Series-I-IB-Enter-A Measurement, Prescribed Spacetime, and Conditional Horizon Access

A documentary synthesis of Series I and I-B under the Big-series fixed-size analogy

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Abstract

This Version 3 consolidates the measurement, prescribed-cone, and conditional-horizon audit of Series-I-IB-Enter-A. Unique local objects are retained and sharpened: calibrated measurement with eigen-sector nondisturbance, semantic no-cloning and confluence, destructive-clock access with the encoded inverse as a distinct task, the scheduler countermodel with directional cone reconstruction under calibration hypotheses, FLRW echo reach at half the one-way radius, cyclic-clock bandwidth, and anisotropic support-function reach. Sibling FLRW-reach and Big01 developments are cited as style only and are not re-expanded here; local floors and one past-only countermodel are kept. A purity-versus-marginal lemma, a finite no-CCR obstruction separating the bandwidth bound from a canonical pair, an explicit Hausdorff $O(\varepsilon)$ cone modulus, and a self-contained Gaussian cross-coherence identity $K_{AB} = \log \Gamma_{-} - \log \Gamma_{A} - \log \Gamma_{B}$ are added. Seven research conjectures are oriented around one fail-able cross-experiment relation that pairs that identity with joint geometric–quantum access estimation; they remain research claims, not theorems, and close no open gate. No spacetime emergence, Einstein dynamics, inherited quantum coefficient, gravity, dark-matter, or mediator identification is asserted.

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Routing, philosophy, and scope

Identity and three roles for earlier material

The manuscript identifier is Series-I-IB-Enter-A. The alias I-Enter-A denotes this same sheet. Its proposed registration status is

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Standing boundary. No spacetime emergence, derived metric, Einstein dynamics, Page curve, island, cosmological bounce, de Sitter quantum state, vacuum-energy selection, inherited characteristic quantum coefficient, compilation, or Host C is claimed. O.1 stays NOT_CLOSED; Gate 0 and ST4b stay NOT_SUPPLIED; XV-B is not opened; XVI-N is not discharged; Dom (T) remains undetermined; J2 remains unresolved; Problems 6, 7, and 9 are named, not solved. Locked Host-A stays NAMED_COMPARISON_ONLY, with $\{\mathrm{GI}, \mathrm{CB}\}$ only. Cited Cheung and OpenAI records are source records, not premises. The declared path is null. Destructive Enter consumes a finite clock encoding, not the geometric time axis. The regular reporting cone is neither I-D dynamical host and is not globally hyperbolic.

Earlier material has three different roles. First, a metric, finite instrument, calibration, or model class may be *supplied explicitly as data*. Second, a conclusion may be *proved locally from displayed hypotheses*. Third, a manuscript may be a *named comparison*, giving provenance and orientation without transferring its conclusions as premises.

The distinction is necessary because the supplied corpus contains different carriers, signatures, gauge domains, operator realizations, states, and access contracts. A common label does not identify those objects. The extensive characteristic-product passages supplied with the plan describe a different analytic programme; they are not inputs to the measurement and finite-clock proofs below.

We use the following statement types:

1. A *theorem* proves a mathematical implication on its displayed domain.

2. A *conditional physical prediction* additionally needs a same-model preparation, acquisition, calibration, and implementation bridge.

3. A *research conjecture* concerns an unsupplied bridge or physical model. Its title and discussion explicitly state that it is not a theorem. No model-level implication is presented as an observation of the universe.

Enter and the meaning of destruction

Cheung's Series I studies a linear quantum calculus in which a live quantum name denotes an owned quantum resource, while a classical record may be copied [5, 2]. Destructive Enter removes a measured quantum name from the continuation's quantum context and returns a classical outcome together with the surviving quantum residual. The introductory philosophical page explains the distinction between a report and the original quantum resource [3].

In the finite semantics used here, the interface has the form

$$\mathrm{Q}_C \otimes \mathrm{Q}_S \to \mathrm{Classical}_R \otimes \mathrm{Q}_S.$$

The right side does not contain the measured factor C. This is an access and output-type statement, not a claim that

every microscopic apparatus degree of freedom has been annihilated. A fresh allocation after readout is a new quantum name and is not reuse of the consumed one.

Four distinctions organize the paper:

record agreement ≠ complete instrument agreement,
destructive readout ≠ universal quantum return,
semantic no-signalling ≠ geometric causality,
a finite code ≠ the Hilbert space of a universe.

Spacetime Enter adds port locations, accessible algebras, routes, controllers, clocks, and resource budgets to a *supplied* geometry [6]. A clock code can denote a calibrated event, stored history, or programme target. It is not itself a coordinate axis. Basis changes on the code do not move the reading event backwards or remove the host's geometric time.

The Shredder Philosophy asks which outputs remain accessible after a specified complete cut [7, 11]. A classical diary, a retained quantum residual, and a replacement output have different recovery properties. A lower bound obtained by discarding a residual cannot be used for a decoder that subsequently receives that residual.

The Big Bang analogy and its limits

In the Big-series analogy, a fixed-size computational resource is compared with an observer-dependent horizon region on a prescribed classical cosmological metric [22, 23, 24, 25, 26]. The analogy becomes mathematical only after its compared objects are declared. A finite causal radius is not a finite number of quantum degrees of freedom. Likewise, an initial allocation is not a spacetime singularity, a resource reset is not a cosmological bounce, and an internal reorganization is not gravitational backreaction.

Big01 supplies prescribed-horizon and access comparisons. Big02 separates declared dark capacity from physical dark matter. Big03 separates coefficient-sensitive and coefficient-blind data. Big04 and its coefficient companion distinguish supplied radiative labels from a source mechanism. Big05 keeps stress and curvature accounts separate from microscopic identification. These are documentary stage descriptions, not a derivation of the Big Bang, inflation, or a late cosmological quantum state.

toprule Source family Named object Boundary retained here

midrule endhead I Measurement characterization, semantic no-cloning, confluence, internal no-signalling The class of strategies and operational contexts must be specified; no geometric cone follows [5].

I-B Complete clock, rods, localized schedule Metric, calibration, and transport permissions are inputs [6].

I-B-G / I-B-G-S / I-B-VP-CR Green realizations and local Ward gate Endpoint and field-domain data are additional [18, 19, 20, 21].

I-C / I-C-CERT Classical-record and replacement recovery floors Different access contracts and different tasks [7, 10].

I-D Two full dynamical hosts and punctured comparisons Neither full host is the reporting cone [12].

En09-A / En09-B Conditioning, access table, sharp clock loss An encoded logical input is not an arbitrary clock input [13, 14, 15].

Big01-A Prescribed horizon, exact replacement error, coefficient and vacuum fibres No finite host Hilbert space or quantum state is supplied [22].

Big-Vac-A / Big06-B Vacuum and residual-source ledgers Neither identifies a vacuum or particle species [28, 29, 27].

Earlier synthesis sheets Reach and assembly style Style only; not premises [31, 32].

Standing records / OpenAI catalogue Programme separations No missing source map, state, or characteristic coefficient is supplied [37, 38, 39, 40, 41, 49].

bottomrule

Series I as a measurement layer

The missing assumptions in the short characterization

The statement "state-sufficient normalized laws and pure positive branches imply Born–Lüders update" is too short to be correct. For example, the two branches

$$\mathscr{I}_0(X) = pX, \qquad \mathscr{I}_1(X) = (1 - p)X, \qquad 0 < p < 1,$$

are normalized, state-sufficient, and pure on pure inputs. They implement a random coin, not a prescribed projective measurement. A calibrated measurement followed by an outcome-dependent unitary can also have pure branches without having the Lüders residual.

The local characterization below therefore makes the candidate class, the measured observable, calibration, and residual preservation explicit. It does not claim that complete positivity follows from the two abbreviated conditions alone. It is an independent finite-instrument version of the operational question named in Series I [5]. The full calculus characterization retains its own syntax and context hypotheses.

Definition (Calibrated projective-instrument class). Let H be finite dimensional and let $\{P_a\}_{a=1}^{r}$ be nonzero orthogonal projections with $\sum_a P_a = I_H$. A candidate is a state-sufficient instrument

$$\mathscr{I}_a : \mathscr{B}(H) \to \mathscr{B}(H),$$

whose branches are completely positive and whose sum is trace preserving. Its probabilities and subnormalized residuals depend only on the input density matrix, not on its preparation ensemble.

Require:

1. *Eigen-sector calibration.* For every unit vector $v \in P_b H$,

$$\operatorname{Tr} \mathscr{I}_a(\operatorname{proj} v) = \delta_{ab}.$$

2. *Eigen-sector nondisturbance.* For every unit vector $v \in P_a H$,

$$\mathscr{I}_a(\operatorname{proj} v) = \operatorname{proj} v.$$

The second condition fixes a complete residual, not merely an outcome probability.

Theorem (Local Born–Lüders characterization). *The unique instrument in Definition is*

$$\mathscr{I}_a(X) = P_a X P_a.$$

Consequently

$$p_a(\rho) = \mathrm{Tr}\,(P_a \rho), \qquad \rho_a = \frac{P_a \rho P_a}{p_a(\rho)} \quad \text{when} p_a(\rho) > 0.$$

For a pure input, every positive branch is a pure residual ray. No normalized state is assigned to a zero-probability branch. These conclusions hold on every untouched reference extension.

For a rank-one reading basis on a measured factor C, deletion of that factor gives the destructive branch

$$X \mathrm{longmapsto} (\langle \tau_a|_C \otimes I_S) X (|\tau_a\rangle_C \otimes I_S).$$

Proof. Write $E_a = \mathscr{I}_a^*(I)$. Complete positivity and normalization give $0 \le E_a \le I$, $\sum_a E_a = I$. Calibration says that E_a has expectation zero on every other sector and expectation one on its own sector. For a positive operator, zero expectation on v implies that the operator annihilates v. Applying this to E_a and $I - E_a$ yields $E_a = P_a$.

Choose Kraus operators K_{aj} for branch a. Since $\sum_j K_{aj}^\dagger K_{aj} = P_a$, every K_{aj} vanishes on $(I - P_a)H$. On a unit vector $v \in P_a H$, nondisturbance gives

$$\sum_j |K_{aj} v\rangle \mathrm{langle} K_{aj} v| = \mathrm{proj}\, v.$$

Every summand is positive, so each $K_{aj} v$ lies in the line spanned by v. A linear operator for which every vector of a subspace is an eigenvector is scalar on that subspace: compare two independent vectors and their sum. Thus $K_{aj} = c_{aj} P_a$. Trace preservation on the sector gives $\sum_j |c_{aj}|^2 = 1$, proving $\mathscr{I}_a(X) = P_a X P_a$.

For $X = \mathrm{proj}\, \psi$, the positive branch is $|P_a \psi\rangle \mathrm{langle} P_a \psi|$, with its stated norm and normalized ray. The formula is a linear-map identity, so it tensors with every reference identity. For $P_a = |\tau_a\rangle\langle \tau_a|_C \otimes I_S$, taking the partial trace over the projected rank-one clock factor produces the displayed destructive branch.

par

This is a uniqueness result inside an explicitly chosen operational class, not a derivation of all quantum theory. The familiar Lüders rule provides the historical measurement comparison [42]. Calibration selects the effects; eigen-sector nondisturbance selects the residual. Neither part may be replaced by a claim about a pure marginal when an untouched reference is present. Purity refers to the complete conditional ray of a pure complete input; a subsystem marginal can remain mixed.

Numerical Lüders check (qubit, not a new theorem). Take $d = 2$ with projectors $P_0 = \mathrm{proj}\,0$, $P_1 = \mathrm{proj}\,1$ on $\mathbb{C}^2$, and the pure input

$$|\psi\rangle = \tfrac{1}{\sqrt{2}}(|0\rangle + |1\rangle), \qquad \rho = \mathrm{proj}\,\psi.$$

Theorem forces the calibrated instrument $\mathscr{I}_a(X) = P_a X P_a$. The Born weights are

$$p_0(\rho) = p_1(\rho) = \tfrac{1}{2},$$

and each positive residual is the pure ray $|a\rangle$. Numerically, the complete residual fidelity to the projected ray is 1, while the referenced diamond distance of the instrument to the identity channel is exactly 1 (the two branches destroy the equatorial coherence). If an untouched reference $R \cong \mathbb{C}^2$ is kept in the Bell state $|\Phi_+\rangle$ with the measured factor, the same instrument yields branch residuals that remain pure on the complete system, yet the reduced state on the unmeasured factor is $\tfrac{1}{2}I$ after either outcome (Lemma). The numerical separation is therefore

$$F(\rho_a^{\mathrm{complete}}, \mathrm{proj}\,a) = 1, \qquad F(\rho_a^S, |\varphi\rangle\langle\varphi|) = \tfrac{1}{2} \quad \text{for every pure} |\varphi\rangle \text{on} S,$$

so a pure Lüders branch never licenses a pure-subsystem claim once a reference is retained. This is a one-line numerical audit of the local lemma and Theorem ; it promotes no conjecture and opens no gate. The same numerical audit extends to a mixed qubit input $\rho = (1 - \varepsilon)\mathrm{proj}\,\psi + \varepsilon\tfrac{1}{2}I$ with $\varepsilon = 0.10$. The Born weights remain $\tfrac{1}{2}$ by symmetry, while each residual acquires an additional maximally mixed component of weight ε inside its sector. The complete residual fidelity to $\mathrm{proj}\,a$ therefore drops from 1 to $1 - \varepsilon = 0.90$, and the referenced diamond distance of the instrument package to identity stays of order one. Nothing in the arithmetic alters the uniqueness

class of Definition ; it only records that a ten-percent depolarising contamination is visible as a ten-percent fidelity deficit on the Lüders residual. The seven research conjectures of this sheet are untouched: the check is a calibration of Theorem and Lemma against two concrete density matrices, not a physical-bridge claim.

A second numerical line uses the destructive clock reading of Theorem on $C \cong \mathbb{C}^2$ with payload $S \cong \mathbb{C}^2$. For the product input $|\tau_0\rangle\langle\tau_0|_C \otimes \mathrm{proj}\, 0_S$, the single positive branch returns the payload unchanged with weight 1, so the payload entanglement fidelity through the destructive branch is 1. For the coherent clock input $(|\tau_0\rangle + |\tau_1\rangle) \otimes |0\rangle/\sqrt{2}$, each branch weight is $\frac{1}{2}$ and each residual payload state is proj 0, while the clock factor is deleted. The referenced fidelity of the clock register to any pure recovery attempt is at most $\frac{1}{2}$, matching the classical-record floor on a qubit. These two numbers—payload fidelity 1 on a calibrated eigen-input, clock fidelity $\leq \frac{1}{2}$ on a coherent clock input—are the numerical content of the local Born–Lüders package under destructive readout. They are recorded here so that later cross-sheet comparisons can cite an explicit arithmetic audit rather than a code alone.

Lemma (Pure branch need not yield a pure subsystem marginal). *Let $H = C \otimes S$ with $\dim C \geq 2$ and $\dim S \geq 2$, and let R be an untouched reference isomorphic to S. Fix a pure complete input*

$$|\Psi\rangle_{CSR} = \frac{1}{\sqrt{2}}(|\tau_0\rangle_C|\Phi_+\rangle + |\tau_1\rangle_C|\Phi_-\rangle),$$

where $|\Phi_\pm\rangle$ are orthogonal maximally entangled states of $S \otimes R$, and let $\{P_a = |\tau_a\rangle\langle\tau_a|_C \otimes I_S\}_{a=0,1}$ be the calibrated reading of Theorem . Then each positive branch residual on CSR is pure, yet the reduced state on S after either positive branch is maximally mixed. Consequently a pure positive branch of a pure input does not imply a pure subsystem marginal when an untouched reference is kept.

Proof. By Theorem the branch-0 residual is the pure ray spanned by $|\tau_0\rangle_C|\Phi_+\rangle$, and the branch-1 residual is the pure ray spanned by $|\tau_1\rangle_C|\Phi_-\rangle$. Tracing out C and R leaves $I_S/2$ in either case. The same conclusion holds for every isomorphic choice of the two orthogonal entangled pairs.

par

Named parallel (style only). Series I records the same operational distinction among complete residuals,

no-cloning, and internal no-signalling under its own syntax [5]. That syntax is not imported here. The present lemma only makes the debug-ledger correction into a labelled local result inside Definition .

Finite linear resources and semantic consistency

Our finite semantic core has quantum names with disjoint ownership, classical words, fixed channels and instruments, and declared fresh allocations. A quantum name is not duplicated by substitution or routing. Classical fan-out is permitted and represented explicitly. All controls that choose a subsequent operation are part of the network rather than external state-dependent choices.

A *legal interleaving* is a topological ordering of a finite acyclic network. Incomparable operations act on disjoint quantum wires. Shared classical information is supplied through explicit copied classical wires. Recorded outcomes and failures remain in the joint output.

Theorem (No-cloning, internal no-signalling, and finite confluence). *For this finite channel semantics:*

1. *No deterministic channel universally clones an unknown quantum state in dimension at least two.*

2. *A nonselective local trace-preserving operation cannot change the reduction on untouched systems, including an initially entangled reference.*

3. *Every legal interleaving of the same finite network gives the same complete recorded channel, and hence the same joint outcome law. These are semantic statements. They neither assign spacetime locations nor determine a geometric causal relation.*

Proof. For unit vectors ψ, φ, put $z = |\langle \psi, \varphi \rangle|^2$. The trace distance of their pure states is $\sqrt{1 - z}$, as follows by diagonalizing the difference on their two-dimensional span. The corresponding two-copy states have distance $\sqrt{1 - z^2}$. For $0 < z < 1$, the latter is strictly larger. A cloning channel would violate trace-distance contractivity. This proves the first assertion.

For a trace-preserving map Λ_A and any operator X,

$$\mathrm{Tr}_A\,[(\Lambda_A \otimes \mathrm{id}_B)(X)] = \mathrm{Tr}_A\, X.$$

One verifies this on elementary tensors and then uses linearity. Equivalently, the adjoint fixes I_A. Take B to include every untouched reference. A selected branch can steer a conditional marginal; the nonselective sum cannot.

Any two topological orderings of a finite acyclic graph are related by adjacent exchanges of incomparable nodes. Their complete recorded maps commute because they act on disjoint quantum and record wires. The same holds for instrument branches before their sums are taken. Explicit control dependencies prevent an outcome-conditioned successor from being exchanged past the node producing its control. Adjacent exchanges therefore preserve the complete linear map. The number of nodes is finite, so every legal interleaving terminates.

par

The no-cloning comparison is standard [43]. The finite confluence argument is not a new proof of unrestricted higher-order reduction confluence or strong normalization. It proves exactly the complete finite semantic statement declared here. Internal no-signalling does not by itself specify which operations are geographically local.

The I-B carrier, destructive clock, and access audit

The regular conical product

Fix $c > 0$, $0 < \mu < 2\pi$, and $\alpha = 1 - \mu/(2\pi)$. Prescribe

$$\begin{aligned} M_\alpha &= \mathbb{R}_T \times (0,\infty)_r \times (\mathbb{R}/2\pi\mathbb{Z})_\varphi \times \mathbb{R}_z, \\ g_\alpha &= -c^2 \mathrm{mathop\,d}T^2 + \mathrm{mathop\,d}r^2 + \alpha^2 r^2 \mathrm{mathop\,d}\varphi^2 + \mathrm{mathop\,d}z^2. \end{aligned}$$

Its stipulated completion adds

$$\mathscr{W} = \mathbb{R}_T \times \{o\} \times \mathbb{R}_z.$$

The missing singular set is a two-dimensional worldsheet. Only a fixed-z section is a worldline. No smooth metric or pointwise Einstein tensor is assigned on $\mathscr{W}$.

Theorem (Regular geometry and the missing-worldsheet diamond). *The metric has signature* $(-+++)$*, is locally flat, and has angular deficit* μ*. With future orientation* ∂_T*, a nonzero future-causal vector* $a\partial_T + w$ *obeys*

$$a > 0, \qquad |w|_{\text{spatial}} \le ca.$$

Static laboratories have proper-time increment mathop dT.

The regular spacetime is not globally hyperbolic. The same missing-axis argument applies at $\alpha = 1$ *if the axis remains removed.*

Proof. On a sufficiently small angular lift,

$$(T, r, \varphi, z)\text{longmapsto}\,(cT, r\cos(\alpha\varphi), r\sin(\alpha\varphi), z)$$

is a local Minkowski isometry because

$$\text{mathop d}(r\cos\alpha\varphi)^2 + \text{mathop d}(r\sin\alpha\varphi)^2 = \text{mathop d}r^2 + \alpha^2 r^2 \text{mathop d}\varphi^2.$$

The circumference is $2\pi\alpha r$, proving the deficit. The signature and causal inequality follow directly from the metric. Setting $w = 0$ gives the proper-time statement.

Choose $r_* > 0$, one angle and axial coordinate, and $A > r_*/c$. The diamond between

$$p = (-A, r_*, \varphi_*, z_*), \qquad q = (A, r_*, \varphi_*, z_*)$$

contains

$$x_n = (0, r_*/n, \varphi_*, z_*).$$

Radial causal travel takes less than A in either direction. The sequence has no convergent subsequence in the regular manifold: its radial limit lies on the excluded worldsheet. The causal diamond is noncompact, excluding global hyperbolicity.

par

This is local to the reporting model. Deleting the axis from a full smooth I-D host changes the model. A late exterior conical chart does not identify the entire dynamical host with [12]. The locked Host-A comparison in the standing boundary is not silently identified with any other source's similarly named host.

Non-global hyperbolicity does not prove nonuniqueness for every equation or mode. It forbids an unqualified use of a globally hyperbolic Green theorem across the missing axis. I-B-G and I-B-G-S add operator realizations and source-test domains; I-B-VP-CR has a positive-core obstruction only in its declared exceptional channel and local class [18, 19, 20, 21]. A local developing chart does not make a flat Green operator intrinsic on the entire cone. Standard wave-equation and conical-boundary background is provided in [46, 47].

Complete finite laboratory data

A supported experiment declares its finite names, port locations, accessible algebras, initial states, ancillary systems, controller registers, incoming data, routes, clock dictionary, and failures. Every installed port and communication route lies in a regular reserve with closure disjoint from $\mathscr{W}$. No undeclared worldsheet input is admitted.

Two resource counts must be distinguished:

$$N_{\mathrm{installed}} \quad \text{and} \quad N_{\mathrm{live,\,peak}}.$$

A scheduled apparatus can contain many installed blank sites while using a smaller moving payload. Conversely, a global live-qubit constraint is not inferred from a clock readout or a local peak. Any such resource bound must be supplied independently.

The clock channel

Let $C \simeq \mathbb{C}^D$, $D = 2^m \geq 2$, with installed basis $\{|\tau_a\rangle\}_{a=0}^{D-1}$. Let S contain every returned quantum system. Set

$$P_a = |\tau_a\rangle\langle\tau_a|, \qquad D_a = \langle\tau_a|_C \otimes I_S.$$

A unitary basis change $B_C|\tau_a\rangle = |a\rangle$, followed by computational-basis Enter on all clock names, has channel

$$\mathscr{M}_C(X) = \sum_{a=0}^{D-1} \mathrm{proj}\, a_R \otimes D_a X D_a^{\dagger}.$$

Theorem (Complete destructive clock and finite-time obstructions). *The channel is CPTP and equals*

$$\sum_a \mathrm{proj}\, a_R \otimes \mathrm{Tr}_C\,[(P_a \otimes I_S)X(P_a \otimes I_S)].$$

For every untouched reference E,

$$\mathrm{Tr}_R\,[(\mathscr{M}_C \otimes \mathrm{id}_E)(X)] = \mathrm{Tr}_C X.$$

Its positive-branch probabilities and normalized residuals are

$$p_a = \mathrm{Tr}\,[(P_a \otimes I_S)\rho], \qquad \rho_{S,a} = D_a \rho D_a^\dagger / p_a.$$

There is no quantum C output and no channel left inverse on the full input space.

Finite matrices cannot satisfy $[T_C, H_C] = i\hbar I_C$ *for* $\hbar \neq 0$. *Indeed,*

$$\|[T_C, H_C] - i\hbar I_C\|_\infty \geq |\hbar|.$$

Consuming C changes neither M_α, g_α, *nor T.*

Proof. The recorded Kraus operators $|a\rangle_R \otimes D_a$ have squared sum $\sum_a P_a \otimes I_S = I_{CS}$. This proves complete positivity and trace preservation. In the clock-basis expansion

$$X = \sum_{a,b} |\tau_a\rangle\langle\tau_b| \otimes X_{ab},$$

both branch expressions return X_{aa}. Summation gives the partial-trace identity, including arbitrary operator blocks on $S \otimes E$. The Born law and positive-branch normalization follow.

Tensor a fixed system state with the two different clock states

$$\frac{|\tau_0\rangle + |\tau_1\rangle}{\sqrt{2}}, \qquad \frac{|\tau_0\rangle - |\tau_1\rangle}{\sqrt{2}}.$$

Their outputs coincide, so no universal left inverse exists.

The trace of a commutator is zero. Thus the trace of the commutator defect is $-i\hbar D$. For any $D \times D$ matrix A, $|\mathrm{Tr}\,A| \leq D\|A\|_\infty$, proving the norm lower bound and the exact-commutator obstruction. Finally the geometric objects are prescribed classical components of the experiment, not factors in the clock channel's codomain.

par

If distinct codes have distinct time labels t_a, exact calibration at one fixed reading event e,

$$p_a > 0 \Rightarrow t_a = T(e),$$

allows only one occurring label. A nontrivial multi-outcome history experiment therefore needs a separate map assigning each word to its history event. A future programme label is not evidence that its labelled arrival has occurred.

The complete clock identity is compared with I-B and En09-A [6, 13, 14, 15]. It remains linear because subnormalized branches are retained. Normalizing a selected branch is not a deterministic CPTP operation on arbitrary inputs.

The shredder cut, with its complete assistance contract

Throughout the paper, channel error is half-diamond distance. It includes every untouched reference but does not grant that reference to the decoder. For $L \simeq \mathbb{C}^d$, define

$$|\Phi_d\rangle = d^{-1/2} \sum_{j=1}^{d} |j\rangle_E |j\rangle_L, \qquad F_e(\Psi) = \langle \Phi_d | (\mathrm{id}_E \otimes \Psi)(|\Phi_d\rangle\langle\Phi_d|) |\Phi_d\rangle,$$

and

$$e(\mathcal{N}) = \inf_{\mathcal{D}\ \mathrm{CPTP}} \frac{1}{2} \| \mathcal{D}\mathcal{N} - \mathrm{id}_L \|_\diamond .$$

This is a whole-code, deterministic, reference-preserving task.

Theorem (Sharp complete cut floors). *Suppose a source-to-decoder process factors through a direct sum of classically flagged quantum blocks Q_a of dimensions k_a. Every quantum system assisting the intermediate factorization is included in those blocks. There is no unlisted entanglement assistance that bypasses this factorization. Let p_a be the branch probability on I_L/d. Then*

$$F_e(\mathcal{D}\mathcal{N}) \le \frac{1}{d} \sum_a p_a k_a, \qquad \frac{1}{2} \| \mathcal{D}\mathcal{N} - \mathrm{id}_L \|_\diamond \ge \left[1 - \frac{1}{d} \sum_a p_a k_a \right]_+ .$$

For a complete classical-only output the sharp floor is $1 - 1/d$. *For blocks of dimension at most $k \le d$, the sharp*

universal floor is $1 - k/d$*. A complete implementation allowance* δ *subtracts at most* δ *from either lower bound.*

Proof. Compose Kraus operators of each encoder branch with those of its decoder. Every resulting logical Kraus operator K_{aj} has rank at most k_a. The singular-value inequality gives

$$|\mathrm{Tr}\, K_{aj}|^2 \le k_a \mathrm{Tr}\,(K_{aj}^\dagger K_{aj}).$$

The Kraus formula for Bell overlap then gives

$$F_e = \frac{1}{d^2}\sum_{a,j} |\mathrm{Tr}\, K_{aj}|^2 \le \frac{1}{d}\sum_a p_a k_a.$$

Testing the referenced output difference with $|\Phi_d\rangle\langle\Phi_d|$ gives distance at least $1 - F_e$.

For sharpness, let S range over the k-element subsets of a fixed basis of L, let P_S be their projections, and set

$$w = \frac{d-1}{k-1}^{-1}, \qquad \mathcal{N}_S(X) = wP_S X P_S.$$

The instrument is complete. Embedding each block back into L gives

$$\Psi_k = \lambda \mathrm{id} + (1-\lambda)\Delta, \qquad \lambda = \frac{k-1}{d-1},$$

where Δ is complete dephasing. The diagonal phase-unitary representation $\Delta = d^{-1}\sum_{j=0}^{d-1} \mathrm{Ad}_{Z^j}$ gives $\frac{1}{2}\|\Delta - \mathrm{id}\|_\diamond \le 1 - 1/d$. Hence $\frac{1}{2}\|\Psi_k - \mathrm{id}\|_\diamond \le 1 - k/d$. Its Bell overlap is k/d, giving the reverse inequality. The $k = 1$ case proves sharpness of the classical floor. Contractivity under decoding and the triangle inequality prove robustness to δ.

par

The contract is essential. Entanglement-assisted teleportation is not a standalone source-to-classical-output factorization with all assistance excluded. Its receiver-side quantum resource must be included in the complete comparison. The present law concerns a verified complete cut, not the length of a visible transcript.

The classical floor is distinct from Haar-average state-estimation infidelity. For a channel with Kraus operators K_j, the Haar second moment gives

$$F_{\mathrm{av}} = \frac{\sum_j \mathrm{Tr}\,(K_j^\dagger K_j) + \sum_j |\mathrm{Tr}\,K_j|^2}{d(d+1)} = \frac{1 + dF_e}{d+1}.$$

Thus classical-only decoding has $F_{\mathrm{av}} \le 2/(d+1)$, rather than a Haar-average infidelity equal to $1 - 1/d$. Known orthogonal inputs can be read and re-prepared perfectly. The reference-preserving channel task is stronger [7, 44, 45].

Four different clock-access questions

Let

$$\mathscr{O}_{\mathrm{cl}} = \Big\{ \sum_a P_a \otimes Y_a : Y_a \in \mathscr{B}(H_S) \Big\}.$$

The basis re-preparation decoder is

$$\mathscr{D}_{\mathrm{bas}}\Big(\sum_a \mathrm{proj}\, a_R \otimes Y_a\Big) = \sum_a P_a \otimes Y_a.$$

Theorem (Sharp clock loss, exact sectors, and an encoded inverse). *For the one clock channel $\mathscr{M}_C$:*

1. *$\mathscr{D}_{\mathrm{bas}}\mathscr{M}_C = \Delta_C \otimes \mathrm{id}_S$, whose fixed space is precisely $\mathscr{O}_{\mathrm{cl}}$. This exactness holds with references.*

2. *On arbitrary unencoded CS inputs, the optimal universal reconstruction error is*

$$\inf_{\mathscr{D}} \frac{1}{2}\|\mathscr{D}\mathscr{M}_C - \mathrm{id}_{CS}\|_\diamond = 1 - \frac{1}{D}.$$

Equivalently, the sharp full-diamond constant is $2 - 2/D$.

3. *For supplied unitaries U_a on a logical system L, the different input encoding*

$$W\psi = \frac{1}{\sqrt{D}}\sum_a |\tau_a\rangle_C \otimes U_a\psi$$

is an isometry, and its recorded output is

$$\mathscr{M}_C(WXW^\dagger) = \frac{1}{D}\sum_a \mathrm{proj}\, a_R \otimes U_a X U_a^\dagger.$$

The decoder

$$\mathscr{R}\Big(\sum_a \operatorname{proj} a \otimes Y_a\Big) = \sum_a U_a^\dagger Y_a U_a$$

recovers every logical input and reference exactly.

4. *If* $\frac{1}{2}\|\widetilde{\mathscr{M}} - \mathscr{M}_C\|_\diamond \le \delta$ *on the same complete interfaces, every decoder satisfies*

$$\frac{1}{2}\|\mathscr{D}\widetilde{\mathscr{M}} - \mathrm{id}_{CS}\|_\diamond \ge [1 - \frac{1}{D} - \delta]_+.$$

Proof. Clock-basis expansion proves the first identity. Its fixed space has zero off-diagonal clock blocks, exactly $\mathscr{O}_{\mathrm{cl}}$.

Put $s = \dim H_S$. For whole-input dimension Ds, the complete clock output has D flagged quantum blocks of dimension s, each with maximally mixed-input weight $1/D$. Theorem gives the lower bound $1 - 1/D$. The phase-unitary expression of $\Delta_C \otimes \mathrm{id}_S$ gives the matching upper bound for $\mathscr{D}_{\mathrm{bas}}$.

Orthogonality of the clock basis gives $W^\dagger W = I_L$. Its a-branch is $U_a X U_a^\dagger / D$. Applying the displayed decoder and summing returns X. These are operator identities and include every reference. The encoded target is logical L, not arbitrary CS.

Finally use decoder contractivity and the triangle inequality with the exact universal lower bound.

par

These are the four-row distinctions compared with En09-B [13, 14, 15]. The surviving system alone always has output $\mathrm{Tr}_C X$. For a product input $\rho_C \otimes \rho_{SE}$, it is ρ_{SE}, independent of ρ_C. Clock dependence in a selected system branch comes through existing input correlations and the available record. The uniform record in the encoded example identifies no unknown logical state.

A Schrödinger-type conditioning identity needs additional data. If

$$(U_C(t) \otimes U_S(t))\rho_{CS}(U_C(t)^\dagger \otimes U_S(t)^\dagger) = \rho_{CS}, \qquad P_a = U_C(t_a) P_0 U_C(t_a)^\dagger,$$

then cyclicity of the partial trace gives

$$\sigma_{S,a} = U_S(t_a)\sigma_{S,0}U_S(t_a)^{\dagger}.$$

Completeness of the covariant basis makes all branch weights $1/D$. Stationarity of the *CS*-marginal alone does not imply this identity on an arbitrary *CSE*-extension. Moreover an energy basis need not be a covariant time-reading basis. Neither conditioning nor an encoded inverse reconstructs a geometric time axis [13, 14, 15].

Metric containment does not select a Lorentz cone

Scheduled ancestry and actual intervention influence

A complete finite network includes all quantum and classical wires that can influence a jointly observed output. Its scheduled ancestors are found by recursively replacing observed output wires by the inputs of the nodes that produce them. Every discarded output is represented by trace, whose adjoint preserves the identity.

For example, for tensor-product tick channels on partitions $\mathscr{B}_j$ of a finite site set,

$$N_{t,t}(Y) = Y, \qquad N_{s,t}(Y) = \bigcup \{B \in \mathscr{B}_{s+1} : B \cap N_{s+1,t}(Y) \neq \varnothing\}.$$

If every block has diameter at most Δ, reverse induction gives a support envelope of radius $(t - s)\Delta$. The ratio Δ/τ for tick duration τ is a schedule parameter, not an invariant physical speed.

Theorem (Complete support and prescribed-metric containment). *Let Φ_Y be the complete channel to a jointly observed output Y, and let A_Y be its scheduled ancestor inputs. Then*

$$\Phi_Y^{*}(\mathscr{B}(H_Y)) \subseteq \mathscr{B}(H_{A_Y}) \otimes I_{A_Y^c}.$$

An intervention on a nonancestor input cannot signal to Y, even with an untouched entangled reference.

If every dependency wire is embedded by an actual future-causal route of g_α, and every interaction takes place at its declared event, then each scheduled ancestor event lies in the supplied causal past of its dependent output. This is containment in a prescribed relation, not reconstruction of that relation.

Proof. Pull an output observable backwards through the network. A node whose outputs are unobserved

encounters identity observables; its unital adjoint introduces no dependence on its inputs. Nodes meeting the backwards support introduce only their declared inputs. Induction gives the algebra inclusion.

Therefore the output channel factors through restriction to the ancestor inputs. A deterministic local operation on a complementary input preserves the ancestor-and-reference reduction by the partial-trace identity in Theorem . The output and reference laws are consequently unchanged.

Each dependency path in the geometric embedding is a concatenation of future-causal routes and localized interaction events. Transitivity of the causal relation places its starting event in the causal past of its endpoint. The metric and routes were assumptions of the embedding.

par

The jointly observed output matters. Two records can separately hide an input bit while their parity reveals it. A marginal-only support audit is not a complete joint-record audit.

A local SWAP chain on reserved ports can implement identity payload transport, including its reference, when each link is independently permitted by the supplied metric and timing contract. An abstract remote SWAP with zero duration is not such a localized operation. Its algebraic definition cannot establish a spacelike transmission permission.

A non-Lorentzian scheduler countermodel

Theorem (Scheduler consistency has a non-Lorentzian model). *There is a family of finite local record networks with: acyclic dependency, bounded degree, finite causal pasts, termination, schedule-independent joint records, intervention sensitivity along every dependency path, and no intervention influence outside that dependency future, whose generated affine reachability cone is*

$$K_{\infty} = \{(t, x) \in \mathbb{R} \times \mathbb{R}^{3} : t \geq \mathrm{lVertx}\|_{\infty}\}.$$

This cone is not linearly isomorphic to a Lorentz cone. Consequently those scheduler properties do not select Lorentzian geometry.

Proof. Use lattice events (n, x), $n \in \mathbb{N}$, $x \in \mathbb{Z}^3$. Connect (n, x) to every $(n + 1, x + s)$ with $s \in \{-1, 0, 1\}^3$. There are at most 27 inputs and 27 outputs per node. Every finite-depth finite-output experiment has a finite ancestor closure.

At each node introduce a fresh classical bit with that node's label. The record consists of this labelled bit together with the union of the incoming labelled records. Classical copies are implemented by explicit fan-out. There is one local update rule; finite experiments use finite alphabets and finite registers, although no uniform memory bound over the entire family is asserted.

Every legal order evaluates the same finite dependency equations. Changing a node's bit changes its labelled entry in every descendant record and in no nondescendant record. Thus confluence, exact reachability sensitivity, and absence of outside influence all hold.

An integer displacement (N, z) is reachable precisely when $N \geq 0$ and $\|z\|_\infty \leq N$: each coordinate can be accumulated independently with increments $-1, 0, 1$ in N steps. The nonnegative real hull of the one-step displacement generators has $t = 1$ section equal to the cube $[-1, 1]^3$. It is K_∞.

The cube cone has finitely many extreme rays, eight in this case. A Lorentz cone in dimension four has infinitely many extreme rays and a strictly convex spatial section. An invertible linear map preserves extreme rays. Hence the cones cannot be linearly isomorphic.

par

This comparison agrees with the source separation in En08-A and the operational-consistency article [16, 17]. Additional affine, homogeneity, self-duality, irreducibility, and strict-convexity hypotheses belong to a different conditional geometric classification. They are not supplied by acyclicity or confluence.

Even a specified Lorentz causal cone does not determine an absolute metric scale. If $\Omega > 0$, then g and $\Omega^2 g$ have the same causal tangent cones. A finite set of ordered events is still weaker. No continuum evolution without an external time parameter is constructed here.

The Big-series analogy on a prescribed classical host

The independent de Sitter comparison

In this section only, supply $H > 0$ and the flat expanding classical metric

$$g_H = -c^2\mathrm{mathop\,d}t^2 + e^{2Ht}\mathrm{mathop\,d}\mathbf{x}^2, \qquad \gamma(t) = (t, 0).$$

This is not . No quantum state or field algebra on is constructed. Let

$$\ell = \frac{c}{H}, \qquad A_H = 4\pi\ell^2.$$

Theorem (Future reception region, fixed area, and echo latency). *For an event* $(t, \mathbf{x})$ *in , a causal signal reaches γ at some finite future time exactly when*

$$|\mathbf{x}| < \ell e^{-Ht}.$$

Its boundary is a null hypersurface. Its fixed-t cuts have proper radius ℓ and area A_H*.*

Within the static patch, a radial echo through areal radius $0 < R < \ell$ *has central-observer elapsed proper time at least*

$$T_H(R) = \frac{2}{H}\mathrm{artanh}\left(\frac{HR}{c}\right),$$

with equality for radial null transport and no device wait. It diverges as $R\mathrm{uparrow}\,\ell$*.*

Proof. The causal speed bound is $|\mathbf{x}| \le ce^{-Ht}$. Thus a signal received at $T > t$ needs

$$|\mathbf{x}| \le c\int_t^T e^{-Hs}\mathrm{mathop\,d}s = \ell(e^{-Ht} - e^{-HT}).$$

Radial null curves attain equality, proving the finite-time condition and, on taking the union over T, the strict horizon inequality.

For $F = e^{Ht}|\mathbf{x}| - \ell$, the squared norm of its gradient on $F = 0$ is

$$-c^{-2}H^2\ell^2 + 1 = 0.$$

The boundary is null. The induced sphere metric is $\ell^2 \mathrm{mathop\,d}\Omega_2^2$, giving the radius and area.

Put $R = e^{Ht}|\mathbf{x}|$. For $R < \ell$, use

$$t_s = t - \frac{1}{2H}\log\left(1 - R^2/\ell^2\right).$$

Direct substitution gives the static metric

$$-c^2 F_R \mathrm{mathop\,d}t_s^2 + F_R^{-1}\mathrm{mathop\,d}R^2 + R^2 \mathrm{mathop\,d}\Omega_2^2, \qquad F_R = 1 - R^2/\ell^2.$$

Every future-causal route obeys $c\,\mathrm{mathop\,d}t_s \geq |\mathrm{mathop\,d}R|/F_R$. Each leg between 0 and R therefore takes at least

$$\int_0^R \frac{\mathrm{mathop\,d}r}{c(1 - r^2/\ell^2)} = \frac{1}{H}\mathrm{artanh}\left(HR/c\right).$$

The central observer has proper time t_s. Two radial null legs attain the lower bound.

par

"No transport across the event horizon" must be read directionally. Events outside this observer's future-reception region cannot send a new signal to that observer. It is not a prohibition on every outward signal: an outgoing null ray emitted at t_0 has

$$|\mathbf{x}(T)| = \ell(e^{-Ht_0} - e^{-HT}),$$

and its areal radius can exceed ℓ at later times. It then cannot return a signal to the original observer.

A finite horizon does not cap the total number of central operations. The observer's future proper time is unbounded. The scale ℓ/c is not a hardware rate or an energy bound. A wait at the observer adds to measured latency without changing the geometric minimum.

No path and the complete fresh-payload contract

Introduce a fresh unknown logical input L at a source event, possibly entangled with an untouched testing

reference. All other inputs and resources are fixed independently of that logical input. The complete receiver interface includes every available record, controller, and quantum resource. No pre-existing encoding of the fresh logical input is granted.

If the source event is outside the reception region of Theorem , a causally embedded finite network has no source-to-receiver path. The backwards support proof then makes its receiver output independent of L. By linearity its channel is

$$\mathscr{N}(X) = \operatorname{Tr}(X)\omega_R.$$

This implication is conditional on the complete causal-network contract. An unconstructed relativistic field acquisition or observer algebra is not supplied by finite-network syntax.

Pre-shared entanglement does not allow nonselective signalling without a delivered classical message. On the other hand, hidden source-dependent initial receiver data would violate the fresh-payload contract. The distinction must be audited before declaring replacement.

Theorem (Exact replacement error and optimized horizon-access floor). *Let $L \simeq \mathbb{C}^d$, $d \geq 2$, and let $\mathscr{R}_\sigma(X) = \operatorname{Tr}(X)\sigma$, where σ has eigenvalues $\lambda_1, \ldots, \lambda_d$. Put*

$$S_\sigma = \sum_{i=1}^{d} \lambda_i^{-1}, \qquad 1/0 = \infty, \quad 1/\infty = 0.$$

Then

$$\frac{1}{2}\|\mathscr{R}_\sigma - \mathrm{id}_L\|_\diamond = 1 - \frac{1}{S_\sigma}.$$

Consequently, after any replacement receiver channel,

$$\inf_{\mathscr{D}} \frac{1}{2}\|\mathscr{D}\mathscr{N} - \mathrm{id}_L\|_\diamond = 1 - \frac{1}{d^2}.$$

The optimum is attained by preparing I_L/d.

If an implemented receiver channel is within δ of a replacement comparison on the same complete interface, every

decoder has error at least

$$[1 - \frac{1}{d^2} - \delta]_+.$$

Proof. Assume first $\sigma > 0$. Choose an eigenbasis e_i and an orthonormal reference basis f_i, and use the input

$$|\psi_p\rangle = \sum_i \sqrt{p_i}|f_i\rangle|e_i\rangle, \qquad p_i = \lambda_i^{-1}/S_\sigma.$$

The replacement output is $\rho_E \otimes \sigma$, with $\rho_E = \sum_i p_i|f_i\rangle$langlef$_i$|. Its overlap with the input is

$$\sum_i p_i^2 \lambda_i = 1/S_\sigma.$$

Testing with $|\psi_p\rangle\langle\psi_p|$ proves the lower bound $1 - 1/S_\sigma$.

For the upper bound use the unnormalized vector $|\Omega\rangle = \sum_i |i\rangle|i\rangle$. Weighted Cauchy–Schwarz gives

$$I \otimes \sigma \geq \frac{1}{S_\sigma}\text{proj}\,\Omega.$$

These are the Choi matrices of $\mathscr{R}_\sigma$ and id_L/S_σ. Thus, with $s = 1/S_\sigma$,

$$\mathscr{R}_\sigma = s\text{id}_L + (1 - s)\mathscr{Q}$$

for a CPTP map $\mathscr{Q}$. The distance between two channels is at most one in half-diamond normalization, proving the matching upper bound. The finite-dimensional Choi criterion follows directly by vectorizing Kraus operators [45].

If some $\lambda_i = 0$, the pure input $|e_i\rangle$langlee$_i$| is orthogonal to the replacement output, so the distance is one.

Every decoded replacement is again a replacement. Cauchy–Schwarz gives

$$d^2 \leq \left(\sum_i \lambda_i\right)\left(\sum_i \lambda_i^{-1}\right) = S_\sigma,$$

with equality exactly at $\sigma = I/d$. A decoder can always prepare that state, proving the optimized result.

Contractivity and the triangle inequality prove robustness.

par

The eigenvalues in belong to the *decoded replacement state*, not an unspecified horizon field state. The exact

fixed-decoder law and its optimized version are different statements. They are compared with Big01-A's thm:Bexact and I-C-CERT's replacement theorem [22, 10].

The three principal floors are now explicit:

c|*c*complete access contract	sharp universal floor
hline classical-only output	$1 - 1/d$
flagged quantum blocks of dimension$k$	$1 - k/d$
replacement output, optimized decoder	$1 - 1/d^2$

For a qubit they are respectively 1/2, $1 - k/2$, and 3/4. No one of these is a Page curve.

Internal reorganization and the coefficient slot

An account consists of a prescribed host, a finite carrier, its complete instrument and decoder, and independently declared labels. An *internal reorganization* changes only the carrier, representation, encoding, or controller and leaves the host data fixed. Invariance of host labels under such an operation is therefore a separation statement, not an Einstein-matter equation.

Introduce a positive action-valued coefficient h_*. In accounts where it is assigned the role of $\hbar$, declare

$$\Theta_H(h_*) = \frac{h_* H}{2\pi k_{\mathrm{B}}}, \qquad S_H(h_*) = \frac{k_{\mathrm{B}} A_H c^3}{4 G_{\mathrm{N}} h_*}.$$

These are the conventional Gibbons–Hawking temperature and area-entropy labels when the additional quantum and gravitational interpretation is supplied [48]. Here they are *declared account functions*. No thermal quantum state, entropy algebra, or finite Hilbert-space dimension is derived from them.

Theorem (Reorganization invariance and coefficient non-selection). *At fixed $H, c, G_{\mathrm{N}}, k_{\mathrm{B}}, h_*$, an internal reorganization leaves ℓ, A_H, and the labels unchanged. It need not leave a device's elapsed delay or access error unchanged.*

If all admitted data are independent of h_*, those data cannot identify h_*, Θ_H, or S_H. For $h_* \in [h_-, h_+]$, $0 < h_- < h_+$, their exact absolute minimax risks under a common data law are respectively

$$\frac{h_{+}-h_{-}}{2}, \qquad \frac{H(h_{+}-h_{-})}{4\pi k_{\mathrm{B}}}, \qquad \frac{k_{\mathrm{B}}A_{H}c^{3}}{8G_{\mathrm{N}}}\left(\frac{1}{h_{-}}-\frac{1}{h_{+}}\right).$$

The product

$$\Theta_{H}(h_{*})S_{H}(h_{*}) = \frac{c^{5}}{2G_{\mathrm{N}}H}$$

is coefficient-blind and cannot select h_{*}. Neither does a fixed-d channel floor from Theorems or .

Proof. The geometric formulas and declared labels contain no carrier variable. Adding an independently chosen central wait changes delay; changing which quantum residual is returned changes the channel. Neither changes the host.

For two endpoint parameter values with identical data laws, every possibly randomized estimator has the same output law. The pointwise triangle inequality implies that the sum of its two absolute risks is at least the separation of the target values. The maximum risk is therefore at least half that separation. The midpoint of each target interval attains the bound. The images of the coefficient interval under the two labels give the displayed risks.

Multiplying and using $A_{H} = 4\pi c^{2}/H^{2}$ gives the product. The dimensionless finite-channel floors contain d, k, but not h_{*}, completing the separation.

par

A "capacity label" $S_{H}/(k_{\mathrm{B}}\log 2)$ is not $\log_{2}\dim H_{\mathrm{universe}}$ without an external finite-Hilbert promise. Even a supplied upper bound on a Hilbert dimension does not specify the dimension of the particular unknown code in a recovery task.

The static spatial region contains infinitely many disjoint regular open sets. Normalized smooth functions supported in those sets form arbitrarily large orthogonal families in L^{2} of the region. Thus finite geometric size alone supplies no finite state-space dimension. It also supplies no energy-dependent quantum speed limit.

The coefficient h_{*} in the conventional label slot is not the unconstructed characteristic graph coefficient. Theorem does not determine either one.

Vacuum fibres and residual-source accounts

Let g be a smooth connected four-dimensional Einstein metric, Ric = $Rg/4$, and let T_* be a conserved symmetric comparison tensor. Let $E^{(1)}, E^{(2)}$ be the metric Euler derivatives of $\int R^2 \mathrm{mathop\,d}V_g$ and $\int R_{ab}R^{ab}\mathrm{mathop\,d}V_g$. Consider the explicitly declared comparison family

$$T_{\mathbf{c}} = T_* + c_0 g + c_G G[g] + c_1 E^{(1)}[g] + c_2 E^{(2)}[g].$$

This family is not asserted to exhaust every physical matter or renormalization prescription.

Theorem (Vacuum-fibre non-selection and residual uniqueness). *On the stated Einstein region,*

$$T_{\mathbf{c}} = T_* + \lambda(\mathbf{c})g, \qquad \lambda(\mathbf{c}) = c_0 - \frac{R}{4}c_G.$$

The coefficient-to-tensor map has rank one and kernel

$$\mathrm{Span}\,\{(R/4, 1, 0, 0), (0, 0, 1, 0), (0, 0, 0, 1)\}.$$

Reports independent of $\mathbf{c}$*, including independent horizon labels, identify neither* λ *nor* $\mathbf{c}$*. For* $\lambda \in [\lambda_-, \lambda_+]$*, the exact absolute minimax risk is* $(\lambda_+ - \lambda_-)/2$*; for unrestricted* λ *it is infinite. Supplying* $T_{\mathbf{c}} - T_*$ *determines* λ *but leaves the three-dimensional coefficient fibre.*

Separately, for supplied $g, \Lambda, \chi \neq 0, T_{\mathrm{known}}$,

$$T_{\mathrm{res}} = \chi^{-1}(G[g] + \Lambda g) - T_{\mathrm{known}}$$

is the unique tensor satisfying the corresponding source-account identity. It is separately conserved exactly when T_{known} *is. At fixed host parameters, the map from known source to residual is an affine isometry in every tensor norm. It supplies no particle nature or constitutive class.*

Proof. The contracted Bianchi identity applied to Ric = $Rg/4$ gives $\nabla R/4 = \nabla R/2$, hence R is constant. Therefore $G = -Rg/4$.

For a compact inverse-metric variation h^{ab}, the first variation of $\int R^2 \mathrm{mathop\,d}V_g$ has derivative-free coefficient

$$2RR_{ab} - \frac{1}{2}R^2 g_{ab} = 0.$$

The integrated derivative terms vanish because R is constant. For $\int R_{ab}R^{ab}\mathrm{mathop\,d}V_g$, the explicit inverse-metric and volume terms give

$$2R_a{}^c R_{bc} - \frac{1}{2}g_{ab}R_{cd}R^{cd} = 0.$$

The remaining integral is $2\int R^{ab}\delta R_{ab}\mathrm{mathop\,d}V_g$. Since $\nabla R^{ab} = 0$ and δR_{ab} is a divergence of the connection variation, compact integration by parts makes it zero. Thus $E^{(1)} = E^{(2)} = 0$. Symmetry is inherited from metric variation; conservation follows from diffeomorphism invariance and compact integration by parts. The rank and kernel are now immediate.

The common-law two-endpoint argument from Theorem proves the bounded risk. Arbitrarily separated values within one unrestricted fibre force infinite worst-case risk. Supplying the tensor difference gives the one scalar λ, not the full coefficient vector.

For the residual claim, algebraic rearrangement proves uniqueness. The Bianchi identity and metric compatibility give $\nabla T_{\mathrm{res}} = -\nabla T_{\mathrm{known}}$. Differences of residuals are negatives of differences of known sources, proving the affine-isometry statement. No algebraic rearrangement proves positivity, dust form, or membership in a supplied microscopic action class.

par

These local comparisons correspond to Big01-A's vacuum fibre, Big-Vac-A's non-selection, and Big06-B's residual ledger [22, 28, 29, 27]. On the de Sitter comparison, $R = 12H^2/c^2$. For a unit timelike vector, $(\lambda g)(u,u) = -\lambda$. Its sign is not determined by coefficient-blind horizon labels.

Without a supplied T_{known}, any symmetric conserved X can be named as the residual by setting $T_{\mathrm{known}} = \chi^{-1}(G + \Lambda g) - X$. An inverse source identity therefore selects neither a metric nor a value of Λ. A stress-account fibre is not a quantum vacuum state.

Conditional cosmic reach and future assumptions

The supplied FLRW class

Supply a positive C^2 scale factor on the future-complete interval $[t_0, \infty)$, and the metric

$$\mathrm{d}s^2 = -c^2\mathrm{d}t^2 + a(t)^2\mathrm{d}\mathbf{x}^2, \qquad \mathbf{x} \in \mathbb{R}^3.$$

"Future-complete" here means that this cosmic-time description continues smoothly for all $t \geq t_0$; no field equation is used. Define

$$\chi_T(t_e) = c\int_{t_e}^{T} \frac{\mathrm{d}t}{a(t)}, \qquad \chi_\infty(t_e) = c\int_{t_e}^{\infty} \frac{\mathrm{d}t}{a(t)},$$

$$D_{\mathrm{reach}}(t_e) = a(t_e)\chi_\infty(t_e).$$

The first two are comoving reach distances. The third is a *radius*, measured as a proper distance on the emission slice; it is not a diameter. For strictly expanding a, put

$$H = \frac{\dot{a}}{a} > 0, \qquad q = -\frac{a\ddot{a}}{\dot{a}^2}.$$

Theorem (Finite reach and smooth past-only non-identification). *A comoving source at distance r can signal to the central observer by time T exactly when $r \leq \chi_T(t_e)$. Reception at some finite time is possible exactly when $r < \chi_\infty(t_e)$ (with the natural reading when the integral is infinite).*

There exist smooth positive strictly expanding scale factors that agree on an entire exponential past and on every junction derivative, but for which χ_∞ is respectively finite and infinite. A past-only experiment with a common complete outcome law cannot decide horizon existence over this class with equal-prior success above 1/2.

Proof. Radial null propagation and the strict positivity of $1/a$ give the reach criteria. A smooth cutoff joining an exponential past to a late linear expansion matches all jets at a junction while sending χ_∞ to infinity; the pure exponential continuation keeps χ_∞ finite. Identical past laws force equal-prior success 1/2. The long parallel development is held as style by Series-II2VI-Enter-A [31, 32]; it is not re-expanded here.

par

Immediate interpretation. Isolation requires an assumption about the future model class, not merely a past fit. A Hubble radius $c/H(t)$ is generally not an event-horizon radius. Finite deadlines probe χ_T, not the completed χ_∞. Named parallel (style only): Big01-A [22].

Uniform future acceleration and nonacceleration (consolidated)

Theorem (Sharp acceleration-controlled future reach). *Suppose $a > 0$ is C^2, strictly expanding, and supplied for all $t \geq t_0$. If $q(t) \leq -\varepsilon$ for every $t \geq t_0$ with $\varepsilon > 0$, then*

$$D_{\mathrm{reach}}(t_0) \leq \frac{c}{\varepsilon H(t_0)}.$$

Such a future-complete class is empty for $\varepsilon > 1$. For $0 < \varepsilon \leq 1$, the bound is sharp on the constant-q comparison histories.

Proof. The margin $\ddot{a} \geq \varepsilon \dot{a}^2/a$ integrates in the a variable to . The identity $\dot{H} \geq (\varepsilon - 1)H^2$ empties the class for $\varepsilon > 1$. Equality histories are the standard constant-q power laws ($\varepsilon < 1$) and exact exponential expansion ($\varepsilon = 1$). Named parallel (style only): Series-VII-Enter-A thm:accel-reach [31, 32].

par

Countermodel retained. Acceleration without a uniform negative bound on q is insufficient. For $t > e$, the comparison $a(t) = t\log t$ has $\ddot{a} = 1/t > 0$, but

$$\int^{\infty} \frac{\mathrm{mathop\,d}t}{t\log t} = \infty, \qquad -q = \frac{\log t}{(\log t + 1)^2} \to 0.$$

Thus "permanent acceleration" alone does not imply a finite event horizon; the uniform margin $q \leq -\varepsilon$ does the work.

Theorem (Concave expansion has no future event horizon). *Suppose $a > 0$ is C^2 on $[t_0, \infty)$, $\dot{a} \geq 0$, and $\ddot{a} \leq 0$ throughout that future. Then $\chi_\infty(t_0) = \infty$. In particular this comoving observer has no finite future event-horizon*

radius in the spatially flat model .

Proof. Concavity gives $a(t) \le a_0 + v_0(t - t_0)$. If $v_0 > 0$ the comparison integral diverges logarithmically; if $v_0 = 0$ the scale factor is constant and the integral likewise diverges. Named parallel (style only): Series-VII-Enter-A cor:nonaccel [31, 32].

par

Consolidation note. The three statements above keep their local labels for cross-reference. Their long parallel developments are not repeated; sibling syntheses are cited as style only, not as premises. Together with Theorem , Theorem locates the future assumption doing the work. No Friedmann or Einstein-matter equation has been derived. For a causally implemented fresh-payload task whose source lies beyond a verified reach limit, Theorem supplies a replacement recovery floor.

Finite echo reach, directional cone reconstruction, clock bandwidth, and anisotropic reception

Guiding principle. Future geometry constrains fresh round-trip tasks; finite clock distinguishability constrains energy resources; calibration, convexity, a speed bound, and directional saturation can approximate a cone section—consistency alone does not.

The theorems below are deductions from explicit printed assumptions. They do not claim mathematical novelty of standard FLRW or convex-set kinematics, experimental confirmation, or that the universe contains the reporting cone. The four research conjectures in Section ask whether suitable physical systems realize the corresponding assumptions.

Finite-deadline echo reach in flat FLRW

Theorem (Finite-deadline echo reach in flat FLRW). *Supply the flat FLRW line element*

$$ds^2 = -c^2\,dt^2 + a(t)^2\,d\mathbf{x}^2, \qquad a(t) > 0.$$

A central observer emits a fresh challenge at t_0. A reflector remains at fixed comoving radius r, receives the challenge, and immediately returns a signal. Assume radial null propagation, no processing delay, and no advance knowledge of the challenge.

Then an echo can return by $T > t_0$ exactly when

$$\boxed{2r \le c\int_{t_0}^{T} \frac{dt}{a(t)}.}$$

An echo can return at some finite time exactly when

$$\boxed{2r < c\int_{t_0}^{\infty} \frac{dt}{a(t)}.}$$

Proof. Introduce the conformal distance coordinate

$$u(t) = c\int_{t_0}^{t} \frac{ds}{a(s)}.$$

An outward radial null signal reaches the comoving reflector when $u = r$. Its immediate return reaches the centre when $u = 2r$. The function u is continuous and strictly increasing on every interval where $a > 0$, which gives both criteria.

par

Conditional prediction. The proper radius, measured on the emission slice, of reachable comoving echo stations is

$$\boxed{D_{\text{echo}}(t_0) = \tfrac{1}{2} D_{\text{reach}}(t_0).}$$

For exact exponential expansion $a(t) = a_0 e^{H(t-t_0)}$, the deadline condition becomes

$$\boxed{a_0 r \le \frac{c}{2H}\left(1 - e^{-H(T-t_0)}\right).}$$

Thus comoving stations beyond $c/(2H)$, measured at emission, cannot complete this fresh echo task—even though some lie inside the one-way future-reception radius c/H.

Important distinction. This is not the static-patch echo of Theorem . A station at fixed comoving radius moves outward in areal radius; a static-patch station at fixed areal radius is a different trajectory.

Directional saturation and approximate cone sections

Theorem (Directional saturation determines an approximate spatial reach ball). *In calibrated affine coordinates, let $K \subset \mathbb{R}^3$ be the compact convex set of displacements attainable during a fixed duration τ. Assume:*

1. *$K \subseteq B_R$, the Euclidean ball of radius $R = c\tau$;*

2. *for every unit direction n, there is $x_n \in K$ satisfying*

$$n \cdot x_n \geq (1 - \eta)R, \qquad 0 \leq \eta \leq 1.$$

Then

$$\operatorname{boxed} B_{(1-\eta)R} \subseteq K \subseteq B_R,$$

and consequently

$$\operatorname{boxed} d_H(K, B_R) \leq \eta R,$$

where d_H denotes Hausdorff distance.

Proof. The support function $h_K(n) = \sup_{x \in K} n \cdot x$ satisfies $(1 - \eta)R \leq h_K(n) \leq R$ for every unit n. A compact convex set equals the intersection of its supporting half-spaces. Every point of $B_{(1-\eta)R}$ satisfies all half-space inequalities defining K, so the smaller ball lies in K. The Hausdorff bound follows from the two ball inclusions.

par

Finite-direction version. Suppose measurements cover only a δ-net of unit directions, measured in Euclidean distance. Under the same outer bound, $h_K(n) \geq (1 - \eta - \delta)R$ for every direction when h_K is R-Lipschitz on the unit sphere. Therefore, when $\eta + \delta \leq 1$,

$$\operatorname{boxed} d_H(K, B_R) \leq (\eta + \delta)R.$$

Corollary (Explicit $O(\varepsilon)$ cone modulus). *Write ε for the relative deficit from the calibrated speed bound in every direction (so $\varepsilon = \eta$ in Theorem , or $\varepsilon = \eta + \delta$ for a δ-net of directions under the R-Lipschitz support-function estimate above). If $0 \le \varepsilon \le 1$, the reach set K is compact and convex, and $K \subseteq B_R$, then*

$$\text{boxed}\, d_H(K, B_R) \le \varepsilon R = O(\varepsilon)$$

as $\varepsilon \to 0$ at fixed calibrated radius R. In particular, saturation within ε of the speed bound in every direction forces Hausdorff convergence to the cone section B_R.

Proof. Immediate from the two ball inclusions of Theorem and the finite-direction estimate, with the identification $\varepsilon = \eta$ or $\varepsilon = \eta + \delta$.

par

Interpretation. Calibration, convexity, a speed bound, and directional saturation imply an approximate cone section, with quantitative modulus $O(\varepsilon)$. They are not derived from scheduling alone (Theorem remains the countermodel for consistency without those assumptions). Named parallel (style only): En08-A / I-B scheduler records [16, 17, 6]. No absolute metric scale is determined without calibrated rods and clocks.

Numerical cone-modulus line (not a new theorem). Fix calibrated radius $R = 1$ and relative directional deficit $\varepsilon = 0.05$ in Corollary . The Hausdorff bound collapses to the concrete number

$$d_H(K, B_1) \le \varepsilon R = 0.05.$$

Equivalently, every supporting radius of K lies in $[0.95, 1]$. For a finite δ-net of directions with $\delta = 0.02$ and Lipschitz constant $R = 1$, the same corollary with $\varepsilon = \eta + \delta$ and $\eta = 0.03$ again yields $d_H(K, B_1) \le 0.05$. Saturation of the speed bound to within five percent therefore forces the reach set into a five-percent neighbourhood of the cone section; the modulus remains $O(\varepsilon)$ and is not a derived physical scale. No Host C is introduced, and the seven research conjectures stay unpromoted. A second numerical probe takes $R = 2$ and a coarser net $\eta = 0.04$, $\delta = 0.06$, so $\varepsilon = 0.10$. Then $d_H(K, B_2) \le 0.20$. Relative to radius, the modulus is again $\varepsilon = 0.10$; absolute Hausdorff distance scales with R exactly as Corollary states. Plotting the two cases $(R, \varepsilon, d_H) \in \{(1, 0.05, 0.05), (2, 0.10, 0.20)\}$ makes

the linear modulus visible without any additional theorem. The finite-direction version with an N-point net on the circle, $\delta = \pi/N$, yields for $N = 32$ the mesh $\delta \approx 0.098$; combined with $\eta = 0.02$ one obtains $\varepsilon \approx 0.118$ and $d_H(K, B_R) \le 0.118\,R$. These three numerical rows—fine net at unit radius, coarse net at radius two, and a thirty-two-point angular mesh—are the cone-modulus number requested for the book expansion. They do not re-expand any shortened reach proof, do not select a physical scale, and do not open Host C.

Bandwidth of a cyclic orthogonal clock orbit

Lemma (Finite matrices admit no exact CCR time pair). *There do not exist finite matrices T_C, H_C on $\mathbb{C}^D$ satisfying*

$$[T_C, H_C] = i\hbar I_C$$

for $\hbar \neq 0$. Moreover

$$\|[T_C, H_C] - i\hbar I_C\|_\infty \ge |\hbar|.$$

Proof. The trace of any commutator vanishes, so $\mathrm{Tr}\,([T_C, H_C] - i\hbar I_C) = -i\hbar D$. For every $D \times D$ matrix A, $|\mathrm{Tr}\,A| \le D\|A\|_\infty$, which forces the norm lower bound and rules out an exact CCR. This is the one-line obstruction already used inside Theorem ; it is isolated here so that the bandwidth bound below is not mistaken for a CCR. Named parallel (style only): I-B prop:no-ccr [6].

par

Theorem (Bandwidth of a cyclic orthogonal clock orbit). *Let*

$$U = e^{-iH_C \Delta t/\hbar}$$

act on a finite-dimensional clock. Suppose a unit vector ψ satisfies:

• *the states $\psi, U\psi, \dots, U^{D-1}\psi$ are orthonormal;*

• *the orbit closes: $U^D\psi = e^{i\chi}\psi$. Let $E_{\min}$ and $E_{\max}$ be the smallest and largest energies in the spectral support of ψ.*

Then

$$\text{boxed}\, E_{\max} - E_{\min} \geq \frac{2\pi\hbar(D-1)}{D\Delta t}.$$

Equality case. *The bound is attained if and only if ψ is a uniform superposition of D equally spaced energies in an arithmetic progression of common difference $2\pi\hbar/(D\Delta t)$ (equivalently: an equally spaced cyclic orthogonal orbit). The bound is not a CCR and does not contradict Lemma .*

Proof. The cyclic condition restricts occupied eigenphases of U to the D roots of e^{ix}. Let p_j be the total spectral weight on root j. Orthogonality gives

$$\langle \psi, U^k \psi \rangle = 0, \qquad k = 1, \ldots, D-1.$$

These are the nonconstant discrete Fourier coefficients of (p_j). Together with $\sum_j p_j = 1$, they imply $p_j = 1/D$. All D equally spaced eigenphases are therefore occupied. The corresponding energy residues modulo $2\pi\hbar/\Delta t$ cannot fit into a real interval shorter than

$$\frac{2\pi\hbar}{\Delta t}\left(1 - \frac{1}{D}\right).$$

Equally spaced energies attain this width and generate the required orbit, proving sharpness. Any other spectral support either misses a root (contradicting $p_j = 1/D$) or spreads over a strictly larger real interval.

par

Conditional prediction. For this clock class, decreasing the interval between perfectly distinguishable readings requires increasing the energy bandwidth. This is a specific clock-resource result, not a universal bound on every approximate or noncyclic clock. It complements Theorem and Lemma : the trace obstruction excludes an exact finite canonical time pair, while the present bound quantifies resources for a cyclic orthogonal orbit. Named parallel (style only): En09-B information–disturbance trade-off and En09-A conditioning [13, 14, 15]. Encoded recovery (Theorem) remains a different contract; beating the unencoded floor is not anomalous.

Support function of anisotropic causal reach

Theorem (Support function of anisotropic causal reach). *Supply the homogeneous metric*

$$ds^2 = -c^2\,dt^2 + \sum_{i=1}^{3} a_i(t)^2\,dx_i^2, \qquad a_i(t) > 0.$$

Let $K_{t_0,T}$ be the set of comoving displacements attainable by causal curves between t_0 and T. Its support function is

$$\boxed{h_{K_{t_0,T}}(n) = c\int_{t_0}^{T} \sqrt{\sum_{i=1}^{3} \frac{n_i^2}{a_i(t)^2}}\,dt.}$$

Proof. At each time, the permitted coordinate velocities satisfy

$$\sum_i a_i(t)^2 v_i(t)^2 \le c^2.$$

Maximizing $n \cdot v$ over this ellipsoid gives

$$\sup_v n \cdot v = c\sqrt{\sum_i \frac{n_i^2}{a_i(t)^2}}.$$

Integrating yields an upper bound on the displacement projection. Choosing the maximizing velocity at each time attains it.

par

Conditional prediction. Different directions generally have different reach limits. Along a principal axis,

$$\boxed{h_{K_{t_0,T}}(e_i) = c\int_{t_0}^{T} \frac{dt}{a_i(t)}.}$$

If the corresponding future integral diverges, reception reach is unbounded along that axis. If all three axis integrals are finite, the full future reach set is bounded. This is a model consequence, not evidence that cosmic expansion is anisotropic.

Research conjectures and exact release

Why the broad conjectures need correction

The plan's three conjectures have useful research content, but their unqualified versions require debugging. A smaller horizon need not worsen a task performed on the central worldline. A size-m clock dictionary does not

bound an external archive or an exact probability law. A fixed-d dimensionless recovery floor need not depend on the coefficient in the $\hbar$ slot.

We therefore retain three labelled research claims about *unsupplied physical bridges*. Their elementary mathematical diagnostics are separated from those claims. None asserts a new particle, dark force, or cosmological quantum state.

Research conjecture (Epoch-sensitive access for a matched task family). There exists a physically justified, same-model family of fresh-input retrieval tasks on a supplied expansion history for which a smaller *matched future reach or deadline-reach region* causes a strictly larger optimized complete-channel error. The comparison keeps the code, source ensemble, assistance, calibration, and decoder contract fixed, and supplies an actual source-to-receiver channel in each epoch.

Research status and test. This is not the claim that the error floor is a universal function of horizon area. Co-located exact transport provides a counterexample to that stronger statement. Nor is $c/H(t)$ substituted for an event horizon.

A finite pilot explains the intended comparison. If a declared task law loses the payload with probability p_i, reports the loss flag, returns the identity channel otherwise, and returns a replacement on loss, its optimized error is

$$e_i = p_i(1 - 1/d^2).$$

The Bell input gives the lower bound, and preparing I/d in the lost branch gives the matching upper bound. Thus $p_1 > p_2$ gives a strict pilot gap. What is conjectural is a physically justified same-model derivation of those complete epoch channels and probabilities from the supplied task ensemble and causal reach. Distinct geometric radii alone do not provide that derivation. No identification with inflation is asserted.

Research conjecture (Finite-memory realization of history retrieval). For a specified history-label task, a physically complete implementation can be shown to leave only an m-symbol classical memory accessible at the retrieval cut. Under that verified cut, the history task obeys the corresponding finite-label retrieval bound, without

interpreting m as gravitational entropy.

Research status and test. The classical counting inequality is elementary, not conjectural. For N equiprobable labels encoded in m symbols,

$$P_{\text{success}} \le \frac{1}{N} \sum_{r=1}^{m} \max_{u} p(r|u) \le \min\{1, m/N\}.$$

An exact deterministic decoder can distinguish at most m labels.

The conjectural part is the identification of the *complete* physical history interface with that finite memory. A surviving quantum system, stored transcript, independent copies, or an external archive changes the contract. A two-outcome probability law can vary injectively over infinitely many parameter values; an exact law is not one sampled word. Repeated independent trials enlarge the observation resource. Therefore clock dimension alone is not an unrestricted history, thermodynamic, or horizon-entropy theorem.

Research conjecture (Coefficient-sensitive physical calibration bridge). A physically complete realization of coefficient-sensitive horizon accounts, jointly matched with its operational readout and access tasks, requires independent normalization data that identify the coefficient assigned to the $\hbar$ slot in that declared account class. Such data may be supplied directly or through an independently calibrated coefficient-sensitive observable.

Research status and test. This does not claim to derive $\hbar$. The literal statement that *every* horizon-associated error formula must receive $\hbar$ as an explicit numerical input is false: the fixed-d laws $1 - 1/d$ and $1 - 1/d^2$ do not contain it. Likewise an equivalent injective calibration observable can replace direct coefficient supply.

The precise mathematical obstruction is already the data-fibre test: a target that varies on one unchanged-data fibre cannot be identified from that data. Theorem proves this for the declared conventional labels. The conjectural bridge is a same-model physical representation, acquisition, and calibration of coefficient-sensitive data together with the relevant horizon task. A label convention, a catalogue family, or a fixed-dimension channel certificate does not supply it.

Active causal tomography and resource realizations

The four conditional theorems of Section leave open whether suitable physical systems realize their assumptions. The following research conjectures address those bridges. They are not theorems and close no open gate. Their consolidation payoff is the fail-able cross-experiment relation of Subsection , not seven disconnected asks.

Research conjecture (Active causal tomography). A physically realizable family of calibrated challenge–response experiments can constrain local causal-cone sections through directional reach measurements, with controlled errors from clocks, routes, and apparatus delays.

Research status and test. Prediction: after accounting for device delays, independently implemented propagation methods converge on a common reach geometry. Failure criterion: incompatible reach sets beyond the declared uncertainty reject the proposed common propagation model. This conjecture supplies the physical bridge needed by Theorem . It does not assert that consistency alone reconstructs a Lorentz cone. It feeds the geometric side of the cross-experiment relation in Subsection .

Standing boundary. No spacetime emergence, derived metric, Einstein dynamics, Page curve, island, cosmological bounce, de Sitter quantum state, vacuum-energy selection, inherited characteristic quantum coefficient, compilation, or Host C is claimed. O.1 stays NOT_CLOSED; Gate 0 and ST4b stay NOT_SUPPLIED; XV-B is not opened; XVI-N is not discharged; $\mathrm{Dom}(T)$ remains undetermined; J2 remains unresolved; Problems 6, 7, and 9 are named, not solved. Locked Host-A stays NAMED_COMPARISON_ONLY, with $\{\mathrm{GI}, \mathrm{CB}\}$ only. Cited Cheung and OpenAI records are source records, not premises. The declared path is null. Destructive Enter consumes a finite clock encoding, not the geometric time axis. The regular reporting cone is neither I-D dynamical host and is not globally hyperbolic.

Research conjecture (Finite-clock resource scaling). Over a specified operating regime, a physically complete family of cyclic finite clocks can approach the orthogonal-orbit bandwidth bound while retaining controlled preparation and readout errors.

Research status and test. Prediction: approximate saturation should follow

$$\Delta E\,\Delta t \approx 2\pi\hbar\frac{D-1}{D}.$$

Required work: derive how imperfect orthogonality and imperfect cyclic closure modify the exact bound of Theorem . The formula above cannot simply be applied unchanged to noisy clocks. This is a laboratory resource conjecture, not a statement that geometric time is finite-dimensional.

Standing boundary. No spacetime emergence, derived metric, Einstein dynamics, Page curve, island, cosmological bounce, de Sitter quantum state, vacuum-energy selection, inherited characteristic quantum coefficient, compilation, or Host C is claimed. O.1 stays NOT_CLOSED; Gate 0 and ST4b stay NOT_SUPPLIED; XV-B is not opened; XVI-N is not discharged; Dom (T) remains undetermined; J2 remains unresolved; Problems 6, 7, and 9 are named, not solved. Locked Host-A stays NAMED_COMPARISON_ONLY, with $\{\mathrm{GI}, \mathrm{CB}\}$ only. Cited Cheung and OpenAI records are source records, not premises. The declared path is null. Destructive Enter consumes a finite clock encoding, not the geometric time axis. The regular reporting cone is neither I-D dynamical host and is not globally hyperbolic.

Research conjecture (Correlation-assisted clock readout). A physically implemented clock–payload encoding can preserve an unknown logical state through destructive clock readout, using the retained residual and outcome-conditioned correction, with an error smaller than the unencoded clock-reconstruction floor.

Research status and test. Theorem already proves the mathematical possibility of an encoded inverse. The conjecture concerns a complete physical implementation. Prediction: logical recovery remains accurate even when the clock record is statistically independent of the unknown logical input. Test: compare encoded and unencoded tasks using reference-preserving channel characterization. Limitation: beating the unencoded floor is not anomalous; it demonstrates that the input task and access contract differ. Together with Proposition , it supplies one side of the fail-able relation in Subsection .

Standing boundary. No spacetime emergence, derived metric, Einstein dynamics, Page curve, island, cosmological bounce, de Sitter quantum state, vacuum-energy selection, inherited characteristic quantum coefficient, compilation, or Host C is claimed. O.1 stays NOT_CLOSED; Gate 0 and ST4b stay

NOT_SUPPLIED; XV-B is not opened; XVI-N is not discharged; Dom (T) remains undetermined; J2 remains unresolved; Problems 6, 7, and 9 are named, not solved. Locked Host-A stays NAMED_COMPARISON_ONLY, with $\{\mathrm{GI}, \mathrm{CB}\}$ only. Cited Cheung and OpenAI records are source records, not premises. The declared path is null. Destructive Enter consumes a finite clock encoding, not the geometric time axis. The regular reporting cone is neither I-D dynamical host and is not globally hyperbolic.

Cross-experiment coherence and access consistency

The seven conjectures ask related physical-bridge questions. The consolidation payoff is one conditional identity among measurements, paired with the already-proved encoded-access distinction, and one research claim that a matched experiment can estimate both sides independently. That relation can fail; it is not a signature an unseen sector can reproduce, and it does not identify a common phase with gravity, dark matter, or a mediator.

Proposition (Gaussian cross-coherence identity; local reprint). *Let two probes acquire random phases through*

$$U = \exp\left[-\frac{i}{2}(\varphi_A Z_A + \varphi_B Z_B)\right],$$

and assume that (φ_A, φ_B) *are jointly Gaussian with zero mean and covariance* $K_{ij} = \mathbb{E}[\varphi_i \varphi_j]$. *Then the single-probe coherence factors are*

$$\Gamma_A = e^{-K_{AA}/2}, \qquad \Gamma_B = e^{-K_{BB}/2},$$

and the two-probe coherence between $|01\rangle$ *and* $|10\rangle$ *is*

$$\Gamma_- = e^{-(K_{AA} + K_{BB} - 2K_{AB})/2}.$$

Consequently

$$\text{boxed}\, K_{AB} = \log \Gamma_- - \log \Gamma_A - \log \Gamma_B.$$

Proof. The phase factor multiplying the $|01\rangle$–$|10\rangle$ coherence is $e^{-i(\varphi_A - \varphi_B)}$. For a zero-mean jointly Gaussian pair the characteristic function gives

$$\mathbb{E}[e^{-i(\varphi_A - \varphi_B)}] = \exp\left(-\tfrac{1}{2}\mathrm{Var}(\varphi_A - \varphi_B)\right),$$

and $\mathrm{Var}(\varphi_A - \varphi_B) = K_{AA} + K_{BB} - 2K_{AB}$. The single-probe identities are the same argument with one phase alone. Taking logarithms yields the displayed covariance entry.

par

Source-record status. The same Gaussian identity appears as a supplied benchmark in Series-II2VI-Enter-A thm:gaussian-cov [31, 32]. The statement above is a self-contained local reprint; it is not imported as a premise of any cosmological state, hidden sector, or mediator identification. It is a conditional deduction under the displayed model, not a conjecture.

Numerical Gaussian cross line (local reprint; not a new theorem). Under Proposition , take the concrete covariance

$$K_{AA} = K_{BB} = 0.20, \qquad K_{AB} = 0.10.$$

Then

$$\Gamma_A = \Gamma_B = e^{-0.10} \approx 0.9048, \qquad \Gamma_- = e^{-(0.20 + 0.20 - 0.20)/2} = e^{-0.10} \approx 0.9048,$$

and the recovered cross entry is

$$K_{AB} = \log \Gamma_- - \log \Gamma_A - \log \Gamma_B = 0.10,$$

matching the supplied covariance to machine precision. If instead $K_{AB} = 0.20$ (perfect common phase), then $\Gamma_- = 1$ while $\Gamma_A = \Gamma_B \approx 0.9048$, so individual coherences decay while the differential coherence is intact. The identity is conditional on the Gaussian model already stated in the proposition; it is the same benchmark as Series-II2VI-Enter-A thm:gaussian-cov and does not select a mediator, a dark sector, or a gravitational identification. A second numerical row takes an anti-correlated packet $K_{AA} = K_{BB} = 0.20$, $K_{AB} = -0.10$. Then

$$\Gamma_A = \Gamma_B \approx 0.9048, \qquad \Gamma_- = e^{-(0.40 + 0.20)/2} = e^{-0.30} \approx 0.7408,$$

and $K_{AB} = \log \Gamma_{-} - \log \Gamma_{A} - \log \Gamma_{B} = -0.10$, again matching. The contrast between the correlated row ($K_{AB} = 0.10, \Gamma_{-} \approx 0.9048$) and the anti-correlated row ($K_{AB} = -0.10, \Gamma_{-} \approx 0.7408$) is the numerical content of the cross identity: differential coherence rises or falls with the sign of K_{AB} exactly as the boxed formula predicts. A third row with independent phases $K_{AB} = 0$ gives $\Gamma_{-} = e^{-0.20} \approx 0.8187$ and recovers $K_{AB} = 0$ from the logs. The three rows together are the Gaussian cross line for this sheet; they reprint Proposition arithmetically and leave every research conjecture unpromoted.

Pairing with encoded access. Theorem already shows that an encoded logical inverse can succeed while unencoded clock reconstruction stays at the floor $1 - 1/D$. The two quantities—cross-coherence covariance under a supplied Gaussian benchmark, and encoded versus unencoded clock access—are logically independent measurement contracts.

Research conjecture (Joint geometric–quantum access as a fail-able relation). A matched family of distributed retrieval experiments can independently estimate both sides of the cross-experiment relation:

1. the Gaussian covariance entry K_{AB} reconstructed from single-probe and differential coherences as in Proposition ; and

2. causal delivery probability together with retained quantum-channel quality on delivered branches, separating geometric exclusion from local decoherence, in the spirit of the encoded versus unencoded distinction of Theorem . The claim is that these estimates can be obtained independently and checked for mutual consistency under declared calibrations. Incompatibility beyond declared uncertainty is a failure of the proposed common model, not evidence for gravity, dark matter, or a mediator.

Research status and test. This restates the former joint-access claim as a *relationship among measurements that can fail*, and orients Conjectures , , , and toward that relation rather than seven disconnected asks. Predictions:

• missed delivery and successful-but-noisy delivery have distinguishable calibrated signatures;

• changing local noise controls alters conditional channel quality without changing geometric reach;

• changing the communication deadline alters delivery probability without necessarily changing the channel on delivered branches;

• reconstructed K_{AB} from $\Gamma_A, \Gamma_B, \Gamma_-$ is stable across independent probe implementations when the Gaussian benchmark applies, and fails cleanly when it does not. Required work: construct the complete instrument, including loss flags, false detections, assistance, and source-independent background events. Do not promote this conjecture to a theorem. Do not identify the common phase with gravity, dark matter, or a mediator.

Standing boundary. No spacetime emergence, derived metric, Einstein dynamics, Page curve, island, cosmological bounce, de Sitter quantum state, vacuum-energy selection, inherited characteristic quantum coefficient, compilation, or Host C is claimed. O.1 stays NOT_CLOSED; Gate 0 and ST4b stay NOT_SUPPLIED; XV-B is not opened; XVI-N is not discharged; Dom (T) remains undetermined; J2 remains unresolved; Problems 6, 7, and 9 are named, not solved. Locked Host-A stays NAMED_COMPARISON_ONLY, with $\{\mathrm{GI}, \mathrm{CB}\}$ only. Cited Cheung and OpenAI records are source records, not premises. The declared path is null. Destructive Enter consumes a finite clock encoding, not the geometric time axis. The regular reporting cone is neither I-D dynamical host and is not globally hyperbolic.

Compatible mathematical release

Theorem (Series-I-IB-Enter-A finite/local release). *The displayed interfaces admit the following compatible assembly:*

1. *a calibrated projective measurement layer with uniquely fixed Born probabilities and Lüders residuals in the stated instrument class, together with Lemma ;*

2. *finite semantic no-cloning, internal no-signalling, and complete recorded-network confluence;*

3. *a prescribed regular conical carrier with a complete destructive clock, exact sector and encoded-logical distinctions, sharp universal clock loss, the finite no-CCR obstruction of Lemma , and the cyclic-orbit bandwidth bound;*

4. *scheduled support contained in a supplied causal embedding, together with a non-Lorentzian scheduler countermodel and the $O(\varepsilon)$ directional-cone modulus of Corollary ;*

5. *separate prescribed-horizon access, replacement recovery, coefficient non-selection, and vacuum/residual-account comparisons (local floors retained; Big01 epoch ledger not restated);*

6. *consolidated FLRW reach under explicit future assumptions, with one past-only countermodel retained, finite-deadline echo reach, anisotropic support-function reach, and the local Gaussian cross-coherence identity of Proposition ;*

7. *seven unproved physical bridge conjectures oriented around the fail-able cross-experiment relation of Subsection . This is a finite/local interface synthesis. It supplies no map deriving a metric from records, no field-theoretic source instrument, and no admission of the inherited characteristic quantum coefficient.*

Proof. Theorem and Lemma supply the measurement layer from its printed calibration and residual hypotheses. Theorem supplies the finite semantic statements. Theorems , , , and , together with Lemma and Theorem , supply the carrier and access interface.

Theorem uses declared routes, while Theorem shows why scheduler properties alone do not supply those routes or a Lorentz cone. Theorem and Corollary add the quantitative cone modulus under calibration hypotheses. Theorems – concern a different prescribed comparison host and explicit accounts; their local floors are retained without restating the full Big01 epoch ledger. Theorems , , and retain the consolidated FLRW statements and one countermodel; sibling reach developments are style only. Theorems and supply the echo and anisotropic support-function deductions. Proposition is a self-contained local reprint of a supplied Gaussian benchmark identity.

The assembly is compatible because the types are not identified: a semantic instrument is not a field acquisition, a calibrated code is not geometric time, a finite task dimension is not a horizon Hilbert-space dimension, a Gaussian coherence identity is not a mediator, and a stress residual is not a selected vacuum or particle. No step constructs the missing metric-generation, source, characteristic-composition, or quantum-admission map. The research

conjectures are not used in any proof.

par

Unchanged programme ledger

The following remain outside the release:

$$\mathrm{Dom}\,(T), \quad \text{U6-sel}, \quad \text{J2}, \quad \text{same-model physical source acquisition},$$
$$\text{full dynamical-host transfer}, \quad \text{a finite-Hilbert promise for a cosmological host},$$
$$\text{a quantum state and observable algebra on the cosmological comparison background}.$$

D1–D8 remain open. O.1 stays NOT_CLOSED. Gate 0 and ST4b stay NOT_SUPPLIED. XVI-N is not discharged. The downstream XV-B quantum-admission exit is not opened. Problems 6, 7, and 9 are named, not solved.

The historical H2 stop in XIV-H and XIV-I's narrower constructed internal I2 amplitude are version-qualified records. The latter does not provide the full I3/J2 characteristic composition. Technical lifting results in XV-B are not an opened downstream quantum-admission exit [33, 34, 35, 36]. No theorem here negates a separately scoped source result or promotes an unresolved construction to a universal nonexistence theorem.

The OpenAI catalogue is a documentary comparison only [49]. The mathematical-physics section is retained as a separation, not as a source of a unique expansion law, a clock-bandwidth constant, a measurement uniqueness theorem, a hidden-sector coupling, vacuum normalization, or the missing characteristic coefficient.

Verification and submission declarations

All local theorem hypotheses, definitions, and proofs needed for this release are printed in this file. The companion citations identify the supplied source records and their named objects; they are not an independent audit of the full corpus or of the latest versions. No proof of the unrelated full characteristic graph is claimed.

Successful double pdflatex typesetting under SOURCE_DATE_EPOCH=1792627200 with matching SHA and label checks **is** asserted for this Version 3 deliverable. Proof-assistant verification, independent numerical execution, referee review, application registration, and journal acceptance are **not** asserted. Authorship is recorded

as "Ngo Cheung". Citing N. Cheung alone does not assign authorship of this synthesis. The registration manifest remains wired:false with declaredPath=null.

appendix

Debugging ledger

toprule Proposed shortcut Correction

midrule endhead State sufficiency, normalization, and purity select the measurement. They do not. The measured projections, calibration, candidate class, and eigen-sector nondisturbance are explicit in Definition .

Pure positive branches mean every local marginal is pure. Purity concerns a complete conditional pure input. Tracing an untouched reference can leave a mixed marginal (Lemma).

The clock's residual identity returns an arbitrary clock state. It returns $\mathrm{Tr}_{C} X$. Whole-input clock reconstruction has error $1 - 1/D$; a logical encoded inverse is a different input task.

A consumed clock removes geometric time. Only the finite measured quantum factor is absent from the continuation. The host and time coordinate remain.

Finite matrices realize an exact canonical time pair. Lemma isolates the obstruction; the cyclic bandwidth bound of Theorem is not a CCR.

Confluence determines the Lorentz cone. The complete lattice record countermodel has cube-cone reachability.

The reporting cone is a full I-D host. Puncturing an axis changes the model; late exterior chart agreement does not identify full backgrounds.

No transport crosses a future event horizon in either direction. The no-reception statement is observer-directed. Outward causal signals can cross the boundary.

The exact replacement formula is already optimized over decoders. Its eigenvalues describe one decoded replacement state. Optimization gives $1 - 1/d^{2}$.

The classical-record and replacement floors are the same. They are $1 - 1/d$ and $1 - 1/d^2$, respectively.

A short record-only transcript prices an entanglement-assisted process. Only a verified complete classical factorization does. All assisting quantum resources must be included.

A finite geometric region has finite Hilbert capacity. The region admits arbitrarily large orthogonal function families. Finite capacity requires an external code or promise.

A horizon light-crossing scale bounds the total operation count. Central future proper time is unbounded; no energy or hardware rate is supplied.

Horizon labels identify vacuum energy or the $\hbar$ coefficient. Only coefficient-sensitive data refine those fibres. Products or labels constant on the fibre do not.

A past fit determines a future event horizon. Smooth futures can share the entire past and junction jets while their future conformal integrals differ.

Any permanent acceleration gives a horizon. The $t \log t$ example accelerates but has infinite conformal future. The uniform margin $q \le -\varepsilon$ does the work.

The uniform acceleration theorem permits any $\varepsilon > 0$ on an eternal smooth future. For $\varepsilon > 1$ that expanding class is empty. The bound is sharp on $0 < \varepsilon \le 1$.

A smaller epoch horizon universally worsens recovery. Co-located identity transport is a counterexample. Matched tasks and derived complete channels are required.

Every horizon-error formula must receive $\hbar$ directly. Fixed-dimension channel floors are coefficient-blind. Coefficient-sensitive targets need identifying data, not necessarily the raw coefficient as a separate argument.

A FLRW comoving echo is the same as the static-patch echo. Theorem uses fixed comoving radius; Theorem uses fixed areal radius on the static patch. Different trajectories.

Scheduler consistency reconstructs the Lorentz cone. Theorem supplies a non-Lorentzian countermodel. Theorem needs calibration, convexity, a speed bound, and directional saturation in addition.

The cyclic-clock bandwidth bound is universal for all clocks. It applies to cyclic orthogonal orbits under the printed hypotheses. Approximate or noncyclic clocks need a separate analysis (Conjecture).

Anisotropic reach proves cosmic expansion is anisotropic. Theorem is a model consequence under a supplied anisotropic metric, not observational evidence.

Beating the unencoded clock floor is anomalous. Encoded recovery uses a different input task and access contract (Theorem ; Conjecture).

The $O(\varepsilon)$ cone modulus is qualitative only. Corollary makes $d_H(K, B_R) \le \varepsilon R$ explicit; Theorem remains the consistency countermodel.

Collapsing cosmic reach drops the past-only countermodel. The $t \log t$ and smooth past-junction countermodels are retained; only the long parallel development is shortened.

The Gaussian K_{AB} identity is a cosmological premise. Proposition is a supplied-benchmark local reprint; it is not a premise of a cosmological state or mediator.

Joint-access tomography identifies a hidden sector. Conjecture is a relationship among measurements that can fail; it does not identify gravity, dark matter, or a mediator.

Research conjectures close programme gates. Conjectures are research claims about physical bridges. They do not close O.1, Gate 0, Dom(T), J2, or Problems 6/7/9.

bottomrule

Unexecuted registration manifest

Proposed metadata

id: Series-I-IB-Enter-A?alias: I-Enter-A?role: documentary-synthesis?declaredPath: null?wired: false?release:? local-interface-proofs: constructed? prescribed-host-comparisons: conditional? physical-bridge-conjectures: unproved? spacetime-emergence: not-claimed? inherited-quantum-admission: not-established

Proposed separation edges

Each proposed edge has one target parent. The notes refuse proof transfer.

toprule Parent Separation note

midrule endhead I Does not import a strategy characterization as a premise deriving geometric time or a causal cone.

I-B Does not import a prescribed carrier as a premise for metric emergence.

I-B-G Does not import a selected Green realization as intrinsic to every hosted finite object.

I-B-G-S Does not import spin-domain identities as a premise selecting a physical core or interacting quantum coefficient.

I-B-VP-CR Does not import the positive-local one-channel obstruction as a universal smooth-core no-go.

I-C Does not import the classical-only cut as a premise pricing a retained quantum residual.

I-C-CERT Does not import a replacement certificate as a premise deriving a horizon or a Page curve.

I-D Does not import either full dynamical host as a premise identifying the reporting cone.

En09-A Does not import conditioned extraction as a premise eliminating an external time parameter.

En09-B Does not import encoded logical recovery as arbitrary clock return.

Big01-A Does not import prescribed horizon labels as a premise for a cosmological state or finite host Hilbert space.

Big-Vac-A Does not import a residual-line comparison as a premise selecting an absolute vacuum energy.

Big06-B Does not import residual-source uniqueness as particle selection or an evolution law.

Series-II2VI-Enter-A Does not import an earlier synthesis or conjecture as a premise.

Series-VII-Enter-A Does not import a later-series interface as a premise for the measurement characterization or

cosmic future law.

thm:flrw-echo Does not identify FLRW comoving echo with the static-patch echo of thm:horizon; fixed comoving radius is a different trajectory.

thm:directional-cone Does not derive calibration, convexity, or a speed bound from scheduler consistency; companion to thm:scheduler.

thm:cyclic-clock-bandwidth Does not claim a universal bound on every approximate or noncyclic clock; complements the finite-time obstruction.

thm:anisotropic-reach Does not assert that cosmic expansion is anisotropic; model consequence only.

conj:active-causal-tomography Research claim; does not close Gate 0 or select a Lorentz cone from consistency alone.

conj:clock-bandwidth-realization Research claim; does not assert that geometric time is finite-dimensional.

conj:encoded-clock-realization Research claim; beating the unencoded floor is not anomalous.

conj:joint-access-tomography Research claim; restated as a fail-able relationship among measurements; does not identify gravity/DM/mediator; does not close O.1.

lem:pure-branch-marginal Local lemma; does not import Series I calculus syntax.

lem:no-ccr Isolates the finite CCR obstruction; bandwidth bound is not a CCR.

cor:cone-modulus Quantitative Hausdorff modulus; does not remove the scheduler countermodel.

prop:gaussian-cross Self-contained supplied-benchmark reprint; not a cosmological premise or mediator claim.

sec:cross-consistency Consolidation subsection; orients conjectures; wires nothing.

bottomrule

The proposed emergence-page text is:

Measurement and a prescribed Enter carrier. Series-I-IB-Enter-A assembles calibrated finite measurement,

destructive-clock access, and causal-controller interfaces. It separately compares them with prescribed-horizon access and conditional FLRW reach. A finite clock dictionary is not geometric time, a finite causal radius is not a finite Hilbert space, and a source-account residual is not a selected vacuum. Version 3 consolidates unique local objects, shortens sibling reach parallels, adds a purity-versus-marginal lemma, a finite no-CCR obstruction, an $O(\varepsilon)$ cone modulus, and a local Gaussian cross-coherence identity, and orients seven research conjectures around one fail-able cross-experiment relation. These are conditional deductions and research claims; they are not spacetime emergence, and they do not identify a common phase with gravity, dark matter, or a mediator.

Standing boundary. No spacetime emergence, derived metric, Einstein dynamics, Page curve, island, cosmological bounce, de Sitter quantum state, vacuum-energy selection, inherited characteristic quantum coefficient, compilation, or Host C is claimed. O.1 stays NOT_CLOSED; Gate 0 and ST4b stay NOT_SUPPLIED; XV-B is not opened; XVI-N is not discharged; Dom (T) remains undetermined; J2 remains unresolved; Problems 6, 7, and 9 are named, not solved. Locked Host-A stays NAMED_COMPARISON_ONLY, with $\{\mathrm{GI}, \mathrm{CB}\}$ only. Cited Cheung and OpenAI records are source records, not premises. The declared path is null. Destructive Enter consumes a finite clock encoding, not the geometric time axis. The regular reporting cone is neither I-D dynamical host and is not globally hyperbolic.

When registration is requested, the next free emergence card is sheet-b74. Unique parents only (as in the proposed table); local labels that are not parents (thm:flrw-echo, the four resource conjectures, lem:pure-branch-marginal, lem:no-ccr, cor:cone-modulus, prop:gaussian-cross, and sec:cross-consistency) stay in the note, not as extra edges. declaredPath=null and wired:false until that request. No label, connection, or status update is claimed to have been installed in this Version 3 deliverable.

Stable local labels

sec:routing?sec:measurement?def:measurement?thm:main?thm:semantic?sec:carrier?eq:cone?thm:nonGH?eq:clock?thm:clock?thm:cut?thm:clock-access?sec:containment?thm:metric-containment?thm:scheduler?sec:big?eq:ds?thm:horizon?thm:Bexact?eq:replacement?eq:horizon-labels?thm:Hcert?thm:vacfibre?sec:cosmic?eq:flrw?thm:reach

?thm:accel-reach?eq:accel-bound?thm:nonaccel?sec:echo-cone-clock?thm:flrw-echo?thm:directional-cone?thm:cyclic-clock-bandwidth?thm:anisotropic-reach?lem:pure-branch-marginal?lem:no-ccr?cor:cone-modulus?sec:cross-consistency?prop:gaussian-cross?sec:research?conj:epoch?conj:history?conj:coefficient?conj:active-causal-tomography?conj:clock-bandwidth-realization?conj:encoded-clock-realization?conj:joint-access-tomography?thm:unified?app:debug?app:registration?app:pc20?app:pc21?app:sha

Source labels must be stored with their source identifier and version. For example, Big01-A@7:thm:P3 is not a local theorem label of this file. The registration manifest remains wired:false.

Plan corrections PC20-IIB and draft verdicts DC20-IIB

toprule ID Item Status

midrule endhead PC20-IIB-1 Retain StandingBoundary after every theorem (via textbackslash Boundary); manual StandingBoundary after every new conjecture; keep D1–D8 open; do not close O.1 / Gate0 / ST4b / Dom(T) / J2 / Problems 6/7/9; Host-A stays NAMED_COMPARISON_ONLY with $\{\mathrm{GI}, \mathrm{CB}\}$. held

PC20-IIB-2 Author "Ngo Cheung"; date 28 October 2026; request t390u; Version 2; honest typesetting note (double pdflatex+SHA/label; proof-assistant / numerical / referee not asserted); SOURCE_DATE_EPOCH=1792627200. held

PC20-IIB-3 New Section : Finite echo reach, directional cone reconstruction, clock bandwidth, and anisotropic reception; guiding principle printed. held

PC20-IIB-4 Four conditional theorems: thm:flrw-echo, thm:directional-cone, thm:cyclic-clock-bandwidth, thm:anisotropic-reach; each followed by textbackslash Boundary. held

PC20-IIB-5 Four research conjectures (not theorems): conj:active-causal-tomography, conj:clock-bandwidth-realization, conj:encoded-clock-realization, conj:joint-access-tomography; three prior conjectures retained; manual StandingBoundary after each new conjecture. held

PC20-IIB-6 Distinctions printed: FLRW echo ≠ static-patch echo; directional cone does not follow from scheduler

alone; cyclic bandwidth ≠ universal clock bound; anisotropic reach ≠ evidence of anisotropy; encoded-floor beating not anomalous. held

PC20-IIB-7 Update thm:unified, debug ledger, separation edges, stable labels, and emergence-page proposal; freeze v1 SHA in app:sha. held

PC20-IIB-8 Abstract 150–200 words; declaredPath=null; wired:false; nothing registered or pushed. held

DC20-IIB-1 StandingBoundary retained after every theorem including the four new ones; manual reminder after each new conjecture. held

DC20-IIB-2 New labels present: sec:echo-cone-clock, thm:flrw-echo, thm:directional-cone, thm:cyclic-clock-bandwidth, thm:anisotropic-reach, and the four new conjectures. held

DC20-IIB-3 Theorems remain conditional deductions; conjectures remain research claims; no proof transfer from cited parents. held

DC20-IIB-4 Opens held: O.1 NOT_CLOSED; Gate0/ST4b NOT_SUPPLIED; Dom(T) undetermined; J2 unresolved; XVI-N not discharged; XV-B not opened; D1–D8 open; Problems 6/7/9 named, not solved. held

DC20-IIB-5 Abstract mentions four new conditional theorems and four new research conjectures; prior three retained; non-claims held. held

DC20-IIB-6 Debug / edge / ingestion updates for all new labels. held

DC20-IIB-7 PC20-IIB / DC20-IIB held; request t390u. held

DC20-IIB-8 declaredPath=null; wired:false; registration unexecuted. held

bottomrule

Plan corrections PC21-IIB and draft verdicts DC21-IIB

toprule ID Item Status

midrule endhead PC21-IIB-1 Retain StandingBoundary / textbackslash Boundary after every new theorem,

lemma, proposition, and corollary; manual StandingBoundary after every restated or new conjecture; keep D1–D8 open; do not close O.1 / Gate0 / ST4b / Dom(*T*) / J2 / Problems 6/7/9; Host-A stays NAMED_COMPARISON_ONLY. held

PC21-IIB-2 Author unchanged; date 28 October 2026; request t391u; Version 3; freeze v2 SHA; SOURCE_DATE_EPOCH=1792627200; retain PC20-IIB/DC20-IIB and append this table. held

PC21-IIB-3 Keep and sharpen unique local objects (def:measurement/thm:main, thm:semantic, thm:clock/thm:clock-access, thm:scheduler/thm:directional-cone, thm:flrw-echo, thm:cyclic-clock-bandwidth, thm:anisotropic-reach). held

PC21-IIB-4 Consolidate sibling material: shorten thm:reach/thm:accel-reach/thm:nonaccel; keep one countermodel; cite II2VI/VII as style only; keep local Big01 floors without restating the epoch ledger. held

PC21-IIB-5 Add lem:pure-branch-marginal, lem:no-ccr with equality-case bandwidth, cor:cone-modulus, and prop:gaussian-cross; each followed by textbackslash Boundary. held

PC21-IIB-6 Add sec:cross-consistency; restate conj:joint-access-tomography as a fail-able relationship among measurements; no gravity/DM/mediator identification; conjectures not promoted to theorems. held

PC21-IIB-7 Registration readiness note: next free card sheet-b74; declaredPath=null; wired:false; nothing registered. held

PC21-IIB-8 Abstract 150–200 words with consolidation theme; update thm:unified, debug, edges, stable labels. held

DC21-IIB-1 PC20-IIB/DC20-IIB retained; PC21-IIB/DC21-IIB held; request t391u. held

DC21-IIB-2 New/changed labels present: lem:pure-branch-marginal, lem:no-ccr, cor:cone-modulus, prop:gaussian-cross, sec:cross-consistency; conj:joint-access-tomography restated. held

DC21-IIB-3 Cross-identity is a proposition (not a conjecture); joint-access remains a conjecture; opens held; no Page/island/bounce/vacuum-energy selection. held

DC21-IIB-4 Cosmic block shortened with labels retained and $t \log t$ / past-only countermodel present. held

DC21-IIB-5 declaredPath=null; wired:false; registration unexecuted; sheet-b74 noted only. held

bottomrule

SHA freeze and build record

sheet: Series-I-IB-Enter-A?version: 4?request: t391u?date: 2026-10-28?author: Ngo Cheung?SOURCE_DATE_EPOCH: 1792627200?FORCE_SOURCE_DATE: 1?wired: false?declaredPath: null?PC: PC20-IIB + PC21-IIB?DC: DC20-IIB + DC21-IIB?frozen_v1_tex_sha256:? fdcb975f41d3fe11ff507358c401836bfe947d8fe9f040d35fccc1580c90df71?frozen_v2_tex_sha256:? 3c6b3bedbb0e03d95ee55d8dac18c335ec1b5228d730be746447bf8da7fb3af7

Successful double pdflatex under the recorded epoch **is** asserted for this deliverable. Proof-assistant checks, independent numerical execution, referee review, and application registration are **not** asserted. Nothing is registered or pushed.

Bibliography discipline (book pass t415u). Sheet codes (I-B, I-C-Ex, En09-A, …) are retained in parent-comparison tables. Bibliography titles follow Scholar or deposit records. Commentary such as "source record; not a premise" lives only in parent tables, not inside string

[1] entries. Bundled parents are split into one entry per citable work. par

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