

Universal Consciousness

Recognition and the Unified Experiencing Whole

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ABSTRACT

Can distinct subjects belong to one experiencing whole? Within Recognition Science's shared physical architecture, we derive an exact criterion: every finite collection of felt occurrences belongs jointly to a subject if and only if the all-occurrences profile lies in the closure of existing subjects' profiles. For a nonempty felt domain, closedness yields an existing whole; nested membership preserves distinct participants. The physical derivations establish matter-photon correlation under the complete atomic source, a fixed observable with an absolute correlation margin, and all-time record retention under a specified holding interaction. Signed operators give exact coherent code capture. A complete finite receiving Hamiltonian captures coherent input with error at most $C_v/\sqrt{N}$ for N bank cells and any normalized initial stock, while retaining the native stock clock and every finite passive reference. A normalized product partner evolving under its independent native clock preserves the same bound. With injectively matched contacts covering the bank, the full receiving and contact Hamiltonian also gives a bank-size-independent constant, including coherent inputs and every finite passive reference. These results assume supplied stock and contacts. The remaining connections are physical realization and completeness, recognition's experiential identity, actual finite subject composition, and realization of the whole-subject limit. These conditions distinguish the positive account from its unfinished universal derivation.

Term	Mathematical object	Physical meaning
Occurrence	An element $e \in \mathcal{E}$	A particular event, including its history.
Felt domain	$\mathcal{E}_f \subseteq \mathcal{E}$	Occurrences that have experience.
Subject domain	$D_s \subseteq \mathcal{E}_f$	Occurrences belonging to subject s .
Occurrence profile	$p_s : \mathcal{E}_f \rightarrow \{0, 1\}$	Which occurrences belong to s .
Experiencing whole	$w \in \mathcal{S}, D_w = \mathcal{E}_f$	An existing subject containing all felt occurrences.

1 Experience within one physical reality

A felt pain, a remembered conversation and a physical comparison are occurrences in reality. A complete physical account has to accommodate the experience as well as the outward behavior. Recognition

Science begins with distinguishable occurrences, comparisons that have information about both terms, and records whose later examination is a further occurrence. These facts connect interaction to history: the information needed for a later comparison must survive until it is used.

The experiential account identifies the inside of recognition with experience. Its attraction is continuity. Experience belongs to the activity already constituting physical interaction, while boundaries, retained history and self-reference account for the organization of local perspectives [1, 2]. The explanatory claim is stronger than assigning the word experience to an internal coordinate. It identifies a physical occurrence with the felt occurrence that must be explained.

Three questions determine the full universal claim. Does the recognition architecture encompass every actual and possible physical carrier and transition? Does recognition have an experiential identity throughout that domain? Do the local experiential domains belong to one actual experiencing whole? A common carrier addresses the first question. An intrinsic inside addresses the second. The third concerns how subjects compose. Each question has its own mathematical content.

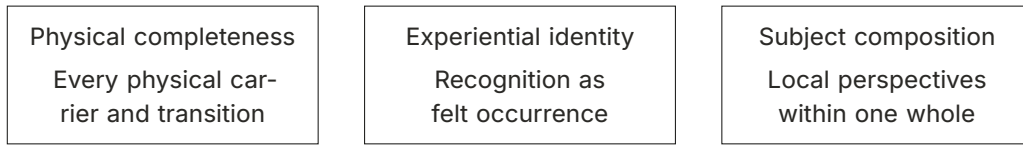


Figure 1. The universal claim has three distinct physical obligations. Interaction within a shared field is relevant to all three, but does not identify their conclusions with one another.

The derivations below make two connections concrete. The original atomic source generates correlation between matter and the complete photon field, and one fixed field effect carries information about its matter branches. At the level of subjects, a closed set of realized occurrence profiles turns finite joint experience into a whole. The first result concerns physical dynamics. The second gives a sufficient composition law whose physical basis remains to be established.

2 Recognition, response and retained distinctions

2.1 What the accepted forcing establishes

The comparison cost is fixed by the native reporting apparatus, literal reporting, continuity on positive inputs and its reference calibration:

$$J(x) = \frac{x + x^{-1}}{2} - 1 = \frac{(x - 1)^2}{2x}, \quad x > 0. \quad (1)$$

Its nonnegativity, unique zero at equality and reciprocity $J(x) = J(x^{-1})$ follow from this identity. The result concerns that specified physical report. Its premises do not equate every arbitrary energy with J .

Under additive recognition, preservation of positive comparisons and an initial costly join, the scale obeys $\lambda^2 = \lambda + 1$; positivity selects $\lambda = (1 + \sqrt{5})/2$. Under the spatial linking correspondence and deformation-erasure conditions, nonzero persistent linking selects three spatial dimensions. These are conditional forcing results with independently specified physical requirements. They do not obtain experiential identity by adding the word inside.

The route from distinction to a physical description also has an operational direction. Different states can have the same present cost and different responses to a calibrated action. Preserving the responses therefore preserves distinctions that the present scalar cost merges. For a stated finite quantum carrier and decision family, preservation of perfectly achievable decisions forces recovery of the full state, including

its correlations with a retained reference [3]. The admitted carrier, actions and consequence calibration remain part of that theorem's domain.

2.2 Recovery transports a read

The elementary recovery argument separates preservation of information from preservation of an unchanged readout.

Proposition 2.1 (Transported reads). *Let $q : S \rightarrow T$ and $r : T \rightarrow S$ satisfy $r(q(s)) = s$ for every $s \in S$. For any read $f : S \rightarrow V$, define $\tilde{f} = f \circ r$. Then*

$$\tilde{f}(q(s)) = f(s). \quad (2)$$

The map q is injective. In particular, any distinction $f(s) \neq f(s')$ survives in the transported read.

Proof. Substitution gives $\tilde{f}(q(s)) = f(r(q(s))) = f(s)$. If $q(s) = q(s')$, applying r gives $s = s'$. Applying (2) at two states proves the final assertion. $\square$

A description with a left inverse retains every source read as a recoverable quantity. A physical identification of experience would benefit from that preservation. The source read must first be connected to actual felt occurrence, and the relevant transport must preserve that identity.

For a concrete example, take

$$X = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, \quad \rho_0 = \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}, \quad \rho_1 = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}.$$

The operation $q(\rho) = X\rho X$ is its own inverse. It sends ρ_0 to ρ_1 , so the fixed read $f(\rho) = \rho_{00}$ changes from 1 to 0. The transported read $\tilde{f} \circ q$ recovers its source value. Both displayed states are normalized positive density matrices.

This example concerns a physical observable. It assigns no experiential status to either state. It shows why recoverability alone cannot be used as an identity law for a fixed read, and why changes in experiential content must be distinguished from loss of experience.

3 Matter and field information from the complete source

A shared physical description needs actual interactions that generate correlations. The complete atomic source provides such an example without removing its field or clock terms. Its matter coordinate consists of $r \in \mathbb{Z}^3$ and four native eight-state registers $n \in \{0, \dots, 7\}^4$. Every matter coordinate carries a vector in the same full photon space $\mathcal{F}$. The total carrier is

$$\mathcal{H} = \ell^2\left(\mathbb{Z}^3; \mathbb{C}^{\{0, \dots, 7\}^4} \otimes \mathcal{F}\right).$$

Here $\mathcal{F}$ contains all photon-number sectors. A state is written $\psi(r, n) \in \mathcal{F}$.

The original self-adjoint source has its site-diagonal field, clock and longitudinal terms, together with all three forward and three reverse charged hopping terms. With e_d the unit step on axis d , the transport part acts as

$$(K\psi)(r) = -g \sum_{d=1}^3 [U_{d,r}\psi(r - e_d) + U_{d,r+e_d}^*\psi(r + e_d)]. \quad (3)$$

The U are unitary native crossings with their full Weyl field action. The remaining site action is diagonal in position, and includes the complete clock mixing among native codes. Let H denote this full source and $\psi_t = e^{-itH}\psi_0$ its evolution in source time.

Take ψ_0 to be supported at the origin, with all native registers zero and photon vacuum Ω , $\|\Omega\| = 1$. This vector belongs to the original operator domain. For the matched source with positive parameters a, C_E , the first charged edge has a nonzero one-photon profile β . Write $W(\beta)$ for its full Weyl unitary and n_* for the native code obtained by the edge's low-bit flip.

The original crossing gives the exact off-site entry $-gW(\beta)\Omega$ at (e_1, n_*) when H acts on ψ_0 . All site-diagonal terms vanish at that distinct position. Consequently the strong derivative of the full evolution gives

$$u_t := \psi_t(0, 0) \rightarrow \Omega, \quad t^{-1}v_t := t^{-1}\psi_t(e_1, n_*) \rightarrow igW(\beta)\Omega. \quad (4)$$

The first limit uses continuity. The second uses $\frac{d}{dt}e^{-itH}\psi_0|_{t=0} = -iH\psi_0$ on the original domain. The other output coordinates remain part of ψ_t .

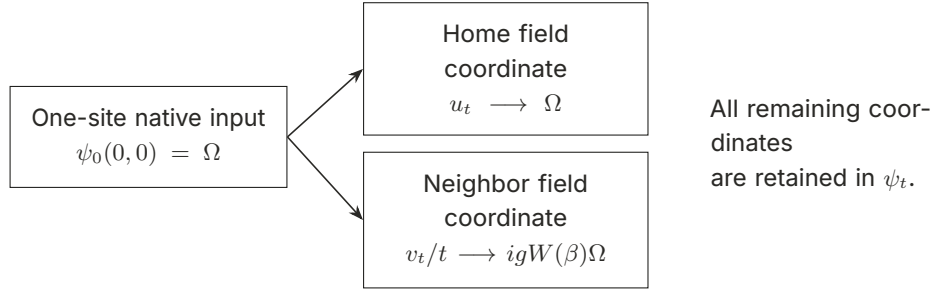


Figure 2. Two coordinates witness correlation in the full unconditioned output. Dividing a coordinate by t describes a mathematical limit; it is not an enacted field amplifier or a selected physical outcome.

Proposition 3.1 (Matter–photon correlation). *For $a > 0$, $C_E > 0$ and nonzero g , with arbitrary native clock coefficient ϵ , the original evolution above is not a matter–photon product for all sufficiently small positive source times. Thus there do not exist coefficients $c_t(r, n)$ and a common photon vector q_t such that $\psi_t(r, n) = c_t(r, n)q_t$ for every r, n .*

Proof. For two photon vectors define their Gram determinant

$$G(u, v) = \|u\|^2\|v\|^2 - |\langle u, v \rangle|^2.$$

If every matter coordinate is proportional to one photon vector, $G(u_t, v_t) = 0$. By (4) and continuity of norm and inner product,

$$\begin{aligned} \lim_{t \downarrow 0} \frac{G(u_t, v_t)}{t^2} &= g^2 (\|W(\beta)\Omega\|^2 - |\langle \Omega, W(\beta)\Omega \rangle|^2) \\ &= g^2 \|W(\beta)\Omega - \langle \Omega, W(\beta)\Omega \rangle \Omega\|^2. \end{aligned} \quad (5)$$

The Weyl vacuum overlap is $\langle \Omega, W(\beta)\Omega \rangle = \exp(-\|\beta\|^2/2)$. Since $\beta \neq 0$, this overlap has norm strictly below 1, whereas $\|W(\beta)\Omega\| = 1$. The residual in (5) is therefore nonzero. The limit is strictly positive because $g \neq 0$. Hence $G(u_t, v_t)/t^2 > 0$ for all sufficiently small positive t . A product output would give zero, which is impossible. $\square$

The source dynamically correlates matter with the photon field from the native vacuum. The proof retains the infinite position carrier, every native register, the complete field and every output coordinate. Its time variable is the source's evolution parameter. A repeatable funded controller, an enacted readout and a physical metric clock each require their own construction. The holding law below supplies retention for its stated apparatus; acquiring the record remains a separate construction. The correlation result supplies a physical interaction; it supplies no experiential identity merely by having been derived.

3.1 One fixed field effect distinguishes the branches

The correlation has a specific observable witness. Use the same fixed field operator at every matter coordinate:

$$Qx = x - \langle \Omega, x \rangle \Omega. \quad (6)$$

This is the orthogonal projection away from the photon vacuum. For a matter branch with field coordinate x , define its weight, joint nonvacuum weight and nonvacuum fraction by

$$B(x) = \|x\|^2, \quad J(x) = \|Qx\|^2, \quad p(x) = \frac{J(x)}{B(x)} \quad \text{when } B(x) > 0. \quad (7)$$

Orthogonality gives $0 \leq J(x) \leq B(x)$, so $0 \leq p(x) \leq 1$. The weights refer to coordinates of the same complete output ψ_t . No branch has been removed or physically amplified.

Proposition 3.2 (A fixed field response carries branch information). *Under the hypotheses of Proposition 3.1, both $B(u_t)$ and $B(v_t)$ are positive for all sufficiently small positive source times, and*

$$p(u_t) < p(v_t). \quad (8)$$

More precisely, with $r_\beta = W(\beta)\Omega - \langle \Omega, W(\beta)\Omega \rangle \Omega$,

$$\begin{aligned} B(u_t) &\longrightarrow 1, & \frac{B(v_t)}{t^2} &\longrightarrow g^2, \\ p(u_t) &\longrightarrow 0, & p(v_t) &\longrightarrow \|r_\beta\|^2 > 0. \end{aligned} \quad (9)$$

Proof. The first two limits follow from (4), the unitarity of $W(\beta)$ and $\|\Omega\| = 1$. Their limits are positive because $g \neq 0$, which also gives positive branch weights near zero positive time. Applying the continuous operator Q to (4) gives $J(u_t) \rightarrow 0$ and $J(v_t)/t^2 \rightarrow g^2\|r_\beta\|^2$. Divide by the corresponding branch-weight limits. The common t^2 scale cancels in the neighbor ratio; this is a calculation on the unconditioned state. The residual is nonzero by the vacuum-overlap argument in Proposition 3.1. Thus the difference $p(v_t) - p(u_t)$ has a strictly positive limit, establishing (8). $\square$

The same vacuum-versus-nonvacuum effect therefore has different probabilities in the two matter branches. The neighbor branch retains its small actual weight, whose leading scale is $g^2 t^2$. The contrast does not assert perfect discrimination in one observation. These probabilities specify information in the physical state; enacting a detector and writing its result into a retained material record remain separate physical constructions.

3.2 An absolute correlation margin

The same branch information has a witness that uses the original joint weights throughout. Let $V(x) = B(x) - J(x)$ be the joint vacuum weight, and define the two-row minor

$$\Delta_t = J(v_t)V(u_t) - J(u_t)V(v_t) = J(v_t)B(u_t) - J(u_t)B(v_t). \quad (10)$$

Here $V(x) = |\langle \Omega, x \rangle|^2 \geq 0$. The four cells in (10) are joint weights in the complete output. All other matter coordinates remain present.

Proposition 3.3 (Absolute signal and its error requirement). *Under the hypotheses of Proposition 3.1,*

$$\lim_{t \downarrow 0} \frac{\Delta_t}{t^2} = g^2\|r_\beta\|^2 > 0. \quad (11)$$

Consequently $\Delta_t > 0$ at every sufficiently small positive source time. For a normalized state, suppose each of the four reported joint cells differs from its actual value by at most η , and the reported vacuum cells lie in $[0, 1]$. Their reported minor $\hat{\Delta}_t$ then satisfies

$$|\Delta_t - \hat{\Delta}_t| \leq 4\eta. \quad (12)$$

In particular $4\eta < \Delta_t$ guarantees a positive reported minor.

Proof. Use the second expression in (10). Equations (4) and (9) give $J(v_t)/t^2 \rightarrow g^2 \|r_\beta\|^2$, $B(u_t) \rightarrow 1$, $J(u_t) \rightarrow 0$ and $B(v_t)/t^2 \rightarrow g^2$. Taking products proves (11); its coefficient is positive by the nonzero residual established above. For either product, write $ab - \hat{a}\hat{b} = a(b - \hat{b}) + (a - \hat{a})\hat{b}$. The exact nonvacuum factor a and reported vacuum factor $\hat{b}$ lie in $[0, 1]$, so its error is at most 2η . The triangle inequality gives (12) for the difference of the two products. The last assertion follows directly. $\square$

The minor cannot be positive if both matter branches have one common field fraction $J = pB$. Its positive value therefore witnesses correlation without dividing the observed weights by a rare branch weight. Equation (11) also retains the small quadratic signal. The error requirement specifies what an instrument would have to resolve; it supplies neither that instrument nor a sampling or repetition guarantee.

3.3 A material record that retains the complete photon field

Retention can be derived for a specified native holding interaction. Let $\sigma \in \{0, 1\}^6$ be six occupation bits and let I be any finite internal and reference index set. The carrier is

$$\mathcal{H}_{\text{hold}} = \bigoplus_{(\sigma, i) \in \{0, 1\}^6 \times I} \mathcal{F}.$$

Every coordinate carries the full photon space. Write f_j for signed fermionic annihilation at cell j , with its sign determined by the occupied cells preceding j , and $N_j = f_j^* f_j$. The reciprocal partner map is $\pi = (2, 3, 0, 1, 5, 4)$, using indices $0, \dots, 5$. Retain the complete finite row matrix

$$K = A_{\text{diag}} + \sum_{j=0}^5 [(1 - N_j) \otimes D_{0j} + N_j \otimes D_{1j} + f_j^* f_{\pi(j)} \otimes B_j^* + f_{\pi(j)}^* f_j \otimes B_j]. \quad (13)$$

The D_{0j}, D_{1j} and every occupation block of A_{diag} are Hermitian matrices on I ; the B_j are arbitrary. For each (σ, i) choose a photon source profile $z_{\sigma, i}$ and its complete compensated source Hamiltonian $H_{\sigma, i}$, with nonnegative free-source coefficient. Define

$$H_{\text{hold}} = \text{diag}(H_{\sigma, i}) + K \quad (14)$$

on the maximal product of the component operator domains. The finite matrix is a bounded Hermitian perturbation, so this operator is self-adjoint on that same domain.

For $b \in \{0, 1\}$ let $C_b = (b, 1 - b, b, 1 - b, 1, 1)$. With four positive data cells and two negative filled reference cells, this is the neutral material code. Let R_b retain exactly the coordinates with $\sigma = C_b$ and every $i \in I$.

Proposition 3.4 (Full photon retention). *For the holding law (14), every $t \in \mathbb{R}$ and every $x \in \mathcal{H}_{\text{hold}}$ satisfy*

$$R_b e^{-itH_{\text{hold}}} x = e^{-itH_{\text{hold}}} R_b x, \quad \|R_b e^{-itH_{\text{hold}}} x\|^2 = \|R_b x\|^2. \quad (15)$$

No operator-domain restriction is imposed on the ambient input x .

Proof. In C_b , the occupations at j and $\pi(j)$ agree for every j . Both hopping columns in (13) therefore vanish by fermionic occupation blocking, including their prefix signs. The remaining row acts by its complete conditional internal matrix within that occupation. Hermiticity also excludes reverse leakage, so K commutes with R_b . Coordinate selection by R_b is zero or the identity in each component; it preserves the exact component domain and commutes with its action. It therefore preserves the full product domain and commutes with H_{hold} there. The imaginary-resolvent identities, their bounded regularizations and the strong limit defining the unitary group then give the first equality in (15) on every ambient input. The unitary norm identity gives the second. $\square$

This result retains arbitrary source profiles, every internal and reference coordinate, and all photon sectors. The partner arrangement, row blocks and ready record are construction inputs. Their enactment from the original spatial atomic source has to be established separately. Because the holding law preserves these probabilities at every time, writing an initially absent occupation record also needs an acquisition interaction. Retention and acquisition are distinct parts of the physical record mechanism.

3.4 A signed reflection word writes the neutral code

The target capture map can be connected to the literal occupation operators. Keep the signed annihilators $f_0, \dots, f_5$ on all 2^6 occupation states, with the same prefix-sign convention as above. For distinct i, j define

$$c_{ij} = f_i + f_j, \quad R_{ij} = 1 - c_{ij}^* c_{ij}. \quad (16)$$

The canonical anticommutation relations give $c_{ij}^2 = 0$ and $c_{ij}^* c_{ij} + c_{ij} c_{ij}^* = 2$. Thus $(c_{ij}^* c_{ij})^2 = 2c_{ij}^* c_{ij}$, so $R_{ij}^* = R_{ij}$ and $R_{ij}^2 = 1$ on the complete carrier. This includes the empty and doubly occupied pair sectors. Let X be a finite source, internal and reference index set, and let $b : X \rightarrow \{0, 1\}$ be an occupation selector. Define W by applying R_{01} followed by R_{23} when $b(x) = 1$, and the identity when $b(x) = 0$, retaining x throughout. Since each controlled reflection is unitary on every occupation state, W is a full unitary.

Proposition 3.5 (Coherent material-code capture). *For any complex Hilbert space $\mathcal{H}_0$ and any component vectors $v_x \in \mathcal{H}_0$, the same unitary word, acting as the identity on $\mathcal{H}_0$, satisfies*

$$W \sum_{x \in X} |C_0, x\rangle \otimes v_x = \sum_{x \in X} |C_{b(x)}, x\rangle \otimes v_x. \quad (17)$$

In particular $\mathcal{H}_0$ can be the complete photon Fock space.

Proof. For $b(x) = 0$, both controls apply the identity. For $b(x) = 1$, the literal signed column actions are

$$R_{01}|0, 1, 0, 1, 1, 1\rangle = -|1, 0, 0, 1, 1, 1\rangle, \quad R_{23}|1, 0, 0, 1, 1, 1\rangle = -|1, 0, 1, 0, 1, 1\rangle.$$

The two minus signs cancel, giving $|C_1\rangle$ with its original amplitude. Linearity proves (17) for arbitrary component vectors. The full matrix unitary and its adjoint lift to inverse isometries on the Hilbert direct sum, so the spectator factor and all its sectors remain present. $\square$

This construction supplies the coherent occupation operator required to write the code. It does not yet derive the interaction that enacts these reflections under the unchanged spatial atomic source. The selector and contacts, ready stock, finite-duration realization, energy funding and autonomous schedule each remain physical construction obligations. Once a code has been acquired, the specified holding law of Proposition 3.4 supplies its separate retention mechanism.

3.5 Coherent capture under the complete finite Hamiltonian

A receiving bank also permits a direct evolution calculation. An empty target leaves the bank unchanged apart from its clock phase. An occupied target couples to a collective occupied-bank state. Keeping the internal clock blocks gives an explicit bound on departure from this transfer.

The native blocks can be specified completely. For indices modulo eight, put

$$\begin{aligned}\rho &= (0, 1, 1, -1, 0, 1, -1, -1), \\ \eta &= (0, 1, 0, 1, 0, -1, 0, -1), \quad \sigma = (1, -1, -1, 1, -1, 1, 1, -1), \\ C_{uv} &= \frac{8\delta_{uv} - 1}{2} + \frac{i}{2}(\rho_{u-v} + \sqrt{2}\eta_{u-v}).\end{aligned}$$

Let $S = \text{diag}(\sigma)$, and let the four columns of Z_0 be $e_{2j} + i\sigma_{2j+1}e_{2j+1}$, $j = 0, \dots, 3$. Set $Z_1 = SZ_0$ and

$$D_0 = \frac{1}{2}Z_0^*CZ_0, \quad D_1 = \frac{1}{2}Z_1^*CZ_1, \quad B = \frac{1}{2}Z_0^*CZ_1. \quad (18)$$

Thus all four internal coordinates remain in each block. The clock C is Hermitian because $\rho_{-j} = -\rho_j$ and $\eta_{-j} = -\eta_j$; in particular D_0 and D_1 are Hermitian.

Take n occupation cells, each with an internal factor $\mathbb{C}^4$. The full finite carrier is $\mathbb{C}^{\{0,1\}^n} \otimes (\mathbb{C}^4)^{\otimes n}$. Let s be a bank of $N > 0$ cells and $k \notin s$ a target. Use the signed annihilators f_j on all occupation states, and write $A^{(j)}$ for a matrix acting on internal factor j . With identity factors suppressed, define

$$L = \sum_{j \in s} f_j B^{(j)}, \quad H_s = \sum_{j \in s} [(1 - N_j)D_0^{(j)} + N_j D_1^{(j)}] + L^* f_k + f_k^* L. \quad (19)$$

This Hermitian matrix retains both occupation-dependent clocks and the complete nonscalar exchange block.

Choose a unit vector $v \in \mathbb{C}^4$ with $D_0 v = E v$, $E \in \mathbb{R}$, and put

$$\begin{aligned}A &= BB^*, \quad \mu = \langle v, Av \rangle > 0, \quad V = \|(A - \mu)v\|^2, \\ M &= D_1 B^* - B^* D_0, \quad c = \sqrt{N\mu}, \quad \tau = \frac{\pi}{2c}, \quad K_v = \frac{\sqrt{V} + \|Mv\|}{\sqrt{\mu}}.\end{aligned} \quad (20)$$

Let x_0, x_1 be occupation strings with every bank cell empty and with target occupations zero and one respectively. Define $r_b = |x_b\rangle \otimes v^{\otimes n}$ and $q = c^{-1}L^* f_k r_1$.

Proposition 3.6 (Finite coherent capture). *Under these conditions, q is a unit vector and, for every $a, b \in \mathbb{C}$,*

$$\|e^{-i\tau H_s}(ar_0 + br_1) - e^{-iNE\tau}(ar_0 - ibq)\| \leq |b|\tau K_v. \quad (21)$$

For a normalized input $ar_0 + br_1$, the right side is at most τK_v .

Proof. The signed anticommutation relations cancel the cross terms in L^2 and in $LL^* + L^*L$. On an empty bank this gives

$$LL^* r_1 = \sum_{j \in s} A^{(j)} r_1, \quad \|L^* f_k r_1\|^2 = N\mu.$$

The clock eigenvector equation and the same occupation identities give

$$H_s r_0 = NE r_0, \quad H_s r_1 = NE r_1 + cq, \quad H_s q = NE q + cr_1 + R, \quad (22)$$

where

$$R = c^{-1}(F + G), \quad F = (LL^* - N\mu)r_1, \quad G = \sum_{j \in s} f_j^* M^{(j)} f_k r_1.$$

The centered internal vectors $(A - \mu)v$ have zero inner product with v . Distinct product-state terms in F are therefore orthogonal, giving $\|F\|^2 = NV$. Distinct terms in G have different occupied bank cells, giving $\|G\|^2 = N\|Mv\|^2$. Hence $\|R\| \leq K_v$.

Compare the exact occupied-target evolution with

$$z(t) = e^{-iNEt}(\cos(ct)r_1 - i\sin(ct)q).$$

Equations (22) give $z'(t) + iH_s z(t) = e^{-iNEt} \sin(ct)R$ and $z(0) = r_1$. Variation of constants and unitarity then imply, for $t \geq 0$,

$$\|e^{-itH_s}r_1 - z(t)\| \leq \int_0^t |\sin(cu)| \|R\| du \leq tK_v.$$

At $t = \tau$, $z(\tau) = -ie^{-iNE\tau}q$. The empty-target branch evolves exactly as $e^{-iNEt}r_0$. Linearity therefore multiplies the occupied-branch error by b , which proves (21). Finally r_0 and r_1 are orthogonal unit vectors, so normalization means $|a|^2 + |b|^2 = 1$ and implies $|b| \leq 1$. $\square$

Proposition 3.7 (Capture with a retained finite reference). *Under the same conditions, let $\mathcal{R}$ be a finite-dimensional reference space with orthonormal basis (e_r) . For arbitrary complex amplitudes a_r, b_r , put*

$$\begin{aligned} \Psi &= \sum_r e_r \otimes (a_r r_0 + b_r r_1), \\ \Phi &= e^{-iNE\tau} \sum_r e_r \otimes (a_r r_0 - ib_r q), \quad B_{\mathcal{R}} = \sum_r b_r e_r. \end{aligned}$$

The joint state obeys

$$\|(I_{\mathcal{R}} \otimes e^{-i\tau H_s})\Psi - \Phi\| \leq \|B_{\mathcal{R}}\| \tau K_v. \quad (23)$$

For normalized Ψ , this is at most τK_v , independently of the dimension of $\mathcal{R}$.

Proof. Write $\epsilon = e^{-i\tau H_s}r_1 + ie^{-iNE\tau}q$. The empty branch is exact, so linearity gives the joint error $B_{\mathcal{R}} \otimes \epsilon$. Orthogonality of the reference basis gives its squared norm as $\sum_r |b_r|^2 \|\epsilon\|^2 = \|B_{\mathcal{R}}\|^2 \|\epsilon\|^2$. The occupied-branch bound is $\|\epsilon\| \leq \tau K_v$. Also $\|\Psi\|^2 = \sum_r (|a_r|^2 + |b_r|^2)$, because r_0, r_1 are orthogonal unit vectors. Thus normalization gives $\|B_{\mathcal{R}}\| \leq 1$. $\square$

The bound controls the joint coherent state, including its relative amplitudes and any retained finite reference, on the stated prepared two-dimensional input space. The output q is a collective bank excitation; it is distinct from the six-cell neutral code above. The ready eigenstock, target contacts and source-time schedule are conditions of this finite construction. Deriving their preparation and actuation from the original spatial, charge-constrained, full-field source remains physical work. This evolution result supplies no additional identification of a record with a felt occurrence or a subject.

3.6 Capture while the stock clock evolves

The eigenstock condition can be removed while retaining coherent input and every finite passive reference. Keep the same finite carrier and Hamiltonian, but let $v \in \mathbb{C}^4$ be any unit vector. Set

$$K = -iD_0, \quad u(t) = e^{tK}v, \quad \mu(t) = \langle u(t), Au(t) \rangle, \quad \mu_0 = \mu(0),$$

where $A = BB^*$ as above. Hermiticity of D_0 gives $\|u(t)\| = 1$. For the native blocks (18), B^* is injective, so $\mu_0 = \|B^*v\|^2 > 0$ for every such v . Let $p(t)$ be the internal product with factor $u(t)$ at each bank cell and

factor v at each other cell. Thus the spectator clocks are fixed, as in H_s . With x_1 as above, define

$$\begin{aligned} r(t) &= |x_1\rangle \otimes p(t), & c_0 &= \sqrt{N\mu_0}, & \tau_0 &= \frac{\pi}{2c_0}, \\ q_v(t) &= c_0^{-1} L^* f_k r(t), \\ S_0 &= 2\|A\| + \|M\|, & \Lambda &= 2\|A\|\|K\|, \\ \Delta_v &= \frac{S_0}{\sqrt{\mu_0}} + \frac{\pi\Lambda}{2\mu_0}, & C_v &= \frac{\pi\Delta_v}{2\sqrt{\mu_0}}. \end{aligned} \tag{24}$$

The matrix norms in these constants are operator norms.

Proposition 3.8 (Native capture from arbitrary normalized stock). *For every unit initial stock v , every nonempty finite bank and the stated empty-bank, occupied-target input,*

$$\|e^{-i\tau_0 H_s} r(0) + i q_v(\tau_0)\| \leq \frac{C_v}{\sqrt{N}}. \tag{25}$$

The constant C_v is independent of bank size. The target $q_v(t)$ uses the initial coupling c_0 ; it is not asserted to be a unit vector.

Proof. The exponential constructs the stock motion for all real times and satisfies $u' = Ku$. Differentiating its expectation gives $|\mu(t) - \mu_0| \leq \Lambda t$ for $t \geq 0$. The exact moving residual is

$$R_v(t) = c_0^{-1} \left[(LL^* - N\mu(t))r(t) + \sum_{j \in s} f_j^* M^{(j)} f_k r(t) + N(\mu(t) - \mu_0)r(t) \right].$$

As in the fixed-stock calculation, the centered product terms in the first summand are orthogonal. Its norm is $\sqrt{N} \|(A - \mu(t))u(t)\| \leq 2\sqrt{N} \|A\|$. The distinct occupation sectors in the second summand give norm $\sqrt{N} \|Mu(t)\| \leq \sqrt{N} \|M\|$. Since $\|r(t)\| = 1$, the final summand has norm at most $N\Lambda t$. Consequently, for $0 \leq t \leq \tau_0$,

$$\|R_v(t)\| \leq c_0^{-1} (\sqrt{N} S_0 + N\Lambda t) \leq \Delta_v.$$

Now put $z(t) = \cos(c_0 t) r(t) - i \sin(c_0 t) q_v(t)$. The native clock action and exchange identities give $z'(t) + i H_s z(t) = \sin(c_0 t) R_v(t)$ and $z(0) = r(0)$. Variation of constants and unitarity bound the deviation from $z(t)$ by $t\Delta_v$ on this interval. At τ_0 , $z(\tau_0) = -i q_v(\tau_0)$ and $\tau_0 \Delta_v = C_v / \sqrt{N}$, proving the claim. $\square$

The empty-target branch also has an exact moving solution. Put $r_0(t) = |x_0\rangle \otimes p(t)$, where x_0 has empty bank occupations and an empty target, and write $r_1(t) = r(t)$. The bright operator annihilates every empty-target sector. Consequently, $H_s r_0(t) = H_{\text{clock}} r_0(t)$, where $H_{\text{clock}} = \sum_{j \in s} D_0^{(j)}$ with identity on occupations, and $e^{-itH_s} r_0(0) = r_0(t)$ for every $t \geq 0$.

Proposition 3.9 (Coherent capture with evolving stock and a reference). *Let E be any finite passive reference with orthonormal basis (e_r) . Under the same bank and unit-stock conditions, set*

$$\begin{aligned} \Omega &= \sum_r e_r \otimes (a_r r_0(0) + b_r r_1(0)), \\ \Theta &= \sum_r e_r \otimes (a_r r_0(\tau_0) - i b_r q_v(\tau_0)). \end{aligned}$$

Then

$$\|(I_E \otimes e^{-i\tau_0 H_s})\Omega - \Theta\| \leq \left(\sum_r |b_r|^2 \right)^{1/2} \frac{C_v}{\sqrt{N}}. \tag{26}$$

If $\|\Omega\| = 1$, the bound is at most $C_v / \sqrt{N}$, independently of the dimension of E . A one-dimensional reference gives the corresponding coherent two-amplitude result.

Proof. Let $e_1 = e^{-i\tau_0 H_s} r_1(0) + i q_v(\tau_0)$. Exact evolution of the empty branch and linearity make the difference on the left of (26) equal to $\sum_r b_r e_r \otimes e_1$. Its norm is exactly $(\sum_r |b_r|^2)^{1/2} \|e_1\|$; apply Proposition 3.8. The input sectors $r_0(0)$ and $r_1(0)$ are orthogonal unit vectors, so $\|\Omega\|^2 = \sum_r (|a_r|^2 + |b_r|^2)$. Normalization therefore gives $\sum_r |b_r|^2 \leq 1$. $\square$

A preparation partner can also retain its native free clock, provided its evolution after preparation is independent of the capture carrier.

Corollary 3.10 (An independently evolving preparation partner). *Let m be finite and let $\chi \in (\mathbb{C}^4)^{\otimes m}$ be a unit vector. On this partner set $F = \sum_{j=1}^m D_0^{(j)}$, and define the joint Hamiltonian*

$$H_{\text{joint}} = F \otimes I + I \otimes H_s.$$

Under the bank and unit-stock conditions of Proposition 3.8, put

$$\xi = a r_0(0) + b r_1(0), \quad \zeta = a r_0(\tau_0) - i b q_v(\tau_0).$$

Then

$$\|e^{-i\tau_0 H_{\text{joint}}}(\chi \otimes \xi) - (e^{-i\tau_0 F} \chi) \otimes \zeta\| \leq |b| \frac{C_v}{\sqrt{N}}. \quad (27)$$

The bound has no dependence on the partner's finite size.

Proof. The product $e^{-itF} \chi \otimes e^{-itH_s} \xi$ solves the joint Schrödinger equation with initial value $\chi \otimes \xi$. Uniqueness gives its equality with $e^{-itH_{\text{joint}}}(\chi \otimes \xi)$ for $t \geq 0$. Subtracting $(e^{-itF} \chi) \otimes \zeta$ therefore gives norm $\|e^{-itF} \chi\| \|e^{-itH_s} \xi - \zeta\|$. The first factor is one by Hermiticity of F . The one-dimensional case of Proposition 3.9 gives (27) at $t = \tau_0$. $\square$

A fixed finite family of additional native contacts can remain active during capture. Each contact retains both clocks and both hopping terms.

Corollary 3.11 (Capture with additional complete native contacts). *For $m \in \mathbb{N}$, choose any cell pairs (i_ℓ, j_ℓ) on the same finite carrier and set*

$$\begin{aligned} V_{\text{ct}} &= \sum_{\ell=1}^m [(1 - N_{i_\ell}) D_0^{(i_\ell)} + N_{i_\ell} D_1^{(i_\ell)} \\ &\quad + f_{i_\ell}^* f_{j_\ell} (B^{(i_\ell)})^* + f_{j_\ell}^* f_{i_\ell} B^{(i_\ell)}], \\ \kappa &= \|D_0\| + (\|D_1\| + \|D_0\|) + 2\|B\|. \end{aligned}$$

Under the bank and unit-stock conditions above, let $\xi = a r_0(0) + b r_1(0)$ satisfy $\|\xi\| = 1$, and put $\zeta = a r_0(\tau_0) - i b q_v(\tau_0)$. Then

$$\begin{aligned} \|e^{-i\tau_0 (H_s + V_{\text{ct}})} \xi - \zeta\| &\leq \frac{C_v}{\sqrt{N}} + \tau_0 m \kappa \\ &= \frac{C_v + \frac{\pi}{2\sqrt{\mu_0}} m \kappa}{\sqrt{N}}. \end{aligned} \quad (28)$$

For fixed m , the constant in this bound is independent of bank size.

Proof. The signed occupation operators satisfy $\|f_i\| \leq 1$ and $\|N_i\| \leq 1$. Placing an internal matrix on one factor, or adjoining an identity tensor factor, preserves its operator norm. Rewrite a row's clock as $D_0^{(i)} + N_i(D_1^{(i)} - D_0^{(i)})$. The triangle inequality and submultiplicativity then bound the full row by κ , including

both hopping terms. Thus $\|V_{\text{ct}}\| \leq m\kappa$ on the entire finite carrier. Both Hamiltonians are Hermitian. The unitary variation-of-constants identity, applied to the unit input ξ , gives

$$\left\| e^{-it(H_s + V_{\text{ct}})}\xi - e^{-itH_s}\xi \right\| \leq t\|V_{\text{ct}}\| \leq tm\kappa \quad (t \geq 0).$$

Combine this with the normalized, one-dimensional-reference case of Proposition 3.9 at $t = \tau_0$. Substituting $\tau_0 = \pi/(2\sqrt{N\mu_0})$ gives the displayed rate. $\square$

Injective matching gives a sharper estimate on the sector with exactly one occupied cell. It separates the extensive empty-clock baseline without discarding it.

Proposition 3.12 (A uniform residual bound for matched contacts). *Suppose that both maps $\ell \mapsto i_\ell$ and $\ell \mapsto j_\ell$ are injective. Retain the entire internal space $\mathcal{K}_{\text{int}} = (\mathbb{C}^4)^{\otimes n}$, and let*

$$\iota_1 : \mathbb{C}^n \otimes \mathcal{K}_{\text{int}} \longrightarrow \ell^2(\{0, 1\}^n) \otimes \mathcal{K}_{\text{int}}, \quad \iota_1(|k\rangle \otimes u) = |1_k\rangle \otimes u$$

be the isometric inclusion, where 1_k has only cell k occupied. With the complete contact operator V_{ct} above, define

$$Q_{\text{ct}} = \sum_{\ell=1}^m I \otimes D_0^{(i_\ell)}, \quad R_{\text{ct}} = V_{\text{ct}} - Q_{\text{ct}}, \quad \kappa_1 = \|D_1 - D_0\| + 2\|B\|.$$

For arbitrary $v \in \mathbb{C}^n \otimes \mathcal{K}_{\text{int}}$,

$$R_{\text{ct}}\iota_1 v = \iota_1 K_{\text{ct}} v, \quad \|R_{\text{ct}}\iota_1 v\| \leq \kappa_1 \|v\|, \quad (29)$$

where

$$\begin{aligned} K_{\text{ct}} = \sum_{\ell=1}^m & \left[|i_\ell\rangle\langle i_\ell| \otimes (D_1 - D_0)^{(i_\ell)} \right. \\ & \left. + |i_\ell\rangle\langle j_\ell| \otimes (B^{(i_\ell)})^* + |j_\ell\rangle\langle i_\ell| \otimes B^{(i_\ell)} \right]. \end{aligned}$$

The bound has no dependence on m or n . Internal amplitudes may be correlated with the occupied cell and with all other internal factors.

Proof. On a one-cell occupation, annihilation at that cell has prefix sign one and gives the vacuum. Creation from vacuum also has sign one. Applying the complete row to these columns therefore gives the three displayed blocks after its empty-clock term is subtracted. Summing the exact columns proves the intertwining identity.

For an injective map, selecting its coordinates is a contraction and extending them by zero is an isometry. The middle operation in each of the three block sums applies one local internal matrix to each selected coordinate. Its norm is at most the largest local matrix norm. The first sum is thus bounded by $\|D_1 - D_0\|$ and the other two by $\|B\|$ each. The triangle inequality and the isometry of ι_1 give (29). $\square$

The empty clocks can be retained exactly in a reference evolution. Set

$$\begin{aligned} H_+ &= H_s + H_{\text{clock}}, & G &= D_0 B^* - B^* D_0, \\ \Delta_+ &= \frac{S_0 + \|G\|}{\sqrt{\mu_0}} + \frac{\pi\Lambda}{\mu_0}, & C_+ &= \frac{\pi\Delta_+}{2\sqrt{\mu_0}}. \end{aligned}$$

Here H_{clock} acts as D_0 at every active bank cell, independently of its occupation. It is the same full operator used above, rather than a scalar energy shift.

Proposition 3.13 (Capture with the extensive clock retained). *Under the unit-stock, nonempty-bank and occupied-target conditions of Proposition 3.8, the complete H_+ evolution satisfies*

$$\|e^{-i\tau_0 H_+} r(0) + iq_v(2\tau_0)\| \leq \frac{C_+}{\sqrt{N}}. \quad (30)$$

The comparison target follows the doubled native stock motion $u(2t)$.

Proof. The empty bank clock becomes $2D_0$ and the occupied bank clock becomes $D_1 + D_0$. Consequently the clock mismatch in the bright action is

$$(D_1 + D_0)B^* - B^*(2D_0) = M + G.$$

Use the explicit path

$$z_+(t) = \cos(c_0 t) r(2t) - i \sin(c_0 t) q_v(2t).$$

The chain rule gives the required doubled clock derivative. In the earlier residual calculation, replace M by $M + G$ and evaluate the product stock at $2t$. The centered product and distinct-occupation terms then have total norm at most $\sqrt{N}(S_0 + \|G\|)$ before division by c_0 . The expectation drift contributes at most $2N\Lambda t$. Thus, for $0 \leq t \leq \tau_0$,

$$\|z'_+(t) + iH_+ z_+(t)\| \leq \frac{\sqrt{N}(S_0 + \|G\|) + 2N\Lambda t}{c_0} \leq \Delta_+.$$

Since $z_+(0) = r(0)$ and $z_+(\tau_0) = -iq_v(2\tau_0)$, unitary path comparison gives a deviation at most $\tau_0 \Delta_+ = C_+/\sqrt{N}$. $\square$

For matched contacts whose left endpoints are exactly the active bank, $Q_{\text{ct}} = H_{\text{clock}}$. The reference dynamics above therefore retain the entire extensive clock baseline of those contacts.

Proposition 3.14 (Capture with a complete matched contact at each bank cell). *Suppose that both contact endpoint maps are injective and $\{i_\ell : 1 \leq \ell \leq m\} = s$, so $m = N$. Let $k \notin s$, $N > 0$, and let the initial occupation have only cell k occupied. For any unit initial product stock v , put*

$$L_v = 1 + \frac{\|B\|}{\sqrt{\mu_0}}, \quad C_{\text{mat}} = \frac{\pi}{2\sqrt{\mu_0}}(\Delta_+ + \kappa_1 L_v).$$

The full Hamiltonian $H_{\text{mat}} = H_s + V_{\text{ct}}$ satisfies

$$\|e^{-i\tau_0 H_{\text{mat}}} r(0) + iq_v(2\tau_0)\| \leq \frac{C_{\text{mat}}}{\sqrt{N}}. \quad (31)$$

The constant is independent of bank size and contact count. Every native occupation and internal coordinate remains in the Hamiltonian. The two endpoint images may overlap; disjointness is not required.

Proof. Injectivity of the left endpoint map and its image equality give $Q_{\text{ct}} = H_{\text{clock}}$, hence $H_{\text{mat}} = H_+ + R_{\text{ct}}$. The vector $r(2t)$ has its sole occupation at k . Each summand of $q_v(2t)$ has its sole occupation at a bank cell. Both vectors therefore have explicit preimages under ι_1 . Distinct bank-cell occupation sectors are orthogonal, so

$$\|q_v(2t)\|^2 = \frac{\mu(2t)}{\mu_0} \leq \frac{\|B\|^2}{\mu_0}, \quad \|z_+(t)\| \leq L_v.$$

Proposition 3.12 now bounds $\|R_{\text{ct}} z_+(t)\| \leq \kappa_1 L_v$. Combining this with the preceding path residual gives

$$\|z'_+(t) + iH_{\text{mat}} z_+(t)\| \leq \Delta_+ + \kappa_1 L_v \quad (0 \leq t \leq \tau_0).$$

Direct unitary comparison with this exhibited path proves (31). The estimate uses the path's explicit one-excitation form; no sector-invariance premise about the unknown actual trajectory is needed. $\square$

The same full matched Hamiltonian retains coherent inputs and every finite passive reference. For this statement let $r_0(t)$ have global vacuum occupation, and $r_1(t) = r(t)$ have only the target occupied.

Proposition 3.15 (Matched capture with a retained reference). *Under the conditions of Proposition 3.14, let (e_r) be an orthonormal basis of any finite passive reference E . Set*

$$\begin{aligned}\Omega &= \sum_r e_r \otimes (a_r r_0(0) + b_r r_1(0)), \\ \Theta_+ &= \sum_r e_r \otimes (a_r r_0(2\tau_0) - ib_r q_v(2\tau_0)).\end{aligned}$$

Then

$$\|(I_E \otimes e^{-i\tau_0 H_{\text{mat}}})\Omega - \Theta_+\| \leq \left(\sum_r |b_r|^2 \right)^{1/2} \frac{C_{\text{mat}}}{\sqrt{N}}. \quad (32)$$

For unit Ω , the bound is at most $C_{\text{mat}}/\sqrt{N}$, independently of the dimension of E .

Proof. The residual R_{ct} annihilates every vacuum occupation column, including arbitrary internal amplitudes. On that sector the full matched Hamiltonian therefore acts exactly as the doubled bank clock. Thus $e^{-itH_{\text{mat}}}r_0(0) = r_0(2t)$. Linearity makes the joint error equal to $\sum_r b_r e_r \otimes \epsilon$, where $\epsilon = e^{-i\tau_0 H_{\text{mat}}}r_1(0) + iq_v(2\tau_0)$. Its norm is $(\sum_r |b_r|^2)^{1/2} \|\epsilon\|$. Apply Proposition 3.14. Orthogonality of the two unit input sectors gives $\|\Omega\|^2 = \sum_r (|a_r|^2 + |b_r|^2)$, proving the normalized bound. $\square$

The evolving stock removes the requirement to prepare a clock eigenvector. An independent partner can retain its free clock; complete matched contacts can remain active with one contact per bank cell and a capture error that decreases as $1/\sqrt{N}$. The latter result uses global vacuum and one-excitation inputs, injective contact endpoints and exact coverage of the active bank by the left endpoints. The reference has identity dynamics. Connecting complete preparation histories to the supplied input and available Hamiltonian, resource supply, contact geometry, autonomous timing and the original spatial source remains physical work. The results do not cover an arbitrary correlated stock preparation. The bright comparison target is not asserted normalized. No measurement or branch selection occurs during these capture evolutions. These finite dynamics remain distinct from the experiential and subject composition laws needed below.

3.7 A budget for direct spatial realization

The bank's growing exchange strength must be supplied by its physical realization. The original spatial source has three forward and three reverse unitary postings with a common strength $g \in \mathbb{R}$. Their sum T_g obeys $\|T_g \psi\| \leq 6|g| \|\psi\|$ on the spatial carrier, with every photon sector retained.

Proposition 3.16 (Spatial transport budget). *Keep a nonempty bank, a target outside it and a unit product stock v . Let $r = r(0)$ have the bank empty and the target occupied, let $X = L^* f_k + f_k^* L$, and retain $\mu_0 > 0$, $c_0 = \sqrt{N\mu_0}$ and $\tau_0 = \pi/(2c_0)$ from (24). Suppose W is a linear isometry from the entire finite occupation and internal carrier into the original spatial carrier. If*

$$\|T_g W r - W X r\| \leq \delta,$$

then

$$c_0 \leq 6|g| + \delta, \quad N \leq \frac{(6|g| + \delta)^2}{\mu_0}, \quad \tau_0 \geq \frac{\pi}{2(6|g| + \delta)}. \quad (33)$$

Proof. The occupation identities give $Xr = L^* f_k r$, and orthogonality of the different occupied-bank columns gives $\|Xr\|^2 = N\mu_0$. Also $\|r\| = 1$. The isometry therefore gives $\|WXr\| = c_0$ and $\|Wr\| = 1$. The triangle inequality yields

$$c_0 \leq \|T_g Wr\| + \|T_g Wr - WXr\| \leq 6|g| + \delta.$$

Squaring the nonnegative sides and dividing by $\mu_0 > 0$ proves the bank-size bound. Since $c_0 > 0$, the same inequality bounds the prescribed capture time from below. $\square$

This is a necessary budget for identifying the bank exchange with the bounded spatial hopping alone, through a supplied isometry. It does not construct that isometry. The full source also has clock and field action; any additional interaction used to realize a larger bank must be derived and included in the physical construction. The result does not bound the speed of every process under the full source.

The full source satisfies the same budget when its actual and desired on-site actions are separated spatially from the exchange target. Write $G = A_{\text{diag}} + T_g$, where A_{diag} is the unbounded direct sum of the complete site operators A_a . Let ι_a insert an internal and full-field vector at site a .

Proposition 3.17 (Full source under spatial separation). *Keep the bank, stock and isometry of Proposition 3.16. Suppose $Wr = \iota_a u$, with $u \in D(A_a)$, and $(WXr)(a) = 0$. For any desired on-site column y , if*

$$\|GWr - (\iota_a y + WXr)\| \leq \delta, \quad (34)$$

then all three bounds in (33) hold. The diagonal source, every native factor and every photon sector remain in this comparison.

Proof. The direct-sum domain includes $\iota_a u$, and $GWr = \iota_a A_a u + T_g Wr$. Since WXr vanishes at site a , it is orthogonal to $\iota_a (A_a u - y)$. Pythagoras and the triangle inequality therefore give

$$\begin{aligned} c_0 = \|WXr\| &\leq \|\iota_a (A_a u - y) - WXr\| \\ &\leq \|GWr - (\iota_a y + WXr)\| + \|T_g Wr\| \\ &\leq \delta + 6|g|. \end{aligned}$$

The bank-size and prescribed-time bounds follow as before. $\square$

Thus arbitrary on-site clock and field action cannot supply this off-site exchange column. The localization conditions still have to hold for a physical bank realization. An implementation acting within the internal and field factors at one site or through a different embedding requires its own construction and analysis.

The complete matched atomic source also bounds a final transfer between sites without requiring a comparison of generator columns. Intermediate states may spread over the entire carrier. Let $U_t = e^{-itG}$ be the original matched-source evolution with $a, C_E > 0$, arbitrary native clock coefficient ϵ and transport coefficient g .

Proposition 3.18 (Endpoint capture budget). *Let x be a unit vector in the full internal and photon carrier at site b , and let y be a unit vector in the full spatial carrier with $y(b) = 0$. For every source time t ,*

$$\|U_t \iota_b x - y\| \geq 1 - 6|g||t|. \quad (35)$$

Consequently, error at most δ requires $1 - \delta \leq 6|g||t|$. If $g \neq 0$, it requires $|t| \geq (1 - \delta)/(6|g|)$.

In particular, fix g, K, C , with $K \geq 0$. If a positive bank size N admits such a normalized transfer at time $K/\sqrt{N}$ with error at most $C/\sqrt{N}$, then

$$\sqrt{N} \leq C + 6|g|K, \quad N \leq (C + 6|g|K)^2. \quad (36)$$

Proof. Let $P_b z = z - \iota_b z(b)$ delete the component at the input site. It is an orthogonal projection and hence a contraction. The diagonal evolution keeps the full internal and field vector at that site. The bounded-perturbation comparison therefore gives

$$\|U_t \iota_b x - \iota_b e^{-itA_b} x\| \leq |t| \|T_g\| \|x\| \leq 6|g||t|.$$

This comparison follows by integrating the difference of the two unitary evolutions on their common operator domain and extending by density. It holds for arbitrary internal vectors, including vectors outside that domain. Since $P_b \iota_b e^{-itA_b} x = 0$ and $P_b y = y$, contraction and the triangle inequality give

$$1 = \|y\| \leq \|P_b(U_t \iota_b x - y)\| + \|P_b U_t \iota_b x\| \leq \|U_t \iota_b x - y\| + 6|g||t|.$$

This proves (35) and the time bound. Substitute $t = K/\sqrt{N}$ and $\delta = C/\sqrt{N}$, then multiply by $\sqrt{N} > 0$. Both sides of the resulting square-root bound are nonnegative, so squaring proves (36). $\square$

This is an endpoint restriction for the complete autonomous matched source, retaining its on-site clocks, fields and all photon sectors. It places no restriction on intermediate states. Externally controlled interactions, a transport coefficient that changes with N , or records formed within the internal and field factors at the same site require separate analysis. The time variable is the source time; identification with a physical clock remains part of the preparation and enactment construction.

4 The identity between recognition and experience

Experience is itself an occurrence within the reality being explained. Recognition supplies the physical structure of distinction, interaction and retained history. The intrinsic experiential interpretation identifies the experienced occurrence with this recognition activity: the physical and experiential descriptions concern one event. If that identity holds, removing experience removes an aspect of the activity itself [1, 2].

4.1 From an experienced occurrence to a universal claim

The argument needs four distinct premises.

1. *An experiential anchor.* A particular first-person episode is independently identified as experienced. A report is evidence about that episode; the existence of a report bit alone is not the anchor.
2. *Same-occurrence identification.* The physical occurrence underlying that episode is an actual native recognition occurrence. Its apparatus, participating degrees of freedom, place, time and history must refer to the episode being identified. Equal comparison values at different places or times do not identify the same occurrence.
3. *Constitution and preservation.* Felt presence belongs to recognition itself and survives the admitted physical formation and transport operations. Those operations may change content, intensity, organization and local perspective while preserving felt presence.
4. *Actual coverage.* These operations reach every occurrence within the universal claim from an anchored experiential class, with their physical enactment and occurrence histories retained.

The anchor, preservation and coverage yield the conditional conclusion: every occurrence so reached is felt. The first two premises identify an experienced recognition occurrence. They do not, by themselves, establish the third premise or extend the identification to the whole domain. Mathematical connectivity between comparison values likewise does not supply the fourth premise's actual occurrence coverage.

The positive reason for the third premise is explanatory continuity. The same necessary recognition structure operates in the anchored case and throughout the physical domain. Reading experience

as intrinsic to that activity joins physical and experiential occurrence without an additional detached carrier. Local organization, retained history and self-reference can then account for differences between perspectives.

The remaining issue is constitutive sufficiency. Recognition can be necessary to an experienced occurrence while experience depends on a particular organization of recognition. That alternative also places experience within the same physical architecture. Rejecting a detached carrier therefore does not exclude it. The intrinsic account must identify why felt presence belongs to recognition at the generality shared by all admitted occurrences, and why the admitted operations cannot remove what makes the anchor experienced. Explanatory continuity motivates this identification; it does not derive the preservation law.

4.2 What the physical evidence must identify

A positive internal coordinate does not establish experiential identity by itself. On a comparison carrier whose inside coordinate $i(c)$ is positive by definition, the condition

$$c \text{ is felt} \iff i(c) > 0$$

is equivalent to declaring every comparison felt. The equivalence gives exact consequences of the interpretation; it does not independently select it as physical law. An actual same-occurrence anchor need not identify a numerical intensity rating with that coordinate.

The physical work starts with the anchored occurrence. Its acquired records and native representation must describe the same episode. The account must then identify what constitutes its felt presence and give a reason that each admitted formation or transport preserves it. Preserving a state, a calibrated response or a record supports this step only through a grounded connection to felt occurrence. The recovery argument in (2) retains that dependency. If the supported operations preserve only a particular experiential organization, their conclusion has that scope; a universal conclusion also needs constitution and coverage over the full domain.

4.3 Two cases for subject membership

Consider one person experiencing two sensations together. The relevant relation is their joint presence to that person. A joint record or a causal connection can help identify its physical basis, but does not by itself establish experiential membership. The account must explain what makes both occurrences belong to that subject together.

Now consider two people exchanging information. Their communication connects their occurrences while their local perspectives remain distinct. A larger experiencing subject would require those occurrences to be jointly present to that subject as well. Local distinctness neither establishes nor excludes such membership. The next section states the precise composition and realization conditions that would establish it. Universal felt presence and existence of an experiencing whole are separate conclusions.

5 An experiencing whole that retains local participants

5.1 Containment and identity do different work

Let $\mathcal{E}$ be an actual occurrence domain and $\mathcal{S}$ a subject domain. A relation $B(e, s)$ means that occurrence e belongs to subject s . Let $\mathcal{E}_f$ be the felt occurrences, and require $B(e, s) \Rightarrow e \in \mathcal{E}_f$. Define

$$D_s = \{e \in \mathcal{E}_f : B(e, s)\}.$$

These definitions specify the objects that a physical account must identify. They do not create an experiencing subject.

An experiencing whole is a subject $w \in \mathcal{S}$ such that

$$\mathcal{E}_f \neq \emptyset, \quad D_w = \mathcal{E}_f. \quad (37)$$

This permits distinct local participants whose domains are contained in D_w . A single exclusive label for each occurrence would impose a different condition.

Proposition 5.1 (Effect of exclusive attribution). *Suppose w satisfies (37) and*

$$B(e, s) \wedge B(e, s') \implies s = s'$$

for every e, s, s' . Then every subject with a nonempty domain equals w .

Proof. Choose $e \in D_s$. It is felt, so $e \in D_w$. Exclusive attribution gives $s = w$. □

The collapse is caused by exclusivity. Containment alone preserves different participants. A description of a whole must retain their histories, needs and effects; a description of a member must retain the shared physical constraints. In RS ethics and economics, these are the same physical bonds and transformations viewed across participants and the whole. Grouping a ledger does not independently establish that the group experiences.

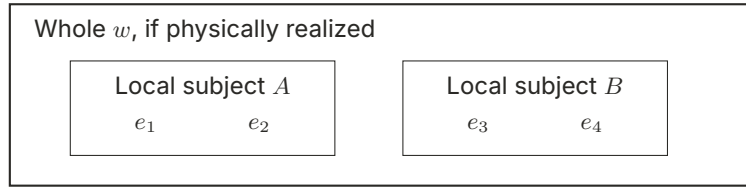


Figure 3. Nested attribution permits $A \neq B$ while their occurrences also belong to w . The enclosing rectangle expresses a containment condition; drawing it is not a physical construction of the whole.

5.2 Finite composition

A binary composition law says that for any $s_1, s_2 \in \mathcal{S}$ there exists $s \in \mathcal{S}$ with

$$D_{s_1} \cup D_{s_2} \subseteq D_s. \quad (38)$$

The original subjects remain present. No equality between them is required.

Proposition 5.2 (Finite joint containment). *Suppose $\mathcal{S} \neq \emptyset$, every felt occurrence belongs to a subject, and (38) holds. For every finite $A \subseteq \mathcal{E}_f$ there exists $s \in \mathcal{S}$ with $A \subseteq D_s$. If a finite family of subject domains covers $\mathcal{E}_f \neq \emptyset$, a whole exists.*

Proof. For the empty set choose any subject. For $A \cup \{e\}$, take a subject containing A and one containing e . Binary composition produces a subject containing their union. This proves the first assertion by finite induction. The same induction joins any finite family of subject domains; a complete finite cover then supplies (37). □

Finite joint containment states that every finite collection can be experienced together. It does not assert that one subject contains an unbounded collection. That additional passage is the limit question.

6 The whole-subject limit

6.1 Finite agreement and an existing subject

For $s \in \mathcal{S}$ define its occurrence profile by

$$p_s(e) = \begin{cases} 1, & e \in D_s, \\ 0, & e \notin D_s. \end{cases} \quad (e \in \mathcal{E}_f). \quad (39)$$

Let $P = \{p_s : s \in \mathcal{S}\}$ be the set of profiles of existing subjects. Give $\{0, 1\}^{\mathcal{E}_f}$ its product topology with discrete $\{0, 1\}$. A basic neighborhood fixes finitely many coordinates. Let $\mathbf{1}(e) = 1$ for every $e \in \mathcal{E}_f$.

Theorem 6.1 (Exact finite-observation criterion). *The profile $\mathbf{1}$ lies in $\text{cl}(P)$ if and only if every finite $A \subseteq \mathcal{E}_f$ is contained in some D_s . If $\mathcal{E}_f \neq \emptyset$ and P is closed, this condition yields an existing whole $w \in \mathcal{S}$. For a nonempty felt domain, a whole exists exactly when $\mathbf{1} \in P$.*

Proof. A basic neighborhood of $\mathbf{1}$ prescribes $p(e) = 1$ on a finite set A . Such a neighborhood meets P exactly when some existing subject contains A . Since these neighborhoods form a basis, meeting every one is precisely $\mathbf{1} \in \text{cl}(P)$.

If P is closed, $\text{cl}(P) = P$, so finite joint containment gives $\mathbf{1} = p_w$ for some $w \in \mathcal{S}$. Equation (39) then says $B(e, w)$ for every felt e . Nonemptiness supplies the other clause of (37). Conversely, a whole has profile $\mathbf{1}$ by its definition. $\square$

The theorem preserves the original subject domain and incidence relation. It realizes the whole as an existing subject under the closedness condition. Adjoining a new label with profile $\mathbf{1}$ would establish a mathematical extension instead.

	0	1	2	3	4	
$p_{\{0\}}$	1	0	0	0	0	$\cdots$
$p_{\{0,1\}}$	1	1	0	0	0	$\cdots$
$p_{\{0,1,2\}}$	1	1	1	0	0	$\cdots$
$\mathbf{1}$	1	1	1	1	1	$\cdots$

Every finite requirement is met
by an existing finite domain.

The full limit is realized only
with an additional limit law.

Figure 4. For occurrences indexed by $\mathbb{N}$, finite domains can match every finite part of the full profile. The all-one profile is a limit of those profiles, but is not the profile of any finite domain.

6.2 Why a limit law is necessary

Take $\mathcal{E} = \mathbb{N}$, declare all occurrences felt, let subjects be finite subsets of $\mathbb{N}$, and define $B(e, s)$ by $e \in s$. Binary composition is set union. Every event belongs to its singleton, and every finite collection belongs to itself. A whole would be a finite subset containing every natural number. Choosing a natural number outside that subset gives a contradiction.

Thus $\mathbf{1} \in \text{cl}(P)$ and $\mathbf{1} \notin P$. This is an exact separation of finite composition from whole-domain realization. It is not asserted to describe a physically admissible universe without a whole subject. Its role is to locate the physical premise that finite composition leaves undecided.

For a nonempty felt domain, compactness gives another sufficient route. Topologize the original subject domain $\mathcal{S}$. For each felt event let

$$O_e = \{s \in \mathcal{S} : B(e, s)\}.$$

If $\mathcal{S}$ is compact, every O_e is closed, and finite joint containment holds, the closed sets O_e have the finite intersection property. Compactness gives $\bigcap_{e \in \mathcal{E}_f} O_e \neq \emptyset$. Any member of this intersection is a whole. These are conditions on actual subjects and their actual memberships. Compactness of a phase coordinate or of a supplied preparation family cannot replace them without a representation connecting those objects to subjects.

7 Subject combination and cosmopsychism

How can experiences belonging to distinct subjects also belong to one subject? Chalmers distinguishes this subject-combination problem from the problems of combining experiential qualities and experiential structures [4]. Our occurrence-to-subject relation addresses joint membership. The profile theorem identifies the passage from finite joint membership to an existing whole; it does not derive the qualities or organization of the whole's experience. Its finite co-presence premise already requires an account of how experiences can belong together.

Roelofs examines composite subjectivity: whether a mind can contain other minds, and whether distinct subjects can share experiences [5]. Nested membership in Section 5 makes this possibility explicit. The exclusive-attribution result identifies the assumption that would collapse inhabited local subjects into a whole. Permitting shared membership removes that particular conflict. A physical account still has to identify the subjects and their memberships; the incidence relation gives those claims a precise form.

Nagasawa and Wager's priority cosmopsychism takes the experiencing cosmos as fundamental and its parts as dependent on it [6]. The profile criterion leaves that direction of dependence undecided. It asks whether a whole is realized in the given subject domain. It neither requires local subjects to be fundamental nor derives their individuation from a prior cosmic subject. Recognition's proposed account of boundaries and retained histories must explain that individuation while preserving the shared physical structure.

Simpson develops a different connection to physics: a hylomorphic account in which the cosmos's mental properties explain its lawful order, without requiring changes to the known physical laws [7]. The physical constructions here establish particular interactions, observable correlations and retained records. The experiential interpretation then concerns the identity of the occurrences participating in those processes. The composition criterion states what their subject membership must supply. This separates a physical mechanism, its experiential identification and the realization of a whole, so that each connection can be examined on its own evidence.

8 The physical derivation that remains

The full universal-consciousness claim concerns one connected reality. Its unfinished connections are now specific.

Physical completeness. The native source and response results must cover the actual and possible carriers, dynamics, preparations, apparatus and records of reality. A supplied finite carrier with a successful recovery theorem establishes that carrier's case. A complete source that generates a field correlation and a branch-dependent field response establishes that interaction and observable. The full-photon holding law establishes retention for its specified apparatus. Universal coverage additionally needs the selection and enactment of every admitted physical operation, with its resources and clock retained.

Experiential identity. An independently experienced occurrence must be the same actual recognition occurrence represented in the physics. The constitution-and-preservation premise in Section 4 must

identify what makes that occurrence experienced and explain why the admitted operations preserve felt presence throughout the domain. The argument must address the possibility that experience depends on a particular organization of recognition. An inside coordinate, a record invariant and a recoverable observable do not settle that issue solely by definition.

Actual whole-subject composition. Actual occurrence-to-subject membership must obey finite joint containment and a physical limit principle, such as closedness of the realized profile set in Theorem 6.1. The whole must be an existing experiencing subject while local participants remain represented. Adding a formal ideal profile leaves this physical realization to be derived.

These conditions give direct ways to assess a proposed completion. A claimed universal source must account for an omitted physical transition. A claimed experiential identity must explain why its same-occurrence law holds across the intended domain. A claimed composition law must realize the limiting profile in the original physical subject domain. Contradictions at any of these connections would require correcting the affected derivation or identification.

The positive argument unites these tasks. Experience occurs within reality; recognition supplies its necessary comparison and record structure; local histories organize perspectives within it. The complete source shows that this architecture includes dynamics that create matter-field correlation with a specific information-bearing field effect. The composition theorem shows how a whole can contain distinct perspectives without erasing them. Establishing the remaining physical identities and limit law would make that connected account a derivation of universal consciousness.

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