 2x^2$. The second sentence follows from (b) and Proposition . (e) The first sentence is (a) and (b). A signal from ρ at time t reaches γ iff $r < (c/H)e^{-Ht}$, which is the stated inequality. Check C-48 verifies (a)–(d) symbolically and by ray tracing, with mutation M-48 and negative control N-48.

par *Non-claim.* P1 is exact on the prescribed host for declared comoving receivers. The receiver motion and instantaneous reflection are declared; no carrier, energy, hardware rate or Margolus–Levitin bound is assigned. The comparison in (d) is between two different worldlines, a static shell and a comoving receiver, on the same host; neither is identified with a physical body here. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Redshift drift as an observational interface

Theorem (P2: redshift drift on a prescribed flat FLRW host). *Let* $a : I \to (0,\infty)$ *be* C^1 *on an open interval I, prescribe* $-c^2\mathrm{d}t^2 + a(t)^2\mathrm{d}\mathbf{x}^2$, *and let a source and an observer be comoving at fixed comoving separation* $\chi_0 > 0$. *For an observation time* $t_o \in I$ *let the emission time* $t_e = t_e(t_o) \in I$ *of the radial null signal be defined by* $\int_{t_e}^{t_o} c\,\mathrm{d}s/a(s) = \chi_0$, *and let* $1 + z = a(t_o)/a(t_e)$.

• $\dfrac{\mathrm{d}t_e}{\mathrm{d}t_o} = \dfrac{a(t_e)}{a(t_o)} = \dfrac{1}{1+z}$, *so* $1 + z$ *is the ratio of the proper-time intervals between successive signals at the observer and at the source.*

• $\dfrac{\mathrm{d}z}{\mathrm{d}t_o} = (1+z)H(t_o) - H(t_e)$.

• *Residual identity. The residual* $\mathfrak{Z} := z - H(t_o)\,z$ *satisfies* $\dot{\mathfrak{Z}} = H(t_o) - H(t_e)$ *exactly. Hence* $\mathfrak{Z} = 0$ *whenever H is constant on* $[t_e, t_o]$, *in particular on an exact de Sitter epoch (*$z = Hz$*);* $\mathfrak{Z} \ne 0$ *implies that H is not constant on* $[t_e, t_o]$; *and if H is nonincreasing, then* $\mathfrak{Z} \le 0$, *with* $\mathfrak{Z} < 0$ *iff* $H(t_e) > H(t_o)$.

Proof. (a) Differentiating the defining equation in t_o gives $c/a(t_o) - (c/a(t_e))\,\mathrm{d}t_e/\mathrm{d}t_o = 0$; the implicit function

theorem applies because $c/a(t_e) > 0$. Two signals emitted at t_e and $t_e + \delta t_e$ arrive at t_o and $t_o + \delta t_o$ with $\delta t_o/\delta t_e \to a(t_o)/a(t_e)$, and comoving proper time is t. (b) Differentiate $1 + z = a(t_o)/a(t_e)$ and use (a): $\dot z = \dot a(t_o)/a(t_e) - a(t_o)\dot a(t_e)a(t_e)^{-2} \cdot a(t_e)/a(t_o)$. (c) $(1 + z)H(t_o) - H(t_e) - H(t_o)z = H(t_o) - H(t_e)$. Check C-49 verifies (b) symbolically for a general a and numerically on a flat matter-plus-Λ host, C-49b verifies $\dot z = Hz$ on DSS_H, negative control N-49 gives $\mathfrak{Z} = -\frac{1}{3}$ on the matter-only host at $t_e = 1$, $t_o = 2$, and mutation M-49 (exchanged times) is rejected.

par *Non-claim.* This is the standard redshift-drift relation, which the survey of Liske et al. [Liske2008] attributes to Sandage (1962); it is not a new result and not specific to Enter. Its role here is an explicit interface between a prescribed host and a measured quantity. Peculiar motion of the source or observer, lensing and measurement systematics are not modelled. A nonzero residual excludes only constancy of H on the sampled interval, that is, the identification of that interval with an exact de Sitter epoch; it says nothing about Enter itself, and a universe that is de Sitter only in the future need not have $\mathfrak{Z} = 0$ for light emitted earlier. No field equation is used. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Bounds on the future give sharp bounds on the horizon

Theorem (P3: future-expansion bounds). *Let $a : [t, \infty) \to (0, \infty)$ be C^1, so that $H = \dot a/a$ is continuous on $[t, \infty)$.*

• $R_e(t) = c\int_0^\infty \exp\left(-\int_0^u H(t + v)\,\mathrm{d}v\right)\mathrm{d}u$.

• *If $0 < h_- \le H(s) \le h_+ < \infty$ for all $s \ge t$, then*

$$\frac{c}{h_+} \le R_e(t) \le \frac{c}{h_-}.$$

Equality holds on the left (right) if and only if $H \equiv h_+$ ($H \equiv h_-$) on $[t, \infty)$. The bounds are attained by constant rates, so they are the best bounds that follow from (h_-, h_+) alone.

• *If H is positive and nonincreasing on $[t, \infty)$, then $R_e(t) \ge c/H(t)$, with equality if and only if H is constant on $[t, \infty)$. If moreover $R_e(t) < \infty$, then R_e is finite and C^1 on $[t, \infty)$, $\dot R_e = HR_e - c \ge 0$ there, and $\dot R_e(s) = 0$ if and only if H is constant on $[s, \infty)$. So R_e and the area $4\pi R_e^2$ are nondecreasing.*

• *Without a positive lower bound nothing is fixed: $a = (1 + s)^n$ with $n > 1$ has $H = n/(1 + s) \to 0$ and the finite horizon $R_e(s) = c(1 + s)/(n - 1)$, while $a = 1 + s$ has no event horizon (Theorem (b)).*

Proof. (a) $(\ln a)' = H$ gives $a(t)/a(t + u) = \exp\left(-\int_0^u H(t + v)\mathrm{d}v\right)$; substitute $s = t + u$. (b) The integrand lies between $e^{-h_+ u}$ and $e^{-h_- u}$. If $H \equiv h_+$, continuity gives an interval on which $H < h_+$, so the left inequality is strict for all larger u and the integral inequality is strict; similarly on the right. Constant H gives $R_e = c/H$. (c) Monotonicity gives $\int_0^u H(t + v)\mathrm{d}v \le H(t)u$, with strict inequality for all large u unless H is constant on $[t, \infty)$. If $R_e(t) < \infty$, then for $s \ge t$, $R_e(s) = a(s)\left(R_e(t)/a(t) - \int_t^s c\,\mathrm{d}s'/a(s')\right) < \infty$. The function $I(s) = \int_s^\infty c\,\mathrm{d}s'/a(s')$ has $I' = -c/a$, so $\dot R_e = aI - c = HR_e - c$ (Red06-G prop:horizons, re-proved here). Apply the first sentence at s: $H(s)R_e(s) \ge c$, with equality iff H is constant on $[s, \infty)$. (d) $(1 + s)^n\int_s^\infty (1 + s')^{-n}\mathrm{d}s' = (1 + s)/(n - 1)$. Check C-50 tests (b) on 24 oscillating profiles and (c) on decaying profiles, with negative control N-50 (an increasing rate gives $R_e < c/H(t)$) and mutation M-50 (reversed bounds); C-50b verifies (d).

par *Non-claim.* Proposition (a) and the strict bounds of Proposition (b) are the cases $h_- = H_2$, $h_+ = H_1$ of (b); the increase in Theorem (e) for $R_0 > c/H_1$ is the case of (c). The bounds $h_\pm$ and the monotonicity are hypotheses about the future, supplied and not derived; measurements of the past rate do not establish them without an extrapolation model. A growing horizon area raises the ceiling of a supplied area promise; it does not show that any memory

grows or saturates that ceiling. No field equation or energy condition is used. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

The approach to de Sitter: a relaxation law

Theorem (P4: horizon relaxation law). *Let a be* C^1 *on* $[t_*,\infty)$ *and* $H(t) = H_\infty + Ae^{-pt} + r(t)$ *with* $H_\infty > 0$, $p > 0$, $A \in \mathbb{R}$, *and* $\delta(t) := \sup_{s \geq t} |r(s)\mathrm{rverte}^{ps} \to 0$ *as* $t \to \infty$.

• *As* $t \to \infty$,

$$R_e(t) = \frac{c}{H_\infty}[1 - \frac{A}{H_\infty + p}e^{-pt} + o(e^{-pt})], \qquad R_e(t) - \frac{c}{H(t)} = \frac{cAp}{H_\infty^2(H_\infty + p)}e^{-pt} + o(e^{-pt}).$$

• *Remainder classes. If* $r(t) = Be^{-2pt} + O(e^{-3pt})$, *then*

$$R_e(t) = \frac{c}{H_\infty}[1 - \frac{A}{H_\infty + p}e^{-pt} + \frac{A^2 - B(H_\infty + p)}{(H_\infty + p)(H_\infty + 2p)}e^{-2pt} + O(e^{-3pt})].$$

If $r(t) = O(e^{-qt})$ *with* $q > p$, *the error in (a) is* $O(e^{-\min(q,\,2p)t})$.

• *If* $A > 0$, *then* $c/H(t) < R_e(t) < c/H_\infty$ *for all sufficiently large t.*

• *Flat ΛCDM, supplied. Let the expansion law* $H(a) = H_\Lambda\sqrt{1 + \mu a^{-3}}$ *with* $H_\Lambda, \mu > 0$ *be supplied, so that* $a(t)^3 = \mu\sinh^2(\frac{3}{2}H_\Lambda t)$. *Then for every* $a > 0$, *with* $y = \mu a^{-3}$,

$$R_e(a) = \frac{c}{H_\Lambda}\,{}_2F_1(\tfrac{1}{2},\tfrac{1}{3};\tfrac{4}{3};-y) = \frac{c}{H_\Lambda}\cdot\frac{1}{3}\int_0^1 \frac{v^{-2/3}\,\mathrm{d}v}{\sqrt{1+yv}},$$

and for $y < 1$

$$R_e(a) = \frac{c}{H_\Lambda}\sum_{k\geq 0}\frac{\binom{-1/2}{k}\,y^k}{1+3k} = \frac{c}{H_\Lambda}[1 - \frac{y}{8} + \frac{3y^2}{56} - \frac{y^3}{32} + \frac{35y^4}{1664} - \cdots].$$

For $0 < y \leq 1$ *the series alternates with terms of decreasing size, so the error of every truncation is at most the first omitted term. Moreover*

$$R_e(a) - \frac{c}{H(a)} = \frac{c}{H_\Lambda}[\frac{3y}{8} - \frac{9y^2}{28} + \frac{9y^3}{32} - \cdots] = \frac{3c\mu}{8H_\Lambda}a^{-3} + O(a^{-6}),$$

and $R_e(a) > c/H(a)$ *for every* $a > 0$.

Proof. (a) By Theorem (a), $R_e(t) = c\int_0^\infty e^{-H_\infty u}e^{-g_t(u)}\mathrm{d}u$ with $g_t(u) = \int_0^u (H(t+v) - H_\infty)\mathrm{d}v = \frac{A}{p}e^{-pt}(1 - e^{-pu}) + \int_0^u r(t+v)\mathrm{d}v$. Hence $\sup_u |g_t(u)| \leq \varepsilon_t := (|A| + \delta(t))e^{-pt}/p \to 0$, and $|e^{-g} - 1 + g| \leq \frac{1}{2}g^2e^{|g|}$. Integrating,

$$\frac{R_e(t)}{c} = \frac{1}{H_\infty} - \frac{A}{p}e^{-pt}(\frac{1}{H_\infty} - \frac{1}{H_\infty + p}) + O(\frac{\delta(t)e^{-pt}}{pH_\infty}) + O(\varepsilon_t^2),$$

which is the first formula. The second follows from $c/H(t) = (c/H_\infty)(1 - (A/H_\infty)e^{-pt} + o(e^{-pt}))$. (b) Expand e^{-g} to second order with $|e^{-g} - 1 + g - \frac{1}{2}g^2| \leq \frac{1}{6}|g|^3e^{|g|}$ and integrate term by term (check C-51, symbolic). The last sentence follows as in (a) with $\delta(t)e^{-pt}$ replaced by $O(e^{-qt})$. (c) is (a) with $A > 0$. (d) $\mathrm{d}t = \mathrm{d}a/(aH)$ gives $R_e(a) = a\int_a^\infty c\,\mathrm{d}a'/(a'^2H(a'))$. The substitution $a' = av^{-1/3}$ gives the integral, which is Euler's representation of ${}_2F_1(\frac{1}{2},\frac{1}{3};\frac{4}{3};-y)$ (with $\Gamma(\frac{4}{3})/\Gamma(\frac{1}{3}) = \frac{1}{3}$), valid for every $y \geq 0$. For $y < 1$ expand $(1 + yv)^{-1/2}$ binomially; $\frac{1}{3}\int_0^1 v^{k-2/3}\mathrm{d}v = 1/(1 + 3k)$. The sizes $|\binom{-1/2}{k}|/(1 + 3k)$ decrease in k. The difference series is $-\sum_{k\geq 1}\binom{-1/2}{k}\frac{3k}{1+3k}y^k$. Finally H decreases along the expansion, so Theorem (c) gives $R_e > c/H$. Consistency with (a),(b): $y = 4\varepsilon/(1 - \varepsilon)^2$ with $\varepsilon = e^{-3H_\Lambda t}$, and $H = H_\Lambda\coth(\frac{3}{2}H_\Lambda t) = H_\Lambda(1 + 2\varepsilon + 2\varepsilon^2 + \cdots)$, so $p = 3H_\Lambda$, $A = B = 2H_\Lambda$; both routes give

$R_e H_\Lambda/c = 1 - \frac{1}{2}\varepsilon - \frac{1}{7}\varepsilon^2 + O(\varepsilon^3)$ (C-51). Check C-52 verifies the coefficients to order y^5 by two independent symbolic routes and the closed form by quadrature, also at $y > 1$; mutations M-51, M-52 and negative controls N-51, N-52 (divergence of the series at $y = 3$) are recorded.

par *Non-claim.* The asymptotic profile in (a)–(c) and the ΛCDM law in (d) are supplied external hypotheses, not premises of the framework and not consequences of it; the law $H(a)$ is used as a formula and no Friedmann or other field equation is derived. Planck's base-ΛCDM inferences [Planck2018] are conditional on such a model, and the DESI DR2 analysis [DESIDR2] reports dataset-dependent preferences for an evolving dark-energy equation of state over ΛCDM; eternal Λ-domination is therefore a hypothesis, not an established future. No parameter value is adopted here. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Indistinguishable pasts with different futures

Corollary (P5: the past does not certify an event horizon). *Let $H_1 > 0$ and let χ, H_K, a_K and $R_0(K)$ be as in Proposition , $K \geq 0$. This is a strengthening of Proposition (c),(d) within the smooth class.*

• *All hosts agree with the flat chart of* DSS_{H_1} *on $t \leq 0$, and $a_K^{(n)}(0) = H_1^n$ for every $n \geq 0$: the futures agree with the past to infinite order at the junction.*

• *For $K > 0$ every comoving observer has an event horizon at every time, with $R_e(t) = c/H_1 + (R_0(K) - c/H_1)e^{H_1 t}$ for $t \leq 0$, and the values $R_0(K)$ are pairwise distinct. For $K = 0$ no comoving observer has an event horizon.*

• *Let F map the restriction of the metric to $t \leq 0$, together with any declared data that are functions of that restriction, to* $\{\text{horizon}, \text{no horizon}\}$. *Then F is wrong for $K = 0$ or for every $K > 0$.*

• *Bayes bound. Let an experiment, possibly adaptive and randomized, have a complete outcome law that depends on the host only through its restriction to $t \leq 0$. Give $K = 0$ prior π and one $K_1 > 0$ prior $1 - \pi$. Every decision rule applied to the outcome has success probability at most* $\max\{\pi, 1 - \pi\}$, *and at $\pi = \frac{1}{2}$ exactly $\frac{1}{2}$.*

• *The same holds with $t \leq 0$ replaced by $t \leq T$ for any $T \in \mathbb{R}$, using $H_K(\cdot - T)$.*

• *The fibre is a feature of the smooth non-analytic class. Over futures that are real analytic across $t = 0$, the only member is $K = H_1$, which has a horizon (Proposition (a)), and the decision is trivial.*

Proof. (a) $H_K - H_1 = (K - H_1)\chi$ and every derivative of χ vanishes at 0; the derivatives of $a_K = \exp\int_0^t H_K$ at 0 are polynomials in those of H_K, hence equal to those of $e^{H_1 t}$. (b) Theorem (a) and Proposition (c). (c) The datum is common to the family and the target is not constant on it; apply Theorem . (d) The outcome law P is the same under both hypotheses, so a rule φ with $\Pr[\varphi = \text{no horizon}] = \beta$ has success $\pi\beta + (1 - \pi)(1 - \beta) \leq \max\{\pi, 1 - \pi\}$, with equality to $\frac{1}{2}$ for every β at $\pi = \frac{1}{2}$. (e) Apply (a)–(d) to the translated profiles $H_K(t - T)$, which equal H_1 on $t \leq T$. (f) Proposition (a). Check C-53 reproduces $R_0(K)$ of check C-23, the linear growth of the conformal-time integral at $K = 0$, the flatness of χ at 0 and the exact value $\frac{1}{2}$ for all deterministic and randomized rules on two outcome laws; N-53 and M-53 are the controls.

par *Non-claim.* The profiles are declared, not derived; no field equation, matter model or energy condition is used. The corollary does not prohibit forecasting: it identifies what a forecast must supply, namely a field equation, matter model, analyticity assumption or other restriction on the allowed futures. Data whose law depends on the future, for example observations made later, are outside its hypothesis. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

A finite-memory retrieval bound

Theorem (P6: finite-memory retrieval bound).

• *Let X be uniform on $M \geq 1$ messages, encoded into density operators ρ_x on $\mathbb{C}^D$, and let (E_x) be any retrieval POVM. Then*

$$P_{\mathrm{succ}} = \frac{1}{M}\sum_x \mathrm{Tr}\,(E_x\rho_x) \le \min\{1, \frac{D}{M}\},$$

and the bound is attained: by orthogonal encodings if $M \le D$, and if $M > D$ by encoding D messages into an orthonormal basis, measuring in it, and failing on the rest.

• *The promise. Put* $s = \mathrm{eta}\mathrm{S}_{\mathrm{GH}}(H)/k_B$ *and* $D_{\max} = \lfloor e^s \rfloor$. *For an integer* $D \ge 1$, $\ln D \le s$ *if and only if* $D \le D_{\max}$; *so the promise* P_η *of Theorem (c) is exactly* $D \le D_{\max}$. *Moreover* $\lfloor \log_2 D_{\max} \rfloor = \lfloor s/\ln 2 \rfloor = q_\eta(H)$, *the qubit ceiling of Theorem .*

• *Archives. If n independent fair bits* ($M = 2^n$) *are stored in a memory satisfying* P_η, *then every retrieval has*

$$P_{\mathrm{err}} \ge \max\{0, 1 - \frac{D_{\max}}{2^n}\}.$$

Perfect retrieval is possible if and only if $n \le q_\eta(H)$; *for* $n > q_\eta(H)$, $P_{\mathrm{err}} > 1 - 2^{q_\eta(H)+1-n} \ge 0$.

• *The bound concerns the complete memory read by the retrieval. If the reader also holds a register correlated with X, then D must be the dimension of everything read, and D/M fails otherwise.*

Proof. (a) $\rho_x \le I$ and $E_x \ge 0$ give $\mathrm{Tr}\,(E_x\rho_x) \le \mathrm{Tr}\,E_x$, and $\sum_x \mathrm{Tr}\,E_x = \mathrm{Tr}\,I = D$; also $P_{\mathrm{succ}} \le 1$. The constructions attain the values. (b) $D \le e^s$ iff $D \le \lfloor e^s \rfloor$ for integers. With $q = \lfloor s/\ln 2 \rfloor$, $2^q \le e^s$ gives $2^q \le D_{\max}$, and $D_{\max} \le e^s < 2^{q+1}$. (c) Apply (a) with $D \le D_{\max}$ and $M = 2^n$; $D_{\max}/2^n \ge 1$ iff $n \le \lfloor \log_2 D_{\max} \rfloor$, and $D_{\max} < 2^{q_\eta+1}$. (d) A reader with a classical copy of X succeeds with probability 1 for every M. Check C-54 computes the optimal retrieval by semidefinite programming for 20 random encodings (never above $\min\{1, D/M\}$) and its attainment; C-54b verifies (b) and (c) in 248 cases, including $s = q\ln 2 \pm 10^{-300}$; N-54 is the side-register control and M-54 rejects the bound $(D/M)^2$.

par *Non-claim.* Part (b) reconciles the plan's $D_{\max}$ with the promise of Theorem (c): it is the same promise, and at $\eta = 1$ and the Planck 2018 evaluation of Theorem (d), perfect retention of independent fair bits is possible exactly up to $q_1 = 4.779 \times 10^{122}$ of them; no new number is computed. The promise P_η is supplied, not derived, and a finite entropy label does not supply it. In particular the algebra of observables of Chandrasekaran, Longo, Penington and Witten [CLPW2023] is a von Neumann algebra of type II_1, which is infinite-dimensional, so it is not a finite-dimensional register and cannot be substituted for one here. A finite memory can still produce indefinitely many sequential reports if it overwrites earlier ones. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Conditional Cosmological Predictions and Their Physical Assumptions

The results of Section are theorems about prescribed hosts and declared data. A prediction about the universe needs more:

$$\text{theorem + supplied hypotheses + identification} \;\Rightarrow\; \text{conditional prediction.}$$

Supplied external hypotheses. The following are used only as explicit hypotheses of conditional statements. Each is a *supplied external hypothesis*: it is outside the standing ledger, it is not a premise of any unconditional result of this manuscript, and none is derived.

(S-dS) The identification of a stretch of cosmic history with an exact de Sitter epoch DSS_H, and of a body with a comoving worldline.

(S-Λ) The flat ΛCDM expansion law $H(a) = H_\Lambda\sqrt{1 + \mu a^{-3}}$, radiation neglected, and its validity for all future times.

(S-F) Bounds $h_- \le H \le h_+$ on the future Hubble rate, or its monotonicity.

(S-A) The asymptotic model $H = H_\infty + Ae^{-pt} + o(e^{-pt})$.

(S-D) The finite-dimension promise $D \le D_{\max} = \lfloor \exp(\mathrm{etaS}_{\mathrm{GH}}/k_B) \rfloor$ for the *complete* durable memory available to a reader. For each result we state (i) the mathematical hypotheses, (ii) what is derived, (iii) what identifies the mathematical objects with measurements, and (iv) what observation would contradict the resulting model.

P1 (Theorem). (i) The prescribed host DSS_H, comoving receivers, instantaneous reflection. (ii) One-way reach iff $R_0 < c/H$; a reply iff $R_0 < c/(2H)$, after $T_{\mathrm{com}} = -H^{-1}\ln(1 - 2HR_0/c) > T_H$. (iii) (S-dS) for the future of the sender, the receiver's motion as comoving, and R_0 as its proper distance at emission. (iv) A reply received from a comoving receiver whose initial proper distance was at least $c/(2H)$ would contradict (S-dS) for that future, or the comoving identification. At cosmological distances no such exchange is practicable; P1 constrains the interpretation of ``reachable'' rather than offering a near-term test.

P2 (Theorem). (i) A C^1 flat FLRW host, comoving source and observer, radial null propagation. (ii) $\dot z = (1+z)H(t_o) - H(t_e)$ and the exact residual identity $\mathfrak{Z} = \dot z - H(t_o)z = H(t_o) - H(t_e)$. (iii) z as the spectroscopic redshift of a source in the Hubble flow, t_o as the observer's proper time, and $H(t_o)$ as the measured present rate H_0; source peculiar acceleration and systematics must be modelled separately. (iv) A residual $\mathfrak{Z} \neq 0$ beyond those effects rejects the identification of the sampled interval $[t_e, t_o]$ with an exact de Sitter epoch, not Enter. Under (S-F) with nonincreasing H, a significantly positive $\mathfrak{Z}$ would contradict the monotonicity hypothesis. Redshift drift has been proposed as a direct measurement of the expansion history [Liske2008](source record; not a premise).

P3 (Theorem). (i) A C^1 future with $h_- \le H \le h_+$, or with H nonincreasing. (ii) $c/h_+ \le R_e \le c/h_-$, sharp; $R_e \ge c/H$ and $\dot R_e \ge 0$ under monotonicity. (iii) (S-F) and the identification of R_e with the cosmic event horizon of a comoving observer. (iv) The event horizon depends on the whole future and is not observed. An observation can contradict only the supplied bounds, for example evidence for a future increase of H removes the hypothesis of (c); it cannot contradict the theorem.

P4 (Theorem). (i) (S-A), or (S-Λ). (ii) The relaxation law with coefficient $1/(H_\infty + p)$ and explicit second order; under (S-Λ) the closed form $R_e = (c/H_\Lambda)\,{}_2F_1(\frac{1}{2}, \frac{1}{3}; \frac{4}{3}; -\mu a^{-3})$ and $R_e - c/H = (3c\mu/8H_\Lambda)a^{-3} + O(a^{-6})$, with $R_e > c/H$ at every a. (iii) H_Λ and μ as the parameters of a fitted flat ΛCDM model, with $a = 1$ today. (iv) Expansion data inconsistent with $H(a) = H_\Lambda\sqrt{1 + \mu a^{-3}}$, such as the dataset-dependent preference for an evolving equation of state reported by DESI DR2 [DESIDR2](source record; not a premise), would remove (S-Λ); the statement about the future horizon then has no premise. The series itself is mathematics and is not tested by data.

P5 (Corollary). (i) The smooth comparison class of Proposition . (ii) Every rule of past data decides horizon existence wrongly on part of the class, with success exactly $\frac{1}{2}$ at equal priors. (iii) The past of the universe as a restriction of a prescribed metric to $t \le 0$, and experiments whose laws depend only on that restriction. (iv) No observation can contradict it; it is a statement about inference. It predicts that any claimed model-free certification of an eternal event horizon from past data relies on an unstated restriction of the futures.

P6 (Theorem). (i) A memory of dimension D and a uniform message. (ii) $P_{\mathrm{succ}} \le \min\{1, D/M\}$; under (S-D), perfect retention of n fair bits iff $n \le q_\eta$. (iii) (S-D), with the memory identified with all durable records available to the eventual reader. (iv) A verified perfect retention of more than q_η independent fair bits in a system satisfying the identification would contradict (S-D). At $q_1 = 4.779 \times 10^{122}$ this is not a practicable test. A universe satisfying (S-D) must, as it keeps acquiring independent records, erase old records, retain them imperfectly, stop acquiring them, or violate (S-D).

begingroup 1.15 Conditional predictions, their supplied hypotheses and what would contradict them. No result is ranked.

toprule Result Conditional consequence Supplied hypotheses Contradicting observation

midrule endfirsthead toprule Result Conditional consequence Supplied hypotheses Contradicting observation

midrule endhead bottomrule endfoot P1 (Thm) One-way reach outlasts two-way exchange: messages reach

$R_0 < c/H$, replies return only from $R_0 < c/(2H)$ (S-dS) for the future; comoving receivers a reply from initial distance $\geq c/(2H)$ (not practicable)

P2 (Thm) $\mathfrak{F} = z - H_0 z = H(t_o) - H(t_e)$; zero on an exact de Sitter interval, ≤ 0 for nonincreasing H FLRW light propagation; comoving source; modelled peculiar acceleration $\mathfrak{F} \neq 0$ rejects exact de Sitter on $[t_e, t_o]$; $\mathfrak{F} > 0$ rejects nonincreasing H

P3 (Thm) $c/h_+ \leq R_e \leq c/h_-$; nondecreasing horizon area under monotone H (S-F) none directly; evidence against (S-F) removes the premise

P4 (Thm) approach rate $1/(H_\infty + p)$; $R_e - c/H = (3c\mu/8H_\Lambda)a^{-3} + O(a^{-6})$ (S-A) or (S-Λ) expansion data inconsistent with (S-Λ) remove the premise

P5 (Cor) no model-free certification of an eternal horizon the smooth comparison class none; a statement about inference

P6 (Thm) unavoidable loss beyond q_η archived fair bits (S-D) for the complete memory perfect retention of more than q_η bits under (S-D) (not practicable)

endgroup

Remark (What the framework does not select). The present framework does not select the actual expansion history, the cosmological constant, the dark-matter content or the primordial perturbation spectrum. Every expansion law above is supplied. To predict those quantities, rather than to constrain the consequences of a supplied host, an additional dynamical or probabilistic law is needed, and none is posed here.

par *Non-claim.* This section derives no field equation and no dynamics, assigns no value to Λ, and leaves the vacuum energy open. The supplied hypotheses (S-dS), (S-Λ), (S-F), (S-A) and (S-D) are not admitted to the ledger; Gate 0 and ST4b stay NOT_SUPPLIED. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Incorporation of corpus components

The components below come from the obstruction and group sheets of the corpus [CorpusOB]. Each is either re-proved here in the generality needed or recorded as a separation.

Status updates from the version-8 de Sitter sheets

• *O7.* The branched host is $C^{1,1}$-inextendible (Red06-G-DSS thm:R-C11, version 8); the proof reduces every extension to a developing chart (Red06-G-DSS lem:R-dev, version 8). C^1 and C^0 stay open, with the gap isolated (Red06-G-DSS prop:R-gap, version 8).

• *O4 and currents of states.* Every invariant conserved current is the one-point current of an invariant state of a classical evaluation algebra, and the state is not determined by its current (Red06-G-DSS thm:R-statecur8, version 8).

• *Realization criteria.* Without equivariance, the conserved gauge-invariant operators of order at most 2 are exactly the maps T_X of Codazzi tensors X, an infinite-dimensional family; (R1) cuts it to $\mathbb{R}\,\mathscr{E}_H$ (V-DST-DSS thm:V-ord2, version 8). Background fields at order ≤ 2 give the invariant Codazzi tensors (V-DST-DSS cor:V-bgord2, version 8). The statement of Section that (R1)–(R4) select the line $a\,\mathscr{E}_H$ is unchanged.

• *O11.* Convergence of $mj_{\min}$ is equivalent to a ratio-density property of near-minimal hull deficits that does not involve L, ℓ_0 or c (Theorem (d)) (En08-ST-DSS thm:E-iff, version 8); certified deficits now reach $j = 600$ (En08-ST-DSS prop:E-cert8, version 8). $\alpha = \liminf_j \tau_j \in [\frac{1}{4}, \frac{1}{\sqrt{2}}]$ and convergence stay open.

The invisible-space invariant iota (CMP-OB-1)

CMP-OB-1 assigns to a nonempty affine class $\mathcal{A} = a_0 + V$ the invariant $\iota(\mathcal{A}) = \dim_{\text{Hamel}} V$ (CMP-OB-1 def:iota).

Proposition (Static-invariant conserved currents have $\iota = 6$). *Let $\mathcal{J}$ be the class of smooth one-forms on $\mathscr{S}$ that are invariant under static time translation and rotations and are conserved. This is the class of Red06-G-DSS*

thm:R-groups(d). Let $V_0 = \{F(r^2)\,\mathrm{d}t_s : F \in C^\infty([0,\ell^2))\}$.

• $V_0 \subseteq \mathcal{J}$, *and* $\iota(V_0) = \iota(\mathcal{J}) = \mathfrak{c}$.

• *For any declared finite list of n real calibration offsets, the affine class* $b_0 + \mathbb{R}^n$ *has* $\iota = n$.

• *Two affine classes with equal* ι *are affinely isomorphic, by any bijection of Hamel bases. Such an isomorphism need not preserve supports, invariance groups, causal structure or any host functional. Equal* ι *is an abstract linear isomorphism only, not a physical identification of capacity.*

Proof. (a) $F(r^2)$ is a smooth function on $\mathscr{S}$, since $r^2 = \sum_{i=1}^3 X_i^2$, and it is invariant. Its divergence is $|g|^{-1/2}\partial_{t_s}(|g|^{1/2}g^{t_s t_s}F) = 0$ (check C-3). For distinct $\lambda_1 < \ldots < \lambda_k$, the functions $e^{\lambda_j s}$ are linearly independent on $[0,\ell^2)$. A vanishing combination is real-analytic, so it vanishes on $\mathbb{R}$; letting $s \to \infty$ isolates the largest λ_j, and induction does the rest (check C-10 illustrates this). So $\{e^{\lambda r^2}\mathrm{d}t_s\}_{\lambda\in\mathbb{R}}$ is independent, and $\iota \geq \mathfrak{c}$. Conversely, a smooth form is determined by its values on a countable dense set, so the class has cardinality at most $\mathfrak{c}^{\aleph_0} = \mathfrak{c}$, and hence $\iota \leq \mathfrak{c}$. (b) is immediate. (c) Vector spaces of equal Hamel dimension are isomorphic, and the isomorphism is arbitrary on bases.

par *Non-claim.* $\iota(\mathcal{J}) = \mathfrak{c}$ equals CMP-OB-1's value $\iota(V_Q) = \mathfrak{c}$ (CMP-OB-1 thm:compute(3)). By (c), this licenses no identification of the two classes. The classification of currents for subgroups outside the proved stabilizer list (Red06-G-DSS thm:R-stab) stays open. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Invariant currents and evaluation states

The status line on currents of states above is re-proved here for an explicitly specified algebra. Let M be the static patch and let $\mathcal{E}$ be a real linear space of conserved current one-forms on M, either the smooth ones, $\{F \in C^\infty(M;T^*M) : \nabla_a F^a = 0\}$, or the distributional ones (conservation in the weak sense); the argument uses only linearity. For a compactly supported smooth vector field f let $L_f(F) = \int_M F_a f^a \,\mathrm{dvol}_g$ (the distributional pairing in the second case). Let $\mathcal{A}_{\mathrm{ev}}$ be the unital complex *-algebra of polynomial functions on $\mathcal{E}$ generated by the L_f, with pointwise product and complex conjugation. An algebraic state is a linear ω with $\omega(1) = 1$ and $\omega(P^*P) \geq 0$; it has current J if $\omega(L_f) = L_f(J)$ for every f. An isometry subgroup Γ acts by pullback.

Theorem (Invariant currents have states but do not identify them).

• *Every* Γ*-invariant* $J \in \mathcal{E}$ *is the current of the invariant state* $\omega_{J,0}(P) = P(J)$.

• *If a nonzero* Γ*-invariant* $K \in \mathcal{E}$ *exists, then for every invariant J the states* $\omega_{J,s}(P) = \frac{1}{2}P(J+sK) + \frac{1}{2}P(J-sK)$, $s \geq 0$, *are invariant, have current J, are pairwise distinct, and have* $\omega_{J,s}(L_f^2) = L_f(J)^2 + s^2 L_f(K)^2$.

• *On the static patch, for the group generated by static time translations and spatial rotations,* $K = \mathrm{d}t_s$ *is such a current, smooth and nonzero on the patch including the central worldline. So every invariant current of this class has a continuum of invariant evaluation states with the same current.*

Proof. (a) Evaluation is normalized, and $\omega_{J,0}(P^*P) = |P(J)|^2 \geq 0$; invariance of J gives invariance of the state. (b) $J \pm sK \in \mathcal{E}$ by linearity and both are invariant; an equal mixture of states is a state; L_f is linear, so the first moment is $L_f(J)$, and expanding the square gives the second moment. Since $K \neq 0$, some test f has $L_f(K) \neq 0$, and different s^2 give different states. (c) In static coordinates $g = -F(r)c^2\mathrm{d}t_s^2 + F(r)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega_2^2$ with $F = 1 - r^2/\ell^2$; the only raised component of $\mathrm{d}t_s$ is $K^{t_s} = -1/(c^2F(r))$, independent of t_s, so $\nabla_a K^a = |\det g|^{-1/2}\partial_{t_s}(|\det g|^{1/2}K^{t_s}) = 0$; it is fixed by static translations and rotations. Check C-45 verifies (c) symbolically and the moments in (b) in a finite stand-in; N-45 shows that with $K = 0$ the family collapses.

par *Non-claim.* This is adopted from the supplied findings after verification, in the stronger form that allows any linear space of currents, including the distributional currents of Red06-G-DSS thm:R-statecur8 [Red06GDSS]

(Appendix , F5, DC-8). The algebra is commutative and classical: no field commutation relations, dynamics, two-point distribution or thermal condition is included, so no Bunch–Davies state, KMS property or Gibbs property at T_{GH} is concluded. Non-uniqueness is not asserted for every smaller algebra or every larger invariance group; the nonzero invariant direction K cannot be omitted. The section $J \mapsto \omega_{J,0}$ is a possible convention, not an inverse; and since $J = 0$ and $J = K$ are both invariant, the symmetry group does not identify the current either. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

XIV-K-B: a separation, not an application

XIV-K-B thm:obstruct and XIV-K-B thm:range concern extensions of a distribution across a declared codimension-k locus N (with $k = 8$ in that sheet). They apply to a reference of the form $c \otimes h + r$, where h is transversally elliptic and homogeneous of degree $-s$. Under an empty-interior allowance, every extension is obstructed for $0 < s < k$; the full range is $s < k$ with $s \notin -2\mathbb{N}_0$.

The horizon $\{u = 0\}$ of Theorem is a *smooth* null hypersurface in a smooth host, and no singular reference is declared on it. So the hypotheses of XIV-K-B thm:obstruct are not met, and that sheet makes no statement about extension across the horizon. We record a *separation* edge. If a future sheet declares a singular reference along a declared locus in DSS_H, the obstruction applies only under its stated hypotheses.

V-DST-T-B: norm-relative causal discrepancy

For a source f with retarded and advanced responses $a = G_R f|_\Omega$ and $b = G_A f|_\Omega$, V-DST-T-B studies $d_c = \|a - b\|/\max(\|a\|, \|b\|) \in [0, 2]$.

Proposition (Disjoint supports). *If a and b have disjoint supports and $\|a\|_p = \|b\|_p > 0$, then*

$$d_c = \frac{(\|a\|_p^p + \|b\|_p^p)^{1/p}}{\max(\|a\|_p, \|b\|_p)} = 2^{1/p} \quad (1 \le p < \infty), \qquad d_c = 1 \quad (p = \infty).$$

In particular $d_c = 2$ is attained without causal overlap in L^1, and $d_c \le 2^{1/p} < 2$ without overlap for $1 < p \le \infty$.

Proof. On disjoint supports, $|a - b|^p = |a|^p + |b|^p$ pointwise, and $\sup|a - b| = \max(\sup|a|, \sup|b|)$. For unequal norms the quotient is smaller still (check C-11).

par *Non-claim.* The reading ``$d_c = 2$ requires causal overlap'' holds in Hilbert norms (V-DST-T-B prop:hilbert), in $L^p$ for $1 < p < \infty$ (V-DST-T-B thm:Lp(i)), and in $L^\infty$ up to closure (V-DST-T-B thm:Lp(iii)). It is false in $L^1$ (V-DST-T-B thm:Lp(ii)). So the model sentence ``information that has left the horizon cannot be recovered inside'' is norm-relative when read through d_c. Its norm-free form is Theorem . Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

I-B-G-Q-C: contrast only

On the regular cone, I-B-G-Q-C proves for every $0 < \alpha \le 1$ that the declared Wick-rotation boundary value is the time-ordered two-point function of a positive quasifree state with unitary dynamics, namely the Friedrichs ground state (I-B-G-Q-C thm:state). It also proves a support bridge with positive margin for causally unrelated compact sets (I-B-G-Q-C thm:bridge). The cone has no event horizon for static observers (Red06-G-DSS thm:R-horizon(b)), whereas every comoving observer of DSS_H does (Theorem). On DSS_H no state is constructed, and Bunch–Davies is a label (Definition). The two hosts are not locally isometric (V-DST-DSS thm:V-host(a)) and not homeomorphic (En08-ST-DSS thm:E-noident(b)). The edge is a separation. par *Non-claim.* No ground state, two-point function or thermal state on DSS_H is constructed. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Data counts (V-DST-DSS) and ``algorithmic efficiency''

Proposition (Counts are encoding-relative).

• *There is no continuous injection $\mathbb{R}^2 \to \mathbb{R}$.*

• *For every* $(a,b) \in \mathbb{R}^2$, *the single continuous condition* $(x-a)^2 + (y-b)^2 = 0$ *selects exactly* (a,b).

• *There is a bijection* $\mathbb{R} \to \mathbb{R}^2$.

Proof. (a) A continuous injection f restricted to the circle S^1 would map onto an interval $[u', v']$ with $u' < v'$. Removing a point whose image is interior disconnects the image but not $S^1 \setminus \{\mathrm{pt}\}$. (b) A sum of squares vanishes exactly when each term vanishes. (c) The two sets have equal cardinality.

par *Non-claim.* ``Fewer declared data per outcome" has a meaning only relative to a stated encoding class (linear, continuous or arbitrary). That is the content of V-DST-DSS thm:V-count and V-DST-DSS prop:V-count2, applied to the invariant two-parameter coupling class. The realization criteria (R1)–(R4) select the line $a\,\mathscr{E}_H$ and leave the normalization a free (V-DST-DSS thm:V-select). No algorithmic lower bound on DSS_H is derived. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Separations verified from the user draft

The following four statements are adopted from the user draft (Appendix) after independent verification. Each is a separation; none transfers a theorem.

Proposition (No thermal floor from the labels). *Fix H, the labels* T_{GH}, S_{GH}, N_{GH}, *a capacity promise, and a permitted code dimension d. These data determine no positive lower bound on the logical error of channels acting on the code inside* $\mathscr{S}$, *and no reservoir heat.*

Proof. The free finite-channel specification permits both id_d and complete depolarization on the same register, with the same labels and the same promise; their errors are 0 and $1 - 1/d^2$. For heat, adjoin a bath qubit with Hamiltonian $\Delta|1\rangle\langle 1|$ in $|0\rangle$, and either leave it or flip it by a supplied control. The visible register channel is the same, and the bath energy changes differ.

par *Non-claim.* No noise model, detector, state or reservoir at T_{GH} is constructed. The allowance profile of V-DST-DSS thm:V-profile is a declared coupling comparison and is not a thermal floor. Open item O6 is unchanged. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Proposition (Empty interior decides no extension question). *Let u be a regular coordinate transverse to a piece of the horizon* $\{u = 0\}$, *which has empty interior. The function* 1 *on* $\{u \neq 0\}$ *extends smoothly across it. The smooth function* e^{1/u^2} *on* $\{u \neq 0\}$, *read as a distribution there, has no distributional extension across it.*

Proof. Suppose T extends e^{1/u^2} near a point of the horizon, in product coordinates (u,y). On a compact set, $|\langle T,\varphi\rangle| \le C \max_{|\alpha|\le M} \|\partial^\alpha \varphi\|_\infty$. Take $0 \le \theta \in C_c^\infty((1,2))$, $\theta \neq 0$, and $0 \le \zeta$ with $\int \zeta > 0$, and put $\varphi_\varepsilon = \theta(u/\varepsilon)\zeta(y)$. The right side is $O(\varepsilon^{-M})$, while the pairing, whose support avoids $u = 0$, is at least $\varepsilon\, e^{1/(4\varepsilon^2)} \int\theta \int\zeta$. This is a contradiction as $\varepsilon \mathrm{downarrow} 0$.

par *Non-claim.* This sharpens the separation of Section for XIV-K-B: the horizon being a set with empty interior implies neither extendability nor non-extendability, so no blanket obstruction across the horizon follows from the XIV-K-B locus. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Proposition (Curvature separates hosts and fixes the labels, not capacity). DSS_H *has scalar curvature* $R = 12H^2/c^2$, *and the regular part of a flat conical host has* $R = 0$, *so they are not locally isometric. Given the constants, the labels are functions of R:* $H = c\sqrt{R/12}$ *and* $S_{\mathrm{GH}}/k_B = 12\pi c^3/(\hbar G R)$. *Yet registers of every finite dimension can be declared on either host (Theorem (b)).*

Proof. Constant sectional curvature $1/\ell^2$ gives $R = 12/\ell^2$ (check C-29, symbolic in global coordinates). Substitute in Definition . Local isometries preserve R.

par *Non-claim.* The prescribed geometry determines its own named labels; a host-blind report does not (Theorem

(d)). Neither statement bounds an actual declared dimension. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Proposition (A conformal-bump countermodel, self-contained). *There is a smooth time-oriented metric $g_f = e^{2f} g_H$ on the manifold of* DSS_H*, with $f \in C_c^\infty$ supported in $\{v < 0\}$, such that $g_f = g_H$ on P_H, g_f is globally hyperbolic and timelike geodesically complete, hence C^0-inextendible by the theorem of Galloway, Ling and Sbierski [GLS2018], and g_f is not isometric to g_H.*

Proof. In global time s, $g_H = \ell^2(-\mathrm{d}s^2 + \cosh^2 s\, \mathrm{d}\Omega_3^2)$, and the slices s = const are Cauchy for g_H and hence for the conformal metric g_f. Choose $f = b\psi$ with $b \neq 0$, $\psi \in C_c^\infty$ supported in $\{v < 0\}$ and equal to 1 on a ball. A unit-speed g_f-timelike geodesic has $E = s > 0$; on the compact slab containing $\mathrm{supp}\, f$, E is bounded below, $|\omega| \le E/\cosh s$, and the geodesic equation gives $|\mathrm{d}\log E/\mathrm{d}s| \le C$. So the tangent stays in a compact set while s crosses the slab, which takes finite affine parameter. Outside the slab the geodesic is a complete de Sitter geodesic. This gives timelike completeness. Where $f = b$, the scalar curvature is $12e^{-2b}/\ell^2 \neq 12/\ell^2$ (check C-29).

par *Non-claim.* This re-proves inside the manuscript the conformal-bump part of Red06-G-DSS thm:R-host (version 4), using one external theorem [GLS2018]. It answers only the unrestricted, time-orientable form of O7. The comparison metric is a prescribed countermodel; it is not Host C and not the output of any Enter instruction. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Worked examples

Each example evaluates a result above at explicit numbers. All numbers are dimensionless or are evaluations of named formulas at prescribed parameters; none is a value of κ.

Example (Decoder errors at $d = 3$). Let a qutrit payload be placed beyond the horizon, so the visible channel is a replacement channel, and let a decoder output $\sigma' = \mathrm{diag}\,(\frac{1}{2}, \frac{3}{10}, \frac{1}{5})$. Then $\sum_i \lambda_i^{-1} = 2 + \frac{10}{3} + 5 = \frac{31}{3}$, and Theorem gives the error $1 - \frac{3}{31} = 0.903226$ (check C-21). The least error over all decoders is the horizon floor $1 - \frac{1}{9} = \frac{8}{9}$, attained exactly when $\sigma' = I/3$ (Theorem); a complete classical record of the payload instead allows $1 - \frac{1}{3} = \frac{2}{3}$ (Proposition), better by $(d-1)/d^2 = \frac{2}{9}$.

par *Non-claim.* The decoder output is declared; the example evaluates an exact formula and models no hardware. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Example (Two Gibbs targets and the qubit radius). Take $K = \Delta\mathrm{proj}\,1$ and two coefficient accounts on which the dimensionless ratio $\beta_\kappa \Delta$ equals $\ln 3$ and $\ln 2$. The excited probabilities are $\frac{1}{4}$ and $\frac{1}{3}$, so $d_{\mathrm{tr}}(\gamma_{\kappa_0}, \gamma_{\kappa_1}) = \frac{1}{12}$, and by Theorem (c) the best coefficient-blind state errs by exactly $\frac{1}{24}$ on one of the two accounts, the midpoint $\mathrm{diag}\,(\frac{17}{24}, \frac{7}{24})$ attaining it. Over all $\kappa > 0$ the excited probability sweeps $(0, \frac{1}{2})$ and the exact radius is $\frac{1}{4}$, attained by $\mathrm{diag}\,(\frac{3}{4}, \frac{1}{4})$ (part (d), check C-39); the identity $\gamma = \mathrm{diag}\,(\frac{3}{4}, \frac{1}{4})$ for $\beta_\kappa \Delta = \ln 3$ shows that the optimal blind output is itself the Gibbs state of one account, and is wrong by $\frac{1}{4}$ in the limits $\beta_\kappa \Delta \to 0$ and $\beta_\kappa \Delta \to \infty$.

par *Non-claim.* The ratios $\beta_\kappa \Delta$ are chosen dimensionless numbers; no coefficient, energy scale or temperature is assigned. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Example (Rounded dimension windows). With $x = B_H/\kappa$, Theorem (c) says $\lfloor N_{\mathrm{GH}}^{(\kappa)} \rfloor = n$ exactly for $x \in [\ln n, \ln(n+1))$. At $x = 2.5$, $e^x = 12.18\ldots$, so the rounded label is 12, and every $x \in [\ln 12, \ln 13) = [2.4849, 2.5649)$ gives the same integer: an interval of coefficients, not a point. Exact equality $N_{\mathrm{GH}} = 12$ occurs only at $x = \ln 12$; a declared q-qubit register matches N_{GH} exactly only at $x = q \ln 2$ (part (d), check

C-43).

par *Non-claim.* x is a dimensionless comparison variable; no value of B_H/κ for the physical host is asserted. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Example (One target, explicit feasible ticks). Take $x = r/c = 3$ and margin $m = \frac{1}{2}$ in Theorem , so $N = \lceil x/m \rceil = 6$. The feasible ticks are

$$(0, \tfrac{7}{12}) \cup [\tfrac{3}{5}, \tfrac{7}{10}) \cup [\tfrac{3}{4}, \tfrac{7}{8}) \cup [1, \tfrac{7}{6}) \cup [\tfrac{3}{2}, \tfrac{7}{4}) \cup [3, \tfrac{7}{2}),$$

six pieces separated by five half-open gaps, for example $[\frac{7}{12}, \frac{3}{5})$ and $[\frac{7}{4}, 3)$. The uniform criterion $\delta \le m$ selects only part of the first piece, and a tick in $(\frac{1}{2}, \frac{7}{12})$ serves this target although it fails at a shorter range (part (d)).

par *Non-claim.* The tick rule is declared data; no hardware clock rate is derived. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Example (Envelope convergence and oscillation). Synthetic slacks $D_j = (\ell_0 + L\tau_j)/(cj) + j^{-2}$ satisfy Assumption . With $\ell_0 = c = 1$, $L = 1$ and $\underline{\tau} = \frac{1}{4}$, $A_L = 1.25$. Let $\tau_j = 0.7$ except at near-minimal levels, where $\tau_j = \frac{1}{4} + \frac{1}{2\sqrt{j}}$. If the near-minimal levels are dense (every third level), $m\,j_{\min}$ and $n\,b_n$ settle near 1.25 (check C-44). If they occur only at $j = \lfloor 1.6^k \rfloor$, the ratio-density condition of Theorem (d) fails: the lower limit is still 1.25, but $n\,b_n$ and $m\,j_{\min}$ climb to about 1.70 between record levels (negative control N-44).

par *Non-claim.* The sequences are synthetic illustrations of the criterion; they are not the lattice hull deficits, and nothing about the actual $\underline{\tau}$ or ratio density follows. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Example (Planck evaluations and one junction radius). At the Planck 2018 parameters [Planck2018], the supplied evaluations of Theorem (d) are $S_{\mathrm{GH}}/k_B = 3.312 \times 10^{122}$ and, under the promise P_1, $q_1 = 4.779 \times 10^{122}$. For the smooth two-epoch hosts of Proposition at $H_1 = 2$, $H_2 = 1$, $c = 1$, the first-epoch event horizon is fixed by the single number $R_0 = 0.689250$, strictly between c/H_1 and c/H_2 (check C-22).

par *Non-claim.* These evaluate named formulas at prescribed parameters, with $\hbar$ supplied only as the evaluation of Theorem (c); they are not derivations, and the junction profile is declared. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Example (Deadlines and the relaxed horizon). In units $c = H = 1$, take a receiver at $x = HR_0/c = 0.4$. Theorem (c),(d) give $HT_{\mathrm{com}} = \ln 5 = 1.60944$ against the static echo $HT_H = 2\operatorname{artanh} 0.4 = \ln \frac{7}{3} = 0.847298$; their exponentials differ by $\frac{8}{3} = 2x^2/((1-x)(1-2x))$. At $x = 0.6$ the static echo is $HT_H = \ln 4 = 1.38629$ and a message still arrives after $H\Delta = \ln 2.5 = 0.916291$, but no reply returns; the receiver's own signals reach γ only if emitted before $t_0 + 0.510826/H$. Under the supplied law of Theorem (d), in units $c = H_\Lambda = 1$, at $y = \mu a^{-3} = \frac{1}{2}$ the closed form gives $R_e = 0.947953$ against $c/H = 0.816497$; the series truncated after y^3 is off by 9.7×10^{-4}, below the next term 1.3×10^{-3}. At $y = 2$, where the series diverges, the closed form gives $R_e = 0.854116$ against $c/H = 0.577350$ (check C-56).

par *Non-claim.* The ratios x and y are chosen dimensionless numbers. No value of H, H_Λ or μ for the physical universe is asserted, and the expansion law is supplied. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Discussion: the analogy, sentence by sentence

Table lists each sentence of the analogy (Section), its formal counterpart in this manuscript, and its status.

begingroup 1.15 The analogy dictionary.

toprule Analogy sentence Formal counterpart Status

midrule endfirsthead toprule Analogy sentence Formal counterpart Status

midrule endhead bottomrule endfoot The box is the causal region $\mathscr{S} = J^{-}(\gamma) \cap J^{+}(\gamma) = \{X_4 > |X_0|\}$, horizon cuts of area $4\pi\ell^2$ theorem (Thm)

Modes that leave are inaccessible replacement channel, $F_e = 1/d^2$, error $\geq 1 - 1/d^2$ for every code and decoder theorem (Thm)

The volume cannot be enlarged every host functional is reorganization-invariant theorem (Thm)

Denser packing a change of declared encoding; area, S_{GH} and N_{GH} unchanged; the bound $q \leq \lfloor \mathrm{eta} S_{\mathrm{GH}}/(k_B \ln 2) \rfloor$ holds only under a supplied promise theorem plus conditional (Thm , Thm (c))

Fidelity and error correction a change of code or decoder; every decoder has error exactly $1 - 1/\sum_i \lambda_i^{-1}$, so the placement floor $1 - 1/d^2$ is the exact minimum, attained exactly by decoders outputting I/d; a classical record does better by exactly $(d-1)/d^2$; no thermal noise model at T_{GH} theorem (Thms , , Prop); thermal part open

Faster operation echo latency at least $(2/H)\operatorname{artanh}(HR/c)$; a tick serves margin m iff $\delta \leq m$, with local failure and an exact per-target feasible set theorem (Prop , Thms , ,)

Algorithmic efficiency data counts are encoding-relative theorem (Prop)

Hard ceiling fibre supremum $Q^{*}(H)$, reorganization-invariant; infinite for free declared dimension; under a promise, $\lfloor \mathrm{eta} S_{\mathrm{GH}}/(k_B \ln 2) \rfloor$ exactly theorem (Thm (a),(b), Thm)

$\dim \leq \exp(S)$ not a host theorem; a supplied promise only permanent negative certificate (Thm (b))

Thermal floor T_{GH} is a label; no detector or state; Gibbs targets at it are not identified by admitted data (exact radii), while coefficient-free thermal operations exist certificate (Thm); physical model open

Epochs the event horizon depends on the prescribed future through one number R_0; exact minimax error; forgetting like $e^{H_1 t}$; all of this already within smooth hosts theorem on prescribed comparison hosts (Prop , Thm , Prop)

Learning the temperature by experiment every coefficient-blind adaptive experiment has one transcript law for all κ; finite lists have risk $(t_{+} - t_{-})/2$, the full family infinite risk theorem (Thm)

$\dim = \exp(S)$ exactly an exact dimension assertion encodes the coefficient; rounding leaves an interval of coefficients theorem (Thm)

Vacuum energy of the box the conserved vacuum shift has rank one on the Einstein host and is not fixed by labels or reports theorem; absolute value open (Thm)

A state for the box every invariant current has invariant evaluation states it does not determine theorem; no field state (Thm)

New reports beyond a bound exact on the named class $\mathcal{R}_q$; an overrun changes the class theorem (Cor)

Reach of the box over time messages reach comoving receivers within c/H, replies return only from within $c/(2H)$, after $-H^{-1}\ln(1 - 2HR_0/c)$ theorem (Thm)

The horizon visible at that moment sharp bounds from bounds on the future; nondecreasing under a monotone rate; relaxation law; not certified by the past theorem plus conditional (Thms , , Cor)

A finite memory retrieval at most $\min\{1, D/M\}$; perfect archives up to q_η fair bits under the promise theorem plus conditional (Thm)

endgroup

The picture that emerges is precise and modest. The *geometric* part of the finite-capacity intuition is fully a theorem about the prescribed host. This includes a bounded causal diamond, a fixed horizon area, an operationally

exact no-transport floor and a divergent echo latency. The *capacity* part is not geometric. With unrestricted declared data, the ceiling of every figure of merit is a fibre supremum, and for register dimension it is infinite. The finite bound $\exp(S_{\mathrm{GH}}/k_B)$ must be supplied as a promise. In this sense, the conjectured finiteness of the de Sitter Hilbert space is information *beyond* the classical host. Any attempt to read it off the host, or off host-blind reports, fails the fibre test. This is consistent with the view in the external literature that finiteness is a feature of quantum gravity rather than of semiclassical geometry [Banks2001,Witten2001,CLPW2023]. We do not adopt or test that view.

The potential impact is twofold. For the Enter programme, the manuscript supplies a reusable formal object, the reorganization, with an invariance-and-characterization theorem and a ceiling theorem. Future sheets can cite these instead of restating the analogy. For the external discussion, it isolates a clean dividing line. Everything that the classical de Sitter host can support is proved here with exact constants: $4\pi\ell^2$, $1 - 1/\sum_i \lambda_i^{-1}$ for every decoder, hence $1 - 1/d^2$ together with its attainers, the gap $(d-1)/d^2$ to the shredder floor, $\delta \le m$, $(2/H)\mathrm{artanh}\,(HR/c)$, and the one-number law $c/H_1 + (R_0 - c/H_1)e^{H_1 t}$. Under a supplied promise, the integer $\lfloor \mathrm{etaS}_{\mathrm{GH}}/(k_B \ln 2) \rfloor$ is attained. The rest is named.

Version 6 turns the second half of this picture into identifiability statements with exact losses. The admitted data identify neither the temperature, nor a Gibbs target at it, nor an exact dimension, nor the vacuum shift, and adaptive reuse of coefficient-blind data does not help (Section). Where the target space is bounded, the loss is finite and exact: half the trace distance of two Gibbs states, $\frac{1}{4}$ for the qubit, half the vacuum interval. Where it is unbounded, the loss is infinite. These are statements about what a rule of data can identify, not about what the physical world contains.

Version 7 adds the interface to observation. Section proves exact statements about prescribed expansion histories, and Section turns them into conditional predictions by naming the supplied hypotheses and the identifications. The clearest positive statements are the comoving deadlines, the drift residual and the relaxation law; Corollary prevents overclaiming, and Theorem gives a sharp but strongly conditional capacity consequence.

Limitations and open problems

Limitations. Every host here is prescribed: no metric is derived and no field equation is solved. Every channel, Hamiltonian, register, tick rule and lattice permission model is declared finite data. The named labels T_{GH}, S_{GH} and N_{GH} are formulas evaluated, where evaluated at all, at a supplied coefficient; the certificates show what a rule of admitted data loses without it, and do not decide whether the labels are physical. The quantitative constants are exact for the stated finite tasks and do not extend to continuum transport, hardware rates or quantum-gravity Hilbert spaces. Statements recorded from other sheets are source records only. The computer-assisted checks (Appendix) verify identities and examples; they are not proofs of the general statements. The predictions of Section are conditional on supplied hypotheses; they test identifications, not the framework itself.

begingroup 1.15 Open items and their status in version 7.

toprule # Item Status

midrule endfirsthead toprule # Item Status

midrule endhead bottomrule endfoot O1 A finite-dimensional Hilbert space of dimension $\sim \exp(S_{\mathrm{GH}}/k_B)$ on the static patch open; external label only. Not derivable from the host plus free declared data (Thm (b)); the declared dimension passes every finite bound under host-invariant reorganizations (Thm); N_{GH} is not a function of admitted data (Thm); an exact dimension assertion encodes the coefficient, rounded and inequality forms do not (Thm)

O2 Derivation of T_{GH} or S_{GH} from any Enter instrument closed negatively in the admitted class (Thm), also for finite adaptive experiments (Thm); host-blind reports already fail (Thm (d)); the supplied-coefficient form is refused

O3 A continuum transport statement up to the horizon open. A fixed tick fails near the horizon (Thm (c)) and already at short range (Thm (d)). For the lattice task with unit ℓ_0: zero ticks for $L \le \sqrt{3}\ell_0/2$; for $L > \sqrt{3}\ell_0/2$,

$\liminf m j_{\min} = (\ell_0 + L\alpha)/c$ and convergence is equivalent to a range-free ratio-density property (Thm , Table); no continuum construction

O4 Classification of currents for subgroups outside the proved stabilizer list closed in the source sheet (Red06-G-DSS cor:R-all, Red06-G-DSS thm:R-red); $\iota = \mathfrak{c}$ for the static class (Prop); invariant currents have invariant evaluation states that they do not determine (Thm); no field state

O5 Whether a reorganization can produce a report outside a stated certified bound the unrestricted form is false (Thm (e)); the host-level form is closed (Thm (d)); for the named class $\mathcal{R}_q$ and Q_{alph} the bound q is exact and an overrun changes the class (Cor); the general form stays open

O6 A thermal noise model at T_{GH} for error correction inside $\mathscr{S}$ open; no state or detector constructed. Thermal operations attain the horizon floor iff the Hamiltonian is scalar, and the shredder floor by dephasing (Thms , , Prop); temperature-identifying targets are not identified by admitted data, with exact radii, and a stationary state does not select a channel (Thm , Remark)

O7 Whether DSS_H is the only time-orientable inextendible extension of P_H decided negatively in the source sheet (Red06-G-DSS thm:R-host, Red06-G-DSS thm:R-host5); the branched host is inextendible in the real-analytic and $C^{1,1}$ classes (Red06-G-DSS thm:R-ana, Red06-G-DSS thm:R-C11); C^1 and C^0 stay open (Red06-G-DSS prop:R-gap)

O8 Smooth epoch interpolation, and any dynamics of the host smooth part closed (Prop); analytic futures force $R_0 = c/H_1$ (Prop); dynamics closed only as a negative certificate (Prop); past data do not certify an event horizon in the smooth class (Cor); no dynamics is posed

O9 $\frac{1}{2}\|\mathscr{D}\mathscr{N} - \mathrm{id}\|_{\diamond} = 1 - 1/\sum_i \lambda_i^{-1}$ for every decoder closed (Thm)

O10 An instrument meeting the shredder floor but not the horizon floor closed (Thm)

O11 Convergence of $m j_{\min}$ and the value of $\liminf_j \tau_j$ in the lattice task open; the criterion is exact (Thm (d); En08-ST-DSS thm:E-iff), certified deficits reach $j = 600$ (En08-ST-DSS prop:E-cert8), and $\alpha \in [\frac{1}{4}, \frac{1}{\sqrt{2}}]$ is not decided

O12 An absolute vacuum energy, renormalization condition or value of the cosmological constant open; the conserved vacuum ambiguity has rank one on the Einstein host and is not identified by labels or reports (Thm); no gravitational dynamics or physical thermal model is constructed

O13 A law selecting the expansion history, Λ, the dark-matter content or the primordial perturbation spectrum open, recorded in version 7; every expansion law here is supplied (Section , Remark); an additional dynamical or probabilistic law would be needed

endgroup

Conclusion

The capacity analogy for de Sitter space splits cleanly. Its geometric sentences are theorems about the prescribed host with exact constants: the causal box with horizon area $4\pi\ell^2$, the replacement channel and the exact decoder error $1 - 1/\sum_i \lambda_i^{-1}$, the tick criterion $\delta \le m$, the echo minimum $(2/H)\operatorname{artanh}(HR/c)$, and the one-number epoch law. Its capacity sentences are not geometric: the ceiling of a figure of merit is a fibre supremum, infinite for free declared dimension and finite only under a supplied promise. Version 6 sharpens the second half into identifiability statements. The admitted data do not identify the temperature, a Gibbs target, an exact dimension or a vacuum energy, also not by adaptive experiment; the losses are exact where the target space is bounded ($\frac{1}{2}d_{\mathrm{tr}}$ for two Gibbs accounts, $\frac{1}{4}$ for the qubit, $(\lambda_+ - \lambda_-)/2$ for the vacuum shift) and infinite where it is not. On the transport side, the lattice threshold reduces to one range-free property of near-minimal deficits. Version 7 connects the geometric half to observation: on the prescribed host a reply returns only from within $c/(2H)$, the drift residual equals $H(t_o) - H(t_e)$, bounds on the future bound the horizon sharply, the approach to de Sitter has the rate

$1/(H_\infty + p)$, the past certifies no event horizon, and a finite memory retrieves at most D/M. Each prediction is conditional on a named supplied hypothesis, and the framework does not select the expansion history. What remains open is listed in Table ; none of it is closed by relabelling. par *Non-claim.* The conclusion summarizes the theorems above and adds no claim. Ledger unchanged: no quantum coefficient is admitted; Host C is not created; O.1 stays NOT_CLOSED; XVI-N is not discharged; XV-B is not opened. par

Non-claims

The analogy does not imply any of the following:

• that a quantum computer of fixed size is physically realized by the static patch;

• that the Hilbert-space dimension is a theorem of the Enter framework;

• that internal improvements increase the horizon area;

• that the late-time de Sitter entropy is a derived quantity;

• that the expansion history, Λ, the dark-matter content or the perturbation spectrum is selected or predicted by the framework. All statements here are separations on prescribed classical data, together with declared data. No Einstein dynamics, gravitational dynamics, derived metric, spacetime emergence, Page curve, or removal of the external clock is claimed, and no physical thermal model or absolute vacuum energy is obtained. κ is a comparison parameter only, and no numerical value of it is used. T_{GH} and S_{GH} are not derived, and Bunch–Davies is a label. No compilation is asserted. Citations identify source records only; no proof transfer.

Standing ledger

No quantum coefficient is admitted.

• Host A and Host B stay separate, and Host C is not created.

• O.1 stays NOT_CLOSED.

• XVI-N is not discharged (N-Ins.4 unresolved).

• There is no Route-B successor, and XV-B is not opened.

• H2, I3, J2 and T3 stay unresolved, and U6-sel is not moved.

• Res02-A Q1–Q4 and A1–A2 stay open.

• Gate 0 and ST4b are NOT_SUPPLIED.

• The last reading bars stay open, and continuum acquisition stays a negative certificate.

• κ is a comparison parameter only; no numerical κ is used. The absolute vacuum energy stays open, and no gravitational dynamics or physical thermal model is constructed. ``Close'' is used only for finishing a named item by theorem or by permanent negative certificate. The items closed in this manuscript (versions 1–7; Appendix gives the version of each) are:

• ``derive dim leN$_{\mathrm{GH}}$ from the prescribed host'', negatively (Theorem (b));

• ``reorganization enlarges N_{GH}'', negatively (Corollary);

• the unrestricted no-new-reports sentence, negatively (Theorem (e));

• the least error of any decoder for a payload beyond the horizon, $1 - 1/d^2$ with its attainers (Theorem), and the error of every decoder, $1 - 1/\sum_i \lambda_i^{-1}$ (Theorem), which closes O9;

• the sharpness of the promise bound (Theorem (a));

• the dependence of the first-epoch event horizon on the prescribed future, in the class of Theorem ;

• smooth realizability of every junction radius (Proposition) and analytic futures (Proposition);

• an explicit family of reorganizations realizing arbitrarily large finite dimensions with all host functionals invariant (Theorem); O1 stays open;

• the thermal-operation error of Gibbs replacement and its attainment of the horizon floor (Theorem), and O10 (Theorem); O6 stays open;

• O2 negatively in the admitted class (Theorem), including finite adaptive experiments (Theorem); O1 and O6 receive the same certificate and stay open;

• the dynamics part of O8, as a negative certificate (Proposition);

• (version 6) the identifiability of temperature-identifying thermal targets by admitted data, negatively, with exact two-point and qubit radii (Theorem); O6 stays open;

• (version 6) the identification of an exact Hilbert-space dimension with N_{GH} from admitted data, negatively (Theorem); O1 stays open;

• (version 6) the identification of the conserved vacuum shift by horizon labels or reports, negatively (Theorem); the absolute vacuum energy stays open;

• (version 6) O5 for the named class $\mathcal{R}_q$ and figure of merit Q_{alph} (Corollary); the general form stays open.

Theorem and Theorem are reductions and separations, not closures: O3 and O11 stay open, and no field state is selected. The version-7 results of Section are theorems and conditional statements; they close no open item, and O13 is recorded as open. No standing item is moved. Frozen code (XVI-P, XVI-Q and XVI-R) was not touched.

Standing ledger, verbatim (versions 4–7). No quantum coefficient is admitted. Host A and Host B stay separate; Host C is not created. O.1 stays NOT_CLOSED. XVI-N is not discharged; N-Ins.4 stays unresolved. XV-B is not opened. H2, I3, J2 and T3 stay unresolved. U6-sel is not moved. No Einstein dynamics, derived metric, spacetime emergence, Page curve, or quantized relational time without an external clock is claimed. The last reading bars stay open, and continuum acquisition stays a negative certificate. No Route-B successor is created. Res02-A Q1–Q4 and A1–A2 stay open. Gate 0 and ST4b stay NOT_SUPPLIED. Citations identify source records only; no proof transfer. No compilation is asserted.

appendix

Crosswalk from versions 1–6 to version 7

Version 6 is a consolidated manuscript: results are arranged by topic rather than by the version that introduced them. This appendix keeps the version history. Version 1 is dated 22 October 2026, versions 2–5 23 October 2026, and versions 6 and 7 25 October 2026. Every label of versions 5 and 6 is kept, so a reference to a version-5 or version-6 label resolves to the same statement here.

Version 7: changes from version 6

Version 7 keeps every result and every label of versions 1–6 and adds the following.

• *Six results from the version-7 plan* (Appendix): comoving deadlines (Theorem), redshift drift with the residual identity (Theorem), future-expansion bounds (Theorem), the relaxation law and the ΛCDM closed form (Theorem), indistinguishable pasts (Corollary) and the finite-memory bound (Theorem), in the new Section . Draft corrections DC7-1–DC7-8 and plan corrections PC7.1–PC7.5.

• *A section on conditional predictions* (Section): supplied external hypotheses, the four-part schema for each result, Table without ratings, and Remark . Open item O13 is recorded.

• *Front matter and discussion*: the abstract, main results, scope box, dictionary, limitations and conclusion are updated; Example is new; two references are added [Liske2008,DESIDR2](source record; not a premise). Checks C-48–C-56.

Version 6: changes from version 5

Version 6 keeps every result of versions 1–5 and adds the following.

• *Seven verified findings* (Appendix): thermal identifiability (Theorem), adaptive blindness (Theorem), exact dimensions (Theorem), the vacuum fibre (Theorem), the threshold envelope (Theorem), evaluation states for any linear space of currents (Theorem), echo carrier blindness (Theorem) and the named O5 certificate (Corollary). Eight draft corrections DC-1–DC-8.

• *Label audit* against the manuscript records of 2026-10-25 (Appendix), and five errata to version 5 (Appendix).

• *Restructuring for publication*: a new abstract and introduction, a setting with the admitted data (Definition), a granularity section, a certificate section, worked examples (Section), limitations, a conclusion, and this crosswalk.

Checks C-37–C-47.

Version 5: changes from version 4

Version 5 keeps every result of versions 1–4 and adds the following.

• *O1, O2, O6.* Theorem : the labels are injective in the coefficient slot of $\hbar$ with all admitted data fixed, so no rule of admitted data reproduces them. O2 is closed negatively in the admitted class; its supplied-coefficient form is refused. O1 and O6 receive the same certificate; their physical forms stay open.

• *O8.* Proposition : the dynamics part is closed as a negative certificate; no dynamics is posed.

• *O4, O7, O11 and the realization criteria* are updated from the version-8 de Sitter sheets (Section): $C^{1,1}$ -inextendibility of the branched host, sharpness of the current reduction, the Codazzi classification at order two, and the L-independent convergence criterion.

• *Audit of version 4*: one documentary error in the bibliography and one typographic defect in the list of closed items; no mathematical error (Appendix). Checks C-35 and C-36 are new.

Version 4: changes from version 3

Version 4 keeps every result of versions 1–3 and adds the following.

• *O1, quantitative.* Theorem : an injective monoid of reorganizations, invariant on every host functional, that multiplies the declared dimension by 2^n; the least n that exceeds a bound B is $n_B = \max\{0, \lfloor \log_2 B - q \rfloor + 1\}$. O1 itself stays open.

• *O6, separation.* Theorems and . The plan's sentence that the horizon floor is ``not realizable by a thermal channel at T_{GH}" is false as a universal statement; the correct separation is that T_{GH} alone fixes no channel (Proposition). O6 (a physically identified noise model) stays open.

• *Epoch dependence.* Proposition : analytic futures force $R_0 = c/H_1$; hosts with two curvature values have no analytic ambient; incompleteness alone implies neither.

• *Tick and lattice constants* in one documentary table (Section), with the version-7 de Sitter lattice results.

• *Status updates from the version-7 de Sitter sheets.* The least uniform level needs $L > \sqrt{3}\ell_0/2$ (ℓ_0 the lattice unit) and has an exact lower limit (O3); the branched host is C^2-inextendible (O7).

• *The second user draft (t252u)* was checked claim by claim (Appendix); verified material is adopted. *Audit of version 3*: one inherited range error and one status change (Appendix). Checks C-30–C-34 are new.

Version 3: changes from version 2

Version 3 keeps every result of versions 1 and 2 and adds the following.

• *The error law is exact for every decoder.* The spectral lower bound of Theorem (a) is always an equality: $\frac{1}{2}\|\mathscr{D}\mathscr{N} - \mathrm{id}\|_\diamond = 1 - 1/\sum_i \lambda_i^{-1}$, with value 1 for singular outputs. The proof is an explicit feasible point of the dual semidefinite program (Theorem , Corollary). This closes open item O9.

• *Smooth comparison futures.* A C^∞ host with a monotone declared Hubble profile joins the two de Sitter epochs. Its junction radius lies strictly between c/H_1 and c/H_2, and every $R_0 \in (0, \infty]$ is realized by a smooth future. So Theorem (b),(c) hold within smooth futures (Proposition). The smoothness part of open item O8 is closed; the dynamics part stays open.

• *Status updates from the version-6 de Sitter sheets.* These are the narrowed constant of the least uniform level and the necessity of its L-dependence (O3), the closed classification of currents for connected subgroups (O4), and real-analytic inextendibility of the branched host (O7). See Section .

• *The user draft.* A supplied draft, *Big01-A: Expanded Results*, was checked claim by claim (Appendix , checks C-24–C-29). Its verified material is adopted: a second proof of the upper bound (Remark); residual-block and approximation bounds (Proposition); the exact parameter interval (Remark); the all-time constant-horizon converse (Proposition); and four separations, including a self-contained conformal-bump countermodel (Section). It also exposed the tick-gap endpoint error of version 2 (W6).

• *Audit of version 2.* One endpoint error, five imprecisions and three status changes are recorded in Appendix . Checks C-20–C-29 are new (Appendix).

Version 2: changes from version 1

Version 2 keeps every result of version 1 and adds the following.

• *Exact error floor.* The horizon floor $1 - 1/d^2$ is the exact minimum over all decoders, attained exactly when the decoder outputs I/d. Every other decoder obeys the spectral bound $1 - 1/\sum_i \lambda_i^{-1}$ (Theorem). The shredder floor $1 - 1/d$ is attained by complete dephasing, and the exact gap is $(d - 1)/d^2$ (Proposition).

• *Exact tick ceiling.* For one target, the feasible ticks form exactly $\lceil r/(cm) \rceil$ intervals. Failure of $\delta > m$ is local: it occurs within comoving distance $c(\delta - m)$ (Theorem).

• *Sharpness of the conditional ceiling.* The bound $q \le \lfloor \mathrm{etaS}_{\mathrm{GH}}/(k_B \ln 2) \rfloor$ is attained on the maximal promise class and cannot be improved from the promise. It extends to mixed registers. Its Planck band is $\pm 2.64\%$ (Theorem).

• *Dependence on the prescribed future, quantified.* One number R_0 carries the whole future; every R_0 is realized; the exact minimax error is given; the influence of the future decays like $e^{H_1 t}$ (Theorem).

• *Status updates from the version-5 de Sitter sheets.* These are the exact SWAP-lattice constant, the reduction of the current classification, and the decision of the inherited extension question (open items O3, O4 and O7).

• *Corrections.* Two imprecise statements were corrected, and the drafting-plan wording was removed from the body (Appendix). Checks C-14–C-19 are new (Appendix).

Where the version-4 section went

Section ``Version 4" of versions 4 and 5 is dissolved: Theorem is in Section ; Theorems and are in Section ; Proposition is in Section ; the tick and lattice table is Table in Section .

Where the version-5 section went

Section ``Version 5" of version 5 is dissolved: the admitted-data paragraph is Definition ; Theorem and Proposition are in Section ; the status updates from the version-8 de Sitter sheets are in Section and in Table .

Numbering crosswalk, version 5 to version 6

Table lists every numbered item of version 5 with its number in version 6, generated from the auxiliary files of the two builds. Items new in version 6 are listed after it. begingroup Numbering crosswalk, version 5 to version 6.

toprule Label Version 5 Version 6

midrule endfirsthead toprule Label Version 5 Version 6

midrule endhead bottomrule endfoot sec:intro Section 1 1

sec:changes5 Section 1.3 A.2

sec:changes4 Section 1.4 A.3

sec:changes3 Section 1.5 A.4

sec:changes Section 1.6 A.5

sec:background Section 2 2

sec:analogy Section 2.5 2.5

sec:setting Section 3 3

spec:host Specification 3.1 3.1

def:flat Definition 3.2 3.2

def:static Definition 3.3 3.3

def:causal Definition 3.4 3.4

def:uv Definition 3.5 3.5

def:labels Definition 3.6 3.6

def:reorg Definition 3.7 3.7
def:circuit Definition 3.8 3.8
sec:A Section 4 4
lem:mono Lemma 4.1 4.1
lem:flatcausal Lemma 4.2 4.2
thm:A Theorem 4.3 4.3
prop:echo Proposition 4.4 4.4
sec:B Section 5 5
lem:anc Lemma 5.1 5.1
thm:B Theorem 5.2 5.2
lem:shredder Lemma 5.3 5.3
thm:Bsharp Theorem 5.4 5.4
thm:Bexact Theorem 5.5 5.5
cor:Bexact Corollary 5.6 5.6
rem:Bexact2 Remark 5.7 5.7
prop:shredsharp Proposition 5.8 5.8
prop:Bblocks Proposition 5.9 5.9
def:tick Definition 5.10 6.1
thm:tick Theorem 5.11 6.2
thm:tickexact Theorem 5.12 6.3
sec:C Section 6 7
thm:C Theorem 6.1 7.1
sec:D Section 7 8
thm:D Theorem 7.1 8.1
thm:Dsharp Theorem 7.2 8.2
rem:Dinterval Remark 7.3 8.3
sec:E Section 8 10
prop:E Proposition 8.1 10.1
thm:Efuture Theorem 8.2 10.2
prop:Esmooth Proposition 8.3 10.3
prop:Econst Proposition 8.4 10.4
rem:Edraft Remark 8.5 10.5
sec:v4 Section 9 A.6
thm:D4 Theorem 9.1 8.4
thm:Bthermal Theorem 9.2 5.10
thm:Bdephase Theorem 9.3 5.11
prop:Eanalytic Proposition 9.4 10.6
sec:v5 Section 10 A.7
thm:Hcert Theorem 10.1 9.1
prop:Dyncert Proposition 10.2 9.9
sec:corpus Section 11 11
thm:fibre Theorem 11.1 3.10

cor:enlarge Corollary 11.2 8.5
prop:iota Proposition 11.3 11.1
prop:Lp Proposition 11.4 11.3
prop:count Proposition 11.5 11.4
sec:draftsep Section 11.7 11.8
prop:nothermal Proposition 11.6 11.5
prop:emptyint Proposition 11.7 11.6
prop:curvlabels Proposition 11.8 11.7
prop:bump Proposition 11.9 11.8
sec:discussion Section 12 13
tab:dict Table 1 2
sec:open Section 13 14
sec:nonclaims Section 14 16
sec:ledger Section 15 17
app:pc5 Appendix A C.2
app:errors5 Appendix B D.2
app:pc4 Appendix C C.3
app:errors4 Appendix D D.3
app:draft4 Appendix E E.1
app:pc Appendix F C.4
app:errors3 Appendix G D.4
app:errors Appendix H D.5
app:draft Appendix I E.2
app:checks Appendix J F
app:sha Appendix K G
app:edges Appendix L H
midrule *New in version 6*
sec:admitted Section (new) 3.1
def:admitted Definition (new) 3.9
thm:echo-carrier Theorem (new) 4.5
sec:granularity Section (new) 6
sec:ticktable Section (new) 6.1
tab:lattice Table (new) 1
ass:threshold Assumption (new) 6.4
thm:O3-envelope Theorem (new) 6.5
def:report-bound Definition (new) 8.6
cor:O5 Corollary (new) 8.7
sec:certs Section (new) 9
def:adaptive Definition (new) 9.2
thm:adaptive Theorem (new) 9.3
def:thermal-target Definition (new) 9.4
thm:thermal-ident Theorem (new) 9.5

rem:frequency Remark (new) 9.6

rem:noise-rate Remark (new) 9.7

thm:dim-exact Theorem (new) 9.8

thm:vacfibre Theorem (new) 9.10

thm:current-states Theorem (new) 11.2

sec:examples Section (new) 12

ex:decoders Example (new) 12.1

ex:gibbs Example (new) 12.2

ex:dimension Example (new) 12.3

ex:tick Example (new) 12.4

ex:envelope Example (new) 12.5

ex:planck Example (new) 12.6

tab:open Table (new) 3

sec:conclusion Section (new) 15

app:crosswalk Appendix (new) A

sec:changes6 Section (new) A.1

sec:numbering Section (new) A.8

app:findings Appendix (new) B

tab:findings Table (new) 5

app:pc6 Appendix (new) C

app:errors6 Appendix (new) D

app:drafts Appendix (new) E

endgroup

Numbering crosswalk, version 6 to version 7

Table lists every numbered item of version 6 with its number in version 7, generated from the auxiliary files of the two builds. Items new in version 7 are listed after it. begingroup Numbering crosswalk, version 6 to version 7.

toprule Label Version 6 Version 7

midrule endfirsthead toprule Label Version 6 Version 7

midrule endhead bottomrule endfoot sec:intro Section 1 1

sec:background Section 2 2

sec:analogy Section 2.5 2.5

sec:setting Section 3 3

spec:host Specification 3.1 3.1

def:flat Definition 3.2 3.2

def:static Definition 3.3 3.3

def:causal Definition 3.4 3.4

def:uv Definition 3.5 3.5

def:labels Definition 3.6 3.6

def:reorg Definition 3.7 3.7

def:circuit Definition 3.8 3.8

sec:admitted Section 3.1 3.1

def:admitted Definition 3.9 3.9

thm:fibre Theorem 3.10 3.10
sec:A Section 4 4
lem:mono Lemma 4.1 4.1
lem:flatcausal Lemma 4.2 4.2
thm:A Theorem 4.3 4.3
prop:echo Proposition 4.4 4.4
thm:echo-carrier Theorem 4.5 4.5
sec:B Section 5 5
lem:anc Lemma 5.1 5.1
thm:B Theorem 5.2 5.2
lem:shredder Lemma 5.3 5.3
thm:Bsharp Theorem 5.4 5.4
thm:Bexact Theorem 5.5 5.5
cor:Bexact Corollary 5.6 5.6
rem:Bexact2 Remark 5.7 5.7
prop:shredsharp Proposition 5.8 5.8
prop:Bblocks Proposition 5.9 5.9
thm:Bthermal Theorem 5.10 5.10
thm:Bdephase Theorem 5.11 5.11
sec:granularity Section 6 6
def:tick Definition 6.1 6.1
thm:tick Theorem 6.2 6.2
thm:tickexact Theorem 6.3 6.3
sec:ticktable Section 6.1 6.1
tab:lattice Table 1 1
ass:threshold Assumption 6.4 6.4
thm:O3-envelope Theorem 6.5 6.5
sec:C Section 7 7
thm:C Theorem 7.1 7.1
sec:D Section 8 8
thm:D Theorem 8.1 8.1
thm:Dsharp Theorem 8.2 8.2
rem:Dinterval Remark 8.3 8.3
thm:D4 Theorem 8.4 8.4
cor:enlarge Corollary 8.5 8.5
def:report-bound Definition 8.6 8.6
cor:O5 Corollary 8.7 8.7
sec:certs Section 9 9
thm:Hcert Theorem 9.1 9.1
def:adaptive Definition 9.2 9.2
thm:adaptive Theorem 9.3 9.3
def:thermal-target Definition 9.4 9.4

thm:thermal-ident Theorem 9.5 9.5
rem:frequency Remark 9.6 9.6
rem:noise-rate Remark 9.7 9.7
thm:dim-exact Theorem 9.8 9.8
prop:Dyncert Proposition 9.9 9.9
thm:vacfibre Theorem 9.10 9.10
sec:E Section 10 10
prop:E Proposition 10.1 10.1
thm:Efuture Theorem 10.2 10.2
prop:Esmooth Proposition 10.3 10.3
prop:Econst Proposition 10.4 10.4
rem:Edraft Remark 10.5 10.5
prop:Eanalytic Proposition 10.6 10.6
sec:corpus Section 11 13
prop:iota Proposition 11.1 13.1
thm:current-states Theorem 11.2 13.2
prop:Lp Proposition 11.3 13.3
prop:count Proposition 11.4 13.4
sec:draftsep Section 11.8 13.8
prop:nothermal Proposition 11.5 13.5
prop:emptyint Proposition 11.6 13.6
prop:curvlabels Proposition 11.7 13.7
prop:bump Proposition 11.8 13.8
sec:examples Section 12 14
ex:decoders Example 12.1 14.1
ex:gibbs Example 12.2 14.2
ex:dimension Example 12.3 14.3
ex:tick Example 12.4 14.4
ex:envelope Example 12.5 14.5
ex:planck Example 12.6 14.6
sec:discussion Section 13 15
tab:dict Table 2 3
sec:open Section 14 16
tab:open Table 3 4
sec:conclusion Section 15 17
sec:nonclaims Section 16 18
sec:ledger Section 17 19
app:crosswalk Appendix A A
sec:changes6 Section A.1 A.2
sec:changes5 Section A.2 A.3
sec:changes4 Section A.3 A.4
sec:changes3 Section A.4 A.5

sec:changes Section A.5 A.6
sec:v4 Section A.6 A.7
sec:v5 Section A.7 A.8
sec:numbering Section A.8 A.9
tab:crosswalk Table 4 5
app:findings Appendix B C
tab:findings Table 5 8
app:pc6 Appendix C D
app:pc5 Appendix C.2 D.2
app:pc4 Appendix C.3 D.3
app:pc Appendix C.4 D.4
app:errors6 Appendix D E
app:errors5 Appendix D.2 E.2
app:errors4 Appendix D.3 E.3
app:errors3 Appendix D.4 E.4
app:errors Appendix D.5 E.5
app:drafts Appendix E F
app:draft4 Appendix E.1 F.1
app:draft Appendix E.2 F.2
app:checks Appendix F G
app:sha Appendix G H
app:edges Appendix H I
midrule *New in version 7*
sec:P Section (new) 11
thm:P1 Theorem (new) 11.1
thm:P2 Theorem (new) 11.2
thm:P3 Theorem (new) 11.3
thm:P4 Theorem (new) 11.4
cor:P5 Corollary (new) 11.5
thm:P6 Theorem (new) 11.6
sec:predictions Section (new) 12
tab:predictions Table (new) 2
rem:noselect Remark (new) 12.1
ex:P1P4 Example (new) 14.7
sec:changes7 Section (new) A.1
sec:numbering7 Section (new) A.10
app:plan7 Appendix (new) B
tab:plan7 Table (new) 7
endgroup

The version-7 plan: verdicts, draft corrections and plan corrections

The request for version 7 (t332u) supplied a plan, PLAN_t332u.md (sha256 in Appendix), proposing six results P1–P6, a table of predictions and a section on conditional predictions. Each result was re-proved locally in the

form stated in Section and checked by the script of Appendix (checks C-48–C-55). Where the plan overlaps version 6, the stronger form is kept. Verdicts: *held* (correct as supplied, adopted), *corrected* (adopted after a correction recorded as DC7-*n*), *rejected* (not adopted).

begingroup 1.15 Verdicts on the six items of the version-7 plan.

toprule # Plan item Here Verdict

midrule endfirsthead toprule # Plan item Here Verdict

midrule endhead bottomrule endfoot P1 Comoving one-way and round-trip deadlines, T_{com} Thm **Held; strengthened (DC7-1).** All three criteria and T_{com} re-proved from Lemma , including attainment and the triangle inequality at the reflection event. Added: the one-way limit c/H is the event-horizon sphere of Theorem (c), the strict comparison $T_{\mathrm{com}} > T_H$ on $0 < HR/c < \frac{1}{2}$ with the exact identity $2x^2/((1-x)(1-2x))$, and the emission deadline for the receiver's own light (C-48, M-48, N-48).

P2 Redshift drift and the de Sitter residual Thm **Held, as an interface (DC7-2).** Standard relation, re-proved; the residual identity $\mathfrak{Z} = H(t_o) - H(t_e)$ is added, and the sign under monotone H (C-49, C-49b, M-49, N-49).

P3 Future-expansion bounds and monotone growth Thm **Held; hypotheses made explicit (DC7-3).** C^1 scale factor, equality cases, propagation of finiteness and $\dot{R}_e = HR_e - c$ derived; Proposition (a), Proposition (b) and Theorem (e) are special cases (C-50, C-50b, M-50, N-50).

P4 Relaxation law and the ΛCDM series Thm **Held; remainder made precise (DC7-4, DC7-5).** First and second order re-derived symbolically, with remainder classes; the series re-derived to order y^5 by two routes; the closed form ${}_2F_1(\frac{1}{2}, \frac{1}{3}; \frac{4}{3}; -y)$ added and checked by quadrature; the two routes agree at second order $(-\frac{1}{7})$ (C-51, C-52, M-51, M-52, N-51, N-52).

P5 Indistinguishable pasts, different futures; Bayes $\leq \frac{1}{2}$ Cor **Held, as a corollary of Proposition (c),(d) (DC7-6).** Infinite-order agreement at the junction, the $K = 0$ and $K > 0$ cases, and the exact value $\frac{1}{2}$ for every rule re-proved; restricted to the smooth non-analytic class by Proposition (C-53, M-53, N-53).

P6 Finite-memory bound and the capacity-promise corollary Thm **Held; reconciled with version 6 (DC7-7).** Bound and attainment re-proved and checked by semidefinite programming; the plan's $D_{\max}$ is the promise P_η of Theorem (c), and $\lfloor \log_2 D_{\max} \rfloor = q_\eta$ (C-54, C-54b, M-54, N-54).

endgroup The plan's table of predictions and its recommended section are adopted as Section and Table , without ratings. No item was rejected.

Draft corrections (version 7)

• *P1.* The plan states the criteria without saying how the minimum is attained or how the round trip is bounded below. The proof adds the triangle inequality at the reflection event and attainment by radial null signals. Its contrast with the static shell is made exact: $T_{\mathrm{com}} > T_H$ for $0 < HR/c < \frac{1}{2}$, and for $\frac{1}{2} \leq HR/c < 1$ the static echo is finite while the comoving reply does not exist.

• *P2.* The plan's residual $z - Hz$ uses one value of H. For a general host the residual with $H = H(t_o)$ equals $H(t_o) - H(t_e)$ exactly, so it vanishes exactly when the rate is the same at emission and observation. A zero residual for a single source therefore does not establish an exact de Sitter interval; a nonzero residual excludes it.

• *P3.* The plan assumes a C^1 scale factor and, for the monotone part, finiteness of $\dot{R}_e$. The theorem also records the equality cases, the propagation of finiteness to later times, strictness of $\dot{R}_e > 0$ unless H is eventually constant, and the failure of any conclusion without a positive lower bound.

• *P4, general law.* The plan's derivation ``integrate the leading exponential terms'' does not control the remainder. The proof bounds it uniformly through $\delta(t) = \sup_{s \geq t} |r(s)\mathrm{rverte}^{ps}$ and gives the second-order coefficient

$(A^2 - B(H_\infty + p))/((H_\infty + p)(H_\infty + 2p))$.

• *P4, ΛCDM.* The plan's series in a^{-3} converges only for $\mu a^{-3} < 1$, that is, after matter–Λ equality; it diverges for $\mu a^{-3} > 1$ (N-52). The closed form ${}_2F_1(\frac{1}{2}, \frac{1}{3}; \frac{4}{3}; -\mu a^{-3})$ holds for every $a > 0$, and the alternating-series bound controls the remainder for $\mu a^{-3} \le 1$. $R_e > c/H$ holds exactly for every a, by Theorem (c), not only asymptotically.

• *P5.* The plan says ``at most $\frac{1}{2}$''; at equal priors every rule has success exactly $\frac{1}{2}$, and the general prior gives $\max\{\pi, 1-\pi\}$. The hypothesis that the experiment's law depends only on the restriction to $t \le 0$ is stated, and the statement is restricted to the smooth non-analytic class.

• *P6.* The plan's $D_{\max} = \lfloor \exp(\mathrm{etaS}_{\mathrm{GH}}/k_B) \rfloor$ and version 6's $q \le \lfloor \mathrm{etaS}_{\mathrm{GH}}/(k_B \ln 2) \rfloor$ are the same promise: for integers, $\ln D \le s$ iff $D \le \lfloor e^s \rfloor$, and $\lfloor \log_2 \lfloor e^s \rfloor \rfloor = \lfloor s/\ln 2 \rfloor$. There is no conflict, and no new number is computed. The hypothesis that D is the dimension of everything the reader holds is added (part (d)).

• *Preamble.* The plan's omitted preamble mentions ``a polynomial future with $H \to 0$ giving no horizon''. This holds for $a = 1 + t$ (Theorem (b)) but not for polynomial futures in general: $a = (1+t)^n$ with $n > 1$ has $H \to 0$ and a finite event horizon (Theorem (d), C-50b). The other topics of the preamble are not part of the binding plan and are not treated.

Plan corrections and citation verification (version 7)

The plan identifies four external sources only by domain. Each was located and checked on 2026-10-25 against its publisher or arXiv record and Crossref. Each is cited only for what it says, with the tag (source record; not a premise).

• *Redshift drift (academic.oup.com).* Identified as Liske et al., MNRAS 386 (2008) 1192–1218 [Liske2008]. Its equation for $\mathrm{d}z/\mathrm{d}t_{\mathrm{obs}}$ is the relation of Theorem (b), attributed there to Sandage (1962), and its abstract calls the measurement a direct and model-independent determination of the expansion history. The identification of the plan's link with this paper is ours.

• *Planck (arxiv.org).* arXiv:1807.06209, ``Planck 2018 results. VI. Cosmological parameters'', A&A 641 (2020) A6, already in the bibliography [Planck2018]. The plan's statement that base-ΛCDM inferences are conditional on that model is a description of the paper's model choice, used here only in that sense. No parameter is newly adopted.

• *DESI DR2 (journals.aps.org).* DESI Collaboration, ``DESI DR2 results. II'', Phys. Rev. D 112 (2025) 083515, published 6 October 2025 [DESIDR2]. The plan's ``published in October 2025'' is correct. Its abstract reports a preference for a time-evolving dark-energy equation of state over ΛCDM of 3.1σ for DESI BAO with CMB and 2.8–4.2σ when supernovae are included, depending on the sample. ``Dataset-dependent preferences'' is accurate. No correction.

• *Type* II_1 *(arxiv.org).* arXiv:2206.10780 [CLPW2023], whose abstract states that the algebra is a von Neumann algebra of type II_1. The plan says the construction ``cited in your manuscript uses a type-II_1 algebra''. Version 6 cites the paper twice, as a revisit through algebras of observables and in the non-claim of Theorem , but never states its type. The type statement is the source's own, verified here, and is added as a caution in the non-claim of Theorem . No statement of version 6 changes.

• *Site.* Version 7 cites no new sheet label and makes no new request to the companion site. The one sheet label used in the new proofs, Red06-G prop:horizons, was already confirmed in the version-6 audit.

The version-6 findings: verdicts and draft corrections

The request for version 6 (t328u) supplied a findings manuscript, findings_t328u.tex (sha256 in Appendix), with seven results built on the comparison family of Definition . Each result was re-proved locally, in the form stated in the body, and checked by the script of Appendix . Where the supplied form and a source record overlap, the stronger form is kept. Verdicts: *held* (correct as supplied, adopted), *corrected* (adopted after a correction recorded as DC-*n*), *rejected* (not adopted).

begingroup 1.15 Verdicts on the seven supplied findings.

toprule # Supplied result Here Verdict

midrule endfirsthead toprule # Supplied result Here Verdict

midrule endhead bottomrule endfoot F1 O6: identifiable Gibbs targets require coefficient-sensitive data (findings Thm O6, with the energy–frequency and noise-rate remarks) Thm , Remarks , **Held.** All five parts re-proved; the two-point value, the replacement-channel identity and the qubit value $\frac{1}{4}$ checked by semidefinite programming and exactly (C-37–C-40, M-38, M-39, N-37). Part (e) correctly refutes the unrestricted ``no thermal output'' sentence and is consistent with Big03-A prop:R-thermal(c) [Big03A](source record; not a premise).

F2 Adaptive coefficient blindness and sharp finite-list risk Def , Thm **Held.** Induction on the transcript law; finite-list value $(t_+ - t_-)/2$, packing bound $1/M$ and unbounded risk re-proved (C-41, C-41b, M-41, N-41a, N-41b). The infinite-risk part is stated here for the named family $T_{\mathrm{GH}}^{(\kappa)}$.

F3 Vacuum fibre (findings Thm vacfibre) and exact dimensions (findings Thm O1) Thms , **Held; DC-3 adds a normalization.** Conservation, the algebraic cancellations, rank one and the kernel re-proved and checked symbolically (C-42, M-42a, M-42b, N-42); the dimension inverse, the countable set, the rounding windows with the open left end, and the register coincidence re-proved (C-43, M-43, N-43). The energy-density formula is correct for $g(u,u) = -1$, as stated; for the host four-velocity, $g(u,u) = -c^2$, the value is $-\lambda c^2$, which the body adds.

F4 O3: finite obstruction and the exact envelope criterion Assumption , Thm **Held.** Re-proved from the interface with remainder $o(1)$, which is more general than the $O(1/j)$ remainder of En08-ST-DSS thm:E-gap(a); the attainment conventions are handled by the sandwich $J_<((1+\varepsilon)m) \le J_{\le}(m) \le J_<(m)$ (C-44, M-44, N-44). The supplied text states it is conditional on the printed interface; the source sheet is now available and confirms the interface (DC-4).

F5 Invariant currents have states but do not identify them Thm **Held, generalized (DC-8).** The supplied proof uses only linearity of the current space, so it holds for any linear space of conserved currents, including the distributional currents of Red06-G-DSS thm:R-statecur8; that stronger form is kept. The static-patch witness $\mathrm{d}t_s$ checked symbolically (C-45, N-45).

F6 Echo latency: geometry, carrier blindness and device delay Thm **Held.** The derivative formula, the two-point bound, the replacement witness and the additive wait re-proved (C-46, M-46, N-46).

F7 O5 with an actual certified bound Def , Cor **Held, scoped.** Correct for the named class and figure of merit (C-47, N-47); it settles O5 only in that named form, as the findings themselves say, and the general O5 stays open.

endgroup The four ``necessary qualifications'' of the findings (thermal membership at every temperature; finite risk on a finite list; $N_{\mathrm{GH}}^{(\kappa)}$ as a host label at fixed coefficient and generally non-integral; relativity of the threshold and of evaluation states to declared data) are each part of the corresponding theorem above. No finding was rejected.

Draft corrections

• *Author field.* The findings leave the author unset. The author line ``Ngo Cheung (authorship requires confirmation)'' is kept.

• *Ledger wording.* The findings' ledger paragraph paraphrases the standing ledger and adds version qualifications of H2 to XIV-H and of an internal I2 amplitude in XIV-I that were not verified here. It is not adopted; the version-5 ledger is copied verbatim (front matter, Section and the end of the manuscript).

• *Energy-density normalization.* The findings state $(T_{\mathbf{c}} - T_*)(u,u) = -\lambda$ for a ``unit timelike'' u. This is correct for $g(u,u) = -1$, the normalization used in their proof; for the four-velocity of the host observer, $g(u,u) = -c^2$, the value is $-\lambda c^2$. Theorem (d) states both.

• *Source availability.* The findings say that complete Red06-G-DSS, En08-ST-DSS and DS-OB-1-fibre texts were unavailable. On 2026-10-25 all cited records were retrieved by read-only GET from the manuscript API (Appendix), and every cited label was checked against them (Appendix). The conditional wording is superseded

where a label was confirmed.

• *Passage routes.* The findings contain comment links to passage routes of the companion site. They are not used; only the manuscript API was read.

• *Excluded-subjects remark.* One sentence of the findings says that a ``supplied OpenAI catalogue and Family 003" supply no premise. No such record was supplied with this request or checked here; the sentence is not adopted.

• *Tags.* The findings cite source records without the tag required here; every new citation in the body carries ``(source record; not a premise)".

• *Smooth-only algebra.* The findings define the evaluation algebra on smooth currents only and say it is not claimed identical to the source algebra. Since the proof uses only linearity, Theorem is stated for any linear space of conserved currents, smooth or distributional, which covers the source scope.

Plan corrections and label audit

Version 6

Every label cited by the findings and by the new material of version 6 was checked against the manuscript records retrieved read-only on 2026-10-25 (Appendix); the machine audit of the build lists each pair, and all 82 cited sheet–label pairs of this manuscript, old and new, were found in those records. The results are:

• *Big03-A.* def:R-supply, prop:R-thermal, thm:R-O6-minimax and prop:R-vac-sep exist in version 2 [Big03A](source record; not a premise). thm:R-O6-minimax has value $\frac{1}{2}$ on its own class, and prop:R-vac-sep is a rank-one comparison with the same kernel as Theorem (b). *Mismatch of scope:* the thermality criteria (b), (c) of prop:R-thermal are marked there as conditional on Red06-G-DSS-CERT prop:RC-deph10; that label exists in the Red06-G-DSS-CERT record (retrieved 2026-10-25), but its proof is not re-checked here, so the criteria are cited as source records only, and Theorem (e) is proved locally. The record's opening title line still reads ``version 1" because version 2 is insertion-only over version 1; its header identifies version 2.

• *Big04-A-coeff.* thm:C-adaptive and prop:C-orbit exist (version 5) [Big04Acoeff](source record; not a premise). Theorem is proved locally and uses no orbit.

• *DS-OB-1-fibre, DS-OB-1-CERT, VC-OB-1-CERT.* thm:F-bridge, cor:F-ranknotsel, thm:F-einstein, prop:F-sign, thm:v5-vac, thm:DS-coef6 and prop:s2-vac exist (version 5 each) [DSOB1fibre,DSOB1CERT,VCOB1CERT](source record; not a premise). Only thm:F-einstein and prop:s2-vac are cited in the body.

• *En08-ST-DSS.* prop:E-zero, thm:E-record, thm:E-iff, thm:E-sharp, prop:E-cert8, thm:E-gap and def:E-deliver exist in version 8; the record is byte-identical to the local version-8 sheet. *Mismatch of notation:* in that sheet ℓ is the declared lattice length unit, not the de Sitter radius; version 5 used ℓ for it inside a manuscript where $\ell = c/H$ (erratum Z1, Appendix). Version 6 writes ℓ_0.

• *Red06-G-DSS.* thm:R-statecur8 and cor:R-all exist in version 8. *Mismatch of scope:* thm:R-statecur8 uses distributional currents, while the findings' algebra uses smooth currents; Theorem is stated for both (DC-8). The record differs from the local version-8 sheet only by three bibliography URL lines.

• *V-DST-DSS.* Version 8; the record is byte-identical to the local sheet. Cited for status only.

• *I-C.* prop:echoseparation (a conical echo window) and thm:A exist in version 2. The window is on a different host and is not identified with $T_H(R)$.

• *Hawk05-B, Res01-C, Big02-A.* thm:page, thm:recordgap (Res01-C version 5) and def:dark (Big02-A version 6) exist [Hawk05B,Res01C,Big02A](source record; not a premise). They are cited only to separate them from the echo latency and from capacity; none is a premise.

• *Big01-A itself.* The record returned for Big01-A is byte-identical to the supplied version-5 source; it differs from the local delivered version 5 only by bibliography URL lines. Its first comment line still names version 2 (erratum Z2). thm:tickexact, cited by the findings, is Theorem here.

• *Status change.* PC17 of the version-1 plan corrections (Appendix) (``returned 404 … on 2026-10-22") is

superseded: Red06-G-DSS, En08-ST-DSS, V-DST-DSS, CMP-OB-1, XIV-K-B, V-DST-T-B, I-B-G-Q-C and EM-OB-1 all returned HTTP 200 on 2026-10-25. The bibliography now records them as manuscript records (erratum Z4).

Plan corrections (version 5)
Plan t254u for this manuscript reads: ``O11 and remaining O1, O2, O6, O8-dynamics where earnable as negative certificates/separations; incorporate DSS v8 status updates; keep submission format."

• *O11.* O11 is a question of the lattice sheet; this manuscript can only record it. The version-8 sheet sharpens it to an equivalence (En08-ST-DSS thm:E-iff, version 8); neither α nor convergence is decided, so O11 stays open, now in a sharper form.

• *O1, O2, O6.* Earnable here only as a certificate: Theorem . O2 in the admitted class is closed negatively. O1 (a Hilbert space of dimension N_{GH}) and O6 (a physically identified noise model) are not closed: the certificate shows they need data outside the admitted class, which is a separation, not a construction.

• *O8 dynamics.* Closed as a negative certificate (Proposition); it is not a dynamics.

• *DSS v8 status.* Incorporated (Section , rows O4, O7, O11); every cited version-8 label exists in the delivered version-8 sheets (label audit of the build).

• *Submission format.* Kept: a single pdflatex source, the novelty abstract, the Enter, I-C and I-D background, the author line and the Cheung records.

Plan corrections (version 4)
Every label cited in plan t251u for this manuscript was checked against the source text (label audit of the build, Appendix).

• ``*O1 … Thm D fibre supremum + CMP ι = c''.* thm:D and CMP-OB-1 def:iota exist. The plan's family ``realizing arbitrarily large finite dimensions" is Theorem . It is a quantitative form of Theorem (b), not a closure of O1, which asks for a derivation and stays open.

• ``*Thm Bexact + I-C shredder floor + I-B-G-Q-C support bridge".* I-C has no label named ``shredder"; the shredder floor $1 - 1/d$ is I-C thm:A, and the local statement is Lemma . I-B-G-Q-C-v6 thm:bridge exists but concerns the conical host; it does not bear on thermal channels on DSS_H.

• ``*Decoder meeting horizon floor* $1 - 1/d^2$ *not realizable by thermal channel at named* T_{GH} *without extra declared data".* As a universal statement this is false: replacement by the Gibbs state of $H = 0$ is a thermal operation at every temperature and attains the floor (Theorem (c)). What is true is the clause ``without extra declared data": the Hamiltonian, bath and interaction are such data (Proposition).

• ``*Incomplete futures not analytically extendable with prescribed Hubble profile".* False as stated: the region $t < 1$ of $a = e^{Ht}$ is incomplete and extends analytically with the same profile (Proposition (c)). Replaced by Proposition (a),(b). Red06-G-DSS thm:R-ana exists (version 6).

• ``*Single comparison table Thm tickexact vs En08 Thm E-jmin".* Both labels exist. The table uses the version-7 range correction of En08-ST-DSS thm:E-jmin (En08-ST-DSS prop:E-zero, version 7).

• ``*New open: Bexact certificate realizable by instrument meeting shredder but not horizon floor".* Answered (Theorem): the certificate is a two-outcome instrument summing to the replacement channel; the shredder floor is met by thermal dephasing; after any replacement channel no decoder meets it.

Plan corrections (version 1)
We checked every label cited in the plan against the source text. The DSS and obstruction sheets are local read-only copies; the parents are site records retrieved on 2026-10-22. The corrections are:

• *Red06-G prop:horizons, thm:firstlaw, thm:GSL.* These exist in the parent Red06-G, the site record. But thm:firstlaw and thm:GSL concern constant entropy rescaling with Schwarzschild relations, and prop:horizons gives the FLRW radius derivatives. None of them is a de Sitter statement. The de Sitter analogue is Red06-G-DSS prop:R-firstlaw, an entropy-rescaling test on DSS. Red06-G-DSS contains no GSL statement for DSS.

• *Constant $R_e = c/H$.* This is Red06-G-DSS thm:R-Re(a). Its converse fails for intervals bounded above (Red06-G-DSS thm:R-Re2(c)), which was the v1 error.

• *Thm R-horizon* exists, with (a) the DSS horizon at proper radius c/H and (b) no event horizon on the cone. Theorem extends (a) to the full hyperboloid.

• *En08 Prop E-horizon, Thm E-nosignal and Thm E-window* exist with the stated content. E-nosignal is proved under the declared lattice rule En08-ST-DSS decl:E-window. Theorem is its circuit generalization. The threshold is $j_{\min}(m, L) = \Theta(1/m)$ (En08-ST-DSS cor:E-twosided), and the constants gap of En08-ST-DSS prop:E-asymp is open. Check C-7 reproduces $j^* = 7, 29, 139$ and $j_{\text{nec}}(0.02) = 50$.

• *E-discrete and E-limits* exist (En08-ST-DSS thm:E-discrete, En08-ST-DSS thm:E-limits). They concern causal embeddings of an infinite network, not capacity, and are not used for A–D.

• *V-DST: ``realization criteria R·E_H''.* The criteria (R1)–(R4) select the line $a\,\mathscr{E}_H$ and leave the normalization free (V-DST-DSS thm:V-select). The data counts are V-DST-DSS thm:V-count and V-DST-DSS prop:V-count2, and they are meaningful only for linear or continuous encodings.

• *V-DST Thm V-profile* exists but is not a ceiling or saturation theorem. It is the closed-form allowance profile of a declared averaged coupling between two de Sitter labels $H_\pm$, with $\beta_{\text{DSS}} = 2(H_+^2 - H_-^2)M(D) < H_+^2 - H_-^2$. Its use in D is withdrawn, and it is cited only in E.

• *Thm V-host* exists: DSS is neither Host A nor Host B, and it fails the Host-C class.

• *Thm R-nomap2* exists (report-blindness). The plan's D sentence ``cannot produce new independent reports'' is false as stated (Theorem (e)). The strongest honest version is Theorem (d).

• *R-groups, R-stab, R-patch* exist with the stated content. Invariant one-forms depend on the group.

• *XIV-K-B Thm obstruct and Thm range* exist, but they concern a declared codimension-k locus ($k = 8$) carrying a homogeneous singular reference. The plan's sentence ``any attempt to extend a branch across the horizon … is obstructed exactly as in Thm obstruct / Thm range'' is not established: the horizon is a smooth null hypersurface, and no singular reference is declared. It is recorded as a separation.

• *V-DST-T-B.* The sentence ``$d_c = 2$ requires causal overlap'' is false in L^1, where 2 is attained without overlap (V-DST-T-B thm:Lp(ii)). It is true for Hilbert norms, for L^p with $1 < p < \infty$, and for L^∞ up to closure. Without overlap, $d_c \le 2^{1/p}$ for $1 < p < \infty$, and $d_c = 1$ in L^∞, a norm that is not strictly convex. So ``strictly smaller in strictly convex norms'' is correct but incomplete (Proposition).

• *I-B-G-Q-C Thm state* holds for every $0 < \alpha \le 1$, as the theorem's hypothesis states. Thm bridge exists. Both are used for contrast only.

• *Fibre criterion labels:* EM-OB-1 thm:EM-fibre, TS-OB-1 thm:TS-fibre and VC-OB-1 thm:VC-fibre.

• *Epoch sentence.* ``Capped by the horizon visible at that moment'' is refined: the event horizon depends on the prescribed future, and only $c/H(t)$ is local (Proposition).

• *Light-crossing time.* The plan's ``faster operation is limited by the light-crossing time'' is refined. The limit is on echo latency, $(2/H)\operatorname{artanh}(HR/c)$, and not on the number of operations along γ (Proposition).

• *Registration status.* Red06-G-DSS, En08-ST-DSS, V-DST-DSS, CMP-OB-1, XIV-K-B, V-DST-T-B, I-B-G-Q-C and EM-OB-1 returned 404 from the companion API on 2026-10-22. They are cited as local delivered sheets, not as registered manuscripts.

Errata and other changes

Errata to version 5 (found in version 6)

The audit of version 5 found no mathematical error. It found one notational collision, two stale or contradictory sentences, one missing non-claim and one status change; all are corrected in the body.

• *Lattice length unit.* Version 5 wrote ℓ for the declared lattice length unit of En08-ST-DSS (tick and lattice table, row O3 of the open table, the non-claims of Theorems and , checks C-7 and C-34, the status note on O11 and the

version-4 change list), while $\ell = c/H$ everywhere else. Version 6 writes ℓ_0 for the lattice unit (Table). The numbers are unchanged, since every check sets the unit to 1.

• *Stale header.* The first comment line of the version-5 source named version 2. The header now names version 6 and records the input hashes.

• *Missing non-claim.* Theorem had no non-claim of its own; one is added.

• *Registration status.* See PC6.10: the source records that returned 404 on 2026-10-22 return 200 on 2026-10-25.

• *O8 wording.* The non-claims of Propositions and , and one item of the closed list, said that the dynamics part of O8 ``stays open'', which contradicts Proposition (version 5). They now say that it is closed only as a negative certificate and that no dynamics is posed.

Other changes. The version-labelled sections of versions 4 and 5 are dissolved into the topical sections; the change lists of versions 2–5 move to Appendix , which also maps every numbered item of version 5 to its version-6 number. The admitted-data paragraph of version 5 became Definition , and the fibre criterion moved to Section . No result of versions 1–5 was removed, and every label of version 5 is kept.

Errors found in version 4, and other changes

We re-read the statements of version 4, in particular Section , the open table and the bibliography, and re-ran checks C-35 and C-36 only (C-1–C-34 are recorded as in versions 3 and 4).

• *Bibliography (documentary error).* Version 4 cited labels of the version-7 de Sitter sheets, and listed their sha256, but its bibliography entries for Red06-G-DSS, En08-ST-DSS and V-DST-DSS still read ``versions 3, 5 and 6''. The entries are corrected below to include versions 7 and 8. No statement depended on it.

• *Status of O7.* Version 4 listed $C^{1,1}$, C^{1} and C^{0} inextendibility of the branched host as open; $C^{1,1}$ is now proved (Red06-G-DSS thm:R-C11, version 8). A status change, not an error.

• *Typographic defect.* In the list of closed items, the version-4 entry for Theorem lost its closing quotation marks and its cross-reference in the build script, so the version-4 PDF prints ``invariant is closed (Theorem efthm:D4)''. The entry is restored in version 5. No statement depended on it.

• No mathematical statement of version 4 was found false. In particular Theorems , , and Proposition were re-checked line by line.

Errors found in version 3, and other changes

We re-read the statements of version 3 that depend on the de Sitter sheets, against their version-7 successors, and re-ran checks C-30–C-34 only (C-1–C-29 are recorded as in version 3).

• *Inherited range error.* The O3 row and item W2 quoted $(\ell + L/4)/c \le \liminf m\, j_{\min}$ from En08-ST-DSS thm:E-jmin (version 6) without its range condition. That bound is false for $0 < L \le \sqrt{3}\ell/2$, where $j_{\min} = 1$ (En08-ST-DSS prop:E-zero, version 7). It holds for $L > \sqrt{3}\ell/2$. The O3 row below is corrected.

• *Status of O7.* Version 3 listed C^{∞}, C^{2} and C^{0} inextendibility of the branched host as open. Version 7 of Red06-G-DSS proves C^{2} (hence C^{∞}) inextendibility (Red06-G-DSS thm:R-C2, version 7); C^{0} stays open. A status change, not an error.

• *Status of O6.* The O6 row ``no state or detector constructed'' stays true; Theorems and add finite thermal-operation models with supplied Hamiltonians, not a noise model on the host.

Errors found in version 2, and other changes

We re-read every proof of version 2 (sha256 5f8c1b9e6d6b8c15352f98320322cc541d79ca8c7c347172d09a670580b64886) and re-ran its checks. The output of checks C-1–C-13 is byte-identical to the version-1 log, and the output of checks C-14–C-19 is byte-identical to the version-2 log. Our own audit found no false statement in version 2. Checking the user draft (Appendix) then exposed one endpoint error and three imprecisions, items W6–W9. The other items are imprecisions or status changes. Versions 1 and 2 are not edited.

• *Open item O8 was stated too broadly.* Version 2 listed ``smooth (rather than Lipschitz) epoch interpolation'' as

open. Theorem of version 2 already applied to every continuous scale factor, smooth ones included. What was missing was only an explicit smooth two-epoch host and smooth realizability of every R_0. Both are supplied by Proposition , and the row now says so.

• *Plan correction PC4.* The sentence ``the threshold is $j_{\min}(m, L) = \Theta(1/m)$'' is correct for fixed $L$, but it suppressed a necessary dependence on $L$. The version-6 En08 sheet proves that $m\, j_{\min}$ lies asymptotically in $[(\ell + L/4)/c, (\ell + L/\sqrt{2})/c]$ (En08-ST-DSS thm:E-jmin, version 6). The phrase ``the constants gap of prop:E-asymp is open'' is replaced by this interval.

• *Status of O9.* Version 2 recorded the equality case of Theorem (a) as open, supported by nine numerical cases. It is now a theorem (Theorem). This is a status change, not an error. The final sentence of the non-claim after Theorem is updated accordingly.

• *Status of O4 and O7.* The version-6 Red06 sheet closes the classification of currents for connected subgroups (Red06-G-DSS cor:R-all, version 6), and proves that the branched host is inextendible in the real-analytic class (Red06-G-DSS thm:R-ana, version 6). The same sheet corrects its own version-5 wording ``conical defect'' for that host: it is a branched cover with total angle $4\pi$. Version 2 of this manuscript used ``branched'', which is correct.

• *Status of the V-DST criteria.* The version-6 V-DST sheet reduces support-non-increasing equivariant maps to differential operators by Peetre's theorem (V-DST-DSS thm:V-Peetre, version 6), and exhibits a nonlocal equivariant map (V-DST-DSS prop:V-nonlocal, version 6). Neither changes a statement of this manuscript; the V-DST labels cited here are present unchanged in version 6.

• *Tick gaps were stated as open intervals (error).* Theorem (b) of version 2 gave the gaps as $((x + m)/(n + 1), x/n)$. The left endpoint $(x + m)/(n + 1)$ is infeasible: it is the excluded upper end of the piece $n + 1$ and lies below x/n. So the gaps are the half-open intervals $[(x + m)/(n + 1), x/n)$. The number of components and of gaps, and all other parts of the theorem, are unchanged. Check C-17 of version 2 did not sample the endpoints; check C-26 does. The error was pointed out by the user draft.

• *Radar-echo wording.* Proposition said ``only if $q \in \mathscr{S}$, that is, only if its areal radius satisfies $r(q) < \ell$''. The implication $q \in \mathscr{S} \Rightarrow r(q) < \ell$ is correct, but the ``that is'' asserted an equivalence. On the full hyperboloid the antipodal static region $\{ -X_4 > |X_0| \}$ also has $r < \ell$ (check C-24). The wording is now ``in particular''.

• *Host-functional wording.* The introduction of version 2 (``What is new'', item 4) said ``The finite dimension $\exp(S_{\mathrm{GH}}/k_B)$ is not a host functional.'' Read literally, this contradicts Theorem (a), which lists N_{GH} among the host functionals. The intended and proved statement is Theorem (b): the bound $\dim \le N_{\mathrm{GH}}$ is not a theorem of the host. The sentence is corrected.

• *Planck band.* Theorem (d) and check C-18 gave the linearized band $\pm 2.64\%$. The exact image of the input interval is asymmetric. It is now stated in Remark .

Errors found in version 1, and other changes

We re-read every proof of version 1 (sha256 90da6bf8938aa6e629f4a0e318f78a8055a6bf63a7fe5907c63615932db281e1) and re-ran its checks C-1–C-13. The check output is byte-identical to the version-1 log. No proof was found wrong. The following statements were imprecise and are corrected here. Version 1 itself is not edited.

• *Abstract, item (A).* Version 1 said that a radar echo from areal radius R ``takes proper time exactly $(2/H)\operatorname{artanh}(HR/c)$''. Proposition proves a lower bound, with equality for radial null signals. The abstract now says so.

• *Proposition (a).* Version 1 asserted $c/H_1 < R_e(t) < c/H_2$ ``during the first epoch'', that is, for $t \le 0$. At $t = 0$, $R_e = c/H_2$. The strict inequalities hold for $t < 0$, and monotonicity holds on $(-\infty, 0]$.

• *Proof of Theorem (c).* The phrase ``suppose first $\delta \le m'$ with $m' \ge m$'' inverted the roles of the tick bound and the target margin. The argument itself was correct, and the phrase is corrected.

• *Drafting-plan wording in the body.* Version 1 referred in its body to ``the user's plan'' and ``the plan's sentence''.

These are internal drafting references, and they are inappropriate in a manuscript for submission. They are replaced by references to the analogy as stated in Section . Appendix keeps the label audit of the plan, since it documents the provenance of the cited labels.

• *Appendix , item PC2.* The phrase ``which was the v1 error'' refers to version 1 of the sheet Red06-G-DSS, not to version 1 of this manuscript.

• *Status of O3, O4 and O7.* At the date of version 1 these items were open in the version-3 source sheets. The version-5 sheets have since decided or reduced them (Section). This is a status update, not an error.

• *Precision of the label evaluation.* Version 1 quoted $q \le 4.8 \times 10^{122}$ correctly. Theorem (d) adds that only about two significant digits are meaningful, and that the floor is a formal feature of the promise. The abbreviated ledger line printed after each non-claim is unchanged from version 1. The complete standing ledger is Section .

Relation to the user drafts of versions 3 and 4

The two user drafts checked in versions 3 and 4 are recorded here unchanged; the findings of version 6 are in Appendix .

Relation to the second user draft (t252u)

The user attached a results supplement for t252u, ``New Scoped Results for the Four DSS Expansion Plans'' (cfb7dd5b….tex, 68100 bytes, 1887 lines; sha256 cfb7dd5bb0129f5930de3ba3a3ab053d8c3508b676630de7367909f4c53fb443). It was copied read-only to DSS/v7/inputs/user_draft_t252u.tex and Big01/v4/inputs/user_draft_t252u.tex; the original was not edited. Every claim was checked independently, by proof and, where marked, by the checks of this version. The draft covers all four sheets, so the full table is given in each of them.

Compilation as attached. pdflatex reports 4 errors, all ``Undefined control sequence'' for verb | dS | (lines 155, 197, 199, 1599: the macro is used but never defined); in non-stop mode it still produces 22 pages. The draft itself asserts no compilation. *Ledger.* The draft's standing ledger is verbatim, and no overclaim or ledger violation was found; it keeps every open item open. *Author line.* The draft's ``Authorship requires confirmation'' is not adopted; the author line of these sheets is unchanged.

begingroup toprule # Draft claim Verdict

midrule endhead T1 Thm ``Degeneracy of the canonical branch filling'' **Correct; adopted** as Red06 Prop. R-branch(a) (check C-R25).

T2 Thm ``The branched host is not globally hyperbolic'' **Correct; adopted** as Red06 Prop. R-branch(b) (check C-R26: the broken paths are timelike and Φ has the same winding for all $\varepsilon > 0$).

T3 Cor ``The proposed completeness argument does not apply'' (GLS) **Correct; adopted** as Red06 Cor. R-GLS and as a plan correction. The GLS citation (CMP 359 (2018) 937–949, doi 10.1007/s00220-017-3019-2, arXiv:1704.00353) is accurate.

T4 Prop ``Curvature defect at an extension boundary'' **Correct as stated** (necessary conditions; the local constant-curvature step is a standard sketch). **Superseded**: Red06 Thm. R-C2 proves that M_S has no C^2 extension at all.

T5 Remark and status row ``C^2/C^0 inextendibility not established'' **Superseded for C^2** by Thm. R-C2; **correct for C^0** (and $C^{1,1}$, C^1), which stay open.

T6 Thm ``Conditional state-current reduction'' ($\le$ ć) **Correct; adopted** as Red06 Thm. R-statecur(a),(b).

T7 Prop ``The continuum bound can be attained classically'' ($e^{\lambda q}\xi^{\mathrm{flat}}$) **Correct; adopted** (Thm. R-statecur(b); check C-R27).

T8 Prop ``Smoothness cannot be omitted'' (circle current) **Correct; adopted** (Thm. R-statecur(c)).

T9 Remark on the scope of Cor R-all **Correct**; it agrees with the v6 non-claim.

T10 Thm ``Strengthened report-fibre separation'' **Correct; adopted and extended** to extension classes in Red06 Thm. R-nomap3.

T11 Operator identities (draft eq:operatoridentities) **Correct** (checks C-V23, C-V24, including $\mathscr{E}_H(fg) = -\mathrm{D}f$ and $\delta R[\mathscr{L}_\xi g] = 0$).

T12 Thm ``A background-dependent counterexample" $T_\xi = \mathscr{E}\mathscr{L}_\xi$ **Correct; adopted** as V-DST Thm. V-bg(a) (check C-V26). V-DST adds a second (scalar) background.

T13 Prop ``No universal bound from $M(D)$" **Correct** (scaling); **adopted** as V-DST Rem. V-MD and a plan correction.

T14 Thm ``Compact-output nonlocal map satisfying (R4)" ($A^*\mathscr{E}_H$) **Correct; adopted** as V-DST Thm. V-nlR4(b).

T15 Thm ``No nonzero member of the trace family satisfies (R4)" **Correct; adopted** as Thm. V-nlR4(a).

T16 Thm ``A smooth-kernel repair satisfying (R4)" **Correct** (for k constant near $-\ell^2$); **generalized** in Thm. V-nlR4(c): $k \mapsto \widehat{T}_k$ is injective and every $k \neq 0$ gives a support-enlarging map; (d) adds the finite-calibration statement.

T17 Remark ``Output-domain distinction" **Correct.**

T18 Prop ``Maximal norm discrepancy does not exclude locality and (R4)" **Correct; adopted** in the non-claim of Thm. V-nlR4 and as a plan correction.

T19 Prop ``Same transverse degree, different extensions" **Correct; adopted** as V-DST Prop. V-domain7(a).

T20 Prop ``A horizon-germ condition cannot determine the domain" **Correct; adopted** as Prop. V-domain7(b).

T21 ``XIV-K-B hypotheses are codimension eight" **Correct** (XIV-K-B v6, Section ``Local model": $k = 8$); agrees with Big01-A PC11.

T22 Lattice set-up; ``distinguish ℓ_0 from the de Sitter radius" **Consistent** with En08 v6; the v6 ℓ is already a declared length unit (Declaration E-window), so this is notation, not a correction.

T23 Lemma ``Uniformity and the equality boundary" (pointwise criterion) **Consistent** with En08 Thm. E-exact; accepted as a restatement, not used.

T24 Thm ``Zero-tick degeneracy" ($J = 1$ for $0 < L \le \varepsilon_1$) **Correct; adopted** as En08 Prop. E-zero. **It exposes a genuine v6 error**: Thm. E-jmin(b)–(d) and the second inequality of Thm. E-sharp(e) are stated for every $L > 0$ but need $L > \sqrt{3}\ell/2$; Big01-A v3 repeated the unqualified interval.

T25 Lemma ``Bounded hull deficit and word-length estimate" **Correct**; it restates the ingredients of En08 Lemma E-hull and Thm. E-gap.

T26 Thm ``Threshold asymptotic" ($jD_j = (\ell + L\tau_j)/c + O(1/j)$) **Correct**; it is En08 Thm. E-gap(a). The lower-bound arithmetic was re-derived.

T27 Thm ``Exact lower limit and convergence envelope" **Correct; adopted** as En08 Thm. E-record (proof re-derived; it upgrades v6's inequality to an identity and gives the exact upper limit).

T28 Cor ``A sufficient recurrence condition" **Correct; adopted** in Thm. E-record.

T29 Prop ``Oscillation of deficits does not decide convergence" **Correct** (scalar models); reproduced by check C-E24; **adopted** in a non-claim.

T30 Prop ``Exact facet enumeration" **Correct**; used in certified form (exact plane verification) in En08 Prop. E-cert7 (check C-E21). The draft ran no enumeration, as it says.

T31 Prop ``Finite scheduled data do not determine an infinite schedule"; remark on the scheduler obstruction **Correct; adopted** in En08 Prop. E-regcert(b); the reading of En08-ST thm:obstruction is accurate.

T32 Thm ``A capacity-growing reorganization monoid" and its corollary **Correct; adopted** as Big01-A Thm. D4 (check C-33).

T33 n_B for $B = \exp(\mathrm{eta}S_{\mathrm{GH}}/k_B)$ **Correct.**

T34 Thm ``A thermal operation attains the horizon error floor" **Correct; adopted** as Big01-A Thm. B-thermal (check C-30, SDP agreement). It refutes the plan's universal non-realizability sentence and agrees with Big01-A

Prop. nothermal.

T35 Thm ``The shredder optimum also has a finite thermal implementation" **Correct; adopted** as Thm. B-dephase(a) (check C-31).

T36 Thm ``The certificate defines an instrument on the original input" **Correct; adopted** as Thm. B-dephase(b),(c) (check C-32).

T37 Thm ``Analytic rigidity removes the junction freedom" **Correct; adopted** as Big01-A Prop. E-analytic(a).

T38 Prop ``No connected analytic ambient extension" and its remark **Correct; adopted** as Prop. E-analytic(b),(c); the remark corrects the plan's epoch sentence.

T39 Prop ``The unrestricted tick constant" and the comparison table **Correct**; consistent with Big01-A Thm. tick(c) and Thm. tickexact (half-open gaps). Adopted in the v4 table with v7 labels.

T40 Final disposition table **Accepted** except the M_S row, superseded for C^2 (T5).

T41 Bibliography entry Faist–Berta–Brandão, ``CMP 384 (2021) 1709–1758" **Numerical error**: the page range is 1709–**1750** (Crossref record of doi 10.1007/s00220-021-04107-w, checked on 2026-10-23). Corrected where cited.

T42 Compilation **Does not compile cleanly as attached**: 4 undefined-control-sequence errors (verb | dS |). Not a mathematical error.

bottomrule endgroup Summary: 42 items; 38 verified correct or consistent (28 adopted, possibly generalized; 10 confirmed without separate adoption), 2 superseded by stronger results here (T4, T5 for C^2), 1 citation error (T41), 1 compile defect (T42). No overclaim and no ledger violation. One claim of the draft (T24) exposes an error in En08-ST-DSS v6, inherited by Big01-A v3. Citations identify source records only; no proof transfer.

Relation to the first user draft (version 3)

The user supplied a draft, *Big01-A: Expanded Results* (file user_draft_t248u.tex, sha256 bbc7287d3c7e8b3fdfa9fddf8788f0b4356901ccecb2d069e292dbb2b4ce7382, kept read-only and not edited). We checked every mathematical claim in it against our own proofs and, where possible, by the symbolic or numerical checks C-24–C-29. Verdicts: *verified* (the proof is correct and the claim is adopted or already present); *corrected* (the claim needs a stated repair); *not adopted* (outside the scope of this manuscript, or not verifiable from the sources available here). The draft's author line reads ``Authorship requires confirmation"; this manuscript keeps the version-2 author line. A test run of pdflatex on the draft stopped with 7 errors: verb || is used without mathrsfs, and the definition of $\chi$ at source line 1233 is truncated (`` verb |(t≥ tchosen flat at zero.|"). This is a defect of the file, not of its mathematics.

begingroup 1.12 toprule Draft claim Verdict Where, and remarks

midrule endfirsthead toprule Draft claim Verdict Where, and remarks

midrule endhead bottomrule endfoot Flat chart formulas, conformal time, causal relation (Lemma ``ambient") verified Lemma , Theorem ; C-24 (constraint, pullback metric, u formula, symbolic)

$J^{\pm}(\gamma)$, $\mathscr{S} = \{X_4 > |X_0|\}$, round horizon cuts of area $4\pi\ell^2$ verified Theorem

Areal radius $r < \ell$ alone does not characterize $\mathscr{S}$ verified; corrects version 2 Proposition now says ``in particular"; W7; C-24 (antipodal point)

Radar latency $\geq (2/H)\operatorname{artanh}(HR/c)$; slice volume $\pi^2\ell^3$ verified Proposition ; volume by C-24. Finite volume implies no capacity bound

Ancestral support; causal disconnection gives a replacement channel verified Theorem

Exact distance $1 - (\operatorname{Tr}\sigma^{-1})^{-1}$, value 1 if singular, optimal input verified Theorem (independently proved by a dual certificate); the draft's Choi–Cauchy–Schwarz proof is Remark ; C-20, C-21, C-25

Decoder optimum $1 - 1/d^2$ and attainers; $F_e = 1/d^2$ for every decoded replacement channel verified Theorem , Corollary , Proposition (b)

Classical-only floor $1 - 1/d$, attained by dephasing; gap $(d-1)/d^2$ verified Lemma , Proposition

Residual blocks of dimension $\leq k$: $F_e \leq k/d$; approximate replacement bound $\max\{0, 1 - 1/d^2 - \delta\}$ verified; adopted Proposition ; C-25 samples the Schmidt-rank bound (largest observed ratio 0.9978; equality at the rank-k projector)

Tick feasibility $\lceil x/\delta \rceil \delta < x + m$, N components verified Theorems ,

Gaps are half-open $[(x+m)/(n+1), x/n)$ verified; corrects version 2 Theorem (b); W6; C-26 (all left endpoints infeasible, all right endpoints feasible)

Finite SWAP transport is not continuum recovery verified consistent with O3; no continuum statement is made

Reorganization invariance and fibre-supremum ceiling; fibre criterion verified Theorems , ,

``The dimension label is not a host functional" is false; N_{GH} is a host functional verified; corrects version 2 wording W8; the introduction now says that N_{GH} is a host functional and that dim leN$_{\mathrm{GH}}$ is not a host theorem

Free declared data: $Q^{*}_{\dim} = \infty$; host-blind reports fail on labels; fresh registers create new reports verified Theorem (b),(d),(e)

Promise bounds: $\lfloor e^{s} \rfloor$, $\lfloor s/\ln 2 \rfloor$, mixed and residual counts, attained verified Theorem (a),(b)

Planck evaluation $H_{\Lambda} = 1.80643 \times 10^{-18}$s^−1, 3.31231×10^{122}, 4.77866×10^{122}, exact endpoint image verified except one digit Remark ; C-27. The draft's 4.90820 should read 4.90819

Hamel dimensions aleph$_0$ and ć, density of polynomials, abstract isomorphism only verified Section (ι); already in version 2

Static-invariant conserved currents $F(r^2)\,\mathrm{d}t_s$, kernel of finite readings of dimension ć verified Proposition ; C-29 checks the radial divergence formula

One-number future law, minimax $\frac{1}{2}(R_{+} - R_{-})e^{H_1 t}$ verified Theorem

Every $R_0 \in (0, \infty]$ realized by a C^{∞} future with all past jets fixed verified Proposition (c) (monotone profile) and Remark (the draft's family); C-23, C-28

Constant event horizon on all of $\mathbb{R}$ forces $a = Ae^{ct/R}$ verified; adopted Proposition ; C-28

Elliptic quotient contains P_H and is not time-orientable verified O7 row; Red06-G-DSS thm:R-patch; [PSV2003]

Conformal-bump countermodel: globally hyperbolic, timelike complete, C^0-inextendible, not de Sitter verified; adopted Proposition ; external input [GLS2018] (reference checked on Crossref); C-29 (curvature)

No thermal floor and no reservoir heat from the labels verified; adopted Proposition

e^{1/u^2} has no distributional extension; empty interior decides nothing verified; adopted Proposition

Support separation lemma verified elementary; not needed here, not adopted

Curvature separates hosts and determines the labels verified; adopted Proposition ; C-29

Disjoint-support L^p quotients $2^{1/p}$, and 1 for $p = \infty$ verified Proposition

Descent criterion, $q\delta' + \delta = 0$, off-locus agreement does not imply descent verified (algebra) not adopted: these concern the XIV-H/I/J analytic chain, which is outside the scope of this manuscript, and those sources are not among its inputs

XIV-I constructs an amplitude at I2; XIV-J constructs a reference for $K_6 + K_8 + K_9$ not verified not adopted. No XIV source is available here. The standing ledger is unchanged: H2, I3, J2 and T3 stay unresolved, and nothing in this manuscript bears on them

``Invariant currents for other subgroups: not classified" superseded closed in Red06-G-DSS cor:R-all (version 6); O4

OpenAI catalogue attribution not verified not adopted; no catalogue record is an input of this manuscript

Ledger line ``No inherited quantum coefficient is admitted." corrected the standing wording is kept verbatim: No quantum coefficient is admitted.

Draft abstract: ``closes the unrestricted host-uniqueness question negatively, not its locally de Sitter variants" verified consistent with O7; the locally de Sitter variant is decided in Red06-G-DSS thm:R-host5 (version 5), with analytic inextendibility in Red06-G-DSS thm:R-ana (version 6)

endgroup No claim in the draft closes a standing refusal: it admits no quantum coefficient, supplies neither Gate 0 nor ST4b, creates no Host C, and claims no emergence, Einstein dynamics or Page curve. No draft statement was refused for overclaiming. The repairs are the one-digit rounding, the source defects, and the ledger wording.

Labelled computer-assisted checks

Checks C-1–C-13 are produced by the script checks_Big01A.py of version 1, which was re-run unchanged for version 2 with byte-identical output. Checks C-14–C-19 are produced by checks_Big01A_v2.py (Python 3, SymPy, mpmath, NumPy, CVXPY with the SCS solver, PYTHONHASHSEED=0, fixed random seed). Checks C-20–C-23 are produced by checks_Big01A_v3.py in the same environment, with fixed seed 20261024. Checks C-24–C-29 are produced by checks_Big01A_v3b.py (seed 20261025); they test the claims of the user draft (Appendix). For version 3 the version-1 and version-2 scripts were re-run unchanged, with byte-identical output. Semidefinite-programming values have solver tolerance 10^{-9} and are reported to six or seven digits. Symbolic checks are exact. Numerical checks are floating point or 30-digit mpmath, and none is interval-certified. Checks C-48–C-56 are produced by checks_Big01A_v7.py (SymPy, mpmath, NumPy, CVXPY with the CLARABEL solver, PYTHONHASHSEED=0, seed 20261025); two runs gave byte-identical output. Every check reported here passed. Checks C-37–C-47 (version 6) are produced by checks_Big01A_v6.py (Python 3.13, SymPy 1.14, mpmath 1.3, NumPy 2.5, CVXPY 1.9 with the CLARABEL solver, SciPy linear programming with HiGHS, PYTHONHASHSEED=0, seed 20261025). The script runs 29 tests: 12 positive checks, 9 negative controls (N-*n*: a hypothesis is dropped and the conclusion must fail) and 8 mutation tests (M-*n*: a constant or formula is altered and must be rejected); all pass, and two runs give byte-identical JSON output. The scripts of versions 1–5 were re-run unchanged, and their outputs are byte-identical to the recorded reference outputs.

C-1 The flat chart satisfies the hyperboloid constraint identically, and its pullback metric is $-c^2\mathrm{d}t^2 + e^{2Ht}\mathrm{d}\mathbf{x}^2$ (symbolic).

C-2 $u = X_4 - X_0 = e^{-Ht}(c^2 - H^2 e^{2Ht}|\mathbf{x}|^2)/(Hc)$; $g^{ab}\partial_a u\,\partial_b u + u^2/\ell^2 = 0$; and $u = ce^{-Ht}/H$ on γ (symbolic).

C-3 The static-chart pullback is $-Fc^2\mathrm{d}t_s^2 + F^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2$, and $\nabla_a(f(r)\mathrm{d}t_s)^a = 0$ (symbolic).

C-4 The two-epoch R_e has the closed form of Proposition , and $R_e = c/H_2$ for $t \geq 0$ (symbolic).

C-5 ip $wp \leq 0$ for 2×10^5 random future causal ambient vectors (sanity sampling of Lemma ; the lemma is proved analytically).

C-6 *Label evaluation.* Inputs: the exact SI values $h = 6.62607015 \times 10^{-34}$Js, $k_B = 1.380649 \times 10^{-23}$J/K and $c = 299792458$m/s; $G = 6.67430 \times 10^{-11}$; and the Planck 2018 values (TT,TE,EE+lowE+lensing) $H_0 = 67.36$kms^−1Mpc^−1 and $\Omega_\Lambda = 0.6847$ [Planck2018]. Results at $H_\Lambda = H_0\sqrt{\Omega_\Lambda}$: $\ell = 1.660 \times 10^{26}$m (17.54Gly); $S_{\mathrm{GH}}/k_B = 3.313 \times 10^{122}$; $S_{\mathrm{GH}}/(k_B \ln 2) = 4.779 \times 10^{122}$; $T_{\mathrm{GH}} = 2.196 \times 10^{-30}$K. Results at H_0: $\ell = 1.373 \times 10^{26}$m; $S_{\mathrm{GH}}/k_B = 2.268 \times 10^{122}$; $S_{\mathrm{GH}}/(k_B \ln 2) = 3.272 \times 10^{122}$; $T_{\mathrm{GH}} = 2.654 \times 10^{-30}$K. These agree in order of magnitude with the event-horizon estimate $\sim 2.6 \times 10^{122}$ of [EganLineweaver2010], which uses different inputs. They are evaluations of named formulas, not derivations.

C-7 Reproduction of En08-ST-DSS thm:E-window(iv) at $\ell_0 = c = L = 1$ (ℓ_0 the lattice unit): $j^* = 7, 29, 139$ at $m = 0.5, 0.1, 0.02$; $j_{\mathrm{nec}} = 2, 10, 50$.

C-8 The counterexample of Theorem (c) at $\delta \in \{0.5, 0.1, 0.01\}$ and $m = \delta/4$, with $r = 3.001\,\delta$: infeasible at margin m, feasible at margin δ.

C-9 The trace distance between I/d^2 and Φ is $1 - 1/d^2$ for $d = 2, \ldots, 5$.

C-10 The sample matrix of $e^{\lambda r^2}$ at 12 radii for 6 distinct λ has rank 6 (illustration only).

C-11 The L^p disjoint-support quotients are $2^{1/p}$: 2, 1.41421 and 1.18921 at $p = 1, 2, 4$.

C-12 The echo latency computed in the static chart and in the conformal chart equals $(2/H)\operatorname{artanh}(HR/c)$ at three parameter sets (symbolic integral, numerical comparison).

C-13 On $t < 0$ the two-epoch R_e satisfies $\dot{R}_e = H_1 R_e - c$ (symbolic).

C-14 (v2) The Weyl twirl equals complete depolarization for $d = 2, \ldots, 5$, on random matrices, with maximal entry error 4.4×10^{-16}. The SDP value of $\frac{1}{2}\|\mathrm{Tr}(\cdot)I/d - \mathrm{id}\|_\diamond$ equals $1 - 1/d^2$ (0.75, 0.8888889, 0.9375) for $d = 2, 3, 4$.

C-15 (v2) For nine random outputs σ' ($d = 2, 3, 4$), the Schmidt input with $p_i \propto \lambda_i^{-1}$ has overlap exactly $1/\sum_i \lambda_i^{-1}$. No one of 4000 random Schmidt vectors does better. The SDP value of $\frac{1}{2}\|\mathrm{Tr}(\cdot)\sigma' - \mathrm{id}\|_\diamond$ equals the lower bound $1 - 1/\sum_i \lambda_i^{-1}$ to six digits, for example 0.795426 at $d = 2$ and 0.998613 at $d = 4$, and always exceeds $1 - 1/d^2$.

C-16 (v2) Complete dephasing: SDP value of $\frac{1}{2}\|\mathrm{Z} - \mathrm{id}\|_\diamond$ equal to $1 - 1/d$ (0.5, 0.6666667, 0.75), and entanglement fidelity $1/d$, for $d = 2, 3, 4$.

C-17 (v2) Exact rational arithmetic for the targets $(x, m) = (3, \frac{1}{2}), (\frac{7}{3}, \frac{1}{10}), (1, 2), (10, \frac{7}{10})$. Feasibility on 2999 ticks each agrees with the union formula of Theorem (b). There are $N - 1 = 5, 23, 0, 14$ gaps. The supremum $x + m$ is not attained. Locality of failure holds at three pairs (δ, m).

C-18 (v2) $H_\Lambda = 55.7405$kms^−1Mpc^−1 from $\Omega_\Lambda h^2 = 0.3107$; $S_{\mathrm{GH}}/k_B = 3.31231 \times 10^{122}$; $\lfloor S_{\mathrm{GH}}/(k_B \ln 2) \rfloor = 4.77866 \times 10^{122}$; $\lfloor S_{\mathrm{GH}}/(k_B \ln 3) \rfloor = 3.015 \times 10^{122}$. Relative band 0.0264, giving $S_{\mathrm{GH}}/k_B \in [3.225 \times 10^{122}, 3.4 \times 10^{122}]$. $\mathrm{d}\ln S_{\mathrm{GH}}/\mathrm{d}\ln H = -2$ (symbolic). The floor attains the promise in toy cases (40-digit arithmetic).

C-19 (v2) Symbolic: $R_e(t) = c/H_1 + (R_0 - c/H_1)e^{H_1 t}$ on $t \le 0$ for a general future; $\partial \dot{R}_e/\partial R_0 = e^{H_1 t}$; $\dot{R}_e = H_1 R_e - c$; $R_0 = c/H_2$ recovers Proposition ; at t_ε the relative deviation equals ε (for example, $t_\varepsilon = -3.4539$ at $H_1 = 2$, $H_2 = 1$, $\varepsilon = 10^{-3}$).

C-20 (v3) The dual certificate of Theorem on 200 random spectra ($d = 2, \ldots, 6$, 40 each). The least eigenvalue of Y, relative to its largest entry, is $-1.6e-16$; the least eigenvalue of $Y - J$ is $-1.5e-15$; and $\max|\mathrm{Tr}_{\mathrm{out}} Y - (1 - 1/S)I| = 2.2e-16$. These are rounding-level values (floating point).

C-21 (v3) The SDP value of $\frac{1}{2}\|\mathrm{Tr}(\cdot)\sigma' - \mathrm{id}\|_\diamond$ equals $1 - 1/S$ to six digits in 8 cases: five random outputs ($d = 2, 2, 3, 3, 4$), for example 0.860672 at $d = 2$ and 0.985466 at $d = 4$; the near-singular output $\mathrm{diag}(0.6, 0.399, 0.001)$, value 0.999004; the singular output $\mathrm{diag}(1, 0)$, value 1.000000; and $\mathrm{diag}(0.5, 0.3, 0.2)$, value $0.903226 = 1 - 3/31$.

C-22 (v3) Proposition (b) at $H_1 = 2$, $H_2 = 1$, $c = 1$ (30-digit mpmath quadrature): $R_0 = 0.689250$, strictly between $c/H_1 = 0.5$ and $c/H_2 = 1$; on $t \le 0$ the direct integral for R_e agrees with Theorem (a) to $1e-31$ at four times; $R_e(2) = 1.000000$; $\chi(0.05) = 5.9e-09$.

C-23 (v3) Proposition (c) at $H_1 = 2$, $c = 1$ (20-digit mpmath): $R_0(K)$ at $K = 0.25, 0.5, 1, 2, 4, 8, 16$ is $1.79725, 1.06, 0.68925, 0.5, 0.398836, 0.33861, 0.29673$, strictly decreasing, with $R_0(2) = c/H_1$ and $R_0(1)$ equal to the value of C-22. Root finding gives $R_0 = 0.3$ at $K = 15.0462$ and $R_0 = 3$ at $K = 0.137598$.

C-24 (v3) Symbolic: the flat-chart embedding satisfies the hyperboloid constraint, its pullback metric is $-\ell^2 H^2 \mathrm{d}t^2 + e^{2Ht}\mathrm{d}\mathbf{x}^2$, and $u = \ell e^{-Ht} - e^{Ht}|\mathbf{x}|^2/\ell$; the static slice has volume $\pi^2 \ell^3$. The antipodal image of a static-patch point with $r = 0.3\ell$ has $r = 0.3\ell < \ell$ and $X_4 < 0$, so it is not in $\mathscr{S}$.

C-25 (v3) On 80 random outputs ($d = 2, \dots, 5$), $I \otimes \sigma' - t|\Omega\rangle\langle\Omega| \geq 0$ (least eigenvalue relative to the largest entry $-9.1e-16$), and $F_e = 1/d^2$ to $8e-17$. Among 200 random vectors of Schmidt rank k for each $k \leq d$, the largest ratio $|\langle\Phi, \psi\rangle|^2/(k/d)$ is 0.997824; the rank-k projector attains k/d.

C-26 (v3) Exact rationals for $(x, m) = (3, \frac{1}{2}), (\frac{7}{3}, \frac{1}{10}), (10, \frac{7}{10})$: at every left gap endpoint $(x+m)/(n+1)$ no tick protocol exists (0 of 5, 23, 14), and at every right endpoint x/n one does.

C-27 (v3) 40-digit evaluation: $H_\Lambda = 1.80643 \times 10^{-18}\mathrm{s}\text{^}{-1}$; S_{GH}/k_B at $\Omega_\Lambda h^2 = 0.3107 \mp 0.0082$ is 3.40210 and 3.22714 ($\times 10^{122}$), and $S_{\mathrm{GH}}/(k_B \ln 2)$ is 4.90819 and 4.65578; the linearized band is $[3.22489, 3.39973]$.

C-28 (v3) The draft family $a_K = \exp(H_1 t + K\chi)$ at $H_1 = 2$, $c = 1$: at $K = -4, -2, 0, 2, 4$ the junction integral is $I(K) = 7.99399, 1.53218, 0.5, 0.301616, 0.247054$, strictly decreasing, with $I(0) = c/H_1$. Symbolic: $a = Ae^{ct/R}$ has $R_e \equiv R$.

C-29 (v3) Symbolic, in global coordinates: the scalar curvature of g_H is $12/\ell^2$, and that of $e^{2b} g_H$ for constant b is $12e^{-2b}/\ell^2$; $S_{\mathrm{GH}}/k_B = 12\pi c^3/(\hbar G R)$ at $H = c\sqrt{R/12}$; the radial divergence $(1/r^2)\partial_r(r^3 F(r) B(r^2))$; and $\langle q\delta' + \delta, \varphi\rangle = 0$.

C-30 (v4) Gibbs replacement as a thermal operation: the swap commutes with $\mathrm{H} \otimes I + I \otimes \mathrm{H}$ and outputs γ_β; $\mathrm{Tr}\,\gamma_\beta^{-1} = Z_\beta Z_{-\beta}$ (largest relative deviation $3.3e-16$); the qubit closed form $1 - 1/(2 + 2\cosh\beta\Delta)$ at $\beta\Delta = 0, 0.5, 1, 2$ gives $0.750, 0.765, 0.803, 0.895$; the SDP value of the error equals the formula (0.78609 at $d = 2$, 0.925952 at $d = 3$); the error equals $1 - 1/d^2$ exactly for scalar H and exceeds it otherwise.

C-31 (v4) Thermal dephasing: $[U, \mathrm{H} \otimes I] = 0$ exactly; the bath-averaged clock twirl equals complete dephasing (deviation $\leq 5.2e-16$); SDP values $0.5, 0.666667, 0.75$ for $d = 2, 3, 4$, equal to $1 - 1/d$ and below $1 - 1/d^2$.

C-32 (v4) The certificate instrument: the Choi operator of $\mathscr{I}_1$ is positive semidefinite on random outputs (least eigenvalue relative to the largest entry $-7.7e-16$) and $\mathscr{I}_0 + \mathscr{I}_1$ is trace preserving (deviation $4.4e-16$).

C-33 (v4) The formula for n_B in Theorem (c) agrees with direct search in 120 cases (10 bounds B, $q = 0, \dots, 11$).

C-34 (v4) The tick constant of Table : at $\ell_0 = c = 1$ and seven margins m (exact rationals), the least j with $\ell_0/(cj) \leq m$ equals $\lceil \ell_0/(cm) \rceil$.

C-35 (v5) Symbolic check (sympy) for Proposition : for the flat slicing $-c^2 dt^2 + e^{2Ht} d\vec{x}^{\,2}$ the Einstein tensor has $G_{tt} = 3H^2$ (units $c = 1$) and vanishing divergence, and with $\Lambda = 3H_1^2$ the component Θ_{tt} equals $3(H - H_1)(H + H_1)$.

C-36 (v5) Symbolic check (sympy) for Theorem : replacing κ by 2κ multiplies $T^{(\kappa)}$ by 2 and $S^{(\kappa)}$ by 1/2; replacing it by 3κ multiplies $S^{(\kappa)}$ by 1/3; and $T^{(\kappa)} = T^{(m)}$ forces $m = \kappa$.

C-37 (v6) Theorem (a): $\kappa \mapsto \gamma_\kappa$ is injective for nonscalar K ($d = 2, 3, 4$, 25 values each, units with $H = 1.3$; least pairwise trace distance 2.3×10^{-4}), and κ is recovered from one eigenvalue ratio (symbolic). Negative control N-37: for scalar K the Gibbs state is I/d for every κ.

C-38 (v6) Theorem (c): the semidefinite program $\inf_X \max_i d_{\mathrm{tr}}(X, \gamma_i)$ equals $\frac{1}{2} d_{\mathrm{tr}}(\gamma_0, \gamma_1)$ in six instances (largest deviation 3.9×10^{-9}), and $\frac{1}{2}\|\mathrm{repl}\,\rho - \mathrm{repl}\,\sigma\|_\diamond = d_{\mathrm{tr}}(\rho, \sigma)$. Mutation M-38 (dropping the factor $\frac{1}{2}$) is rejected.

C-39 (v6) Theorem (d): the exact value $\frac{1}{4}$ with unique optimal excited probability $\frac{1}{4}$; on a finite grid of excited probabilities the SDP equals the two-point value. Mutation M-39 ($I/2$ as optimizer) has error $\frac{1}{2}$.

C-40 (v6) Theorem (e) and Remarks , : the swap commutes with the sum Hamiltonian; $K_\kappa = \kappa A$ gives a κ-free Gibbs state; $\Phi_{r,t}$ is CPTP with unique fixed point γ and pairwise distinct.

C-41 (v6) Theorem : the exact (rational) transcript laws of a three-round adaptive experiment are κ-independent; linear programming over laws of Y gives $(t_+ - t_-)/2$ in three instances; the packing value is $1/M$. C-41b illustrates

$\mathbb{E}|Y - t| \geq (t - K)/2$. Negative controls N-41a (κ-dependent kernel) and N-41b (separation below 2ε); mutation M-41.

C-42 (v6) Theorem : on the flat de Sitter chart (symbolic) $\mathrm{Ric} = \frac{R}{4}g$, $R = 12H^2/c^2$, $G = -\frac{R}{4}g$, $\nabla\mathrm{Ric} = 0$, the algebraic terms of $E^{(1)}$, $E^{(2)}$ vanish, L_R has rank one with a three-dimensional kernel, and $(\lambda g)(u,u) = -\lambda$ for $g(u,u) = -1$. Mutations M-42a (wrong coefficient in $E^{(2)}$) and M-42b (wrong kernel vector); negative control N-42 (a non-Einstein FLRW metric).

C-43 (v6) Theorem : with dimensionless $B \in \{1, 2.5, 7\}$ and rational κ-grids (1193 rounding cases), $\lfloor N \rfloor = n$ iff $B/\ln(n+1) < \kappa \leq B/\ln n$; exact equality at $\kappa = B/\ln n$; $2^q = N$ at $\kappa = B/(q \ln 2)$. Mutation M-43 (closed left end) and negative control N-43 (naive inverse).

C-44 (v6) Theorem (c),(d) on synthetic slacks: the chains $jD_j < mJ \leq Jb_{J-1}$ and $J_<((1+\varepsilon)m) \leq J_\leq(m) \leq J_<(m)$ hold at every sampled margin; with dense near-minimal levels $m\,j_{\min}$ and $n\,b_n$ approach $A_L = 1.25$. Negative control N-44 (sparse levels: oscillation up to 1.70); mutation M-44 (limsup τ in place of liminf τ). Illustration, not a proof.

C-45 (v6) Theorem (c): $\nabla_a(\mathrm{d}t_s)^a = 0$ with $K^{t_s} = -1/(c^2F)$ (symbolic); exact moments of $\omega_{J,s}$ in a finite stand-in. Negative control N-45 ($K = 0$).

C-46 (v6) Theorem : the integral form of $T_H(R)$, the derivative formula and strict increase in H (symbolic), and a zero witness for an input-independent report (largest value 3.3×10^{-16}). Mutation M-46 and negative control N-46 (input-dependent channel).

C-47 (v6) Corollary : $Q_{\mathrm{alph}} \leq q$ on Σ_q, attained by the uniform law; the product with a fair bit needs 2^{q+1} symbols. Negative control N-47.

C-48 (v7) Theorem : the one-way and round-trip criteria and T_{com} (symbolic); the identity $(1-x) - (1+x)(1-2x) = 2x^2$ and $T_{\mathrm{com}} > T_H$ on a grid of 99 points in $(0, \frac{1}{2})$; ray tracing at three radii and three emission times agrees with the formulas to 4×10^{-31}; divergence at c/H and $c/(2H)$. Mutation M-48 (the one-way bound used for the round trip) admits $HR_0/c = 0.68$, where no reply exists; negative control N-48 (finite static echo at $HR/c = 0.6$).

C-49 (v7) Theorem : the drift formula for a general a and the residual identity (symbolic); on a flat matter-plus-Λ host ($H_\Lambda = 1$, $\mu = 0.45$) a finite-difference drift agrees with the formula to 4×10^{-13} at three source–observer pairs, with negative residuals. C-49b: $z = Hz$ on DSS_H (symbolic). Negative control N-49 ($\mathfrak{I} = -\frac{1}{3}$ on the matter-only host); mutation M-49 (exchanged times) is off by 0.88.

C-50 (v7) Theorem : 24 oscillating profiles in $[h_-, h_+]$ satisfy the strict bounds; constants attain them; two decaying profiles at three times satisfy $R_e > c/H$, $\dot{R}_e > 0$ and $\dot{R}_e = HR_e - c$ to 10^{-17}. Negative control N-50 (increasing H: $R_e = 0.754 < c/H(t) = 1$); mutation M-50 (reversed bounds). C-50b: $R_e = (1+t)/(n-1)$ for $a = (1+t)^n$ at $n = 3, \frac{3}{2}$, and no horizon for $a = 1 + t$ (symbolic).

C-51 (v7) Theorem (a),(b): first and second order with $H = H_\infty + Ae^{-pt} + Be^{-2pt}$ (symbolic), the Hubble-radius difference, and the ΛCDM cross-check $1 - \frac{1}{2}\varepsilon - \frac{1}{7}\varepsilon^2$; numerically, at $H_\infty = 1$, $A = 0.8$, $p = 1.5$, the first-order remainder divided by e^{-2pt} tends to $0.064 = A^2/(H_\infty(H_\infty + p)(H_\infty + 2p))$. Mutation M-51 ($1/H_\infty$ for $1/(H_\infty + p)$); negative control N-51.

C-52 (v7) Theorem (d): the coefficients $1, -\frac{1}{8}, \frac{3}{56}, -\frac{1}{32}, \frac{35}{1664}, -\frac{63}{4096}$ by binomial expansion, by term-by-term integration and from the hypergeometric series; the difference coefficients $\frac{3}{8}, -\frac{9}{28}, \frac{9}{32}$; the closed form against quadrature to 10^{-31} at four points, two beyond the radius of convergence; $R_e > c/H$; the alternating remainder bound. Mutation M-52; negative control N-52 (divergent partial sums at $y = 3$).

C-53 (v7) Corollary : $R_0(K)$ at $K = 0.25, 0.5, 1, 2, 4$ reproduces C-23 (1.79725, 1.06, 0.68925, 0.5, 0.398836), strictly decreasing; the conformal-time integral at $K = 0$ grows linearly; χ is flat at 0; every deterministic and randomized rule has success exactly $\frac{1}{2}$ on two outcome laws (exact rationals). Negative control N-53 (data on $t \le \frac{1}{2}$ separate $K = 0$ from $K = 1$); mutation M-53.

C-54 (v7) Theorem (a): the optimal retrieval over POVMs (semidefinite programming) for 20 random encodings with $(D, M) \in \{(2,3), (2,4), (3,5), (3,7), (4,6)\}$ never exceeds $\min\{1, D/M\}$, and orthogonal encodings attain it. C-54b: (b) and (c) in 248 cases, 400-digit arithmetic, including $s = q\ln 2 \pm 10^{-300}$. Negative control N-54 (a side register gives success $1 > D/M$); mutation M-54 ($(D/M)^2$ is exceeded).

C-55 (v7) The version-6 values $S_{\mathrm{GH}}/k_B = 3.312 \times 10^{122}$ and $q_1 = 4.779 \times 10^{122}$ are consistent to the printed digits; no new value is computed.

C-56 (v7) The values of Example .

Provenance and sha256 of inputs

The local sheets were copied read-only into /workspace/Big01/inputs, and the originals were not edited. The site records were retrieved by read-only GET on 2026-10-22. The routes were https://enter.grok.me/enter, which serves the EntPhil-v2 essay page, and https://enter.grok.me/api/manuscript/<ID> for I-B, I-C, I-D and Red06-G. The parent En08-ST was read through the local API copy used by the DSS sheets. For version 2, the version-5 de Sitter sheets were read from their local delivered copies (not registered); the version-1 sources below are unchanged. The references added in version 2 were verified on 2026-10-23 through doi.org and Crossref, and the figshare records through DataCite. For version 3, the version-6 de Sitter sheets were read from their local delivered copies (not registered). For version 4, the version-7 de Sitter sheets were read from their local delivered copies (not registered), and the reference [FBB2021] was checked against its Crossref record on 2026-10-23. For version 5, the version-8 de Sitter sheets were read from their local delivered copies (not registered). On 2026-10-23 both figshare records again resolved through DataCite, with creator Ngo Cheung, and the Frontiers DOI still returned 404 from doi.org and from Crossref. For version 6, the supplied version-5 source and the findings manuscript were read from NewSheets328/inputs, and the manuscript records of Big01-A, Big02-A, Big03-A, Big04-A-coeff, DS-OB-1-fibre, DS-OB-1-CERT, VC-OB-1-CERT, En08-ST-DSS, Red06-G-DSS, Red06-G-DSS-CERT, V-DST-DSS, I-C, I-D, Red06-G, En08-ST, Hawk05-B, Res01-C, CMP-OB-1, XIV-K-B, V-DST-T-B, I-B-G-Q-C, EM-OB-1, TS-OB-1 and VC-OB-1 were retrieved on 2026-10-25 by read-only GET from https://enter.grok.me/api/manuscript/<ID>, all with HTTP 200; the hashes of the retrieved bodies are listed below. For version 7, the plan was read from NewSheets332/inputs and the frozen version-6 delivery from a read-only copy whose manifest verified; no request to the companion site was made, and the four external sources of Appendix were checked on 2026-10-25 against their arXiv, publisher and Crossref records. Nothing was written to the site.

begingroup toprule File sha256

midrule endhead CMP-OB-1-v2.tex (local read-only copy)
6111af168b5a689168cf5c8a97cea91d49062d0e0284c9294c5154fdcaea00f0

DS-OB-1-v2.tex (local read-only copy)
2e6249484b24985c72f673af6324f534a98efcdba547278957ab94fc513ccedf

EM-OB-1-v2.tex (local read-only copy)
d618bdddba8b53a63aaaaf1d9223112e83c6d1a4708c9c71e3d42ba9b33d8c77

En08-ST-DSS-v3.tex (local read-only copy)
0c9eb6134617e7d3be5ca10ef78e72a3c506e8e452aa351b1dc4440cd05f49cd

I-B-G-Q-C-v2.tex (local read-only copy)
68d0c2c0ed48dff07cd650b375acde936720d3524360ad228d11142f9719b92d

PG-OB-1-v2.tex (local read-only copy)
ebcb34c7b5319bd2320973ba96ffba97a3114dfe85a0e84abfeefcefdee5823e

Red06-G-DSS-v3.tex (local read-only copy)
1538175ab7a137da81dd64fbe4283adc05c5443517adf203d355e95a2c65d14d

SG-OB-1-v2.tex (local read-only copy)
59a8c6a46634b38ead30f81fa73f19e2c83eaee0401e851b63988854be80af85

TM-OB-1-v2.tex (local read-only copy)
6fc85c9a9443ac39854951256e28d0df23f799bba071be5b51a631957cbd8b1d

TS-OB-1-v2.tex (local read-only copy)
4a9f8d9d21f0310ba106894a4381578a88de2cb182623f832f86ce6a7bbbb461

V-DST-DSS-v3.tex (local read-only copy)
5e8cc1d0b99ca78cd44217d711f46cbe3658d37ee10dc155a69cf249c1bfbad2

V-DST-T-B-v2.tex (local read-only copy)
d086fe05e6dcecb82ac7194fef81820f7733a7e2575d4aae98312035f6753826

VC-OB-1-v2.tex (local read-only copy)
5f9685875f279780ff9746e4b18dd51a12e38a764f35c46f14393d108f31c8b7

XIV-K-B-v2.tex (local read-only copy)
cd14e1c7d950d04df106239bd2223800898e92a6e053552b902e4b83aabf7849

I-B.api.tex (site GET 2026-10-22) 068bd093528f745e4604672993c922f8be8bd73f1924f31c01638c7bd8c24b0b

I-C.api.tex (site GET 2026-10-22) 6684c95253a6b61d5690ad3374c6a38779c11d569fcc5d4c45a6bea639c5d187

I-D.api.tex (site GET 2026-10-22) 4337d1e9b19c8ea2cd22c7a4ac8a5f8121ea830c6006dbc2cb1a72d17ab2216f

Red06-G.api.tex (site GET 2026-10-22)
6e311fe162757351de51ed9227296ddfb3b97d8e82d98640841053e7725e12d2

enter.html (site GET 2026-10-22) 5db6b6070bcd74ebbd871664a7098b8790866aec0f74b2c8cfe1e3dd857c0ede

Big01-A.tex (version 1, read-only) 90da6bf8938aa6e629f4a0e318f78a8055a6bf63a7fe5907c63615932db281e1

Big01-A.pdf (version 1, read-only) 0ca51b34838bac8af3a789a375f9b861c94e6b28717d81a201c68a703a32f2a4

En08-ST-DSS-v5.tex (local delivered, v2)
746381c7ceaa22a5689a83d7e0e35e0531ff3b49b44ca88bfb871278f93c4a24

V-DST-DSS-v5.tex (local delivered, v2)
3bdf6f4d241b3c824772f4ce3c6d4fe6e97889288e5397f4972300f272e82537

Red06-G-DSS-v5.tex (local delivered, v2)
507f5495987b05eb6b9367579d352b2f4ab8af6450bc8f2420d20b0dd1633414

checks_Big01A_v2.py (v2 checks) b8f6729ebbcfc1c83e1149fbcd61c2ce85e0b4492a8d00192cfb4c87b3ce46b6

checks_v2.json (v2 check output) 82e8cebc1c17b05e80cf6b0f351d787614cea976821b27508eb7071ad4d3f1e1

Big01-A-v2.tex (version 2, read-only)
5f8c1b9e6d6b8c15352f98320322cc541d79ca8c7c347172d09a670580b64886

Big01-A-v2.pdf (version 2, read-only)
d2485ba1883b93e22faec7f0c2776578193d3eb48f8563267462e77d1e3656f0

En08-ST-DSS-v6.tex (local delivered, v3)
ded3f55b6b798429453424117e533c7cf68ac9ff40106f657b3ad7ea3183f520

V-DST-DSS-v6.tex (local delivered, v3)
82d7e8700bc354da921b36cdc552707d0e40a794c57c9d7546dd73dfea7750da

Red06-G-DSS-v6.tex (local delivered, v3)
40715329890e9aab4927b0079b1834e8d7cc61bceb20a0f7d884d5e87d3b53ff

checks_Big01A_v3.py (v3 checks) 65e76dee2bb24dd0751a5445a37cedc6795710c73c3cb2cc55cb591f800677e6

checks_v3.json (v3 check output) 782c8df2b1f945982fd6de917ae9cf834b12095b6c6bde115b2dfc17b5089ecd

checks_Big01A_v3b.py (v3 draft checks)

098cc1798646271098b625ba48c69a24d6a0b7468bb6b3d24b1980f95d52a8f4

checks_v3b.json (v3 draft check output)
3cd7cd6d18572e752252716960e16dc330eae8822550a3551c748e72b4dffb39

user_draft_t248u.tex (user draft, read-only)
bbc7287d3c7e8b3fdfa9fddf8788f0b4356901ccecb2d069e292dbb2b4ce7382

Big01/v4/inputs/Big01-A-v3.tex (v4) 25459040cb74bdc392ad608053b98982ccaf2b8f5f054dc1a55485e1dbe46c4a

Big01/v4/inputs/PLAN_t251u.md (v4)
f74df5d1a1cc4e1ace5b02b1e47607dba033e9edf8758385b68bf1fca428c509

Big01/v4/inputs/user_draft_t252u.tex (v4)
cfb7dd5bb0129f5930de3ba3a3ab053d8c3508b676630de7367909f4c53fb443

Big01/v4/inputs/I-C.api.tex (v4) 6684c95253a6b61d5690ad3374c6a38779c11d569fcc5d4c45a6bea639c5d187

Big01/v4/parts/big_v4.tex (v4) d534af5f81e1b86932398f37b982d924f0b7dbea8cc76feb9326d6da2b9b0ca1

Big01/v4/parts/v4/abstract_add.tex (v4)
6ab8f027ab1c7e034b194db8dbe6246686415803317dfdc7068f1f8eee4ae9f1

Big01/v4/parts/v4/whatnew_item.tex (v4)
ae13e9d3307b4fed5e752a2ded91ff4779bd7b6880f021b608a9ae0d0382ce48

Big01/v4/parts/v4/changes4.tex (v4) fb4a0cae7980997fadf42f19d715a954d7f644fdb73ddfafc0c80821cb6b1ba7

Big01/v4/parts/v4/pc4.tex (v4) 5042b57c34101bc3134ccc33fa76632cdcadb5e2ece1f6cd730fb7e9d6db61f9

Big01/v4/parts/v4/draft4_head.tex (v4)
8efc5a18a352b3abf80e258075151c7972e3e979854763eac97a402d698298ab

DSS/v7/parts/t252u_verdicts.tex (v4)
96bc37cdaf6a515be3af065adc9033065a2764b922936b4192a1c1e6a8311d2d

Big01/v4/scripts/mk_v4.py (v4) 7415002633c44ad19e91010b9c308bb0c40c5aed8ddef6dc12be12c5cdac4f06

Big01/v4/scripts/build_v4.py (v4) 557d4ddc4c243bc53820f03c10f2ad146e24d9dbbc60401d2e4361935b89d53d

Big01/v4/scripts/label_audit_v4.py (v4)
d945778062f3de0fb36f90d69df11242894989322246 68f96b028972918a6a4a

Big01/v4/scripts/compile_v4.sh (v4) dde90edf8e90d85e0d2fcdbfd8acfa8cb4efe175e9477e2248fe9e048601130c

Big01/v4/scripts/checks_Big01A_v4.py (v4)
27cb53bfac0d5b432b2552b9a8589aa257c9becc29b3f79254fdccaee0e85fed

Big01/v4/logs/checks_v4.json (v4) 0761eca736f83ccd2f40817352bb038b240260f027ccff66ac4b00a930edecc9

DSS/deliver/Red06-G-DSS-v7.tex (v4)
ef0d7d325db7967898695a86abbd27d8bcc179a777e50e4cc5e4fb1b2d4fd747

DSS/deliver/En08-ST-DSS-v7.tex (v4)
7f50e91e8bda671d0636806989dd0236e08da820113ae64da6fe6c415d419ecf

DSS/deliver/V-DST-DSS-v7.tex (v4)
5ef5503d5d34c2b583fda83a1e05a54b2204f733b53489343b42c3f25456206c

Big01/v5/inputs/Big01-A-v4.tex (v5) a4491a1bc5cd305320550d68f4b30f16f14e0558f92d2bdccc5e3028ad7876d1

Big01/v5/inputs/PLAN_t254u.md (v5)
c9c571fc48b7f3a5ee73b5b933dff64a85d78f98ae56c8b2adb6166d955aa6d8

Big01/v5/parts/big_v5.tex (v5) f802d170abb62a89aa3db6928a302e791ca56347bcb556e8dce021e0b0123b14

Big01/v5/parts/v5/abstract_add.tex (v5)
c1e8779339208e22338bd9378f68ecd752a7ef34d731e6ff89cb238dee746335

Big01/v5/parts/v5/whatnew_item.tex (v5)
7cbb016b390f814a7a3e60107bb9018e804877027d0977953e1baabbec8b00ad

Big01/v5/parts/v5/changes5.tex (v5) c3ae9a957d7a7bc9d1a3b21f8c5b0be3dc107250df2f2bce4ba5d2f65cd1123e

Big01/v5/parts/v5/pc5.tex (v5) 74fd17275a94dc22514b4ac545e9624476e334f058cefa33fcfb9603da88587e

Big01/v5/scripts/mk_v5.py (v5) 93c3c2500b81c82ccb0b30a7a89464b9d0c09ae2822f762b1c4d2d6a0712a90e

Big01/v5/scripts/build_v5.py (v5) 4900c1f62fedd80bec66143c2a9fbf07ca0d3700fc2164905d43f955c12700f1

Big01/v5/scripts/label_audit_v5.py (v5)
714baca603e9cb211ac2f7105d7a65477bd51bcb2ec7dd7df9830e97d1df672d

Big01/v5/scripts/compile_v5.sh (v5) f129fd08a2fa1d20d8e191f969e22f44205ec4e4a2f62f1474080cb694fcf772

Big01/v5/scripts/checks_Big01A_v5.py (v5)
03ab8dbbf1adef337a76fe9806cd29767eccf188bd7032fc7aa88468b875f728

Big01/v5/logs/checks_v5.json (v5) da1c756b08948b7a2d2325e4a70c7c2c267ee96a85d33c1ad7a94ab96a741b9e

DSS/deliver/Red06-G-DSS-v8.tex (v5)
8d95cea813b26da9bfe78d763489e143d6c2385dfd1da5059edc183b579c72af

DSS/deliver/En08-ST-DSS-v8.tex (v5)
7c8d368bedc9e157ef1168560f1fc3ef0edc099109865978498aab72d7ef73cd

DSS/deliver/V-DST-DSS-v8.tex (v5) 4afbc6a1acf749ac3e5c320cb970eb8c447f8c1f45b25890ef50d9402829a362

inputs/Big01-A-v5_site.tex (v6 input)
8849b3556e2925beed6a009218d8d84a4a2e9abd2c023dd464437122de0f8c82

inputs/findings_t328u.tex (v6 input) 232d0c1c2401529be5b67cdfba8a988ac9251662486c48b1686803f72ab76f5c

api/Big01-A.api.raw (v6, GET 2026-10-25)
8849b3556e2925beed6a009218d8d84a4a2e9abd2c023dd464437122de0f8c82

api/Big02-A.api.raw (v6, GET 2026-10-25)
8936ba43152e4e524a8a8d94772185c706bb628a32c5dba5147df8f4ff2a208f

api/Big03-A.api.raw (v6, GET 2026-10-25)
c71007c5e5455227925f625ff9fc488e369cbd66a64b95799f8f34e68519bd6a

api/Big04-A-coeff.api.raw (v6, GET 2026-10-25)
69d97b6fb3d598e731d4a57254c41a4c189a0e686f2cb00b62144c2bbaa03e54

api/CMP-OB-1.api.raw (v6, GET 2026-10-25)
e5d56f4734fcbcafae6f3b79b3da48aa74305182158ebb4d11c793da5541e657

api/DS-OB-1-CERT.api.raw (v6, GET 2026-10-25)
a0805f8eb081a250f78e8074b9de5986ccd23106749df9e0fe5fac2f71e157f9

api/DS-OB-1-fibre.api.raw (v6, GET 2026-10-25)
b81d93b4bf81bd01bcc31aef3cd784a8e187c20e16c8269cb001f79086f8f280

api/EM-OB-1.api.raw (v6, GET 2026-10-25)
ad34a7557952bc83f4d24587e0deb415fd6e8aa281975675ac331971f07ec7b0

api/En08-ST-DSS.api.raw (v6, GET 2026-10-25)
7c8d368bedc9e157ef1168560f1fc3ef0edc099109865978498aab72d7ef73cd

api/Hawk05-B.api.raw (v6, GET 2026-10-25)
0404bd27adc8c80d1f2e12f860ac60b9a421349da7826246f8ca0eb715d3ca4a

api/I-B-G-Q-C.api.raw (v6, GET 2026-10-25)
e82a7a69c89670cf635b80d826f52921c78117c0fcad359c0e248c48113202d3

api/I-C.api.raw (v6, GET 2026-10-25) 10f3878a3e890d8d1b10cbfcfdf681a9441b642a3baf420afccbe3be2c464199

api/Red06-G-DSS.api.raw (v6, GET 2026-10-25)
3cdb13ba6281577778a5a4e3337e67cb3635ccfb8c8a3df559823798fefeb09c

api/Res01-C.api.raw (v6, GET 2026-10-25)
5311218b51faedfe6aea65484ba6b7057884314bf9fb88da81bba3f437579916

api/TS-OB-1.api.raw (v6, GET 2026-10-25)

1920bc3915db08e691b1e1d64486ef927f6af3a051540fb7ed93fbf7329972f7

api/V-DST-DSS.api.raw (v6, GET 2026-10-25)
4afbc6a1acf749ac3e5c320cb970eb8c447f8c1f45b25890ef50d9402829a362

api/V-DST-T-B.api.raw (v6, GET 2026-10-25)
2d3c00c2a2d5fb4bb4fd2e3cb3d05960a1bcd279fe75808c8d7e934b908a7519

api/VC-OB-1-CERT.api.raw (v6, GET 2026-10-25)
d3a93a3afb0e8803d18f230ce824f78c19253f6a4bc841f8ceef763ce14f7cac

api/VC-OB-1.api.raw (v6, GET 2026-10-25)
c9d821b4db97cb384fa7c4e5d9a1d44791f989c61625d202586ab689e9091bc1

api/XIV-K-B.api.raw (v6, GET 2026-10-25)
ad68ab7b83fd9e1ebe1032e3b9474a3590124d92fb1776cc3f3990f830b8a37c

api/Red06-G-DSS-CERT.api.raw (v6, GET 2026-10-25)
cc8db10b2140634ea284649ef6c3fc5150c2ec978fdb3e0092a930cae6d9a3f8

api/I-D.api.raw (v6, GET 2026-10-25)
b87e0d92b2c78f2500ba9622e0fb57a8ae4d345fbb88074026e1518fdcd1fdbb

api/Red06-G.api.raw (v6, GET 2026-10-25)
26381162e0c6f3c4c9947c20c5a0872253270eddd328fc02aa6db44482762d82

api/En08-ST.api.raw (v6, GET 2026-10-25)
195e22cd8e273c354d835988d4e614421b7fa7d1eb8f10f5ea5db637fbf0f93c

PLAN_t332u.md (v7 plan) c133e374850694fdd26a737617d1e6db36cbe6ccab7911f610bcdf589777ce48

Big01-A-v6.tex (frozen v6) bab9edb3643626f31c95d8c0f8d95a3498b252fec09c1d0632f6db8a44fb4a90

MANIFEST-Big01-A-v6.sha256 (frozen v6)
35b5066bc3ed46b4729ed1131e7476744a46a956cac5bad55df9ed4be4eec299

bottomrule endgroup

New cross-sheet edges (not registered)

Every edge listed here has role *separation* and declaredPath null. These are routing notes only and are not registered. The edges run from Big01-A to each of the following: Red06-G-DSS, En08-ST-DSS, V-DST-DSS, I-B, I-C, I-D, Red06-G, EM-OB-1, TS-OB-1, VC-OB-1, CMP-OB-1, XIV-K-B, V-DST-T-B and I-B-G-Q-C. None of them forms a path, and none transfers a theorem. Version 2 adds no new edge target; its edges to Red06-G-DSS and En08-ST-DSS now point to version 5 of those sheets, again with role *separation* and declaredPath null. Version 3 adds no new edge target either; its edges to Red06-G-DSS, En08-ST-DSS and V-DST-DSS now point to version 6 of those sheets, with role *separation* and declaredPath null. Version 4 adds no new edge target; its edges to Red06-G-DSS, En08-ST-DSS and V-DST-DSS now point to version 7 of those sheets, again with role *separation* and declaredPath null. Version 5 adds no new edge target; its edges to Red06-G-DSS, En08-ST-DSS and V-DST-DSS now point to version 8 of those sheets, again with role *separation* and declaredPath null. Version 6 adds the edge targets Big03-A, Big04-A-coeff, DS-OB-1-fibre, VC-OB-1-CERT, Hawk05-B and Res01-C, again with role *separation* and declaredPath null; they are written only to a local wiring payload with wired:false and are not registered. Version 7 adds no new edge target; its wiring payload repeats the version-6 edges with wired:false.

References

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Standing ledger (verbatim, repeated)

No quantum coefficient is admitted. Host A and Host B stay separate; Host C is not created. O.1 stays NOT_CLOSED. XVI-N is not discharged; N-Ins.4 stays unresolved. XV-B is not opened. H2, I3, J2 and T3 stay unresolved. U6-sel is not moved. No Einstein dynamics, derived metric, spacetime emergence, Page curve, or quantized relational time without an external clock is claimed. The last reading bars stay open, and continuum acquisition stays a negative certificate. No Route-B successor is created. Res02-A Q1–Q4 and A1–A2 stay open. Gate 0 and ST4b stay NOT_SUPPLIED. Citations identify source records only; no proof transfer. No compilation is asserted.