Described Twice?

A finite audit of a possible gravity–measurement seam

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Abstract

Could quantum measurement and weak-field gravitational sourcing describe one record-making process? We test this hypothesis using finite quantum instruments and explicitly declared event models. On 50,401 histories, commit and billing counts agree under a one-bill-per-commit convention. Later audits establish an exact jump–tape–commit correspondence but do not select a billing law. Additive history currents form $\mathbb{Z}[i]^{224}$; their weights remain free. The absolute pair unit is nondefinable from the retained algebra and observables and requires a dimensionless normalization input whose value is unselected.

Two source rules, quantum-until-commit Q and records-only R, agree after commitment and differ before it. On a declared two-qubit extension, R remains separable, whereas Q is entangled precisely when the invariant cross phase Ξ is nontrivial. A common local tomography instrument tests this distinction, with an exact threshold for independent local dephasing. Two admissible control-to-phase maps nevertheless give opposite decisions at the same control and noise point.

The record-service ceiling does not bound source entanglement growth on the audited product extension. The primitive system-only action cannot reproduce both the record channel and record transport; a local environment and a transfer sector are jointly minimal within the declared enlargement class. Subsequent conditional extensions still leave repeated-use dynamics, history weights, scheduling and physical time unselected. The result is a finite consistency audit and conditional discriminator, with explicit remaining assumptions, rather than a derivation of a gravity–measurement identity.

Keywords: quantum measurement; semiclassical gravity; gravitationally induced entanglement; quantum instruments; finite models; theory auditing

1 Two descriptions, one thing?

Different mathematical descriptions can refer to the same physical process. Establishing that they do requires a map that preserves observable predictions. Three historical examples motivate this standard of comparison.

The history of heat gives the cleanest warning. Mechanical work and heat were once accounted for in different conceptual ledgers. Rumford's friction experiments challenged a conserved caloric substance, while Joule's later measurements established a mechanical equivalent of heat [1, 2]. Agreement of events was not enough. What closed the identification was a conversion law: a unit of work and a unit of heat could be put on one quantitative scale. Before that link, "the same process" was a plausible reading; after it, the statement had calculational content.

Einstein began his 1905 relativity paper with another asymmetry of description. The observed current induced by a magnet and a conductor depends on their relative motion, yet the pre-relativistic account described two quite different causal stories depending on which body was said to move [3]. Special relativity did not merely declare the stories equivalent. It supplied the transformations under which electric and magnetic descriptions fit one field.

The quantum-mechanical case is closest to the method used here. In 1926, Schrödinger argued for a correspondence between his wave mechanics and the Heisenberg–Born–Jordan formulation [4]. The early comparison was historically decisive but did not establish every operator-domain and representation condition required by a modern equivalence theorem [5, 6]. Dirac and Jordan subsequently developed transformation theory [7, 8]; von Neumann supplied a systematic Hilbert-space foundation in 1932 [9]. These developments connected representations through mathematical structure, not through similarity of terminology.

These stories are not evidence for the proposal below. They are guardrails for how to state it. A suggestive resemblance is not a unification. A shared event census is not yet an identity. The work is done by the map between descriptions, the invariants it preserves, and the counterexamples it survives.

2 The proposal and the claim boundary

The proposal can be said in one sentence:

> *Quantum measurement and weak-field gravitational sourcing may be two accounts of one record-making process: measurement describes how a finite increment becomes a committed fact, while gravity describes the physical billing attached to that commitment.*

That is a hypothesis, not the result of this paper. The word "record needs an operational definition." A measurement record may mean an outcome stored in an apparatus, an exported environmental mark, a Kraus label, or a durable classical register. A gravitational billing record may mean a source event, a stress increment, an erasure, or an entry in a macroscopic service ledger. Reusing one noun does not make these objects identical. Previous work in the framework therefore separates transition support, effects, instruments, environmental export, cadence and physical selection [10]. The Born analysis likewise distinguishes the appearance of a quadratic form from a uniqueness theorem for probability [11].

Here a *commit* is an exported outcome in the original event model; a *bill* is an event assigned a gravitational service cost by a stated coverage rule. A bill count is not an energy, action or stress tensor. The model assumes complex Hilbert spaces and the standard density-operator probability rule; it does not derive quantum theory from event counting.

We use *frozen* to mean that the mathematical domain and comparison rule were fixed before the calculation. A *carrier* is the specified state space or event set; a *face* is a behavior that a proposed extension must reproduce. The audit identifiers INT59, INT60, and so on label versioned research records. These records document conditional results within this programme, not independent experimental confirmations.

Table 1 separates the resulting theorems, assumptions and open physical questions.

The strongest sentence licensed by the calculations is therefore:

> *The framework locates a possible gravity–measurement seam at the record interface and reports exact comparisons on explicitly declared finite carriers.*

Table 1: Claim ledger. "Frozen carrier" means the explicitly enumerated finite subject used by the audit, not all possible histories or all quantum systems.

Statement	Status	Meaning
$N_{\text{commit}} = N_{\text{bill}}$ in count and timing	Exact in the declared model	Exact on all 50,401 frozen histories, conditional on the declared one-commit/one-bill event model.
The finite-C_4 current ring is $\mathbb{Z}[i]$	Exact in the declared model	Both inclusions and the norm law are exact; later additive history assignments form $\mathbb{Z}[i]^{224}$, with unselected weights.
The absolute pair unit is fixed by the banked algebra	Refuted at the frozen perimeter	The algebra admits inequivalent physical unit interpretations; one dimensionless normalization input is required and its value is unselected.
The pre-commit gravitational source rule is unique	Refuted at current perimeter	Two exact inequivalent completions produce the same committed face.
The two source rules are operationally distinguishable	Conditional theorem	One common local instrument separates them exactly when the cross phase is nontrivial.
The framework supplies a numerical entangling phase	OPEN	Two admissible control-to-phase maps split the decision; the action, scale and clock remain unselected.
The primitive action reproduces all required behaviors	Refuted in scope	A local environment and a record-transfer sector are necessary in the declared cell-local enlargement class.
Gravity and measurement are one mechanism	HYPOTHESIS	Located at a precise seam, neither proved nor killed.
The framework is a theory of quantum gravity	Not claimed	No continuum, strong-field, Lorentz-restoration or complete dynamical theorem is supplied here.

The purpose of the finite machinery below is to test that sentence until it either becomes an identity or exposes the missing map. In the present audit the proposal becomes less grand and more testable: a conditional experimental fork is constructed, while the remaining choices concern current weights, billing, dynamics and physical calibration. No theorem yet shows that one action principle selects all of them.

3 The finite record model

Only a small part of the wider finite-QEC substrate programme is needed; QEC denotes quantum error correction. A local cell has a valid sector $P\mathcal{H}$ and an invalid or service sector $Q\mathcal{H}$, where $P + Q = I$ and $PQ = 0$. A service event takes a valid basis word through a named address into $Q\mathcal{H}$; a retained address can guide its return. The full register definition and integer census are postponed to Appendix A. The main argument needs their operational consequence, not their construction: word return can be exact while quantum coherence is only partly preserved.

Three integer-valued quantities must be kept distinct:

$$N_{\text{commit}}(h) = \text{number of committed record events in history } h, \tag{1}$$
$$N_{\text{bill}}(h) = \text{number of gravitational bills assigned to } h, \tag{2}$$
$$N_{\text{pair}}(h) = \text{closed-pair inventory assigned to the amplitude data.} \tag{3}$$

The first two count events. The third is constructed from an amplitude inventory and is projective: multiplying a common amplitude representative can change its integer value without changing the normalised quantum state. Confusing these three ledgers is precisely the error the audit was designed to expose.

A fine-grained quantum instrument is a family of completely positive (CP) maps $\mathcal{I}_k(\rho) = M_k \rho M_k^\dagger$ whose sum preserves trace. The probability of outcome k is $\operatorname{Tr} \mathcal{I}_k(\rho)$; the normalized conditional state is $\mathcal{I}_k(\rho)/\operatorname{Tr} \mathcal{I}_k(\rho)$ whenever that probability is nonzero. A coarse outcome may contain a sum of such Kraus branches. Summing over k discards the outcome label [12]. For a recorded branch k, a jump operator L_k and a return operator R_k act between $P\mathcal{H}$ and $Q\mathcal{H}$. At word level, the addressed bit flip is an involution, so the fine record gives exact return. At channel level the full cycle is not the identity. For address k, define the exit projector on the valid sector by $E_k = \sum_{x:k\in S_x} |x\rangle\langle x|$, where S_x lists the addresses whose bit flips leave that sector. With X_k the addressed bit flip, the outward and branch-conditioned return operators are $L_k = \sqrt{\gamma}\, Q X_k P$ and $R_k = P X_k Q$ on the corresponding branch. Their product is $R_k L_k = \sqrt{\gamma} E_k$. Together with the no-jump branch, the recovered cycle is the generalized dephasing channel

$$\Phi_\gamma(\rho) = K_0 \rho K_0 + \gamma \sum_k E_k \rho E_k, \qquad K_0 = \operatorname{diag}_x \sqrt{1-\gamma n_x}, \tag{4}$$

Here ρ is a state on $P\mathcal{H}$, $n_x = |S_x|$, and γ is a dimensionless per-invocation service parameter, not a rate. The identity $K_0^\dagger K_0 + \gamma \sum_k E_k = P$ proves trace preservation on this sector. The exact census partitions the 48 valid words into 12 exit-profile blocks; the admissible range is $0 < \gamma \le 1/6$; the upper bound follows because the largest exit-address count is $\max_x n_x = 6$. On a matrix unit $|x\rangle\langle y|$ the multiplier is

$$\sqrt{(1-\gamma n_x)(1-\gamma n_y)} + \gamma |S_x \cap S_y|. \tag{5}$$

It equals one precisely when $S_x = S_y$. Thus a record cycle returns basis words exactly but preserves coherence only within the 12 profile blocks. This distinction matters below: basis-word return, recovery of an arbitrary quantum state and a physical invocation law are different requirements. At $\gamma = 0$, every jump vanishes and the whole channel is the identity.

4 Audit U1: do the two ledgers count the same events?

The first audit asks the least metaphysical version of the proposed identity: given one fixed service history, do the measurement and gravitational ledgers count the same commits, at the same times?

4.1 Frozen history class

The carrier was frozen before result contact. It contains:

- one primary history built canonically from the 12 exit-profile blocks;
- every one-cycle history, one for each of the 224 fine exit events; and
- every ordered two-cycle history, $224^2 = 50{,}176$ cases.

The total is therefore

$$1 + 224 + 224^2 = 50{,}401. \tag{6}$$

No early stopping was permitted. Count disagreement, timing disagreement and a type failure were frozen as separate outcomes before the sweep.

The declared event model assigns one bill to each realised commit. This is a conditional model, not an adopted law of nature. Within that model, the result was exact:

$$N_{\mathrm{commit}}(h) = N_{\mathrm{bill}}(h) \quad \text{in number and timing for every frozen } h. \tag{7}$$

There were zero count mismatches and zero timing mismatches. Merged increments did not double-bill. Refining a record sector did not change the event count. These results are recorded in the governed INT59 audit [13].

4.2 Why this is not yet the conversion law

Equation (7) checks implementation of the declared event convention. Since that convention already assigns one bill to each commit, the equality is not independent evidence for a physical identity. The missing link appears when one attempts to compare the event count with the closed pair inventory N_{pair}. Under a common rescaling of the amplitude representative, $A \mapsto 2A$, the normalised quantum probabilities are unchanged while a witnessed integer inventory changes as

$$(5, 16, 9) \longmapsto (20, 64, 36), \qquad N_{\mathrm{pair}} \longmapsto 4N_{\mathrm{pair}}. \tag{8}$$

A greatest-common-divisor convention can choose a primitive representative mathematically, but no physical process in the retained source perimeter selects that convention. Nor does a standard CP instrument manufacture an absolute population of independent pair units from a projective quantum state.

The original audit therefore lands at

$$\boxed{\texttt{PAIR\_UNIT\_LINK\_OBSTRUCTED}} \tag{9}$$

In plain language: the two ledgers agree on when events occur, but the framework does not derive the absolute unit that would make them one accounting system. The later complete frozen-perimeter test strengthens this from a missing construction to a scoped nondefinability theorem: distinct physical unit interpretations satisfy the same algebra and every admitted observable. The unit must therefore enter as one declared dimensionless normalization input. Its value is not selected. The result is relative to the frozen language; a genuinely new source-bound observable could reopen it.

The heat analogy helps identify the remaining question. U1 is the pre-Joule position: the two ledgers track the same events, but their absolute exchange unit is an input rather than a consequence of the retained ratios. Announcing a derived value where only a normalization has been declared would be the very historical mistake invoked to motivate the work.

4.3 Pinning the finite current ring

The obstruction in Eq. (8) makes the coefficient ring a physical audit question rather than a notational detail. In the frozen C_4 constructor, where C_4 is the four-element phase group, the literal alphabet is

$$\{1, i, -1, -i\}.$$

Every finite sum over this alphabet has integer real and imaginary coordinates, so the constructed currents lie in $\mathbb{Z}[i]$. Conversely, every $a + bi$ with $a, b \in \mathbb{Z}$ is obtained by a finite signed repetition of 1 and i. These two inclusions prove, without extrapolating from a sample, that the exact current ring of this constructor is

$$R_{\mathrm{pair},C_4} = \mathbb{Z}[i]. \tag{10}$$

Literal summation and coordinate accumulation agree on all 625 frozen witnesses in $[-12, 12]^2$, and the two inventory routes give

$$A\bar{A} = x^2 + y^2 \in \mathbb{Z}_{\geq 0}. \tag{11}$$

The Gaussian unique-factorisation theorem then gives the familiar but here sector-scoped consequence: a positive integer n is representable as $x^2 + y^2$ if and only if every prime congruent to 3 modulo 4 has even valuation. Zero is represented separately by $(0, 0)$. The exact census on $0 \leq n \leq 256$ has 98 representable values and no disagreement with the theorem. This does not pin unit-normalised Hilbert amplitudes, which may require adjoining a square root of the total norm, and it does not import the $\mathbb{Q}(\zeta_8)$ coefficient field independently witnessed in the mass layer.

The same repair also answers a more important question negatively. The 50,401 U1 histories store event triples, counts, timing and mismatch type, but no branch amplitude, Gaussian-current contribution, phase or pair inventory. The executed generator contains no current constructor. Across the frozen source perimeter, 291 of 323 declared paths are byte-exact and inspectable and 32 are absent from the banked object namespace; the complete executed history schemas are nevertheless carried in the certificate. Thus the audit earns an exact source-materialisation obstruction, not a failed-search verdict and not a universal no-go. At the INT67 stage the absent object was an actual-history current, together with its physical scale and amount-to-bill map.

4.4 What the later current and billing audits establish

INT71 constructs all additive current assignments on the free monoid of the 224 exit events. Choosing a Gaussian integer w_e for each event e gives

$$J(h) = \sum_{e \text{ occurring in } h} w_e, \qquad \mathrm{Hom}(F_{224}, (\mathbb{Z}[i], +)) \cong \mathbb{Z}[i]^{224}. \tag{12}$$

Here F_{224} means finite ordered event sequences under concatenation. Order is retained in the history even though this additive current sums its contributions. Zero weights, unit weights and doubled unit weights obey the same admitted laws. Thus the current is now constructible, but neither its weights nor $|J(h)|^2$ are selected by the event count [14].

INT76 strengthens count agreement to an explicit correspondence between jumps, consumed fresh tape cells and export commits. Across the counterfactual history census there are $12 + 224 + 2(224^2) = 100{,}588$ occurrences; no individual history contains more than twelve cycles. Each correspondence preserves the history, position and event identity. It holds through export, a common prefix of the compared trajectories: a used tape retains information, whereas the original U1 history subsequently erases its record.

This distinction prevents an inference about bills. Per-commit billing, per-tape-consumption billing and erasure-only billing remain distinct conventions. At the originating export horizon, fresh tape has a commit and a used cell but no erasure. Erasure-only billing therefore assigns zero there; a possible later erasure must not be backdated. INT77–INT80 select no billing law and close that selection campaign with physical invocation unresolved. INT82 correspondingly separates an exact finite record correspondence, premise-bound bill support, and an open extension to all physical increments [14, 15].

INT81 fixes a different issue: keeping the unital Gaussian ring and all admitted observables fixed still permits distinct interpretations of its physical unit. Doubling a current is *not* a

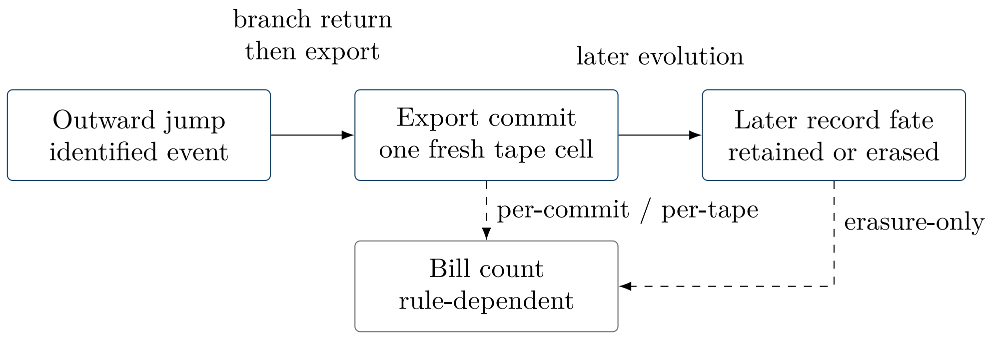

Figure 1: Event correspondence does not select billing. The jump–commit–tape correspondence is exact on the specified histories. Dashed arrows denote alternative billing conventions; they are not simultaneous charges. Fresh tape exports a record without erasing it.

unital-ring automorphism; the proof varies physical interpretation while preserving the algebra. The normalization input has no selected value, and an event bijection does not fix the amount assigned to an event [16].

5 Audit U2: what sources gravity before commitment?

The second audit asks about one mass in a coherent superposition of two locations. It does not attempt a strong-field theory, a cosmology, or a continuum Einstein equation. Its question is narrower: before a record has committed, does the gravitational mediator follow the quantum source, or do only committed records source it?

5.1 Exact symbolic carrier

The calculation is carried out over the exact localized ring

$$\mathcal{R} = (\mathbb{Q}[p, q, c, d]/(p + q - 1,\ cd - pq))\,[(pq)^{-1}]. \tag{13}$$

The star operation fixes p, q and exchanges c, d. Physical states are the complex specializations with $0 < p < 1$, $q = 1 - p$, $d = \bar{c}$, and $|c|^2 = pq$. Thus $\rho_S = \left(\begin{smallmatrix} p & c \\ d & q \end{smallmatrix}\right)$ is positive, normalized and pure. The inverse $(pq)^{-1}$ restricts the symbolic calculation to nonzero branches; the classical endpoints are checked separately. The source, mediator and record are distinct systems. The two source profiles are

$$T_L = (1, 0), \qquad T_R = (0, 1), \tag{14}$$

with a symbolic nonzero coupling coefficient. No gravitational strength is selected by this construction.

Two completions were constructed from the same subject and the same commit instrument.

Q: quantum until commit. Write the initial source as $a_L|L\rangle + a_R|R\rangle$, with $|a_L|^2 = p$, $|a_R|^2 = q$. Q implements the isometry $|L\rangle \mapsto |L, m_L\rangle$, $|R\rangle \mapsto |R, m_R\rangle$, with orthogonal mediator response states. Before commitment, source and mediator retain the branch coherence. The pre-commit state has Schmidt rank two, and its reduced-source determinant is

$$\det \rho_S = pq = p(1 - p) \neq 0 \tag{15}$$

on the localized carrier (the mediator trace removes c and d).

R: records only. R implements $|j\rangle \mapsto |j, m_0\rangle$ for $j = L, R$, so the mediator remains in its ready state. Before commitment, the mediator does not carry the source coherence. The corresponding pre-commit state has Schmidt rank one and $\det \rho_S = 0$.

Candidate R is not an isolated conceptual possibility. Collapse-sourced semiclassical gravity, classical-channel models and postquantum classical–quantum dynamics provide distinct but relevant living relatives [17–19]. The present finite construction is not identified with any of them; the comparison locates it within an active family of attempts to couple classical gravitational variables consistently to quantum matter.

The determinant was fixed as the comparison invariant before the candidates were compared. The two completions are therefore exactly inequivalent for a genuine superposition and coincide at the classical endpoints $p = 0$ or $p = 1$.

5.2 The surprising equality after commit

Both completions are passed through the same six-Kraus commit instrument. One explicit representation, with the output record initially omitted, is

$$B_{j\mu} = |j, m_j, r_j\rangle\langle j, m_\mu|, \qquad j \in \{L, R\}, \quad \mu \in \{0, L, R\}. \tag{16}$$

Its six terms obey $\sum_{j,\mu} B_{j\mu}^\dagger B_{j\mu} = I_6$ on source times mediator. Grouping by j gives the two observed outcomes. Both inputs produce the same nonselective output $\sum_{j=L,R} p_j |j, m_j, r_j\rangle\langle j, m_j, r_j|$, where $p_L = p$ and $p_R = q$. The map is trace preserving, linear in the density operator and independent of ensemble decomposition, as required by the standard CP-map framework [12, 20]. Conditional on the two records, the selective probabilities are p and q, and each realised branch carries one commit and one conditional bill. The outcome probabilities sum to one; the expected bill is one only under the declared per-commit convention.

Despite their pre-commit inequivalence, Q and R have literally identical:

- commit instrument;
- post-commit density operator;
- committed source profiles T_L and T_R;
- commit count and conditional bill count; and
- action on the audited remote subsystem.

With a two-dimensional remote ancilla, the $6imes2$ input space has 144 matrix units. No-signalling was checked as a map equality on that basis, with zero failures for both completions. A classical shared-randomness control was also constructed; it lacks the off-diagonal source–mediator entries and is not equal to Q.

The result is an exact two-witness underdetermination theorem:

$$\boxed{\texttt{SOURCE\_RULE\_UNDERDETERMINED}} \tag{17}$$

In plain language: the committed record is fixed, but the present framework does not decide whether gravity followed the coherent source before that record formed. On the declared one-source, two-location, weak-field carrier [21], the current framework fixes the committed face but does not determine whether the mediator was quantum before commitment. It does not mean that no deeper rule can determine it.

5.3 Controls and old no-go arguments

A naive expectation-value source was tested directly. On both localized branches its mean profile disagrees with the actually committed profile. This is a finite control in the class exposed experimentally by Page and Geilker, who found the simplest semiclassical Einstein equation with an expectation-value source inconsistent with observation [22]. The control excludes neither Q nor R.

Eppley and Hannah argued that coupling a classical gravitational field to quantum matter leads to serious contradictions [23]. Their thought experiment does not function as a general theorem: its premises and inferences have been challenged in detail [24, 25]. We therefore use it only as an adversarial prompt. The operative check here is the explicit one: linear CP evolution, ensemble independence and no-signalling on the full frozen matrix-unit basis. Both candidates pass it. These are kinematic source maps; no Hamiltonian, energy–momentum conservation or backreaction theorem is supplied. Modern causality and vacuum-fluctuation analyses sharpen why such checks must be stated as concrete dynamical claims rather than inherited from the old thought experiment [26–28].

6 The two-source discriminator

One-source observations made after commitment cannot distinguish Q from R, because the candidates are constructed to agree there exactly. The audited distinction is their pre-commit source–mediator entanglement. This makes the logic of gravitationally mediated entanglement proposals especially relevant. Bose and collaborators, and independently Marletto and Vedral, proposed two-mass protocols in which entanglement of the masses witnesses a nonclassical mediator under specified locality assumptions [29, 30]. A covariant account relates the same class of phase to a superposition of proper times and geometries [31]. A complementary proposal asks whether measuring the field of a spatially superposed source necessarily causes quantum measurement disturbance [32].

The two-source extension uses a normalized product input $(a_L|L\rangle + a_R|R\rangle) \otimes (b_L|L\rangle + b_R|R\rangle)$. Q composes the coherent source maps with a *premised* diagonal mediator-phase interaction and uncomputation, leaving $|\psi_Q\rangle = \sum_{ij} a_i b_j z_{ij} |ij\rangle$. The interaction is an additional assumption; one-source coherence alone does not derive the two-source phase gate. Let z_{ij} be the unit branch phase for the four source configurations $i, j \in \{L, R\}$. After a global phase and local rephasings remove three phase degrees of freedom, the complete invariant is the cross ratio

$$\Xi = \frac{z_{LL} z_{RR}}{z_{LR} z_{RL}}. \tag{18}$$

For the quantum-until-commit completion Q, the coefficient matrix M obeys

$$\det M = a_L a_R b_L b_R \left(z_{LL} z_{RR} - z_{LR} z_{RL} \right). \tag{19}$$

For nonzero branch amplitudes, the pure two-qubit state is therefore entangled if and only if $\Xi \neq 1$. Equivalently,

$$\det(\rho^{T_B}) = -|\det M|^4 < 0 \quad \Longleftrightarrow \quad \Xi \neq 1. \tag{20}$$

Here T_B denotes partial transpose on source B: $\rho^{T_B}_{ij,kl} = \rho_{il,kj}$. A separable state has a positive partial transpose (PPT); for two qubits PPT is also sufficient for separability. No higher-dimensional sufficiency claim is imported [33, 34]. The R null hypothesis starts with product preparations and permits local CP operations, post-commit classical communication and shared classical randomness. Each permitted constructor preserves a decomposition $\rho_R = \sum_\lambda r_\lambda \rho_A^\lambda \otimes \rho_B^\lambda$, with $r_\lambda \geq 0$ and $\sum_\lambda r_\lambda = 1$. The audit supplies explicit decompositions for all six members of its frozen comparison class and proves closure under its four product-sum-preserving constructors. A direct quantum channel or a shared quantum environment is outside this premise class.

One frozen, informationally complete instrument is applied identically to Q and R: nine local Pauli-setting pairs with four outcomes each, giving 36 outcomes. Choosing each setting pair with probability 1/9 gives the 36 effects $F_{abst} = \frac{1}{9}\Pi_s^{(a)} \otimes \Pi_t^{(b)}$, where $a, b \in \{x, y, z\}$, $s, t \in \{-1, 1\}$ and $\Pi_s^{(a)} = (I + s\sigma_a)/2$. They sum to I_4 and span the two-qubit operator space. Exact reconstruction followed by the sign of $\det(\rho^{T_B})$ separates the candidates. For balanced inputs $|a_L| = |a_R| = |b_L| = |b_R| = 1/\sqrt{2}$, at the test point $\Xi = -1$, Q has partial-transpose eigenvalues $(-1/2, 1/2, 1/2, 1/2)$ and determinant $-1/16$, whereas the displayed pure-product R control has spectrum $(0, 0, 0, 1)$ and determinant zero. Other separable R states can have different nonnegative spectra; this spectrum is not a claim about the entire R class. No-signalling holds as a map identity on the complete frozen matrix-unit basis. This is the result the earlier version of the paper could only propose:

$$\boxed{\text{R is separable; Q is entangled exactly when } \Xi \neq 1.} \tag{21}$$

This is a decision rule for exact probabilities, not an error-free single-shot measurement: tomography requires repeated preparations. Finite experimental samples would require confidence bounds and an explicit measurement-error model. It is a conditional discriminator. The theorem does not derive that nature chooses Q, nor that a laboratory control produces $\Xi \neq 1$. Nor can this experiment turn a measured normalization into a derivation. Because the absolute pair unit is nondefinable from the frozen algebraic perimeter, a future source-bound two-source interface may calibrate its declared value; the calibration interface is not yet constructed and no experimental outcome is interpreted here.

6.1 Noise and the registration boundary

The same decision rule was extended to an exact local-dephasing class rather than reusing the noiseless separable bound. Write $0 \leq \eta_A, \eta_B \leq 1$ for the two visibility parameters: each local dephasing map preserves populations and multiplies off-diagonal elements by its η. Define

$$\Delta_\Xi = (\Xi - 1)(\Xi^{-1} - 1) = 4\sin^2(\theta/2), \qquad \Xi = e^{i\theta}. \tag{22}$$

Let $p_A = |a_L|^2$, $q_A = |a_R|^2$, $p_B = |b_L|^2$, $q_B = |b_R|^2$ and $K = p_A q_A p_B q_B$. The partial-transpose determinant is

$$\det(\rho_\eta^{T_B}) = K^2 \left[\left((1 - \eta_A^2)(1 - \eta_B^2)\right)^2 - (\eta_A \eta_B \Delta_\Xi)^2 \right]. \tag{23}$$

For nonzero branch weights, entanglement is present precisely when

$$\eta_A \eta_B \Delta_\Xi > (1 - \eta_A^2)(1 - \eta_B^2). \tag{24}$$

The determinant criterion is necessary and sufficient for two-qubit entanglement [35]. R cannot give a false positive within the declared noise model. Noise can make the Q output separable, so a null result does not choose R; this is loss of discrimination between models, not a failure of complete tomography to detect entanglement in its output state. At $\eta_A = \eta_B = 1$, Eq. (23) gives $-K^2\Delta_\Xi^2$, exactly Eq. (20). Appendix B gives a short derivation.

What remains open is the arrow from laboratory controls to branch phase. The nonuniqueness is constructive. With

$$C(w) = \frac{1 + iw}{1 - iw}, \tag{25}$$

the two exact maps $z_A(w) = C(w)$ and $z_B(w) = C(w + w^3)$ share the same zero limit and first derivative. At the common point $w_{LL} = w_{RR} = 1$, $w_{LR} = w_{RL} = 0$, $\eta_A = 2/5$, $\eta_B = 1/2$, and balanced inputs, $\Xi = z(1)^2$. Map A gives $\Xi = -1$; map B gives $\Xi = (-7 - 24i)/25$. They give opposite decisions: the stored determinant is $-2431/2560000$ for A and $33689/64000000$ for B. The instrument and noisy threshold are fixed; only the admissible control-to-phase map differs. This is an exact two-witness underdetermination theorem, not a fitted uncertainty bar. The downstream candidate-to-outcome calculation is complete conditionally. The laboratory-to-dimensionless-control map remains unspecified, and the control-to-phase map is nonunique. These are two separate physical inputs.

7 Time, composition and the action-layer test

Three further audits ask whether the missing phase law can be recovered from already-banked kinematics. Each gives a negative result of a different type.

7.1 The service ceiling is not an entanglement-rate ceiling

For $0 < \gamma \leq 1/6$, stationary repetition of Eq. (4) gives record-layer matrix-unit multipliers $m_{xy}(\gamma)^n$: 12 profile pairs remain one and 132 cross-profile pairs are strictly attenuated. On the proved two-source product lift, however, the joint state factorises into a source state and two local record factors. The γ channel therefore drops out of source negativity identically. With the balanced input used for the two fixed phase candidates, define negativity by $\mathcal{N}(\rho) = (\|\rho^{T_B}\|_1 - 1)/2$. Then

$$\mathcal{N}_n = \frac{1}{4}|\Xi^n - 1|, \tag{26}$$

independent of γ. For a general normalized product input the prefactor $1/4$ is replaced by $|a_L a_R b_L b_R|$. This tensor-product extension assumes fresh independent environments for repeated application of Φ_γ; it is not a derived law for reuse of a previously occupied apparatus. Moreover, no banked clock converts commit index n to laboratory time. Two positive-rational clocks agree on every retained face and give arbitrarily different rates. Thus the ceiling is an exact bound on record-coherence attenuation, not on gravitational entanglement growth. This rules out a tempting new-physics claim rather than weakening the audit.

7.2 Additive rational controls are obstructed in-carrier

The two maps above also fail ordinary additive composition. For example, $C(1)^2 = -1$ while $C(2) = (-3 + 4i)/5$. The Cayley map does compose under the transported law

$$C(a)C(b) = C\left(\frac{a+b}{1-ab}\right), \tag{27}$$

with its pole treated on $\mathbb{P}^1(\mathbb{Q})$, but that law is induced by the chosen map and has no independent physical authority.

The stronger obstruction is carrier-theoretic. The Gaussian-rational unit circle has the exact decomposition

$$G_{\mathbb{Q}} = \{z \in \mathbb{Q}(i) : z\bar{z} = 1\} \cong \mu_4 \oplus \bigoplus_{p \equiv 1\ (4)} \mathbb{Z} \cdot [\pi_p/\bar{\pi}_p]. \tag{28}$$

Here $\mu_4 = \{1, i, -1, -i\}$ and $p = \pi_p \bar{\pi}_p$ for each split Gaussian prime. Each element has only finitely many nonzero integer coordinates. The group contains no nontrivial divisible subgroup: infinite divisibility forces every integer coordinate to vanish and also kills the finite torsion. By contrast, $(\mathbb{Q}, +)$ is divisible. Consequently

$$\mathrm{Hom}(\mathbb{Q}, G_{\mathbb{Q}}) = 0. \tag{29}$$

No nontrivial exact additive rational control law exists in the frozen phase carrier. Integer iteration $z(n) = z(1)^n$ remains lawful and is precisely the commit-index semigroup already used above. A nontrivial law with additive rational controls must therefore enlarge the phase carrier, or replace additivity by a separately justified composition law. An action confined to the same group cannot evade the obstruction.

7.3 What a viable action must add

The first action search used a closed seven-term primitive grammar: one electric Casimir term on each of three owned link orbits, Wilson terms on two local C4 loop types and the bridge-C6 loop, and one cell-local compressed mass term. The five required behaviors are the electric structure, Wilson-loop structure, mass compression with its exit–return dressing, the record channel, and intercell record transport. No member of the primitive grammar reproduces all five; the coefficients remain symbolic. A system-only Hermitian action induces unitary conjugation and cannot realise the generalized-dephasing channel, which preserves 192 matrix units while strictly attenuating 2,112. Conversely, link-local gauge terms and a cell-local mass have no off-diagonal matrix elements between distinct two-cell record configurations, so they do not transport records. This is an exact no-action theorem for the stated primitive grammar, not for all variational or open-system dynamics.

The minimal enlargement was then classified on the four-node lattice

$$\{A_1,\ A_1 + E_{\text{local}},\ A_1 + T,\ A_1 + E_{\text{local}} + T\}.$$

The cell-local environment has the explicit dilation

$$|v_x\rangle = \sqrt{1 - \gamma n_x}\,|\text{idle}\rangle + \sqrt{\gamma} \sum_{k \in S_x} |k\rangle, \tag{30}$$

whose overlaps reproduce Eq. (5) on all 2,304 matrix units. Tensor support proves that this sector cannot transport records. The transfer class T contains an explicit occupation functor and a symbolic record intertwiner, so it supplies structural transport, but as a system-only class it cannot remove the nonunitary γ obstruction. Both sectors are therefore necessary, and their independently constructed union is the unique minimal completion of these five behaviors inside the cell-local lattice (Fig. 2).

Two boundaries matter. A shared environment can shuttle records and therefore escapes the cell-local minimality theorem; it is reported separately, with no mediator credit. And the required operative isometry and occupation-transfer object are not literally identical to objects already banked for other purposes. The classification specifies the additional operator types, but it does not select their coefficients or supply a clock. Later work declares a particular transport extension as an explicit premise; that conditional extension must not be confused with a derivation of transport from this primitive action [36].

7.4 Current boundary: repeated use and physical time

The later relevant results sharpen the qualification on repetition. INT94 leaves the transfer-to-tick map unselected; INT95 leaves history weights and the service schedule unselected. INT96 exhibits two unitary completions of the same first-blank isometry that yield different probabilities on reuse of an occupied apparatus. Thus the first-cycle channel does not determine repeated-use dynamics [36].

INT97R then checks a declared rule for a fixed ten-label pointer: the new pointer stays in the same cell, the previous information remains in the joint state, and no export, erasure or reset occurs. Conditional on that rule and the separately declared transfer extension,

$$\Delta N_{\text{read}} = 1, \qquad \Delta N_{\text{commit}} = \Delta N_{\text{bill}} = \mathbf{1}[\ell_{\text{new}} \neq \ell_{\text{prior}}]. \tag{31}$$

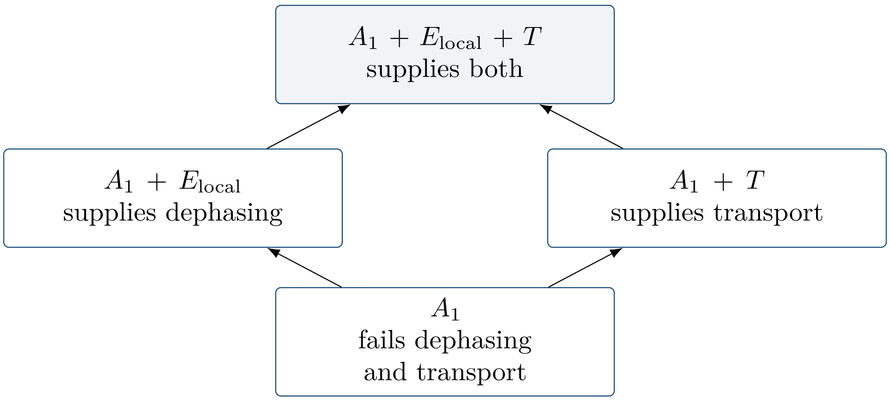

Figure 2: Minimality is relative to this four-element inclusion class. The arrows add allowed operators, not time evolution. A shared environment lies outside the class and may carry a transfer channel; the diagram does not establish uniqueness among all open-system actions.

At $\gamma = 1/12$, its 3,696 supported two-read histories divide into 544 same-label reads and 3,152 label changes. This is consistency of a new premise, not a derived billing law or a replacement of U1's export-defined commit. On first use the blank outcome has zero support and the declared rule reduces to one read, commit and bill. On reuse, a read need not create a new pointer increment. The example prevents extending U1's count identity to arbitrary invocations [37].

These later conditional constructions select no physical unit, phase law, laboratory clock or gravitational coupling. The original finite theorems remain valid at their own domains.

8 Method: preregistration and adversarial countersigning

Large foundational claims are cheap unless failure is made durable. The calculations in this programme use a preregistration-and-countersign method: the subject, candidate class, exact arithmetic, controls, landing rules and nonimplications are fixed before result contact; a separately assigned reviewer then replays the certificate; and the pair is banked only after both agree. This is a reproducibility procedure, not independent empirical validation; shared assumptions and common software can still introduce correlated errors. The method is described publicly in Elliman [38].

Negative results remain results. U1 banked an obstruction rather than manufacturing a unit; U2 retained two survivors rather than choosing the more appealing rule; the time extension refuted the proposed entanglement-rate ceiling; and the primitive action search banked a scoped no-action theorem. A separate registered dark-energy branch was rejected under its own comparison rule and remains published as a negative outcome [39]. A registration is allowed to die.

The implementation layer has a separately governed theorem rather than an assurance of software correctness. On the complete frozen domain of 1,769,472 three-action words, within-route bracketing agreement, cross-route agreement and canonical-serialization agreement are proved analytically and by one licensed hermetic execution. First-stage cache agreement (C-3) is explicitly excluded and was not assessed because of an implementation defect. Thus the manuscript may cite the three proved invariances, but not an unqualified "uniform coherence" claim [40].

Exactness remains local to the declared object. The 50,401-history sweep is exhaustive for its frozen grammar, while a matrix-unit basis is complete only for its declared finite map. Neither statement becomes a universal theory by being exact. The two-source discriminator is now constructed, but physical invocation remains conditional on the missing control-to-phase and action arrows. Numerical gravity registrations are likewise kept separate from the structural theorem here.[1]

Table 2 summarises the completed audit path. The table is a map of claim boundaries, not a ladder in which later rows inherit broader authority from earlier ones. The original INT59–INT67 sequence has certificates bound at its terminal INT67 pair-bank [43].

Table 2: Exact audit path and retained boundary.

Audit	Exact result	Boundary retained
Cross-count	50,401 histories agree in commit/bill count and timing	Absolute unit is one declared normalization input; value unselected
One source	Q and R are inequivalent before commit and identical after it	Source rule unselected
Two sources	R separable; Q entangled iff $\Xi \neq 1$	Cross phase premised, not derived
Registration	One noisy decision rule; two phase maps split one exact point	Laboratory-to-phase map underdetermined
Time extension	γ attenuates record coherence exactly	No entanglement-rate or clock theorem
Composition	Additive rational phase law obstructed in $G_{\mathbb{Q}}$	Integer iteration only; enlargement unadopted
Primitive action	No seven-term action satisfies all five faces	Open-system and transfer enlargements not refuted
Minimal enlargement	$E_{\text{local}} + T$ uniquely minimal in the cell-local lattice	Shared-environment escape; coefficients unselected
Ring repair / later carrier	$R_{\text{pair},C_4} = \mathbb{Z}[i]$; additive carriers $\mathbb{Z}[i]^{224}$	Original U1 lacked currents; later weights remain free

9 What would turn the proposal into a unification claim?

Four missing arrows separate the present paper from the statement that gravity and quantum measurement are the same mechanism.

1. **A source-bound calibration and amount link.** The absolute pair unit is not derivable from the complete frozen algebraic perimeter and is therefore one declared dimensionless normalization input. Its value remains unselected. A physical process must calibrate that value and construct the amount map from pair units to the theorem-grade event carrier; the exact event bijection alone does not supply an amount or a bill. Equation (10) pins the finite ring, not this physical scale.
2. **A physical action, phase law and clock.** The minimal-enlargement theorem types the environment and transfer sectors that a cell-local action must contain, but does not adopt their operative maps, select coefficients or derive laboratory time. Choosing a convenient Cayley map would be a new postulate, not a derivation.
3. **Physical invocation and empirical selection.** The common two-source instrument supplies an exact conditional decision procedure. A laboratory implementation must establish

[1] The separate numerical commitments have comparison and kill rules [41, 42]; none enters either audit. The July *Locked Zero-Parameter Prediction* title of the Newton-constant preprint records an earlier claim status: the proton mass is a dimensional anchor, the grade conditional, and outside-sector completeness open. At the complete frozen absolute-unit perimeter, the G-lock value is identical under inequivalent unit interpretations and its dependency closure contains no pair-unit edge. Thus the G-lock is pair-unit-free at that scope; this selects no normalization value.

that its locality, mediator and noise premises apply, and the programme must justify the extension from the proved finite record correspondence to physical increments and supply the separate bill coverage rule. A pointer read alone need not be a new commit.

4. **The continuum and covariance lift.** The finite weak-field construction must recover an empirically adequate relativistic response. An emergent-Lorentz proposal inherits, rather than evades, the obligation to show restoration within experimental bounds; the Weinberg–Witten restrictions apply when their premises, including Lorentz-covariant conserved currents or stress tensors, hold [44]. The present kinematic model neither establishes those premises nor proves an exception. In particular, the latest propagation audit treats the nearest-neighbour photon kernel as internal and excludes the literal matter walker as a physical propagation law; neither may be silently used as a completed relativistic lift [36].

Only after these arrows close would the stronger sentence become available: "measurement is the quantum description and gravity the macroscopic accounting of one record process." In this paper that sentence is a destination, not a conclusion.

10 Discussion

The historical analogy identifies a useful question, but its answer now requires more than a conversion factor. Additive currents exist but their weights are free; finite record events correspond but bill coverage is unselected; first-use channels exist but repeated-use dynamics are not fixed. No result proves that one remaining action principle selects all these inputs.

The two-source theorem is operationally sharper. Under the full locality, source-preparation and noise assumptions, a negative partial-transpose determinant excludes the stated R class. A null does not select R because zero cross phase and sufficient dephasing are compatible with Q. The test does not derive its own physical phase, duration or mediator interpretation. A later postselection-based conditional-transfer audit (INT84) likewise distinguishes Q from a separately declared R family, but that family is not the six-member class used here and its result is not a universal statement about classical gravity [45].

The reproducibility boundary is also substantive. Exact symbolic identities can be checked independently, whereas assertions about a complete source perimeter depend on the frozen records and their admission rules. Public certificate availability, explicit premises and a reproducible build are therefore part of the evidential requirements, not substitutes for a physical experiment.

11 Conclusion

The finite U1 model gives matching commit and bill counts on 50,401 histories under its declared event convention. Later results establish a jump–tape–commit correspondence and classify the additive current family as $\mathbb{Z}[i]^{224}$, without selecting its weights or a billing law. The physical pair unit requires a declared normalization input whose value remains free in the audited language.

U2 supplies two inequivalent pre-commit source rules with an identical committed output. Their two-source extensions give a conditional entanglement test with an exact local-dephasing threshold. The service-channel bound does not select an entanglement rate, and the primitive action needs environment and transfer sectors to reproduce the required finite behaviors. Recent conditional extensions still leave physical timing, repeated-use selection and history weights open.

These results locate precise agreements and missing maps. They do not yet identify gravitational sourcing with quantum measurement, derive a numerical laboratory prediction, or supply a complete theory of quantum gravity.

A Carrier specification

The local carrier has the 256 basis words of eight binary registers ordered as

$$(G0, G1, LQ, C0, C1, I3, \chi_{\rm reg}, W).$$

These are names of binary addresses for this audit; $\chi_{\rm reg}$ is a register bit and is distinct from the cross phase Ξ. The census uses only the following predicate and does not require an interpretation of each bit as a measured particle quantum number. A word is valid when three rules hold: $G0$ and $G1$ are not both one; $W = \chi_{\rm reg}$; and $LQ = 0$ exactly when $(C0, C1) = (0, 0)$. Direct enumeration gives 48 valid words and 208 invalid words. From the $48 \times 8 = 384$ one-address bit flips, 224 leave the valid sector and 160 remain inside it.

Those 224 fine exit events reach 112 service states. Twelve of the 112 have a unique valid parent; 100 require retained record information. The 48 valid words form 12 equal exit-profile blocks of four words each. The fine address record is sufficient for exact word return, although it is not minimal: the minimum is three distinguishable classes of the seven active addresses, realised by 36 unlabelled partitions. Address $I3$ never exits the valid sector and is omitted from that partition count. These are the finite record objects used by the audit sequence; no claim is made that the census exhausts carriers outside this declared cell.

B Derivation of the two-source noise threshold

Local phase rotations commute with dephasing in the branch basis and do not alter partial-transpose eigenvalues. For this invariant calculation we can therefore use the four phase amplitudes $(1, 1, 1, \Xi)$. This gauge choice must not be used to compare fixed-instrument outcome probabilities between models; those require all four original phases.

Put $a = \eta_A$, $b = \eta_B$. Removing the diagonal product-amplitude factors from the noisy density matrix leaves

$$R = \begin{pmatrix} 1 & b & a & ab\Xi^{-1} \\ b & 1 & ab & a\Xi^{-1} \\ a & ab & 1 & b\Xi^{-1} \\ ab\Xi & a\Xi & b\Xi & 1 \end{pmatrix}. \tag{32}$$

Writing $D = \mathrm{diag}(\sqrt{p_A p_B}, \sqrt{p_A q_B}, \sqrt{q_A p_B}, \sqrt{q_A q_B})$ gives $\rho_\eta = DRD$. Because D factorizes into real diagonal local matrices, $\rho_\eta^{T_B} = DR^{T_B}D$ and $(\det D)^2 = K^2$. Expanding the four-by-four determinant yields

$$\det R^{T_B} = \left[(1-a^2)(1-b^2)\right]^2 - a^2b^2\left[(\Xi-1)(\Xi^{-1}-1)\right]^2, \tag{33}$$

which proves Eq. (23). At $a = b = 1$, the pure state has Schmidt coefficients s_1, s_2; its partial-transpose eigenvalues are $s_1^2, s_2^2, s_1s_2, -s_1s_2$. Since $s_1s_2 = |\det M|$, the determinant is $-|\det M|^4$ and its negativity is $|\det M|$.

Data and code availability

The versioned preprint archive has concept DOI 10.5281/zenodo.22182961. This revision (version 0.5) has DOI 10.5281/zenodo.22407952. It retains the INT59–INT67/D27 and INT81/INT81P certificate archives from version 0.4 and adds a CANON supplement covering the records reviewed through INT97R. The supplement includes the cited horizon registration, external result files and frozen source snapshots, with a SHA-256 manifest. An independent script verifies the manuscript's principal finite-dimensional matrix calculations. Repository hashes identify provenance; the deposited files provide the corresponding accessible evidence.

The original audit archive records terminal commit `730fb1ab` (184 governed commits and $\binom{184}{2} = 16{,}836$ ancestry-pair checks). Those pair checks are provenance checks, not 16,836 independent physics experiments. The normalization theorem and its wording propagation are identified by `7ffb95ad` and `dcd893bc`; the separate D27 implementation theorem by `0617bb0b`. C-3 cache agreement is excluded from that theorem.

The later audit records cited here are included in this version's supplement and identified by their immutable commit identifiers. The supplement is an evidence snapshot; it does not reproduce the full historical Git environment, and this manuscript review did not exhaustively replay every certificate. The consistency cutoff is the INT97R result at `e2503b3d`, read with DRIFT K16. The later INT96R parent ruling at `4ecb7327` is not a new result and is assigned no result credit here.

Statements and declarations

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Author contributions

D.G.E. conceived the hypothesis, designed the framework and audit programme, interpreted the results, and takes responsibility for the claims and their boundaries.

Declaration on AI assistance

OpenAI Codex was used for source inspection, exact-computation orchestration, reference checking, LaTeX drafting and editorial revision. The author selected the research questions, approved the governing scopes, reviewed the mathematical and physical claims, and accepts full responsibility for the manuscript. AI output is not treated as independent evidence.

Competing interests

The author declares no competing interests.

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