

Supplement I — Event Layer Formal Supplement

Formal anchor of the physical program

Megan Anderson

AI ARMY, INC. · aiarmy.co

2026

Citation rule. This supplement is the single formal home for the physical program’s definitions, axioms, and theorems. Papers cite results by their stable name (e.g., “Event Closure Theorem,” “Axiom of No Certainty Promotion”), never by position number — so renumbering can never again drift against citations. Each object is stated once here; companion papers reference rather than restate.

Part 1 — Definitions

Notation. H_{space} a Hilbert space for a composite system admitting subsystem decomposition; states ρ in $D_{\text{state}}(H_{\text{space}})$; lawful evolution α_t (unitary or CPTP), $\rho(t) = \alpha_t(\rho_0)$. The event layer introduces no modification of α_t ; it supplies an operational criterion for when correlations qualify as public facts.

Definition (Event Variable). An event variable E is a coarse-grained classical label associated with a distinguished family of sector projectors $\{P_{i_k}\}$ on H_{space} satisfying $\sum_k P_{i_k} = I$ and $P_{i_\ell} P_{i_k} = \delta_{k\ell} P_{i_k}$. The sectors P_{i_k} are candidate outcome classes.

Definition (Sector Separation). For global state $\rho(t)$, the sector separation parameter is $\epsilon_{\text{SP}}(t) := \max_{\{k \neq \ell\}} \|P_{i_k} \rho(t) P_{i_\ell}\|_1$. Sectors are effectively separated at t when $\epsilon_{\text{SP}}(t) \ll 1$ (suppression of inter-sector interference).

Definition (Record Observable). A record observable R is an observable supported on an accessible subsystem $M \subseteq H_{\text{space}}$ (memory, apparatus, environmental fragment) whose eigenstates correlate with values of E . Operationally, R is a candidate witness of an event.

Definition (Durability Window). With $R(t)$ the induced record state, the durability window is $\Delta(t) := \sup\{\tau > 0 : \text{for all } t' \text{ in } [t, t+\tau], D(R(t), R(t')) < \epsilon\}$, where $D(\cdot, \cdot)$ is an operational distance (e.g. trace distance). A record is durable if $\Delta(t) > \Delta_{\text{min}}$.

Definition (Redundancy / Public Accessibility). For disjoint environment/witness fragments $\{F_1, \dots, F_m\}$, the redundancy measure is $R_{\{\delta, m\}}(t) := \max\{r \leq m : \text{for all } j \leq r, \chi(E:F_j) \geq (1-\delta) \chi(E:F)\}$, with χ the Holevo information and F the full environment. An event is publicly redundant if $R_{\{\delta, m\}}(t) \gg 1$.

Definition (Publicization Time). $t_{\text{pub}}(E) := \inf\{t : \epsilon_{\text{SP}}(t) \ll 1, \Delta(t) > \Delta_{\text{min}}, R_{\{\delta, m\}}(t) \gg 1\}$. (Informal reading, from the conceptual family: the earliest time a record becomes durable, redundant, and accessible enough to support shared inference.)

Part 2 — Axiom

Axiom of No Certainty Promotion Without Publicization. Let $C_{\text{cert}}(O,t)$ denote observer O 's certainty assignment to an event proposition. Then $C_{\text{cert}}(O,t) = 1 \implies t \geq t_{\text{pub}}(E)$. Equivalently, certainty may not be promoted beyond the private-record layer unless closure holds: $\epsilon_{\text{SP}} \ll 1, R_{\{\delta,m\}} \gg 1, \Delta > \Delta_{\text{min}}$.

Status: a semantic constraint on the upgrade from conditioned inference to factual assertion — not a dynamical modification. Compatible with collapse, Everettian, and relational interpretations (each supplies a different ontology beneath the same operational surface).

Part 3 — Core Theorems

Event Closure Theorem. E is an actual public event $\iff (\epsilon_{\text{SP}}(t) \ll 1 \wedge \Delta(t) > \Delta_{\text{min}} \wedge R_{\{\delta,m\}}(t) \gg 1)$. This provides operational closure from possibility to fact: actuality is the conjunction of three independently necessary conditions.

Record Persistence Theorem. Let $R(t)$ be a candidate record observable correlated with E . Then: (1) if $\Delta(t) > \Delta_{\text{min}}$ and $R_{\{\delta,m\}}(t) \gg 1$, the record defines a stable public fact over $[t, t+\Delta]$; (2) if $\Delta(t) \leq \Delta_{\text{min}}$, any instantaneous redundancy is operationally ephemeral and does not license event actualization. Durable redundancy is necessary for factual persistence.

Event-Time-Order Corollary. With $\tau(E) := t_{\text{pub}}(E)$, the set of public events admits a partial order $E_1 <_{\tau} E_2 \iff \tau(E_1) < \tau(E_2)$. This event-time ordering is induced by publicization and is distinct from microscopic evolution-time.

Consistency of Event Assertions (FR/Wigner Resolution). If all agents restrict factual assertions to events satisfying the closure criterion, then no Frauchiger–Renner / Wigner's-friend contradiction can be derived. Proof structure: contradictions require combining (i) observer-relative conditioned certainty, (ii) global unitary evolution, (iii) cross-agent certainty promotion. The Axiom of No Certainty Promotion disallows (iii) prior to publicization; conditioned statements remain sector-relative and cannot be composed into a globally inconsistent set of public facts. The paradox-generating step is blocked without altering dynamics. ■

Part 4 — Independence Constructions (the closure ingredients are mutually independent)

Five finite unitary counterexamples establish that no closure ingredient implies another — the answer to “isn’t your durability just redundancy restated?” This is the program’s strongest anti-redundancy asset and is featured, not cut.

Condition held	Condition that fails	Construction
$\epsilon_{SP} \ll 1$	$\Delta \leq \Delta_{min}$	imprint + environment-only scramble
$\epsilon_{SP} \ll 1$	$R_{\{\delta,m\}} \approx 1$	single-fragment witness (m=1)
$R_{\{\delta,m\}} \gg 1$	$\Delta \leq \Delta_{min}$	ephemeral redundancy (rapid overwrite)
$\Delta \gg \Delta_{min}$	$R_{\{\delta,m\}} \approx 1$	durable private memory (error-corrected single subsystem)
$R_{\{\delta,m\}} \gg 1$	$\epsilon_{SP} \approx 1$	imperfect non-pointer-basis copying

Conclusion: decoherence suppresses interference, redundancy distributes information, durability stabilizes facts — but none alone closes the gap from possibility to actuality. Event closure requires their conjunction.

Part 5 — Temporal Publicization Index (admissible-functional class)

This section states the admissible functional class for the Temporal Publicization Index (TPI).

Definition (Temporal Publicization Index). A TPI is any functional $TPI(t) = \Phi(\tilde{x}(t), \tilde{y}(t), \tilde{z}(t))$ of rescaled sector-separation, redundancy, and durability (\tilde{x} decreasing in ϵ_{SP} ; \tilde{y} increasing in $R_{\{\delta,m\}}$; \tilde{z} increasing in Δ beyond Δ_{min}), satisfying:

1. Monotonicity: $d_{\Phi}/d_{\tilde{x}} \leq 0$, $d_{\Phi}/d_{\tilde{y}} \geq 0$, $d_{\Phi}/d_{\tilde{z}} \geq 0$.
2. Normalization: $\Phi(1,0,0) = 0$, $\Phi(0,1,1) = 1$.
3. Closure compatibility: $TPI(t) \geq \Theta_{crit} \Leftrightarrow (\epsilon_{SP} \ll 1) \wedge (R_{\{\delta,m\}} \gg 1) \wedge (\Delta > \Delta_{min})$, for some Θ_{crit} in $(0,1)$.

The TPI is therefore not unique; it is an admissible class of operational measures consistent with the closure criterion.

Canonical multiplicative form. $TPI(t) = (1 - \tilde{x}(t)) \cdot \tilde{y}(t) \cdot \tilde{z}(t)$ — vanishes if any ingredient vanishes, $\rightarrow 1$ at maximal closure, three axes contribute independently.

Publicization threshold. $t_{pub}(E) = \inf\{t : TPI(t) \geq \Theta_{crit}\}$ (equivalent to the Event Closure Theorem).

Non-Instantaneity (Proposition). If $\tilde{z}(t) \approx 0$ over an interval, then no matter how rapidly decoherence occurs or redundancy rises, $TPI(t) \approx 0$. Durability supplies an irreducibly temporal constraint.

Robustness (Proposition). If Φ is continuous and tolerances (δ, ϵ) fixed, small perturbations of $\rho(t)$ induce small perturbations of $TPI(t)$: publicization is stable under operational noise (not a pathological boundary condition).

Modeling-choice boundary. The specific functional Φ , the rescalings, and Θ_{crit} are per-system modeling choices, justified empirically/theoretically per context. The class fixes structure; it does not supply universal values.

Naming firewall. The cognitive analogue — the Subjective Publicization Index (SPI) — is owned by the cognitive program in Supplement II and named by structural analogy only. The parallel is structural only; no evidential weight transfers between regimes.

Part 6 — Redundancy and Information-Theoretic Objectivity

Holevo information $\chi(E:F_j) = S(\sum_k p_k \rho_{F_j}^{\{k\}}) - \sum_k p_k S(\rho_{F_j}^{\{k\}})$ bounds the classical information about E extractable from fragment F_j . Objectivity (quantum-Darwinism sense) arises when many disjoint fragments each carry near-complete information: $\chi(E:F_j) \geq (1-\delta)\chi(E:F)$. The event-layer framework extends this by (1) separating durability as an independent requirement, (2) providing explicit closure semantics, (3) defining t_{pub} as the threshold of durable redundancy. Redundancy is necessary but not sufficient (requires durability; see Independence Constructions).

Part 7 — Time Taxonomy (shared, firewall-exempt vocabulary)

This taxonomy is the shared vocabulary artifact for distinguishing senses of time across the program. Organized by what is measured, not by philosophical label:

Label	What is measured	Domain	What it is <i>not</i>
Metrological	standardized duration unit / time scale	engineering, metrology	not a fundamental “flow”
Proper	invariant elapsed time along a worldline	SR/GR local	not a global clock; path-dependent
Coordinate	a label in a chosen chart/foiliation	GR modeling	not directly measured; not unique
Evolution	parameter indexing dynamical laws	classical/quantum dynamics	not a record of when facts occur
Operational quantum	a time-tagged measurement outcome distribution	experiment-specific	not a universal time operator
Relational	conditional ordering relative to a subsystem clock	closed/constrained systems	not unique; clock-choice dependent
Event	when a durable record is established	any regime with records	not defined by coordinate t alone
Publicization	earliest time a record is shareable/stably accessible	multi-agent	not “instantaneous collapse time”
Subjective	perceived duration/order	cognitive/neural	not metrological time
Representational	internal ordering for inference/control	agent models (bio/AI)	not a physical clock reading

Scope locks: no new physical time variable is proposed; evolution time is not measured clock time by default; event/publicization time is a record-based factuality criterion, not a collapse mechanism; subjective/representational time is descriptive, built over event anchors (no upward claim); extreme regimes are treated as regime limits.