Invariant Temporal Ordering Framework V28/F8: A Foundational Historical-Critical Reconstruction of Transformation Semantics, Physical Production Linkage, and Successor Attribution

Youssry Ghandour
Independent Researcher

ITOF Foundation Series VIII (F8)
July 23, 2026

Abstract

The Invariant Temporal Ordering Framework V28/F8 reconstructs the ontology of time from one common cosmic-stage domain and one fixed, irreversible earlier–later ordering, represented by $T_{\text{ITOF}} = (\mathcal{S}_C, \prec_C)$. Time denotes the universal ordering and succession of common cosmic stages in one common cosmic extension. It does not denote matter, energy, a field, a force, a coordinate, a metric interval, a proper-time functional, a clock output, a moving carrier, or a causal participant in physical change.

V28/F8 adopts one actual first cosmic stage, physically realized with the origin of the universe understood as the totality of all physically realized systems. The first stage is not changeless: the identities present there undergo their first bearer-specific positive physical realizations. The Cosmic Moment Axiom governs every actual common cosmic stage, including the first. For a bearer with an earlier identity member, $\text{FurtherReal}_A(r, s)$ records the ordering of two positive realizations and does not independently assert a difference in their contents. No greatest cosmic stage is postulated, so universal termination is not inevitable; however, under the adopted eventual-ending, non-terminal outcome-closure, and no-infinite-same-stage-cascade commitments, a cosmic stage is greatest exactly when it is the universal terminal stage.

The complete cosmic domain is distinguished from the prefix attained relative to a reference stage. Every physical bearer has one unique formation member and, under the explicit eventual-ending postulate, one unique ending member in its complete identity history; formation, ending, and prediction windows remain epistemic localizations. One-stage bearer histories are admissible. A non-terminal ending must have a physically continuous outcome, but it produces a successor only where an actual stage-indexed production incidence is realized. An ending may instead, or additionally, contribute to already extant bearers. Conservation, similarity, shared constituents, records, and naming do not identify a successor or transfer numerical identity.

Ontic facts, states, measurements, records, model representations, and scientific warrant remain categorically distinct. Successor acyclicity follows from explicit successor-model constraints

rather than from time, cosmic order, CMA, or conservation alone, and no finite primordial-rooted lineage theorem is adopted. Within ITOF, relativistic coordinates, metrics, proper-time functionals, spacetime geometries, and clock outputs are rejected as definitions or identities of time, without any claim of compatibility or reconciliation. The framework nevertheless retains an explicit empirical burden: a scientifically warranted later-stage counterinstance to positive bearer realization contradicts bearer-relative UCC and, under the relevant membership conditions, CMA, while finite null records remain protocol-bounded evidence governed by preregistered rejection criteria.

Version lineage and revision status. V28/F8 is a sequential historical-critical successor to V27/F7 [1]. V27/F7 remains the immediate comparison baseline, but V28/F8 independently adopts after sequential re-evaluation: one actually realized first cosmic stage; CMA at every actual cosmic stage including that first stage; one unique actual formation member and one unique eventual ending member for every bearer history; a stage-relative distinction between the complete cosmic domain and the prefix attained by a reference stage; physical-outcome closure for non-terminal endings; and typed successor production only where a new identity is physically produced. These commitments are not inherited automatically from V26/F6 or any earlier draft. The present version retains the corrected production-incidence semantics, the separation of ontic facts from scientific warrant, the distinction between continuing contributors and ending productive predecessors, the admission of one-stage bearer histories, successor acyclicity derived from the declared same-stage cascade constraint, and an independent optional production-dependence route. It neither equates every physical outcome with successor formation nor adopts a finite primordial-rooted lineage theorem.

Canonical definition of time

Time denotes the universal ordering and succession of common cosmic stages in one common cosmic extension.

$$T_{\mathrm{ITOF}} = (\mathcal{S}_C, \prec_C).$$

Here $\mathcal{S}_C$ is the complete extensional domain of common cosmic stages physically realized in the actual cosmic history, and $\prec_C$ is their one fixed and irreversible earlier–later ordering. Complete-domain quantification is not a claim that a later member is already attained at an earlier member. Stage-relative attainment is represented separately by $\mathcal{S}_C^{\leq a}$ and $\mathrm{AttainedBy}(s; a)$. The definition does not assign physical content, causal power, motion, metric magnitude, or clock output to time. Time is not a physically influencing factor, does not cause physical change, and does not possess the constitutive properties, capacities, or mechanisms of physical factors. The physical content, magnitude, rate, mechanism, influence, and observability of change remain properties, relations, or realized engagements of actual physical systems.

Cosmic Moment Axiom

The cosmic-stage population condition states:

$$\mathrm{CSP}: \quad \forall s \in \mathcal{S}_C, \qquad \mathcal{S}_{\mathrm{phys}}(s) \neq \varnothing.$$

The independently adopted cosmic-origin postulate fixes one actual least stage:

$$s^0_{\mathrm{C}} \in \mathcal{S}_C, \qquad \neg\exists r \in \mathcal{S}_C\,(r \prec_C s^0_{\mathrm{C}}).$$

A non-vacuous applied succession additionally requires at least one actual later stage:

$$\mathrm{NCEC}: \quad \exists s \in \mathcal{S}_C\,(s^0_{\mathrm{C}} \prec_C s).$$

The axiom is

$$\boxed{\mathrm{CMA}: \quad \forall s \in \mathcal{S}_C\, \forall A \in \mathcal{S}_{\mathrm{phys}}(s)\,\Big(\mathrm{Present}_{\mathrm{C}}(A; s) \wedge \mathrm{PhysReal}^{+}_{A}(s)\Big)}.$$

At every actual common cosmic stage, all physical systems whose identities are then realized are present at that same stage and each undergoes its own bearer-specific positive physical realization. At s^0_{C}, this includes the identity-forming realization through which each initially present bearer becomes actual. At any later stage, CMA covers every bearer then present: identity-forming realization where a bearer begins there, later-history realization where that bearer has an earlier identity member, and identity-ending realization where its unique ending boundary is attained. These bearer-relative classifications are governed by their separate definitions; CMA itself does not determine which classification applies. The superscript + denotes positive physical realization, not necessarily a numerical difference from an earlier state. CSP, the cosmic-origin postulate, NCEC, and CMA have different logical roles. None makes time, the stage, or the ordering relation a cause of change. The full typed statement is given in Axiom 5.1.

Core notation at a glance.

$\mathcal{S}_C$	Complete extensional domain of actually realized common cosmic stages, with least member s^0_{C}.
$\mathcal{S}_C^{\leq a}$, $\mathrm{AttainedBy}(s; a)$	Stage-relative attained prefix and attainment relation at reference stage a.
$\prec_C$	One fixed and irreversible earlier–later ordering on $\mathcal{S}_C$.
T_{ITOF}	ITOF temporal denotation, defined by $(\mathcal{S}_C, \prec_C)$.
I_A	Identity domain of physical bearer A.
$\mathcal{H}_A$	Identity-bounded physical history $(I_A, \prec_C\,\vert_{I_A}, X_A)$.
$\mathrm{AttainedFormation}_A(f)$, $\mathrm{End}_A(e)$	Unique formation and ending boundary classifications in a complete bearer history.
$\mathrm{PhysReal}^{+}_{A}(s)$	Bearer-specific positive physical realization in A at stage s.
CMA, UCC(A)	Universal common-stage axiom and its bearer-relative continuity consequence.

Contents

1. Foundational Position and Dependency Order

1.1 The point of departure

V28/F8 distinguishes four foundational roles without deriving one type from another: actual physical systems and their bearer-specific physical realizations; the primitive common cosmic-stage domain $\mathcal{S}_C$; the fixed irreversible earlier–later order $\prec_C$ on that domain; and the bearer–stage membership relation by which a realized system belongs to $\mathcal{S}_{\text{phys}}(s)$. The universe denotes the totality of all physical systems without exception. Time denotes neither those systems nor their changes; it denotes the universal ordering and succession of the common cosmic stages in one common cosmic extension.

The governing architecture is non-generative:

$$\text{physical systems and bearer-specific realization: physical ontology,}$$
$$(\mathcal{S}_C, \prec_C): \ \text{temporal denotation,}$$
$$A \in \mathcal{S}_{\text{phys}}(s): \ \text{bearer–stage membership,}$$
$$\text{CMA}(s): \ \text{independent common-stage presence-and-realization axiom.}$$

No arrow from physical change creates a stage or its order, and no definition of a stage or time produces physical change. CMA supplies the independent universal physical claim at every actual common cosmic stage, including the first stage. The stage is shared, while the realized state and change are bearer-specific.

1.2 Definition, domain condition, application condition, axiom, principle, and result

A definition fixes the meaning and type of a term or symbol. A domain condition constrains membership in a declared primitive domain without adding a bearer-level physical law. An application condition supplies an explicit non-vacuity commitment for applying the framework. An axiom states an independent governing physical commitment. A principle records a general constraint not generated by notation alone. A result follows from declared definitions, domain and application conditions, axioms, and principles. V28/F8 maintains the following status order:

- the time definition, physical-system meaning, identity domain, state map, and physical-history tuple are definitions;
- identity-domain nonemptiness follows analytically from applying PhysicalSystem(A) to an actually realized bearer;
- CSP is the governing population condition; the cosmic-origin postulate supplies the unique least stage s^0_{C}; and NCEC states that the applied extension contains at least one stage later than s^0_{C};
- identity-domain convexity is an independent persistence constraint; each complete bearer history additionally has one actual formation member and, under the eventual-ending postulate, one actual ending member;

- CMA is the universal axiom of common-stage presence and bearer-specific positive physical realization at every actual stage;
- formation is identity-forming positive physical realization; ending is identity-ending positive physical realization; and stage-relative attainment prevents a later boundary from being treated as already reached at an earlier reference stage;
- UCC is the bearer-relative consequence of CMA across later members of an individual identity domain and does not apply non-vacuously to a one-stage history;
- non-terminal physical-outcome closure and the primitive physical-origin and production relations are explicit physical commitments; the successor-producing ending classification is derived from an actual stage-indexed direct-successor relation, and every scientific attribution requires bearer-specific evidence and model warrant;
- process-stage sets, identity domains, and stage-resolved transformation boundaries remain distinct types, and every independently qualified intermediate bearer receives its own history;
- record gaps, first detections, and threshold events remain epistemic or operational facts unless a validated bearer-specific bridge warrants an ontological boundary;
- operational hypotheses, evidence objects, decision rules, and conclusions remain distinct protocol-bounded propositions.

1.3 Formal construction and type discipline

The principal ontological predicates are $\mathrm{PhysicalSystem}(A)$, $\mathrm{ExistsAs}(A, s)$, $\mathrm{Present}_{C}(A; s)$, and $\mathrm{PhysReal}^{+}_{A}(s)$. The identity domain is $I_A = \{s \in \mathcal{S}_C \mid \mathrm{ExistsAs}(A, s)\}$. The predicate $\mathrm{StudyQualified}_{P,M}(A)$ belongs to an epistemic and protocol-relative level and never limits the universal quantifiers of CMA.

A stage variable s is an element of $\mathcal{S}_C$; it is not a record, coordinate value, clock reading, bearer state, event point, or geometrical hypersurface. The relation $\prec_C$ is strict, transitive, total on distinct stages, fixed, and irreversible. V28/F8 does not additionally assume density, discreteness, continuity, gaplessness, countability, metricity, or equal spacing.

Stages are primitive actual ordered members of $\mathcal{S}_C$. A common cosmic stage is individuated as a distinct actual member of the one fixed irreversible ordering, not by requiring a unique observable signature, state content, or magnitude of change. At every actual common cosmic stage, CMA states bearer-specific positive physical realization for every then-existing system. A later stage remains distinct even when one or more systems realize states equivalent to earlier states under a declared criterion; recurrence of state does not reproduce, reverse, or identify the cosmic stage.

1.4 Definitions do not create physical facts

A definition of identity, formation, ending, record, state, or stage does not physically cause the corresponding occurrence. Physical systems and their actual relations realize the physical facts. Formal definitions classify those facts, preserve type boundaries, and display inferential dependencies.

1.5 No circular dependence

The time definition does not contain CMA as part of its meaning. It fixes the denotation of time as the universal ordering and succession of common cosmic stages. CMA then states the independent universal physical content realized at each actual common cosmic stage. Conversely, CMA does not define $\prec_C$, create stage identity, or cause the existence of a stage. This separation prevents a definition of time from proving physical change and prevents physical change from being treated as a generator of temporal objects.

1.6 Historical-critical inheritance from V27/F7 to V28/F8

V28/F8 is constructed by sequential historical-critical review of the V27/F7 preprint [1], not by additive compilation of earlier versions. V27/F7 remains the immediate comparison baseline, but comparison does not prevent V28/F8 from making a later, explicitly reasoned foundational choice. The governing V28/F8 reconstruction preserves one common cosmic-stage domain, one fixed irreversible earlier–later ordering, bearer-specific physical histories, the separation of ontic facts from measurement and warrant, and the rejection of relativistic quantities as definitions of time.

The present version independently adopts after sequential re-evaluation: a unique actual first cosmic stage at the physical origin of the universe; positive physical realization at that first stage and every later actual stage under CMA; one unique formation boundary and one unique eventual ending boundary for every complete bearer history; stage-relative attainment of those boundaries; and non-terminal physical-outcome closure, with successor production restricted to identity-producing endings. It also adopts after sequential re-evaluation typed many-to-many production linkage, direct incidence, finite successor closures, successor acyclicity derived from the same-stage cascade constraint, an independent optional production-dependence route, and the exclusion of an infinite same-stage cascade of one-member bearer histories. These commitments are postulates, principles, or model constraints of the appropriate type; none is represented as a theorem of strict order alone or as a consequence of conservation language. The framework does not adopt a finite primordial-rooted lineage theorem.

For every candidate element q,

$$\text{Inherited}_{V27\to V28}(q) \Longrightarrow \text{Revalidated}_{V28}(q).$$

Revalidation may preserve, reject, or deliberately revise the comparison baseline, but no notation or earlier occurrence of a claim substitutes for that review.

1.7 Governing commitments and derived results

The governing commitments are: the universe is the totality of actual physical systems; s^0_{C} is the actual least cosmic stage at which the universe and its initially present systems are physically realized; CSP classifies every cosmic stage as physically populated; NCEC supplies at least one stage later than s^0_{C}; CMA governs every actual common cosmic stage; the complete cosmic domain is distinguished from the prefix attained by a reference stage; identity persistence is order-convex; every complete bearer history has one unique formation member and one unique eventual ending member; every non-terminal ending has a physically continuous outcome, while successor production is asserted only for an identity-producing ending; and bearer-specific change is grounded in the physical bearer and its actual factors and engagements. UCC follows from CMA only over bearer-relative later members and therefore remains distinct from first-stage or formation-stage realization. Scientific attribution of formation, ending, physical origin, transformation, outcome continuation, and successorship requires bearer-specific identity criteria and independent domain warrant. A universal final cosmic stage is physically conditional, not asserted as inevitable; under Proposition 11.8, its existence is equivalent to the existence of a greatest cosmic stage under the adopted closure package.

2. The Universe as the Totality of All Physical Systems

2.1 Governing meaning

Define

$$\text{Universe} := \text{TotalityOfAllPhysicalSystems}, \qquad \mathcal{U}_{\text{phys}} := \{A \mid \text{PhysicalSystem}(A)\}.$$

The universe is not a second-order bearer added above those systems and does not possess one independent bearer history $\mathcal{H}_U$. References to cosmic physical history denote the plurality of physical-system histories within the one common cosmic ordering, not a single bearer history belonging to an additional cosmic object.

2.2 The first cosmic stage and the conditional terminal stage

Postulate 2.1 (Cosmic Origin Postulate)**.** The cosmic-stage domain has one unique actual least member s^0_{C}:

$$s^0_{\mathrm{C}} \in \mathcal{S}_C, \qquad \neg\exists r \in \mathcal{S}_C\,(r \prec_C s^0_{\mathrm{C}}), \tag{1}$$

and therefore, by totality,

$$\forall s \in \mathcal{S}_C, \qquad s = s^0_{\mathrm{C}} \vee s^0_{\mathrm{C}} \prec_C s.$$

The physical origin of the universe is the realization of that first common stage together with its nonempty population and the identity formation of every initially present bearer:

$$\begin{aligned} &\mathcal{S}_{\text{phys}}(s^0_{\mathrm{C}}) \neq \varnothing \\ &\qquad\qquad \wedge \forall A \in \mathcal{S}_{\text{phys}}(s^0_{\mathrm{C}})\, \text{IdentityFormationRealized}_A(s^0_{\mathrm{C}}). \end{aligned} \tag{2}$$

The conjunction in Equation (2) is the cosmic-origin realization; no additional predicate or second-order cosmic bearer is introduced. CMA separately supplies the universal positive-realization commitment at s^0_{C}, while the formation classification identifies the subtype realized by the initially present bearers. The postulate therefore does not duplicate $\text{PhysReal}^+_A(s^0_{\mathrm{C}})$ as a separate physical premise and does not introduce a changeless preliminary stage.

A final cosmic stage is not postulated as inevitable because the existence of a greatest member of $\mathcal{S}_C$ is not postulated. The terminal conditions state that all systems then present end there, no new bearer forms, and no successor or later cosmic stage is realized. Under the adopted closure package, Proposition 11.8 proves that a greatest cosmic stage exists exactly when a universal terminal stage exists. Thus the beginning is a governing postulate of V28/F8, whereas universal ending remains a conditional physical possibility whose existence is equivalent to, but does not independently guarantee, a greatest cosmic stage.

2.3 Physical-system status and study qualification

The ontological predicate is

$$\mathrm{PhysicalSystem}(A).$$

A physical system is an actually realized physical bearer distinguished by an identity criterion and by the physical organization or characteristics through which that identity is realized. It is not merely a possible object, a property, factor, influence, interaction, mechanism, or record.

Its identity domain is

$$I_A := \{s \in \mathcal{S}_C \mid \mathrm{ExistsAs}(A, s)\}. \tag{3}$$

Because PhysicalSystem(A) denotes an actually realized bearer rather than a merely possible type, the governing type condition is

$$\mathrm{PhysicalSystem}(A) \Longrightarrow I_A \neq \varnothing. \tag{4}$$

This is an analytic consequence of the predicate's declared meaning, not a postulate that produces physical existence.

The predicate applies independently of present observability, detectability, classification, or experimental access. By contrast,

$$\mathrm{StudyQualified}_{P,M}(A)$$

is protocol- and model-relative. It may be false or unsettled even when PhysicalSystem(A) is true. Therefore no universal axiom is restricted to study-qualified systems.

2.4 All systems and local classifications

Subsystem, composite, organism, molecule, clock, planet, field configuration, and other classifications identify bearers under domain-specific criteria. Such classifications may overlap or be nested. They do not divide the common cosmic stage and do not create private temporal domains.

2.5 No temporal container

The phrase "systems exist in time" is avoided when it suggests a temporal container. The precise claim is that a system's identity is physically realized at members of the common cosmic-stage domain. The system, its state, and its change are physical. Time denotes the universal ordering and succession of the common cosmic stages in the one common cosmic extension.

3. Necessary Bearer-Specific Change

3.1 Change as part of the Cosmic Moment Axiom

Bearer-specific physical realization is no longer governed by an axiom independent of CMA. It is included in the reconstructed Cosmic Moment Axiom. The bearer-level existence–change statement is the following consequence:

$$\mathrm{ECP}(A, s): \quad A \in \mathcal{S}_{\mathrm{phys}}(s) \Longrightarrow \mathrm{Present}_{\mathrm{C}}(A; s) \wedge \mathrm{PhysReal}_A^{+}(s).$$

ECP is therefore a named consequence, not an additional principle. This avoids duplicating the same universal quantification in two foundational laws.

3.2 Why physically realized change may remain unobserved

A physically realized change may remain unresolved because it lies below instrument sensitivity, occurs outside the selected variables, is masked by compensating effects, remains within a declared stability tolerance, falls between sampling operations, is obscured by noise or uncertainty, is inaccessible through the available signal path, or becomes noticeable only through cumulative manifestation. Resolution of a noticeable effect is therefore not the ontological beginning of change. Bearer-specific change does not begin with examination, pause during measurement, or end when a record is obtained. CMA governs every actual common cosmic stage, while the derived UCC result governs every later member of the relevant bearer identity history; identity-forming and identity-ending change remain classified by their own boundary conditions. These commitments apply before, during, and after the finite protocol wherever the relevant bearer identity is realized.

Non-detection and unspecified change content

$$\begin{aligned} &\neg\,\mathrm{Detected}_{P,M,\varepsilon}(A, s) \not\Rightarrow \neg\,\mathrm{PhysReal}_A^{+}(s),\\ &\neg\,\mathrm{Detected}_{P,M,\varepsilon}(A, s) \not\Rightarrow \mathrm{SpecifiedHiddenChange}_A(s). \end{aligned} \tag{5}$$

Equation (5) states both limits. The first non-entailment prevents absence of a record from being treated as absence of change. The second prevents non-detection from being used to invent a particular content, magnitude, or mechanism. CMA governs positive bearer-specific physical realization at every actual stage; domain evidence governs what that change was and how it occurred.

Truth-valued realization predicates are not compared as if they were change contents. Define the realized-content domain

$$I_A^{\mathrm{real}} := \{s \in I_A \mid \mathrm{PhysReal}_A^{+}(s)\}.$$

For every actual physical bearer, universal CMA entails $I_A^{\mathrm{real}} = I_A$. The restricted notation is retained as a local typing device for occurrence and content maps, so those definitions do not silently use CMA as part of their meaning; the equality is a consequence of the axiom, not a definition of PhysReal. Let $\mathfrak{C}_A$ be the declared bearer-specific realization-content codomain and define

$$\mathcal{C}_A : I_A^{\mathrm{real}} \longrightarrow \mathfrak{C}_A, \qquad \mathcal{C}_A(s) := \mathrm{RealizationContent}_A(s).$$

Thus change content is assigned only where positive physical realization is asserted. For two systems at the same stage, both realization predicates may be true:

$$\mathrm{PhysReal}_A^+(s) \wedge \mathrm{PhysReal}_B^+(s).$$

Their change contents can be compared only after declared maps into a common comparison domain:

$$\Psi_A^{\mathcal{C}} : \mathfrak{C}_A \longrightarrow \mathfrak{C}_{AB}, \qquad \Psi_B^{\mathcal{C}} : \mathfrak{C}_B \longrightarrow \mathfrak{C}_{AB}.$$

A bearer-specific difference under a declared criterion may then be written

$$\Psi_A^{\mathcal{C}}(\mathcal{C}_A(s)) \not\equiv_{\Gamma_{AB}^{\mathcal{C}}} \Psi_B^{\mathcal{C}}(\mathcal{C}_B(s))\,.$$

The displayed non-equivalence is not inferred merely from the truth of the two realization predicates. No cross-bearer comparison is assumed without a common codomain or explicit comparison maps.

3.3 Internal factors and actual physical engagements

For a bearer A, represent the declared physical ground of realization as the typed pair

$$\mathcal{G}_A(s) := \Big(\mathcal{I}_A(s), \mathcal{E}_A(s)\Big),$$

where $\mathcal{I}_A(s)$ denotes declared internal physical factors and $\mathcal{E}_A(s)$ denotes actual physical engagements with other systems, fields, exchanges, boundary conditions, and environments. The ordered pair prevents an unproved set-theoretic union of differently typed objects. The distinction is analytical and high-level, not a claim that every physical mechanism decomposes uniquely or exclusively into two independent classes.

A participating physical system may itself be an influencing bearer in another system's engagement domain, while remaining bearer-distinct from the system it influences. Conversely, a physical factor is not thereby a separate system: it may be a state, property, relation, exchange, boundary condition, or mechanism borne by one system or realized among several systems. Thus

$$\mathrm{InfluencingBearer}(B, A; s) \Longrightarrow \mathrm{PhysicalSystem}(B),$$

but

$$\mathrm{RelevantPhysicalFactor}(F, A; s) \not\Rightarrow \mathrm{PhysicalSystem}(F).$$

System-to-system interaction, overlapping influence, and part–whole engagement do not erase bearer identity. They specify physically relevant relations among distinct or compositionally related bearers and belong to the physical ground of change rather than to time, the common stage, or the ordering relation.

Let $\mathfrak{O}_A^{\mathrm{real}}$ be the bearer-specific domain of realized physical-occurrence objects. Define the occurrence-object map only on the realized domain:

$$\omega_A : I_A^{\mathrm{real}} \longrightarrow \mathfrak{O}_A^{\mathrm{real}}, \qquad s \longmapsto \omega_A(s) := \mathrm{OccurrenceObject}(A, s),$$

with

$$\mathrm{Realized}(\omega_A(s)), \qquad s \in I_A^{\mathrm{real}}.$$

By the definition of I_A^{real}, an occurrence object is introduced only at a stage for which $\mathrm{PhysReal}_A^+(s)$ is asserted. For every such stage,

$$s \in I_A^{\mathrm{real}} \Longrightarrow \mathrm{GroundedIn}(\omega_A(s), \mathcal{G}_A(s)) .$$

The grounding relation therefore takes a realized physical occurrence object rather than a truth-valued proposition as its first argument. Time, the stage, and the succession relation are excluded from the causal ground.

3.4 No motion, materiality, or machinery of stages

A cosmic stage is not matter, energy, a field, a mechanism, a carrier, or a moving entity. It does not enter a bearer, transport it, or produce its change. Physical systems do not move from one stage-object to another. A later stage is the common stage at which later physical realization is actual.

3.5 Physical grounding, localized change, and bearer scale

A localized alteration may warrant change in the bearer to which it is validly attributed, but attribution must preserve bearer and scale. A molecular change does not automatically establish the ending of an organism; a cellular record does not automatically represent the complete state of the organism; and a change in a subsystem may coexist with persistence of the composite identity. Chemical, genetic, biological, and macroscopic applications therefore require explicit part–whole and identity criteria.

4. Cosmic Succession, Common Extension, and the Meaning of Time

4.1 Canonical definition

Canonical definition

Definition 4.1. Time denotes the universal ordering and succession of common cosmic stages in one common cosmic extension.

$$T_{\mathrm{ITOF}} = (\mathcal{S}_C, \prec_C). \tag{6}$$

Time is not a physically influencing factor, does not cause physical change, and does not possess the constitutive properties, capacities, or mechanisms of physical factors. The physical content and causal grounding of change belong to actual physical systems and to the states, properties, relations, exchanges, and mechanisms physically borne by or realized among them.

Here $\mathcal{S}_C$ denotes the complete extensional domain of common cosmic stages physically realized in the actual cosmic history, and $\prec_C$ their one fixed and irreversible earlier–later ordering. Fixity means that once $r \prec_C s$, the order does not reverse or become interchangeable. The stages taken together form the one common cosmic extension. Neither the extension, the stage, nor the ordering relation is a moving carrier, physical container, or causal mechanism.

For every reference stage $a \in \mathcal{S}_C$, define the attained cosmic prefix and the stage-relative attainment predicate by

$$\mathcal{S}_C^{\leq a} := \{s \in \mathcal{S}_C \mid s = a \ \lor \ s \prec_C a\}, \tag{7}$$

$$\mathrm{AttainedBy}(s; a) \iff s \in \mathcal{S}_C^{\leq a}. \tag{8}$$

The complete-domain notation is theory-level, extensional, and tenseless as a mode of quantification. It does not assert physical co-attainment of all stages, make a later member physically attained at an earlier member, or turn the cosmic extension into a pre-existing container. If $a \prec_C v$, then $v \notin \mathcal{S}_C^{\leq a}$, even when the complete actual history contains v. Accordingly, an earlier protocol may predict or constrain a later outcome without warranting that outcome as already attained, and later actuality is never inferred from prediction alone.

The common cosmic extension consists in the universally shared succession of common cosmic stages under one fixed irreversible earlier–later ordering. It is not an independently acting entity and it does not contain, transport, or produce the bearer-specific physical changes realized at its stages.

4.2 Meaning and identity of cosmic stages

Every $s \in \mathcal{S}_C$ is a primitive member of the one common ordered domain. Its identity is not defined by a bearer state, selected observable, coordinate value, record, clock output, or geometrical slice. Under CMA, each actual common cosmic stage expresses the co-presence and bearer-specific physical realization of every system then extant:

$$s \in \mathcal{S}_C \quad \overset{\text{expresses}}{\longmapsto} \quad \left\{ \left(\mathrm{Present}_{\mathrm{C}}(A; s), \mathrm{PhysReal}_A^{+}(s) \right) \mid A \in \mathcal{S}_{\mathrm{phys}}(s) \right\}.$$

The arrow is expressive, not causal or productive.

4.3 The common domain, succession, and order type

For $r, s, u \in \mathcal{S}_C$, the adopted order is strict, transitive, and total on distinct members:

$$\neg(s \prec_C s), \qquad (r \prec_C s \wedge s \prec_C u) \Longrightarrow r \prec_C u,$$

$$r \neq s \Longrightarrow (r \prec_C s) \vee (s \prec_C r).$$

The order is fixed and irreversible. The independent Cosmic Origin Postulate supplies the unique least member s_C^0; this endpoint is not derived from strict total order alone. V28/F8 does not infer that the domain is dense, discrete, continuous, gapless, metric, countable, equally spaced, or equipped with immediate successors. No greatest member is postulated. Under Proposition 11.8, any greatest member would be exactly the universal terminal stage under the adopted ending-and-closure package.

4.4 What the definition excludes

Time does not denote matter, energy, a field, a force, a coordinate, a metric interval, a proper-time functional, a clock output, a causal participant in change, or a physically influencing factor. It neither causes physical change nor possesses the constitutive properties, capacities, or mechanisms through which physical factors act. These exclusions are governing type boundaries. Separate physical arguments are required for any broader criticism of a model that uses those objects.

4.5 The extension is common

No system possesses a private domain of cosmic stages. A bearer's identity domain is a subset of the common domain:

$$I_A \subseteq \mathcal{S}_C.$$

Different formation histories, terminations, state paths, and records therefore constitute different bearer-specific physical histories within the same cosmic ordering, not different times.

5. The Common Cosmic Stages and the Cosmic Moment Axiom

5.1 The common cosmic stages

At a common cosmic stage s, every physical system whose identity is then realized is present at that same stage. Spatial separation, signal delay, different state content, and unequal clock readings do not divide the stage. Presence does not mean instantaneous communication, equal physical conditions, or a common mechanism of change.

Define

$$\mathcal{S}_{\mathrm{phys}}(s) := \{A \in \mathcal{U}_{\mathrm{phys}} \mid \mathrm{ExistsAs}(A, s)\} = \{A \in \mathcal{U}_{\mathrm{phys}} \mid s \in I_A\}.$$

For each $A \in \mathcal{S}_{\text{phys}}(s)$,

$$\text{Present}_{\text{C}}(A; s) \iff \text{PhysicalSystem}(A) \wedge s \in I_A.$$

Accordingly,

$$A \in \mathcal{S}_{\text{phys}}(s) \iff \text{Present}_{\text{C}}(A; s).$$

The explicit occurrence of $\text{Present}_{\text{C}}$ in CMA is retained for semantic emphasis on universal common-stage presence; it adds no independent condition beyond membership in $\mathcal{S}_{\text{phys}}(s)$.

The cosmic-stage population condition is

$$\boxed{\text{CSP}: \quad \forall s \in \mathcal{S}_C, \qquad \mathcal{S}_{\text{phys}}(s) \neq \varnothing}. \tag{9}$$

This condition states that every actual cosmic stage is physically populated. It is logically distinct from the Cosmic Origin Postulate and from CMA: population does not itself assert bearer-specific change, and CMA does not create the domain or its systems.

Because s^0_{C} is the actual least member, a non-vacuous applied succession is stated by

$$\boxed{\text{NCEC}: \quad \exists s \in \mathcal{S}_C \, (s^0_{\text{C}} \prec_C s)}. \tag{10}$$

This is an application condition asserting that the actual extension contains at least one stage after cosmic origin. It does not impose a greatest member, metric, discreteness, countability, or an immediate successor of s^0_{C}.

Define the global later-stage predicate and bearer-relative later-history predicate by

$$\text{Later}_{\text{C}}(s) \iff s \in \mathcal{S}_C \wedge s^0_{\text{C}} \prec_C s, \tag{11}$$

$$\text{LaterInHistory}_A(s) \iff s \in I_A \wedge \exists r \in I_A \, (r \prec_C s). \tag{12}$$

The first predicate excludes only s^0_{C}; the second states that the bearer itself has an earlier identity member. Neither predicate defines physical change.

5.2 Governing statement

Axiom 5.1 (Cosmic Moment Axiom)**.** At every actual common cosmic stage, every physical system whose identity is then realized is present at that same stage and undergoes its own bearer-specific positive physical realization:

$$\boxed{\text{CMA}: \quad \forall s \in \mathcal{S}_C \, \forall A \in \mathcal{S}_{\text{phys}}(s) \Big(\text{Present}_{\text{C}}(A; s) \wedge \text{PhysReal}^+_A(s)\Big)}. \tag{13}$$

The non-emptiness of $\mathcal{S}_{\text{phys}}(s)$ is supplied by CSP, while the existence and leastness of s^0_{C} are supplied by Postulate 2.1. CMA neither defines those commitments nor follows from them.

The stage-indexed form is

$$\text{CMA}(s) \iff s \in \mathcal{S}_C \wedge \forall A \in \mathcal{S}_{\text{phys}}(s) \Big(\text{Present}_{\text{C}}(A; s) \wedge \text{PhysReal}^+_A(s)\Big). \tag{14}$$

The universal axiom asserts $\forall s \in \mathcal{S}_C$ CMA(s). At s_{C}^0, positive realization is the identity-forming realization of the initially present bearers and requires no earlier state of the same bearer. The superscript + states positive physical realization at one bearer–stage pair; it does not itself encode a comparison with an earlier occurrence. The ordered bearer-relative relation is therefore defined separately:

$$\mathrm{FurtherReal}_A(r,s) \iff r,s \in I_A \wedge r \prec_C s \wedge \mathrm{PhysReal}_A^+(r) \wedge \mathrm{PhysReal}_A^+(s). \tag{15}$$

Thus $\mathrm{FurtherReal}_A(r,s)$ is an ordered-bearer bookkeeping relation between two positive realizations of the same identity. Under universal CMA, once $r,s \in I_A$ and $r \prec_C s$ are fixed, the two PhysReal conjuncts are already supplied; consequently FurtherReal does not constitute an additional witness of physical realization or of unequal realization content. It does not state that one change object moves from r to s, and it does not determine or entail a difference in magnitude, content, state, or mechanism. Any such difference requires a separately declared bearer-content comparison and warrant.

5.3 Bearer specificity and non-causation

For $A, B \in \mathcal{S}_{\mathrm{phys}}(s)$, CMA does not entail equal state, content, magnitude, mechanism, distribution, rate, or observability:

$$\mathrm{CMA}(s) \nRightarrow \mathrm{SameChangeContent}_{A,B}(s), \qquad \mathrm{CMA}(s) \nRightarrow \mathrm{SameChangeMagnitude}_{A,B}(s),$$

$$\mathrm{CMA}(s) \nRightarrow \mathrm{SameChangeMechanism}_{A,B}(s) \wedge \mathrm{SameObservability}_{A,B}(s).$$

Coincidental similarity remains possible under a declared comparison criterion; it is not supplied by common-stage unity.

The physical ground belongs to each bearer and its actual factors and engagements. Time, the stage, and $\prec_C$ do not cause, energize, transport, or mechanize the change.

5.4 Spatial separation

If A and B are spatially distant and both belong to $\mathcal{S}_{\mathrm{phys}}(s)$, their distance does not split s or postpone either bearer's physical realization to a different common stage. Define

$$\mathrm{CoPresent}_{\mathrm{C}}(A,B;s) \iff \mathrm{Present}_{\mathrm{C}}(A;s) \wedge \mathrm{Present}_{\mathrm{C}}(B;s).$$

Then

$$A,B \in \mathcal{S}_{\mathrm{phys}}(s) \Longrightarrow \mathrm{CoPresent}_{\mathrm{C}}(A,B;s),$$

but

$$\mathrm{CoPresent}_{\mathrm{C}}(A,B;s) \nRightarrow \mathrm{SignalExchange}(A,B;s),$$
$$\mathrm{CoPresent}_{\mathrm{C}}(A,B;s) \nRightarrow \mathrm{CausalInfluence}(A,B;s).$$

Distance affects propagation, records, synchronization procedures, and observational access. It does not create private stage domains or a signal requirement for common-stage membership. No signal creates common-stage presence, and CMA implies no instantaneous causal channel.

Spatial separation, signal delay, and epistemic access

For any $A, B \in \mathcal{S}_{\text{phys}}(s)$, spatial separation and signal delay have no effect whatsoever upon their membership in the same common cosmic stage s:

$$\begin{aligned} &A, B \in \mathcal{S}_{\text{phys}}(s) \wedge \text{Dist}(A,B) > 0 \wedge \text{SignalDelay}(A,B) > 0 \\ &\quad \Longrightarrow \text{CoPresent}_{\text{C}}(A,B;s). \end{aligned} \tag{16}$$

Neither propagation duration nor delayed reception divides, postpones, deforms, or reassigns that stage. The relation $\text{CoPresent}_{\text{C}}(A,B;s)$ is an ontic common-stage proposition, not an operational synchronization rule and not a clock output. Distance and signal delay affect only causal interaction, record production, transmission, reception, and epistemic reconstruction. They do not affect the cosmic stage itself.

A scientific assertion assigning two reconstructed distant occurrences to one exact s requires a separately validated attribution and reconstruction bridge:

$$\text{Warrant}_{P,M}[\text{CoPresent}_{\text{C}}(A,B;s)] \not\Rightarrow \text{InstantaneousCausalChannel}(A,B;s). \tag{17}$$

This requirement concerns the observer's warrant, never the ontic unity of the stage. Where records do not determine one exact stage, the admissible empirical result may be an ordering bound or localization window. That limitation belongs solely to knowledge and reconstruction; it neither divides the common stage nor delays the physical realization of either distant bearer.

6. Identity Formation, Domain Continuity, and Physical Origin

6.1 Cosmic origin and bearer formation are distinct levels

The first cosmic stage is the physical origin stage of the universe as the totality of initially realized systems. It does not follow that every later bearer already existed at s^0_{C}. Stars, organisms, instruments, composite systems, and other later identities form at their own bearer-specific boundaries within the same cosmic ordering.

6.2 Actual formation boundary and evidential resolution

Define the attained formation classification for an arbitrary bearer–stage pair by

$$\boxed{\text{AttainedFormation}_A(f) \Longleftrightarrow f \in I_A \wedge \text{IdentityFormationRealized}_A(f) \wedge \neg\exists r \in I_A\,(r \prec_C f)}. \tag{18}$$

The predicate combines stage membership, the domain-specific identity-formation occurrence, and leastness within the bearer identity domain. It does not derive formation from leastness alone.

Postulate 6.1 (Actual Formation Boundary)**.** Every physically realized system has one and only one attained formation member:

$$\boxed{\forall A \in \mathcal{U}_{\text{phys}}\ \exists! f \in I_A\ \ \text{AttainedFormation}_A(f)}. \tag{19}$$

For that unique member, write

$$f_A := \iota f \in I_A \ \ \mathrm{AttainedFormation}_A(f), \qquad f_A = \min_{\prec_C} I_A.$$

The independently adopted ontic boundary-exclusivity condition constrains every formation occurrence to the least member of the same bearer identity domain:

$$\forall A \in \mathcal{U}_{\mathrm{phys}}\ \forall s \in \mathcal{S}_C, \qquad \mathrm{IdentityFormationRealized}_A(s) \Longrightarrow [s \in I_A \wedge \neg \exists r \in I_A\,(r \prec_C s)]\,. \tag{20}$$

Together with Definition (18), this condition yields the derived equivalence

$$\mathrm{IdentityFormationRealized}_A(s) \Longleftrightarrow \mathrm{AttainedFormation}_A(s).$$

Only the occurrence-to-boundary direction is independently adopted; the reverse direction is already contained in the derived boundary definition. The condition excludes any second or later use of the identity-formation predicate for the same numerical bearer. Later assembly, repair, reorganization, or phase change within a persisting identity must therefore be classified as later-history realization rather than a new formation of that same bearer.

The ontic boundary and its epistemic resolution are different types of claim. A protocol-relative estimate is written

$$\mathrm{EstimatedFormationWindow}_{P,M}(A, W), \qquad \varnothing \neq W \subseteq \mathcal{S}_C,$$

and, when scientifically warranted, constrains the unique actual boundary:

$$\mathrm{EstimatedFormationWindow}_{P,M}(A, W) \Longrightarrow f_A \in W. \tag{21}$$

The window is not an extended formation object and does not create several ontological beginnings. Improved evidence may narrow W without changing f_A. The first observation, first accepted detection, or first record of A need not equal its formation stage.

6.3 Identity-forming change and later bearer change

The actual formation member is the positive physical realization through which a new bearer identity becomes actual. Formation is a type of bearer-specific physical occurrence and is classified within $\mathrm{PhysReal}^+_A$; it is not an alteration from a nonexistent earlier state of that same bearer. The physical production or reorganization through which A forms may involve changes in predecessor or contributing systems, while $\mathrm{FormationReal}_A(f_A)$ classifies the resulting first realization of A itself. Accordingly,

$$\mathrm{IdentityFormationRealized}_A(f) \not\equiv \mathrm{StateDifferenceFromEarlierSameBearer}_A(f).$$

The two expressions are truth-valued propositions with different meanings and truth conditions. Identity-forming change requires no earlier state of A, because A is first physically realized as that bearer at its attained formation member. Define the derived identity-forming-change classification by

$$\mathrm{FormationReal}_A(f) \iff \mathrm{AttainedFormation}_A(f) \wedge \mathrm{PhysReal}^+_A(f). \tag{22}$$

Because identity formation is declared to be a type of physical change, the boundary classification carries the analytic change bridge

$$\mathrm{AttainedFormation}_A(f) \Longrightarrow \mathrm{PhysReal}^+_A(f), \tag{23}$$

not as an additional causal law but as the explicit classification of physically realized formation as change. Consequently, for every physical bearer,

$$\mathrm{AttainedFormation}_A(f) \iff \mathrm{FormationReal}_A(f),$$
$$\mathrm{FormationReal}_A(f) \Longrightarrow \neg\exists r \in I_A\,(r \prec_C f).$$

The formation bridge is a subtype-classification rule: it records that a physically realized formation boundary belongs to the general positive-realization genus. CMA independently supplies the universal all-bearer assertion at f_A, whether $f_A = s^0_{\mathrm{C}}$ or f_A is later. Their agreement is classificatory coherence, not cumulative evidence and not a claim that time, the stage, or CMA causes formation.

Later bearer alteration is classified separately by $\mathrm{LaterReal}_A(s)$. Formation-stage change and later-history realization are mutually exclusive under their defining clauses: an attained formation member has no earlier member in I_A, whereas later-history realization requires one. They are not jointly exhaustive of every bearer-stage classification. Identity-ending change is separately classified and may overlap with later-history realization when an attained ending member has an earlier member in the same identity domain. Formation, later-history realization, and ending are classifications of bearer-specific physical change; they are not different temporal domains, and no one classification defines the physical mechanism of another. Any domain claim about the mechanism of formation remains independently warranted.

6.4 Identity-domain convexity

Identity persistence is represented by order convexity within the common cosmic domain:

Principle 6.2 (Identity-Domain Convexity)**.**

$$\boxed{\mathrm{IDC}\colon \forall A \in \mathcal{U}_{\mathrm{phys}}\ \forall r,t \in I_A\ \forall s \in \mathcal{S}_C, \quad r \prec_C s \prec_C t \Longrightarrow s \in I_A}. \tag{24}$$

This principle excludes an internal absence of the bearer identity between two stages at which that identity is realized. The least member is supplied separately by Postulate 6.1; convexity itself does not produce that member, a greatest member, discreteness, topological continuity, or observationally resolvable stage-by-stage persistence.

6.5 Physical-origin relations

A claim that bearer B physically formed from direct contributors $\mathcal{P}$ at a stage-resolved formation event requires an independently warranted relation. Define

$$\begin{aligned}\text{OriginatesAt}(B,\mathcal{P},s) \iff\ & \text{FormationReal}_B(s) \wedge \varnothing \neq \mathcal{P} \subseteq \mathcal{U}_{\text{phys}} \\ & \wedge \forall A \in \mathcal{P}\left[\text{Present}_C(A;s) \wedge \text{PhysReal}^+_A(s) \wedge \exists r \in I_A\,(r \prec_C s)\right] \\ & \wedge \text{PhysicalOriginLink}(\mathcal{P},s,B).\end{aligned} \tag{25}$$

The definition makes both the successorś identity-forming change and the contributing physical realizations explicit. It does not make OriginatesAt universal, does not require every contributor to end, and does not treat the stage or time as a causal contributor. Contribution and persistence are distinct. Define

$$\text{ContinuesAfter}(A,s) \iff A \in \mathcal{U}_{\text{phys}} \wedge s \in I_A \wedge \exists u \in I_A\,(s \prec_C u).$$

Thus $\text{OriginatesAt}(B,\mathcal{P},s)$ alone neither entails nor excludes $\text{ContinuesAfter}(A,s)$ for a contributor $A \in \mathcal{P}$. A continuing contributor is asserted only when the origin relation and the separate persistence condition are both warranted. When formation is known only within a window, the origin claim must be formulated at the corresponding window resolution rather than converted into an exact-stage assertion.

6.6 Formation, change, and epistemic restraint

Formation of a bearer identity is itself identity-forming physical change and may include alteration of predecessors, assembly, division, merger, phase reorganization, or another domain-specific mechanism. It is not a change from an earlier state of the same bearer; it is the physical realization through which that bearer begins. At the actual formation member, CMA supplies positive physical realization, and UCC governs every bearer-relative later member thereafter. Where evidence resolves only a formation window, the framework retains the unique actual boundary while refusing to invent its exact stage from limited evidence. Observation may identify a formation or detectability window, but a finite record does not by itself establish the exact cosmic stage at which the identity boundary or a selected manifestation occurred.

7. Physical Systems, Identity, State, and Physical Realization

7.1 Physical systems and study-qualified bearers

A bearer is included in the universal ontology by $\text{PhysicalSystem}(A)$. Experimental eligibility is stated separately by $\text{StudyQualified}_{P,M}(A)$. The latter requires declared identity, attribution, model, and protocol conditions; it does not determine whether the bearer exists or is included in CMA. The governing bearer type is

$$\mathsf{Bearer} := \mathcal{U}_{\text{phys}},$$

and study qualification selects only from that type:

$$\mathrm{StudyQualified}_{P,M}(A) \Longrightarrow \mathrm{PhysicalSystem}(A).$$

The primitive bearer-stage predicates have signatures

$$\begin{aligned}
\mathrm{ExistsAs},\ \mathrm{PhysReal}^{+} &: \mathcal{U}_{\mathrm{phys}} \times \mathcal{S}_C \longrightarrow \{\top, \bot\},\\
\mathrm{IdentityFormationRealized},\ \mathrm{IdentityEndingRealized} &: \mathcal{U}_{\mathrm{phys}} \times \mathcal{S}_C \longrightarrow \{\top, \bot\},\\
\mathrm{PhysicalOutcomeLink} &: \mathcal{U}_{\mathrm{phys}} \times \mathcal{S}_C \times \mathcal{U}_{\mathrm{phys}} \longrightarrow \{\top, \bot\}.
\end{aligned}$$

The derived ending-outcome and successor relations have signatures

$$\begin{aligned}
\mathrm{SuccessorProducingEnd},\ \mathrm{ExtantOutcomeContinuation} &: \mathcal{U}_{\mathrm{phys}} \times \mathcal{S}_C \longrightarrow \{\top, \bot\},\\
\mathrm{SuccAt} &: \mathcal{U}_{\mathrm{phys}} \times \mathcal{U}_{\mathrm{phys}} \times \mathcal{S}_C \longrightarrow \{\top, \bot\},\\
\mathrm{Succ} &: \mathcal{U}_{\mathrm{phys}} \times \mathcal{U}_{\mathrm{phys}} \longrightarrow \{\top, \bot\}.
\end{aligned}$$

Bearer indexing is understood where required. The boundary predicates $\mathrm{AttainedFormation}_A$ and End_A, the ordered realization relation $\mathrm{FurtherReal}_A$, and the ending-outcome classifications $\mathrm{SuccessorProducingEnd}_A$ and $\mathrm{ExtantOutcomeContinuation}_A$ are derived from the declared primitive relations and bearer domains. Scientific assertion of an extant-recipient outcome is separately expressed by $\mathrm{OutcomeWarrant}_{P,M}[\cdot]$; the warrant is not a conjunct of the ontic linkage. The domain-specific ontological predicates used in the atomic application have signatures

$$\mathrm{AtomicAlterationRealized},\ \mathrm{OnticBearerAttribution} : \mathcal{U}_{\mathrm{phys}} \times \mathcal{S}_C \longrightarrow \{\top, \bot\}.$$

Here $\mathrm{OnticBearerAttribution}_A(s)$ is an ontological bearer–occurrence attribution: it states that the realized atomic alteration at stage s belongs to bearer A. It is formally distinct from protocol- and model-relative evidential predicates such as $\mathrm{ValidBearerAttribution}_{A;P,M}(J)$. These atomic predicates support a domain-specific classification rule; they are not additional universal axioms. Transformation and origin links have their separately declared set-valued signatures.

7.2 Ontic state and model-relative state representation

For each physical system A, let Ω_A^{ont} be the codomain of bearer states treated as ontically complete relative to the adopted physical ontology, the declared bearer boundary, and the identity criterion for A. This is an ontological modelling commitment, not a claim of epistemically exhaustive access to every fact about the bearer or its environment. The ontic state map is

$$X_A : I_A \longrightarrow \Omega_A^{\mathrm{ont}}.$$

For each bearer A, let $\mathcal{K}_A$ be the declared index domain of bearer components or attributable sub-descriptions associated with the projections $\pi_{A,k}$. An ontic component is $X_{A,k} = \pi_{A,k} \circ X_A$, with $k \in \mathcal{K}_A$. Every declared bearer criterion Γ_A specifies a nonempty criterion-relevant component set

$$\varnothing \neq K(\Gamma_A) \subseteq \mathcal{K}_A$$

and, for every $k \in K(\Gamma_A)$, a component comparison rule $\Gamma_{A,k}$. Criterion-indexed ontic equivalence is written

$$X_A(s) \equiv_{\Gamma_A} X_A(t),$$

and means equivalence only under the declared ontic criterion Γ_A; it does not identify the cosmic stages. The criterion must satisfy the component-consistency condition

$$X_A(s) \equiv_{\Gamma_A} X_A(t) \Longrightarrow \forall k \in K(\Gamma_A),\ X_{A,k}(s) \equiv_{\Gamma_{A,k}} X_{A,k}(t).$$

Thus a valid criterion-relevant component difference is sufficient to defeat bearer equivalence under Γ_A, while component agreement alone need not establish complete bearer equivalence unless the declared criterion supplies that converse bridge.

A protocol or model M does not directly possess the complete ontic state. It supplies a declared partial or model-limited representation

$$\rho_{A,M} : \Omega_A^{\mathrm{ont}} \dashrightarrow \Omega_{A,M}.$$

Its induced stage domain is

$$I_{A,M} := \{s \in I_A \mid X_A(s) \in \mathrm{Dom}(\rho_{A,M})\},$$

and the model-relative state map is the total map on that induced domain,

$$X_{A,M} : I_{A,M} \longrightarrow \Omega_{A,M}, \qquad X_{A,M}(s) := \rho_{A,M}(X_A(s)).$$

A selected model component is $X_{A,M,k} = \pi_{A,M,k} \circ X_{A,M}$. Equality of a selected component does not entail equality of the ontic state.

For $s, t \in I_{A,M}$, criterion-indexed equivalence at the representational level is written

$$X_{A,M}(s) \equiv_{\Gamma_{A,M}} X_{A,M}(t),$$

and means equivalence only under the declared model and criterion. It implies neither ontic equality nor recurrence of the cosmic stage. An empirical transition from model equivalence to ontic equivalence requires an independently warranted completeness bridge.

States of different systems may belong to different ontic and model codomains. A cross-bearer comparison is defined only after declared representation maps into a common comparison space. No direct equality $X_A(s) = X_B(s)$ is presumed without such a bridge.

7.3 Positive physical realization and later-history realization

The predicate

$$\mathrm{PhysReal}_A^+(s)$$

is primitive at the ontological level and states bearer-specific positive physical realization in A at stage s. In V28/F8, positive physical realization is the general change genus: it includes identity-forming realization, later-history realization while the bearer identity remains actual, and identity-ending realization when the identity ceases. It is not identical with $\mathrm{ExistsAs}(A, s)$,

$\text{Present}_{\text{C}}(A; s)$, detection, a clock reading, or a selected observable. Mere bearer presence therefore does not analytically entail $\text{PhysReal}^{+}_{A}(s)$; the universal entailment is the independent physical content of CMA. Formation and ending bridges classify already declared boundary occurrences as subtypes of this genus and are not additional empirical proofs of CMA.

Positive physical realization is an occurrence predicate, not a numerical difference operator on two recorded states. Formation does not require an earlier state of the same bearer, and ending is not mere absence after the history but the realized occurrence by which that bearer identity ceases. For $r, s \in I_{A,M}$, a comparison such as $X_{A,M}(r) \not\equiv_{\Gamma_{A,M}} X_{A,M}(s)$ may provide evidence for a noticeable bearer difference, but it neither defines $\text{PhysReal}^{+}_{A}(s)$ nor identifies the exact stage at which the underlying realization first became noticeable. The associated occurrence object $\omega_A(s)$ is introduced only on I^{real}_{A}. These classifications remain bearer-indexed: no entity called change moves, transfers, or is transported from one bearer to another.

Define the bearer-relative later-realization classification by

$$\text{LaterReal}_A(s) \Longleftrightarrow \text{LaterInHistory}_A(s) \wedge \text{PhysReal}^{+}_{A}(s). \tag{26}$$

This term does not mean that the bearer necessarily continues after s; a stage-resolved identity-ending change may occur at a stage that is later within the bearer's history. Formation-stage change and later-history realization are mutually exclusive under their defining clauses but are not jointly exhaustive of every bearer-stage classification. The derived ending-change classification is separately governed and may overlap with later-history realization where its own conditions hold.

7.4 Primitive predicates, signatures, and inferential status

Predicate and signature	**Status**	**Ontological or inferential role**
$\text{PhysicalSystem}(A)$	Primitive ontological	States that A is an actually realized identity-bearing physical bearer.
$\text{ExistsAs}(A, s)$	Primitive ontological	States that the identity of A is physically realized at s; it defines I_A.
$\text{PhysReal}^{+}_{A}(s)$	Primitive ontological	States bearer-specific positive physical realization, the general ITOF change genus encompassing identity-forming, later-history, and identity-ending realization. It is distinct from mere existence or presence and is not defined by observation or by a two-record difference.
$\text{IdentityFormationRealized}_A(s)$	Primitive ontic, domain-dependent	Classifies a stage-resolved identity-formation occurrence; scientific assertion of the occurrence requires separate bearer-specific warrant.
$\text{IdentityEndingRealized}_A(s)$	Primitive ontic, domain-dependent	Classifies a stage-resolved identity-ending occurrence; scientific assertion of the occurrence requires separate bearer-specific warrant.

Predicate and signature	Status	Ontological or inferential role
$\mathrm{AttainedFormation}_A(s)$, $\mathrm{End}_A(s)$	Derived boundary predicates	Conjoin the relevant occurrence predicate with membership and leastness or greatestness in the bearer identity domain; boundary exclusivity prevents repeated formation or ending for one numerical bearer.
$\mathrm{FurtherReal}_A(r, s)$	Derived ordered-bearer relation	Records the order between two positive realizations of the same bearer. Under CMA it adds no independent realization or content-difference witness beyond ordered same-bearer membership.
$\mathrm{TransformativeFailure}_A(s)$	Primitive physical-path predicate	Describes a physical transformation path that may ground identity ending; it is not identical with the ending result.
$\mathrm{SuccessorProducingEnd}_A(s)$	Derived ontic, domain-dependent branch classification	Holds exactly when the attained ending has at least one stage-indexed direct successor at the same boundary, as defined by Equation (78). It does not identify any particular successor, successor set, or production-incidence edge. Scientific attribution requires separate warrant and is not inferred from ending or conservation alone.
$\mathrm{PhysicalOutcomeLink}(A, s, B)$	Primitive ontic, domain-dependent relation	States a physically realized contribution from ending bearer A to recipient B; use in the extant-recipient branch additionally requires that B has an earlier member of its own identity history and remains realized after s. Scientific attribution is separately warrant-dependent.
$\mathrm{OutcomeWarrant}_{P,M}[\cdot]$	Protocol- and model-relative epistemic predicate	Licenses scientific assertion of a specified physical-outcome linkage; it does not create or enter the ontic fact.
$\mathrm{ExtantOutcomeContinuation}_A(s)$	Derived ontic relation	Classifies an outcome in which a recipient already realized before s receives the contribution at s and remains realized after that boundary.
$\mathrm{PhysicalOriginLink}(\mathcal{P}, s, B)$	Primitive ontic, domain-dependent relation	States a physical origin linkage whose scientific assertion requires separate identity, physical, protocol, and model warrant.
$\mathrm{PhysicalProductionLink}(\mathcal{P}, s, \mathcal{Q}; \mathcal{E})$	Primitive ontic, typed relation	States an actual productive linkage; its truth entails a well-typed specification but is not generated by that specification.

Predicate and signature	Status	Ontological or inferential role
$\text{TransformAt}^{\text{ont}}(\mathcal{P}, s, \mathcal{Q}; \mathcal{E})$	Derived ontic relation	Conjoins the productive linkage with ending realization for every productive predecessor and formation realization for every successor.
$\text{TransformWarrant}_{P,M}[\cdot]$	Protocol- and model-relative epistemic predicate	Warrants scientific assertion of the enclosed ontic transformation proposition; it is not a conjunct of the ontic fact.
DirectOutput, SuccAt, Succ, Succ^{+}, IndSucc	Derived ontic relations	Classify one production-incidence edge, stage-indexed direct successorship, its existential stage projection, positive finite closure, and strict indirect successorship.
NoInfiniteSameStageCascade	Successor-model coherence constraint	Excludes an infinite sequence of one-stage bearers at one common boundary; with unique formation and ending boundaries and stage-indexed successorship, it also entails finite successor acyclicity by periodic repetition.
$\lhd_{\text{tr}}$	Optional domain-model relation	When independently required to be strict and transitive and to contain every direct successor edge, it supplies a second sufficient route to successor acyclicity; it is not part of the time definition, CMA, or successorship by definition.
$\text{FormationReal}_A(s)$, $\text{LaterInHistory}_A(s)$, $\text{LaterReal}_A(s)$, $\text{EndingReal}_A(s)$	Derived	Classify identity-forming change, bearer-relative later membership and realization, and identity-ending change.
$\text{OriginatesAt}(B, \mathcal{P}, s)$	Derived ontic relation	Classifies a direct physical-origin relation; persistence of a contributor is stated separately by ContinuesAfter.
$\text{SuccW}_{P,M}(A, e, \mathcal{Q})$	Derived epistemically qualified relation	Conjoins a one-predecessor ontic transformation with its separate protocol- and model-relative warrant.

Physical realization is not identical with observation or detection:

$$\text{PhysReal}^{+}_{A}(s) \not\Rightarrow \text{Detected}_{P,M,\varepsilon}(A, s), \qquad \neg\,\text{Detected}_{P,M,\varepsilon}(A, s) \not\Rightarrow \neg\,\text{PhysReal}^{+}_{A}(s).$$

7.5 Bearer specificity

State, realization content, change mechanism, and physical history belong to the bearer. A signal, instrument, record, or model may represent selected aspects but does not replace the bearer. Cross-system comparison requires declared mappings, variables, units, identity criteria, and protocols.

8. Identity Domains and Physical Histories

8.1 Identity domain

For a physical system A, its identity domain is:

$$I_A = \{s \in \mathcal{S}_C \mid \mathrm{ExistsAs}(A, s)\}.$$

Every member of I_A belongs to the common cosmic-stage domain:

$$I_A \subseteq \mathcal{S}_C.$$

The inclusion states participation in the common extension. It does not define a private time for A. By Principle 6.2, the domain is order-convex wherever the same identity is realized at two bounding members. Convexity alone supplies neither endpoint; the unique least formation member is supplied by Postulate 6.1, while the unique greatest ending member in the complete bearer history is supplied by Postulate 11.1. Whether that greatest member has been attained by a reference stage is expressed separately by $\mathrm{CompletedBy}(A; a)$.

8.2 Ontological identity gaps and epistemic record gaps

Identity-domain absence and absence of evidence have different logical status. Under identity-domain convexity,

$$r, t \in I_A \wedge r \prec_C s \prec_C t \Longrightarrow s \in I_A.$$

Accordingly, an established ontological absence of A between two proposed realizations of that same numerical identity contradicts continuous identity persistence; a later physically qualified bearer may resemble A or belong to the same class, but it cannot restore the terminated numerical identity merely by recurrence. By contrast, a missing record does not establish an identity gap:

$$\neg\, \mathrm{RecordAvailable}_{P,M}(A; s) \not\Rightarrow s \notin I_A.$$

A record gap may result from limited access, sampling, storage, transmission, attribution, or reconstruction. It becomes evidence for an ontological gap only through a separately validated bearer-specific inference.

8.3 Physical history

The physical history of A is:

Definition 8.1.

$$\mathcal{H}_A = (I_A, \prec_C|_{I_A}, X_A). \tag{27}$$

The history includes the stages at which the identity is realized, the restriction of $\prec_C$ to those stages, and the bearer states realized there.

Histories may differ in formation boundary, extent, termination boundary, state content, recurrence, and observational record:

$$\mathcal{H}_A \neq \mathcal{H}_B.$$

This inequality does not imply different cosmic extensions. It records different physical histories within the same extension.

8.4 Same class and different histories

Two systems may belong to the same class while having different histories:

$$\mathrm{SameClass}(A, B) \not\Rightarrow \mathcal{H}_A = \mathcal{H}_B.$$

Manufacturing differences, environmental exposure, interactions, internal events, damage, repair, and measurement interventions may all separate their histories. Class membership supports comparison; it does not erase bearer individuality.

8.5 No private stage domain

The framework rejects the replacement of I_A by an independent domain of temporal stages belonging only to A. If A and B coexist at s, then $s \in I_A \cap I_B$, and the stage is the same stage for both. Their changes remain different.

8.6 Composite, Nested, Open, and Distributed Systems

Composite identity

A composite system has an identity that is not reducible to the independent persistence of every constituent. Constituents may be replaced, exchanged, or transformed while the composite identity continues. Conversely, many constituents may persist after the composite identity ends. The governing non-entailments are

$$\mathrm{PartOf}(p, A; r) \wedge \mathrm{ExistsAs}(p, t) \wedge r \prec_C t \not\Rightarrow t \in I_A,$$

$$\mathrm{ConstituentReplacement}(A; r, t) \not\Rightarrow t \notin I_A.$$

The first blocks inference from constituent survival to bearer survival; the second blocks inference from constituent replacement to bearer termination. Both judgments remain governed by the declared identity criterion for the composite bearer.

Nested bearers

When B is physically part of A, both may be physical bearers under different questions. Their histories satisfy

$$I_A \subseteq \mathcal{S}_C, \qquad I_B \subseteq \mathcal{S}_C,$$

but neither history is automatically identical to the other. A change of B may be part of the change of A, while the ending of B may or may not end A.

Open and exchanging systems

Exchange with an environment does not disqualify a bearer. Living systems, clocks, stars, planets, and laboratory apparatus are open to different degrees. The identity criterion must state which exchanges are compatible with persistence and which transformations terminate the identity.

Distributed systems

A distributed system may have spatially separated components. The separation does not create multiple cosmic stages. Records and control signals may propagate between components with delay, while all components then existing participate in the same common stage. The physical unity of the distributed bearer is an identity question, not a consequence of instantaneous communication.

9. Universal Change Continuity

9.1 Bearer-relative later domain

For a physical system A, define

$$I_A^+ := \{s \in I_A \mid \exists r \in I_A\,(r \prec_C s)\}.$$

This is the set of members of the bearer identity domain that are later relative to at least one other member of that same domain. Its definition is compatible with the independently postulated least identity member f_A, but it does not use that member as a cause or as a premise for change.

Universal Change Continuity is the bearer-level conditional

Universal Change Continuity

$$\mathrm{UCC}(A) \iff \mathrm{PhysicalSystem}(A) \wedge \forall s \in I_A\,\left[\mathrm{LaterInHistory}_A(s) \Longrightarrow \mathrm{PhysReal}_A^+(s)\right]. \tag{28}$$

The stage-indexed form is

$$\mathrm{UCC}(A, s) \iff A \in \mathcal{S}_{\mathrm{phys}}(s) \wedge \mathrm{LaterInHistory}_A(s) \wedge \mathrm{PhysReal}_A^+(s).$$

To distinguish a well-formed universal conditional from an actually extended bearer history, define

$$\mathrm{NontrivialHistory}(A) \iff \exists r, s \in I_A\,(r \prec_C s), \tag{29}$$

and

$$\mathrm{UCC}^+(A) \iff \mathrm{UCC}(A) \wedge \mathrm{NontrivialHistory}(A).$$

Thus UCC does not impose the least member; Postulate 6.1 supplies it independently. Its universal conditional may be true for a history with no bearer-relative later member, but such truth is not counted as non-vacuously realized continuity. The strengthened proposition $\mathrm{UCC}^+(A)$ records the additional fact that the bearer history contains at least one ordered pair. Neither form requires more than one stage for every bearer or asserts a universal physical mechanism.

Proposition 9.1 (Stage-indexed bearer consequence of CMA)**.**

$$\forall A\, \forall s \in \mathcal{S}_C, \quad \mathrm{CMA}(s) \wedge A \in \mathcal{S}_{\mathrm{phys}}(s) \wedge \mathrm{LaterInHistory}_A(s) \Longrightarrow \mathrm{UCC}(A, s). \tag{30}$$

Proof. Fix A and s satisfying the antecedent. CMA supplies $\mathrm{Present}_{\mathrm{C}}(A; s) \wedge \mathrm{PhysReal}_A^+(s)$. The condition $\mathrm{LaterInHistory}_A(s)$ supplies bearer-relative later membership. These clauses are exactly the defining clauses of $\mathrm{UCC}(A, s)$. The actual formation postulate is not used as a cause of change; only the stage membership and CMA clauses enter this implication.

Proposition 9.2 (Universal bearer consequence of CMA)**.**

$$\mathrm{CMA} \Longrightarrow \forall A\ [\mathrm{PhysicalSystem}(A) \Longrightarrow \mathrm{UCC}(A)]\,. \tag{31}$$

Proof. Fix an arbitrary physical system A. Let $s \in I_A$ and assume $\mathrm{LaterInHistory}_A(s)$. Then some $r \in I_A$ satisfies $r \prec_C s$. Because $I_A \subseteq \mathcal{S}_C$, it follows that $\mathrm{Later}_{\mathrm{C}}(s)$. Membership $s \in I_A$ also gives $A \in \mathcal{S}_{\mathrm{phys}}(s)$. The universal CMA statement therefore yields $\mathrm{PhysReal}_A^+(s)$. Since s and A were arbitrary, the defining universal conditional of $\mathrm{UCC}(A)$ holds for every physical system.

Corollary 9.3 (Non-vacuous bearer continuity)**.**

$$\mathrm{CMA} \Longrightarrow \forall A\ \Big[\mathrm{PhysicalSystem}(A) \wedge \mathrm{NontrivialHistory}(A) \Longrightarrow \mathrm{UCC}^+(A)\Big]\,. \tag{32}$$

The propositions do not derive physical truth from logic alone. They display that UCC is the bearer-relative expression of CMA over later members of a bearer history, while $\mathrm{NontrivialHistory}(A)$ supplies the separate non-vacuity condition. Principle 6.2 constrains identity-domain persistence and is not a cause of physical change.

9.2 Physical ground of later-history realization

For each $s \in I_A^+$, UCC gives $s \in I_A^{\mathrm{real}}$, and the realization is attributed to the bearer through its typed physical ground:

$$\mathcal{G}_A(s) = \Big(\mathcal{I}_A(s), \mathcal{E}_A(s)\Big), \qquad \mathrm{GroundedIn}(\omega_A(s), \mathcal{G}_A(s))\,.$$

No universal mechanism is imposed, and time, the stage, and the ordering relation are not included among the causes.

9.3 Continuity, stability, and observational restraint

UCC is ontological and does not require every stage to be separately resolvable by an instrument. Stability, equilibrium, recurrence, or non-detection under selected variables does not establish complete stasis. A finite null result is bounded by the bearer, identity warrant, model, variables, sensitivity, sampling, and protocol.

9.4 Universality without identical change

The universality concerns the occurrence of bearer-specific realization throughout later members of identity persistence. It does not imply a common magnitude, mechanism, rate, state, or observational manifestation. CMA supplies universal scope over all extant systems at every actual common stage, including the later stage under consideration; UCC expresses the later-history consequence for one bearer across its identity domain.

10. Stability, Recurrence, Localized Change, and Difficult Systems

10.1 Rest, stability, equilibrium, and recurrence

Relative rest

Kinematic rest is a relation between a system and a selected reference. If

$$\boldsymbol{v}_{A/R} = 0, \tag{33}$$

then the position of A does not change relative to R under the adopted description. This does not establish that the complete physical state is unchanged:

$$\boldsymbol{v}_{A/R} = 0 \not\Rightarrow X_A(s) \equiv_{\Gamma_A} X_A(t). \tag{34}$$

Microscopic motion, thermal redistribution, field interaction, chemical process, stress relaxation, radiation exchange, and other realizations can continue while the centre or visible boundary remains fixed relative to the reference.

Terrestrial rest is local and relative

A sample on a laboratory table may be at rest relative to the table, building, and local terrestrial coordinate system. The sample, instrument, researcher, laboratory, and building nevertheless share the rotation of Earth, Earth's orbital motion, and wider motion of the solar system. Hence

$$\boldsymbol{v}_{A/R_{\text{lab}}} = 0 \not\Rightarrow \boldsymbol{v}_{A/R_{\text{other}}} = 0. \tag{35}$$

This example establishes the relativity of the kinematic description. It is not the primary reason that physical realization continues. Even if A is treated as at rest in the chosen frame, its internal–external interweaving remains physically active.

Fixed position and selected quantities

A fixed position is one quantity among many:

$$\widehat{\boldsymbol{x}}_{A/R,P}(r_1) = \widehat{\boldsymbol{x}}_{A/R,P}(r_2) \not\Rightarrow X_A(s) \equiv_{\Gamma_A} X_A(t). \tag{36}$$

The same rule holds for temperature, mass, pressure, shape, intensity, or another selected output. An equality may be informative about that quantity while remaining silent about unmeasured components.

Stability

Stability means that a system remains within a specified regime, basin, tolerance, pattern, or response class under stated conditions. It does not mean complete stasis. A stable structure can undergo continuous molecular motion, exchange, repair, microscopic rearrangement, or slow degradation. A stable clock can continue cycling. A stable orbit is motion, not immobility.

The stability predicate must include the controlled variable and tolerance:

$$\mathrm{Stable}_{Q,\epsilon,J}(A) \iff \forall \lambda \in J,\ Q_A(\lambda) \in \mathcal{N}_\epsilon(Q_*), \tag{37}$$

where λ is the declared model or operational parameter and $\mathcal{N}_\epsilon(Q_*)$ is a tolerated neighbourhood. This does not establish equivalence under a bearer-complete criterion.

Stability across later stages

In ITOF, stability across later common stages means persistence within a declared physical regime, pattern, or tolerance while bearer-specific change continues. It does not mean that the bearer has one frozen physical phase between two stages. A later phase may resemble an earlier one, or selected quantities may remain equal, without cancelling the intervening realizations or reversing the cosmic order:

$$\mathrm{Stable}_{Q,\epsilon,J}(A) \not\Rightarrow \mathrm{NoPhysicalChange}_A(J). \tag{38}$$

An archaeological stone provides a concrete cumulative case. During a limited observation window no macroscopic difference may be resolved, while thermal, mineral, chemical, microphysical, environmental, and stress-related alterations may accumulate across the bearer's later history. A crack, colour change, loss of material, or surface erosion observed years or centuries later did not therefore arise wholly and at once when it became visible. Let

$$r_1 \prec_P r_2 \prec_P \cdots \prec_P r_n$$

be records ordered by the declared protocol, with $O(r_i)$ their typed outputs.

Cumulative manifestation in archaeological stone

$$\begin{aligned} &\forall i < n: \quad d_{P,D}(O(r_i), O(r_{i+1})) \le \varepsilon_{P,D}, \\ &d_{P,D}(O(r_1), O(r_n)) > \varepsilon_{P,D} \not\Rightarrow \exists! s_k\ \mathrm{EntireAlterationOccurredAt}(A, s_k). \end{aligned} \tag{39}$$

Equation (39) formalizes why the later visible effect may be the cumulative manifestation of many small bearer-specific realizations. The records constrain manifestations under the declared protocol; they do not canonically identify the cosmic stages at which the contributing realizations occurred. Prior non-detection does not establish cessation, while later noticeability does not compress the whole alteration into one stage.

Equilibrium and steady state

Equilibrium may express vanishing net flux, stationary probability distribution, balance of opposing processes, or extremization within a model. Dynamic equilibrium can involve continuous opposing exchanges whose net measured result is zero. Thus

$$\sum_i J_i = 0 \not\Rightarrow \forall i,\ J_i = 0, \tag{40}$$

and even $J_i = 0$ for selected macroscopic channels does not establish absence of every microscopic realization.

A steady state is similarly a condition on selected observables or distributions. The statement

$$\frac{dQ_A}{d\lambda} = 0 \tag{41}$$

uses model parameter λ and quantity Q_A. It does not state that the complete state is identical across the cosmic extension, and it does not define time.

Periodic return

If a system later realizes a condition equivalent to an earlier condition under a declared criterion, then

$$s \prec_C t \wedge X_A(s) \equiv_{\Gamma_A} X_A(t) \Longrightarrow s \neq t \wedge \neg(t \prec_C s). \tag{42}$$

A patient may be ill, recover, and later become ill again. The later illness may be equivalent to the earlier illness under a declared disease criterion, yet it remains a later physical state because the common cosmic stages have not reversed. Likewise, if a selected quantity returns after a cycle,

$$Q_A(\lambda + T) = Q_A(\lambda), \tag{43}$$

the cycle has not returned the system or the universe to an earlier cosmic stage. Intermediate realizations occurred, other bearer components may differ, and all extant systems continued to change. Even an idealized periodic solution represents recurrence in selected variables, not temporal repetition.

Adverse-scenario burden

Rest, stability, and equilibrium become relevant to the universal-change principle only if they support a domain-adequate adverse case. The burden is not to show a flat graph. It is to show that a physical system maintained identity over the investigated domain and realized no physical change in any physically relevant component, relation, property, or process. The distinction makes the principle testable without defining change as a binary transition.

Governing rest and stability rule.

Kinematic rest, stable appearance, equality of a selected quantity, periodic return, and equilibrium are descriptions of specified relations or observables. None is identical with complete physical stasis.

10.2 Localized, chemical, genetic, and biological change

Local physical difference as a sufficient witness

A system can realize physical change through a difference confined to one component, relation, boundary region, molecular site, cell, or substructure while its global organization and identity persist. Throughout V28/F8, $X_A(s)$ denotes the bearer state treated as ontically complete relative to the adopted physical ontology, bearer boundary, and identity criterion, while $X_{A,k}(s)$ denotes only an attributable component or selected sub-description of that state. Then

$$\begin{aligned} &\forall u \in I_A\ \forall v \in I_A, \quad \forall k \in K(\Gamma_A), \\ &\quad \Big[u \prec_C v \wedge X_{A,k}(u) \not\equiv_{\Gamma_{A,k}} X_{A,k}(v) \\ &\quad \wedge \mathrm{ValidStateComponentAttribution}_{A,P,M}(k; u, v) \wedge \mathrm{IdCont}_A(u, v) \Big] \\ &\implies \mathrm{Warrant}_{P,M}[X_A(u) \not\equiv_{\Gamma_A} X_A(v)]\,. \end{aligned} \tag{44}$$

The analytical index k marks the location or component relevant to the claim. It carries no assumption that the system is permanently decomposable into independent parts. One validly attributed non-equivalence in a criterion-relevant component warrants non-equivalence of the bearer states under Γ_A by the declared component-consistency condition. The formula is universally quantified, so no witness variables occur outside their binding scope.

Magnitude, distribution, and threshold

The logical status of a physical difference is independent of its magnitude. A change can be macroscopic, microscopic, molecular, genetic, relational, or distributed across many small components. Let δQ_A denote a real difference in a selected quantity and $\epsilon_{D,P}$ the effective threshold of detector D under protocol P. The subthreshold condition is

$$0 < |\delta Q_A| < \epsilon_{D,P}. \tag{45}$$

This relation explains an expected non-resolution under the stated instrument model. Evidence for the actual difference comes from a physical model, an independent channel, accumulated manifestation, improved sensitivity, or another warranted route. The ontic claim and the detection claim therefore remain explicitly separated.

The spatial distribution also matters. A small difference spread across the entire system and a larger difference confined to one site may produce different records while both qualify as change. The test must report magnitude, location, sampling fraction, and the relation between sampled material and the declared bearer.

Chemical realization

Chemical change includes bond formation and breaking, oxidation, reduction, hydrolysis, diffusion, phase nucleation, compositional redistribution, polymer-chain scission, cross-linking, and surface reaction. Single-molecule studies also demonstrate directly resolved molecular dynamics in individual enzymatic systems [56]. The early alteration may occupy a microscopic region while dimensions, mass, colour, or mechanical response remain within tolerance. Later macroscopic degradation can manifest the accumulation and coupling of many earlier localized realizations.

A complete chemical inference chain has the form

$$\begin{aligned}&\text{chemical alteration in } A \longrightarrow \text{sample–instrument interaction}\\&\qquad\longrightarrow \text{record } r_D \longrightarrow \text{model-based attribution to } A.\end{aligned}$$

Accelerated-weathering and mechanical-analysis standards provide operational methods for controlling radiation, humidity, temperature, loading, and sampling conditions [41, 42, 43, 39, 40, 44]. The acceleration comes from altered physical factors and reaction conditions. Extrapolation to service conditions therefore requires a declared kinetic or degradation model and an uncertainty statement.

Genetic bearer hierarchy

A genetic claim must identify its bearer before assigning change. At least six distinct levels occur:

(i) a DNA or RNA molecule;

(ii) a chromosome, plasmid, organelle genome, or other genomic structure;

(iii) a cell;

(iv) a tissue or cellular mosaic;

(v) an organism or continuing cell lineage;

(vi) a population, species sample, or evolutionary lineage.

A difference established at one level transfers to a higher level only through an explicit bearer relation. A validly attributed substitution in one molecule warrants molecular change. Attribution to a cell requires evidence that the molecule belongs to that cell. Attribution to an organism requires a sampling and organizational bridge. Attribution to a population requires frequency, sampling, and lineage analysis. This hierarchy prevents automatic transfer from one altered component to every containing or related bearer.

Canonical genetic-change condition

Let

$$g_{A,k} : \Omega_A^{\mathrm{ont}} \longrightarrow \mathfrak{G}_{A,k}, \qquad G_{A,k} := g_{A,k} \circ X_A,$$

be a declared genetic projection selected by Γ_A, with $k \in K(\Gamma_A)$ and genomic component criterion $\Gamma_{A,k}$. Let $E_{A,k}$ denote a separately declared epigenomic or regulatory projection with its own codomain and comparison criterion. A genomic change witness is

$$\begin{aligned}
&\forall u \in I_A\ \forall v \in I_A, \quad \forall k \in K(\Gamma_A), \\
&\quad \Big[u \prec_C v \wedge G_{A,k}(u) \not\equiv_{\Gamma_{A,k}} G_{A,k}(v) \\
&\quad \wedge \mathrm{IdCont}_A(u,v) \wedge \mathrm{ValidGeneticAttribution}_{A,P,M}(k; u, v)\Big] \\
&\implies \mathrm{Warrant}_{P,M}[X_A(u) \not\equiv_{\Gamma_A} X_A(v)]\,.
\end{aligned} \tag{46}$$

The projection declaration makes the genetic feature an attributable component of the bearer state, while the component criterion supplies the explicit bridge from genomic non-equivalence to bearer non-equivalence under Γ_A. An epigenomic or regulatory witness uses $E_{A,k}$ with its own attribution and persistence conditions. Sequence or structural genomic change and epigenomic regulation must not be conflated, even when both contribute to a broader hereditary or regulatory history. Genetic and molecular evidence can nevertheless provide strong bearer-specific witnesses of continuing and accumulated physical change across investigated identity-preserving histories. Relevant routes include sequence alteration, repair, transcriptional activity, chromatin reorganization, epigenetic modification, molecular turnover, and regulation. An unchanged sampled sequence does not establish complete stasis of the declared genetic bearer, cell, organism, or lineage; conversely, no finite genetic record exhaustively tests every common cosmic stage.

Plain-language reading of the genetic witness

The displayed rule requires four determinations before a component-level genetic difference may warrant a bearer-level difference: the two compared realizations belong to the same declared bearer; they are ordered within that bearer's continuing identity history; one declared genetic component differs under its stated criterion; and the component attribution, protocol, and model are valid for that bearer. Only then does the component difference warrant non-equivalence of the bearer state under the broader declared criterion. The rule does not imply that every genetic difference has a detectable phenotype, that a difference in one sampled molecule automatically characterizes a cell, organism, or population, or that an unchanged sample establishes complete physical stasis.

Genetic realization and phenotypic manifestation

Genetic difference and phenotypic effect are separate physical claims. Write

$$\Delta G_A(u,v)$$

for a genetic difference and

$$\Delta \Phi_A(u,v)$$

for a phenotypic difference. The theory permits

$$\Delta G_A(u,v) \neq 0 \quad \wedge \quad \Delta \Phi_A(u,v) = 0 \tag{47}$$

within the resolution and domain of the phenotype test. Regulatory buffering, redundancy, tissue restriction, allele fraction, developmental timing, and environmental conditions may delay or suppress a detectable phenotypic manifestation. Conversely, a phenotypic difference can arise from non-genetic physical changes. The two evidential chains must therefore be reported independently.

Somatic mutation, mosaicism, and lineage

Somatic mutation provides a direct example of localized change within continuing biological identity. A variant may arise in one cell, propagate through a descendant clone, remain restricted to a tissue, or attain a measurable mosaic fraction. The organism retains its identity while a subset of its cells acquires a physically distinct genetic state. Studies of somatic mosaicism and accumulated mutation document these bearer-specific patterns [45, 46, 47, 48, 49, 50].

For a lineage L, let $G_{L,k} := g_{L,k} \circ X_L$ be the declared lineage-genetic component projection selected by Γ_L, with comparison criterion $\Gamma_{L,k}$. The valid relation is

$$\begin{aligned}
&\forall u \in I_L\ \forall v \in I_L, \quad \forall k \in K(\Gamma_L),\\
&\quad \Big[u \prec_C v \wedge \mathrm{IdCont}_L(u,v) \\
&\quad \wedge \mathrm{LineageSupported}_{P,M}(L; u, v) \wedge G_{L,k}(u) \not\equiv_{\Gamma_{L,k}} G_{L,k}(v) \Big] \\
&\Longrightarrow \mathrm{Warrant}_{P,M}[X_L(u) \not\equiv_{\Gamma_L} X_L(v)]\,.
\end{aligned}$$

Lineage evidence may include ancestry markers, clonal structure, spatial sampling, cell labels, or phylogenetic reconstruction. The declared projection and component criterion provide the bridge from a lineage-genetic difference to warranted bearer-state non-equivalence. The inferred ancestral sequence remains a reconstruction with uncertainty; the extant molecular samples remain physical records.

Epigenetic and regulatory change

Epigenetic marking and chromatin organization are physical features of molecular and cellular systems. A methylation difference, histone modification, nucleosome relocation, or durable regulatory-state alteration qualifies when materially instantiated, correctly attributed, and relevant to the declared state description. Its persistence, reversibility, and functional effect are separate questions. The framework therefore recognises epigenetic change without equating every transient regulatory fluctuation with a stable hereditary alteration.

Genetic records and exact-stage limits

A sequencing output is a downstream detector record. Sample extraction, amplification, library preparation, sequencing, base calling, alignment, and variant inference occur after the molecular realization and add their own physical transformations. A valid record chain can warrant that the genetic difference existed within a bounded source history:

$$\mathrm{ValidatedGeneticRecord}_{P,M}(r_D) \Longrightarrow \mathrm{ConstrainsGeneticWindow}_{P,M}(A, W_G). \tag{48}$$

Here W_G is a sampling and reconstruction window in the evidential domain, not a subset of the cosmic-stage identity domain. A validated reconstruction may additionally return a non-unique candidate-stage set $\mathrm{CandidateStages}_{G;P,M}(A, r) \subseteq I_A$; this set is model-conditioned and is not a canonical record-to-stage map. The evidential window may be broad because sampling is sparse, molecular alteration is progressive, a variant begins in a small cellular fraction, the selected assay omits the affected locus, mosaic distribution separates tissues, or the signal remains below the method's detection threshold.

For compactness in the following boundary, write $\mathcal{K}_G(r_1) := \mathrm{CandidateStages}_{G;P,M}(A, r_1)$ for the model-conditioned candidate-stage set.

Genetic detection does not compress genetic history into one stage

$$\begin{aligned} \mathrm{GeneticDifferenceDetected}_{P,M}(r_2) &\not\Rightarrow \exists! s \in I_A \ \ \mathrm{CompleteGeneticAlterationAt}(A, s), \\ \mathcal{K}_G(r_1) \neq \varnothing \wedge \neg\, \mathrm{GeneticDifferenceDetected}_{P,M}(r_1) &\not\Rightarrow \forall s \in \mathcal{K}_G(r_1)\, \neg\, \mathrm{PhysReal}_A^+(s). \end{aligned} \tag{49}$$

Equation (49) shows why a later positive test may record the accumulated or progressively distributed result of molecular and lineage changes across many stages. The validated records can warrant a physically attributable genetic difference at the proper bearer level, but they do not show that the entire alteration arose instantaneously at detection. When the model-conditioned candidate-stage set is nonempty, a prior negative test does not by itself prove absence of physical realization throughout that set. For any separately declared candidate stage $s \in \mathcal{K}_G(r_1)$, the negative record alone likewise does not warrant $\neg\, \mathrm{PhysReal}_A^+(s)$; this stage-specific restraint is stated in prose rather than incorrectly placing a metalevel non-entailment sign inside the scope of a quantifier. If the candidate-stage set is empty, the record supplies no candidate-stage claim rather than a vacuously confirmed absence claim. Nor does a negative test warrant one specified undetected mutation.

Biological organization and continuing identity

Living systems maintain organization through metabolism, exchange, repair, signalling, replication, regulated turnover, immune activity, and environmental engagement. Homeostasis is a dynamically maintained regime. Phenotypic persistence can therefore coexist with continuous molecular, cellular, and relational change.

The identity criterion must match the bearer. Replacement of molecules may preserve cellular or organismal identity; replacement of cells may preserve tissue identity; lineage divergence may physically end one lineage identity while establishing successor lineages, with the boundary warranted through domain-valid criteria and evidence. The framework separates persistence of organization from identity of constituents and separates termination of a bearer from annihilation of its physical material.

Restricted empirical change and continuity claims

For an operationally estimated identity window $\widehat{I}_{A;P,M}$ and declared comparison domain J, distinguish the local or study-level change witness

$$\mathrm{EmpiricalChangeWitness}_{A;P,M}(\widehat{I}_{A;P,M}, J)$$

from the stronger continuity-support proposition

$$\mathrm{UCC}^{\mathrm{emp}}_{A;P,M}(\widehat{I}_{A;P,M}, J).$$

The first states that one or more accepted comparisons provide a protocol-bounded bearer-specific change witness. It does not establish continuing realization throughout the represented history. The stronger proposition is licensed only through an explicit coverage and model bridge:

$$\begin{aligned}\mathrm{UCC}^{\mathrm{emp}}_{A;P,M}(\widehat{I}_{A;P,M}, J) \iff\ & \mathrm{EmpiricalChangeWitness}_{A;P,M}(\widehat{I}_{A;P,M}, J)\\ & \wedge \mathrm{ContinuityCoverageAdequate}_{P,M}(A; \widehat{I}_{A;P,M}, J)\\ & \wedge \mathrm{AcceptedContinuityModel}_{P,M}(A; \widehat{I}_{A;P,M}, J).\end{aligned} \tag{50}$$

Coverage adequacy requires preregistered control of the represented segments, admissible gaps, sensitivity, attribution, and the physical route by which the model connects accepted observations across those segments. A single differing record pair may satisfy the change-witness predicate while failing the continuity-coverage predicate. Even when the stronger proposition holds, "throughout" ranges only over the protocol-resolved and model-supported portion of the bearer history. It does not assert that each common cosmic stage was individually accessed, does not quantify over the complete ontic domain I_A, is not identical to $\mathrm{UCC}(A)$, and cannot by itself establish unrestricted CMA or UCC.

Biological life history as a domain-valid model

A complete organismal life history can provide a domain-valid model of identity formation, identity formation realization, ordered biological succession, criterion-relative function and failure, recovery or recurrence, and identity termination where it occurs. The model is not a separate biological time and does not enumerate common cosmic stages. Biological phases such as development, maturity, disease, recovery, ageing, and terminal decline are coarse-grained classifications of many realized states within one identity domain.

Biological life-history model

For a study-qualified organism A satisfying $\mathrm{StudyQualified}_{P,M}(A)$,

$$\begin{aligned} &\mathrm{AdequateBiologicalHistoryModel}_{P,M}(A;\widehat{I}_{A;P,M},J) \\ &\qquad \mathrm{EmpiricalChangeWitness}_{A;P,M}\left(\widehat{I}_{A;P,M},J\right), \\ &\qquad \mathrm{ContinuityCoverageAdequate}_{P,M}(A;\widehat{I}_{A;P,M},J), \\ \Longrightarrow &\qquad \mathrm{AcceptedContinuityModel}_{P,M}(A;\widehat{I}_{A;P,M},J), \\ &\qquad \mathrm{UCC}^{\mathrm{emp}}_{A;P,M}\left(\widehat{I}_{A;P,M},J\right), \\ &\qquad \mathrm{Warrant}_{P,M}[\mathrm{OrderedBiologicalSuccession}(A;J)]. \end{aligned} \tag{51}$$

Here $\widehat{I}_{A;P,M}$ is the operationally estimated identity window, not the exhaustively known ontic domain I_A. The model supports the restricted empirical continuity proposition and ordered biological succession within its declared evidence, sampling, sensitivity, and reconstruction limits; it does not by itself warrant $\forall s \in I_A^+\ \mathrm{PhysReal}_A^+(s)$. Postulate 6.1 independently supplies the unique ontic formation member $f_A = \min_{\prec_C} I_A$; the biological protocol may warrant only a localization window and therefore need not identify that member exactly. Disease may constitute failure only relative to a declared biological, physiological, regulatory, or clinical criterion κ:

$$\begin{aligned} &\mathrm{Disease}_{A,\kappa}(s) \wedge \mathrm{FailureCriterionMet}_{A,\kappa}(s) \Longrightarrow \mathrm{FunctionalFailure}_{A,\kappa}(s), \\ &\mathrm{FunctionalFailure}_{A,\kappa}(s) \not\Rightarrow \mathrm{End}_A(s). \end{aligned} \tag{52}$$

A diagnosis that remains unchanged across a clinical interval does not establish complete biological stasis. Conversely, disease, recovery, remission, and recurrence are ordered physical changes within the continuing history while the organismal identity persists. The history ends when the organismal identity physically ceases; the biological criterion and protocol provide fallible grounds for judging that boundary, and no universal calendar age fixes it. A century-scale interval may be used in an illustrative human dataset, but no fixed numerical age is a governing identity-termination condition.

Biological scale discipline

Microscopic and macroscopic descriptions possess equal logical standing when they match the bearer and claim. A macroscopic witness can establish macroscopic change. A molecular or genetic witness can establish localized change. Transfer across scales requires a physical bridge specifying containment, causal influence, sampling, organisation, or aggregation. This discipline allows the theory to be universal without flattening the hierarchy of biological and material systems.

10.3 Difficult-system classes

Purpose of difficult-class analysis

Universal continuing change cannot be supported only by obviously active systems. The strongest tests involve systems described as stable, stationary, isolated, in equilibrium, in a ground state, periodic, or long-lived. Each description must be translated into its actual physical and mathematical claim before it is treated as a possible counterexample.

Classical fixed points

A fixed point of a dynamical model satisfies

$$\dot{\boldsymbol{x}} = \boldsymbol{f}(\boldsymbol{x}) = 0. \tag{53}$$

The equation concerns model variables $\boldsymbol{x}$ under specified dynamics. To become a physically adequate adverse scenario for universal physical realization, one must show that $\boldsymbol{x}$ is bearer-complete, physically instantiated, identity-preserving at a later common cosmic stage, and unaffected by omitted variables, fluctuations, coupling, or model limits. A formal fixed point alone is not sufficient.

Thermodynamic equilibrium

Thermodynamic equilibrium is characterized by macroscopic conditions and extremal or balance relations. Microscopic descriptions may still include motion or fluctuations. Even if an ideal equilibrium model assigns stationary macroscopic variables, the ontology of the actual system must be examined. The claim "the temperature is constant" is weaker than "the complete physical state is equivalent."

Open-system steady states

An open system can maintain a stationary distribution while exchanges and transitions continue. In a master-equation description,

$$\frac{d\rho}{d\lambda} = \mathcal{L}(\rho), \qquad \mathcal{L}(\rho_{\text{ss}}) = 0, \tag{54}$$

where λ is the model parameter and ρ_{ss} a steady state. The equation states stationarity under the generator. It does not prove absence of quantum jumps, environmental exchange, correlations, or unrepresented physical realization. Open quantum systems provide especially clear examples of stationary statistical description with ongoing interaction [21, 24, 22].

Stationary quantum states

For a strictly isolated system represented by a time-independent Hamiltonian, an energy eigenstate satisfies

$$\hat{H}|\psi\rangle = E|\psi\rangle, \qquad |\psi(t)\rangle = e^{-iEt/\hbar}|\psi(0)\rangle. \tag{55}$$

Here t is the evolution parameter of the quantum model and is not identified with T_{ITOF}. For a selected observable $\hat{O}$, one may obtain

$$\frac{d}{dt}\langle \hat{O} \rangle = 0. \tag{56}$$

The strict-isolation qualification specifies the idealized domain of the unitary expression; it does not establish that any concrete physical bearer is completely isolated. These equations state stationarity within a declared representation and selected observable set. ITOF does not infer bearer-attributable physical change merely from a global phase when the adopted interpretation supplies no physical distinction. It also does not infer complete physical stasis from stationary expectation values. The analysis must distinguish the state vector, the actual bearer, fields and boundary conditions, environmental coupling, relational degrees of freedom, the completeness of the observable set, and the identity criterion.

A stationary-state candidate is therefore a stringent test rather than a case dismissed by definition. CMA continues to govern the bearer as a physical system, but the type, content, magnitude, and mechanism of its bearer-specific change remain open wherever domain evidence does not determine them. A domain application of the derived UCC result must identify an actual physical route to later-history realization or state the unresolved bearer-complete obligation explicitly. No unspecified "hidden change" may be introduced merely to protect universality. Precision spectroscopy, quantum-jump observation, and environmental-coupling studies provide domain-specific evidence, but no single experiment closes every interpretive and class-level question [23, 24, 29, 30, 31, 32].

Experimentally isolated atoms and energy exchange

An experimentally isolated atom remains a physical system with its own physically realized identity and bearer boundary. Isolation does not establish complete physical stasis or remove every physical condition and relation; it places the atom within a newly defined experimental arrangement:

$$\mathrm{ExperimentallyIsolated}_P(A) \not\Rightarrow \mathrm{CompletePhysicalStasis}(A).$$

Within this atomic application, energy emission or absorption, an electronic or nuclear transition, ionization, recombination, decay, or another physical interaction is classified as bearer-specific physical change when the alteration is physically realized and ontically attributed to the declared atomic bearer. The emitted or absorbed energy is part of the physical engagement; it is not a substance called change that moves between bearers. Bearer identity must be decided separately under the adopted identity criterion. This ontological classification is distinct from the protocol-relative evidential warrant by which an experiment supports the attribution. The displayed implication is a sufficient domain-classification rule; it does not state that every bearer-specific physical change in an atom has this form.

Ontically attributed atomic alteration is bearer-specific physical change

$$\mathrm{AtomicAlterationRealized}_A(s) \wedge \mathrm{OnticBearerAttribution}_A(s) \Longrightarrow \mathrm{PhysReal}_A^+(s). \quad (57)$$

$$\mathrm{LaterInHistory}_A(s) \wedge \mathrm{PhysReal}_A^+(s) \Longrightarrow \mathrm{LaterReal}_A(s).$$

If the declared bearer identity persists, the occurrence is change within the continuing history of that atom or ion. If the occurrence ends the predecessor identity or forms warranted successor systems, the ending-and-formation classifications apply at the same common stage instead. Such observations provide direct evidence of change under the stated conditions, but they do not determine the complete change content of the bearer at every actual common cosmic stage or prove unrestricted CMA or UCC from one experiment.

Casimir configuration as a boundary-conditioned quantum case

A Casimir configuration is useful because it separates a quantum-field calculation from temporal ontology. For ideal parallel plates of area A and separation a, the standard model gives

$$E_{\mathrm{Cas}} = -\frac{\pi^2 \hbar c}{720\, a^3} A, \qquad P_{\mathrm{Cas}} = -\frac{\pi^2 \hbar c}{240\, a^4}. \quad (58)$$

The calculated energy difference and pressure belong to the field–boundary system, its geometry, and the approximations of the model [20]. Variation of a, plate properties, temperature, or material response changes the physical configuration and predicted force. None of these quantities denotes a deformation, acceleration, or multiplication of time.

The case also disciplines universal-change reasoning. A stationary idealized Casimir model does not by itself establish complete stasis of the real field–boundary bearer, while the existence of a non-zero calculated pressure does not by itself prove continuing change in every component. The required analysis remains bearer-complete and distinguishes model stationarity, boundary-conditioned energy, material response, measurement interaction, and actual physical realization.

Ground states and vacuum descriptions

A ground state is lowest with respect to a Hamiltonian under specified boundary conditions. A vacuum state is defined within a field-theoretic representation. Neither phrase automatically denotes a physical system in complete stasis. Interactions, fluctuations, detector response, boundary changes, and representation dependence must be analysed. At the same time, V28/F8 must not use the words “vacuum fluctuation” as a universal placeholder that immunizes the principle. A claimed route must be physically specified and evidentially supported.

Exact isolated ground-state challenge

For an actual bearer claimed to instantiate an exactly isolated ground state throughout a nontrivial identity-preserving history, the issue cannot be closed by the stationary equation alone and cannot be rescued by an unspecified hidden process. The adverse route is explicit:

$$\begin{aligned}
&\mathrm{ExactIsolatedGroundStateWarrant}_{\Pi}(A, J) \\
&\wedge \mathrm{BearerCompleteStasisWarrant}_{\Pi}(A, J) \\
&\wedge \mathrm{NontrivialHistoryWarrant}_{\Pi}(A, J) \\
&\qquad \Longrightarrow \mathrm{Reject}_{\Pi}(\mathrm{UCC}(A)) \,.
\end{aligned} \tag{59}$$

The first warrant identifies the physical bearer and the applicability of the exact-isolation and ground-state description; the second warrants complete physical stasis relative to the preregistered bearer-complete claim; and the third prevents vacuity. If the available quantum model supplies stationarity but neither an actual bearer-complete change mechanism nor a bearer-complete stasis warrant, the application remains unresolved. Model stationarity is not stasis by definition, but CMA is not empirically satisfied merely by repeating the axiom.

Stable particles and long-lived systems

Stability may mean no observed decay within a bound or exact stability under a declared theory. A stable particle can still participate in interactions, propagation, field relations, or composite systems. Model-relative exact stability does not by itself establish that one actual numerical bearer persists without end; it states the stability result licensed by that model and its assumptions. V28/F8 separately adopts eventual identity ending as an explicit full-history physical postulate. Accordingly, an exactly isolated bearer physically warranted to remain the same numerical identity without ending would be a direct counterexample to Postulate 11.1, not a case to be neutralized by invoking unspecified change or redefining stability. Until such bearer-complete warrant exists, long lifetime, non-observed decay, and theoretical stability remain distinct from proof of endless numerical identity.

Periodic and recurrent systems

Exact recurrence in model variables does not repeat the cosmic stage. A periodic oscillator undergoes successive physical states even when a coordinate repeats. Poincaré recurrence, where applicable, concerns return arbitrarily close to an earlier region of state space under restrictive conditions; it does not imply reversal of cosmic order or identity of the entire universe at two stages.

Geometrically stationary relativistic models

A stationary spacetime admits a timelike Killing structure in an appropriate region. This geometrical symmetry does not establish that all physical systems represented in the model are changeless, nor that the cosmic extension stops. The word "stationary" belongs to the metric symmetry and must not be transferred without analysis to temporal ontology.

Difficult-class conclusion

No difficult class is dismissed by definition. Each receives an explicit bearer, state, identity, model, evidence, and adverse-scenario analysis. This approach keeps restricted hypotheses operationally testable and the unrestricted universal claim empirically pressure-sensitive and scientifically accountable, while avoiding two errors: treating every stationary equation as proof of stasis, or invoking unspecified hidden processes whenever evidence is absent.

11. Ending, Transformation, Physical Production, and Successor Attribution

11.1 Functional failure and identity ending

Functional failure alone does not necessarily end a system:

$$\mathrm{FunctionalFailure}_A(s) \not\Rightarrow \mathrm{End}_A(s).$$

A partial, structural, or functional failure may be a physically realized change within the continuing history of A while the bearer identity remains valid. Identity ends only when the physical conditions by which A remains that bearer cease to be realized under the declared identity criterion. $\mathrm{IdentityEndingRealized}_A(e)$ names the stage-resolved ontological ending itself; the scientific assertion that it occurred at e requires separate bearer-specific warrant. $\mathrm{TransformativeFailure}_A(e)$ names a physical path or mechanism that may ground that ending. Neither is definitionally reducible to the other.

11.2 Eventual ending, complete bearer history, and stage-relative attainment

Define the general ending-boundary classification by

$$\boxed{\mathrm{End}_A(e) \iff e \in I_A \wedge \mathrm{IdentityEndingRealized}_A(e) \wedge \neg\exists u \in I_A\,(e \prec_C u)}. \tag{60}$$

This definition combines membership, the domain-specific identity-ending occurrence, and greatestness within the bearer identity domain. Greatestness alone does not create an ending occurrence.

Postulate 11.1 (Eventual Identity Ending)**.** Every physical bearer has, in its complete identity history, one and only one ending member:

$$\boxed{\forall A \in \mathcal{U}_{\mathrm{phys}}\ \exists! e \in I_A\ \ \mathrm{End}_A(e)}. \tag{61}$$

Equivalently,

$$\mathrm{EventualIdentityEnd}(A) \iff \exists! e \in I_A\ \ \mathrm{End}_A(e).$$

For the unique ending member, write

$$e_A := \iota e \in I_A\ \ \mathrm{End}_A(e), \qquad e_A = \max_{\prec_C} I_A.$$

This is an explicit full-history physical commitment, not a consequence of strict order, convexity, CMA, or conservation alone.

Foundational status and counterexample burden

The postulate is deliberately adopted rather than presented as an observational theorem. It closes every complete bearer identity domain with one actual ending member and thereby fixes the boundary semantics used throughout V28/F8. Replacing the postulate with the mere possibility of ending would change that foundational commitment rather than clarify it. Its non-derivability also makes its risk explicit: if an actual bearer—for example, a bearer classified as a proton under a declared identity criterion—were warranted to retain the same numerical identity throughout the complete cosmic history without any ending member, Postulate 11.1 would be false. Non-observed decay over a finite interval, a lower lifetime bound, or exact stability within a declared model does not by itself establish that complete-history counterexample.

The independently adopted ontic boundary-exclusivity condition constrains every identity-ending occurrence to the greatest member of the same bearer identity domain:

$$\forall A \in \mathcal{U}_{\text{phys}}\ \forall s \in \mathcal{S}_C, \qquad \text{IdentityEndingRealized}_A(s) \Longrightarrow [s \in I_A \wedge \neg\exists u \in I_A\ (s \prec_C u)]\,. \tag{62}$$

Together with Definition (60), this condition yields the derived equivalence

$$\text{IdentityEndingRealized}_A(s) \Longleftrightarrow \text{End}_A(s).$$

Only the occurrence-to-boundary direction is independently adopted; the reverse direction is already contained in the derived boundary definition. The condition prevents any earlier or repeated use of the identity-ending predicate for the same numerical bearer. Physical failures or major transformations that do not terminate the declared identity remain later-history changes.

Define full-history completeness and stage-relative attained completion by

$$\text{HistoryComplete}(A) \Longleftrightarrow \exists e \in I_A\ \ \text{End}_A(e), \tag{63}$$

$$\text{CompletedBy}(A; a) \Longleftrightarrow a \in \mathcal{S}_C \wedge \exists e \in I_A\Big(\text{End}_A(e) \wedge \text{AttainedBy}(e; a)\Big). \tag{64}$$

The historical status predicate is stage-indexed:

$$\text{OngoingAt}(A; s) \Longleftrightarrow s \in I_A \wedge \neg\exists e \in I_A\Big(\text{End}_A(e) \wedge (e = s \vee e \prec_C s)\Big).$$

Under Postulate 11.1, every bearer is history-complete in the complete-domain sense. This does not mean that its ending has been attained by every earlier reference stage. If $a \in I_A$ and $a \prec_C e_A$, then

$$\text{OngoingAt}(A; a) \wedge \neg\,\text{CompletedBy}(A; a) \wedge \neg\,\text{AttainedBy}(e_A; a).$$

Thus the framework avoids both an undefined future endpoint and the contradictory claim that a later endpoint is already attained at an earlier stage. Later knowledge that A ended does not retroactively make it non-ongoing at earlier identity stages.

Identity ending is bearer-specific positive physical realization:

$$\text{EndingReal}_A(e) \Longleftrightarrow \text{End}_A(e) \wedge \text{PhysReal}^{+}_A(e), \tag{65}$$

and the classification bridge is

$$\mathrm{End}_A(e) \Longrightarrow \mathrm{PhysReal}^{+}_A(e). \tag{66}$$

The ending bridge is a subtype-classification rule: it records that an attained identity-ending boundary belongs to the general positive-realization genus. CMA separately supplies the universal all-bearer assertion at that stage. Their agreement is classificatory coherence rather than an additional empirical premise.

A termination window is introduced only when ending has been attained relative to a reference stage a while its exact location remains epistemically unresolved:

$$\begin{aligned} &\mathrm{CompletedBy}(A;a) \wedge \mathrm{EstimatedTerminationWindow}_{P,M}(A, W \mid a) \\ &\quad\Longrightarrow \left[\varnothing \neq W \subseteq \mathcal{S}_C^{\leq a} \wedge e_A \in W\right]. \end{aligned} \tag{67}$$

The window records epistemic localization, not several endings and not an extended ontological ending. A predicted future region belongs to a protocol or model target domain and is not an attained termination window.

11.3 Physical causes of transformative failure

For a stage-resolved identity ending, let $\mathfrak{O}_A^{\mathrm{end,real}}$ be the bearer-specific domain of realized identity-ending occurrence objects, and define

$$I_A^{\mathrm{end}} := \{e \in I_A \mid \mathrm{EndingReal}_A(e)\}, \qquad \eta_A : I_A^{\mathrm{end}} \longrightarrow \mathfrak{O}_A^{\mathrm{end,real}},$$

$$e \longmapsto \eta_A(e) := \mathrm{IdentityEndingOccurrence}(A, e).$$

Represent a high-level analytical factor description by

$$\mathcal{F}_A(e) := \left(\mathcal{F}_A^{\mathrm{int}}(e), \mathcal{F}_A^{\mathrm{ext}}(e), \mathcal{F}_A^{\mathrm{joint}}(e)\right).$$

This triple is not a unique microphysical decomposition. Transformative failure alone neither introduces an ending-occurrence object nor defines identity ending.

11.4 Typed physical-production linkage

Let $\mathcal{P}$ and $\mathcal{Q}$ be proposed productive-predecessor and successor sets, and let $\mathcal{E}$ be a proposed production-incidence relation. First define the purely formal production-specification domain:

$$\begin{aligned} \Lambda_{\mathrm{prod}} := \Big\{ \langle e, \mathcal{P}, \mathcal{Q}, \mathcal{E} \rangle \ \Big|\ & e \in \mathcal{S}_C \wedge \varnothing \neq \mathcal{P} \subseteq \mathcal{U}_{\mathrm{phys}} \wedge \varnothing \neq \mathcal{Q} \subseteq \mathcal{U}_{\mathrm{phys}} \\ & \wedge \mathcal{P} \cap \mathcal{Q} = \varnothing \wedge \mathcal{E} \subseteq \mathcal{P} \times \mathcal{Q} \\ & \wedge \forall A \in \mathcal{P}\ \exists B \in \mathcal{Q}\ ((A, B) \in \mathcal{E}) \\ & \wedge \forall B \in \mathcal{Q}\ \exists A \in \mathcal{P}\ ((A, B) \in \mathcal{E}) \Big\}. \end{aligned} \tag{68}$$

The last two clauses make $\mathcal{E}$ left-total and right-total over the declared sets. They do not make it the complete bipartite relation $\mathcal{P} \times \mathcal{Q}$. The set $\mathcal{P}$ contains only productive predecessors represented as ending and incident to at least one successor in this linkage; it is not the set of every bearer that happens to end at e.

The primitive ontic relation PhysicalProductionLink$(\mathcal{P}, e, \mathcal{Q}; \mathcal{E})$ states that the declared production linkage is physically realized. Its type constraint is

$$\text{PhysicalProductionLink}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E}) \Longrightarrow \langle e, \mathcal{P}, \mathcal{Q}, \mathcal{E} \rangle \in \Lambda_{\text{prod}}. \tag{69}$$

The converse is invalid:

$$\langle e, \mathcal{P}, \mathcal{Q}, \mathcal{E} \rangle \in \Lambda_{\text{prod}} \not\Rightarrow \text{PhysicalProductionLink}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E}).$$

Accordingly, a well-typed tuple is a formal specification, not an evidence object and not an ontic production fact. When PhysicalProductionLink holds, each $(A, B) \in \mathcal{E}$ denotes one actual direct production incidence within that linkage. Ontic linkage, formal specification, and scientific warrant remain distinct types.

11.5 Probabilistic production models and realized outcomes

The production-incidence relation is not a deterministic trajectory law and does not require a model to predict one unique successor set in advance. A high-energy or stochastic model may assign conditional probabilities to a family of candidate production specifications:

$$\mathbb{P}_M(\lambda \mid \mathcal{C}), \qquad \lambda = \langle e, \mathcal{P}, \mathcal{Q}, \mathcal{E} \rangle \in \Lambda_{\text{prod}}, \tag{70}$$

where $\mathcal{C}$ states the declared preparation and model conditions. These probabilities are model outputs; they neither make every candidate linkage actual nor replace the identity and production criteria. If one outcome is physically realized, PhysicalProductionLink classifies the actual linkage and $\mathcal{E}$ records the realized direct incidences. Scientific identification of that realized outcome still requires separate warrant. Thus particle creation, decay, annihilation, branching, fusion, and other probabilistically represented processes need not be forced into deterministic lineage: probability belongs to prediction over possible outcomes, whereas PhysicalProductionLink and TransformAt$^{\text{ont}}$ classify the outcome that actually occurs.

11.6 Ontic transformation and epistemic warrant

A stage-resolved ontic transformation is

$$\begin{aligned} \text{TransformAt}^{\text{ont}}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E}) \Longleftrightarrow\ & \text{PhysicalProductionLink}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E}) \\ & \wedge \forall A \in \mathcal{P}\ \ \text{EndingReal}_A(e) \\ & \wedge \forall B \in \mathcal{Q}\ \ \text{FormationReal}_B(e). \end{aligned} \tag{71}$$

The ontic relation contains no observation or decision clause. Its scientific attribution is the distinct epistemic proposition

$$\mathrm{TransformWarrant}_{P,M}\left[\mathrm{TransformAt}^{\mathrm{ont}}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E})\right].$$

Accordingly,

$$\neg\,\mathrm{TransformWarrant}_{P,M}[\mathrm{TransformAt}^{\mathrm{ont}}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E})] \not\Rightarrow \neg\,\mathrm{TransformAt}^{\mathrm{ont}}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E}),$$

but absence of warrant does not permit scientific assertion of the ontic relation. Conversely, possession of evidence or a formal specification does not create the ontic fact.

The exact-stage proposition may be true independently of whether it is presently known. Scientific assertion of one exact e, one productive-predecessor set, one successor set, and one incidence relation requires an independently validated bearer-specific inference bridge. If the evidence supplies only a transformation-boundary window, the admissible scientific conclusion retains that window and does not assert one exact e, $\mathcal{P}$, $\mathcal{Q}$, or $\mathcal{E}$. Continuing contributors that do not end at e are represented by OriginatesAt or another bearer-appropriate physical-origin relation together with ContinuesAfter; they are not inserted into the productive-predecessor set $\mathcal{P}$.

11.7 Transformation process, boundary resolution, and intermediate bearers

A physical transformation process may occupy a model- or evidence-relative stage set

$$J_{\mathcal{P}\rightsquigarrow\mathcal{Q}} \subseteq \mathcal{S}_C,$$

containing precursor interactions, late predecessor realizations, continuing contributors, transient configurations, independently qualified intermediate bearers, and early successor realizations. This process set is not automatically an identity domain, and its extension across several stages does not contradict the possible truth of a stage-resolved identity-boundary proposition. The predicate $\mathrm{TransformAt}^{\mathrm{ont}}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E})$ classifies one ontic common-stage boundary at which productive-predecessor identities end and successor identities form; it does not assert that every causal, dynamical, or preparatory part of the transformation is instantaneous.

Whenever an intermediate configuration satisfies an independently declared bearer criterion, it receives its own identity domain and history rather than being suppressed as an untyped transition. Conversely, a sequence of observations or model states does not by itself prove that each member is a distinct bearer. If evidence warrants only a process window or boundary window, write a protocol-relative estimate such as

$$\mathrm{EstimatedTransformationWindow}_{P,M}(\mathcal{P}, \mathcal{Q}, W), \qquad \varnothing \neq W \subseteq \mathcal{S}_C,$$

without inferring a unique e, a direct successor edge, or an exact predecessor–successor incidence relation.

A transformation process or boundary window does not by itself classify an ending as successor-producing, identify an extant recipient, or warrant a particular production-incidence edge. Those claims require the stage-indexed ontic relations defined below and their separate evidential warrants. Conversely, a new identity may form through contributors that remain extant and therefore are not productive-predecessor identities in the ending sense.

11.8 Direct successor, positive closure, and strict indirect successor

Direct production incidence is

$$\mathrm{DirectOutput}(A, B; \mathcal{P}, e, \mathcal{Q}, \mathcal{E}) \iff \mathrm{TransformAt}^{\mathrm{ont}}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E}) \wedge A \in \mathcal{P} \wedge B \in \mathcal{Q} \wedge (A, B) \in \mathcal{E}.$$

Define the stage-indexed direct-successor relation by

$$\mathrm{SuccAt}(A, B; e) \iff e \in \mathcal{S}_C \wedge \exists \mathcal{P}, \mathcal{Q}, \mathcal{E}\ \ \mathrm{DirectOutput}(A, B; \mathcal{P}, e, \mathcal{Q}, \mathcal{E}). \tag{72}$$

The unindexed direct-successor relation is its existential stage projection:

$$\mathrm{Succ}(A, B) \iff \exists e \in \mathcal{S}_C\ \ \mathrm{SuccAt}(A, B; e). \tag{73}$$

Therefore direct successorship requires a particular ontic incidence edge, and the derived identity-producing classification at e is fixed by the existence of at least one successor formed at that same boundary rather than at an unrelated stage. Co-membership in predecessor and successor sets is insufficient. Scientific assertion of $\mathrm{SuccAt}(A, B; e)$ or $\mathrm{Succ}(A, B)$ requires separate warrant for at least one supporting transformation proposition and its edge. Exact-stage warrant is stronger than unindexed successor warrant:

$$\mathrm{Warrant}_{P,M}[\mathrm{SuccAt}(A, B; e)] \Longrightarrow \mathrm{Warrant}_{P,M}[\mathrm{Succ}(A, B)]\,, \tag{74}$$

$$\mathrm{Warrant}_{P,M}[\mathrm{Succ}(A, B)] \not\Longrightarrow \exists e \in \mathcal{S}_C\ \ \mathrm{Warrant}_{P,M}[\mathrm{SuccAt}(A, B; e)]\,. \tag{75}$$

The nonconverse permits scientific warrant for direct successorship within a declared transformation window even when no exact cosmic-stage localization is justified.

11.9 Universal terminal ending and non-terminal physical-outcome closure

Define the greatest-cosmic-stage predicate by

$$\mathrm{Greatest}_{\mathrm{C}}(g) \iff g \in \mathcal{S}_C \wedge \neg\exists u \in \mathcal{S}_C\ (g \prec_C u). \tag{76}$$

For $s_\Omega \in \mathcal{S}_C$, define universal terminal ending by

$$\begin{aligned} \mathrm{TerminalUniverse}(s_\Omega) \iff\ & \mathrm{Greatest}_{\mathrm{C}}(s_\Omega) \\ & \wedge \forall A \in \mathcal{S}_{\mathrm{phys}}(s_\Omega)\ \ \mathrm{End}_A(s_\Omega) \\ & \wedge \neg\exists B \in \mathcal{U}_{\mathrm{phys}}\ \ \mathrm{AttainedFormation}_B(s_\Omega). \end{aligned} \tag{77}$$

The definition is conditional: V28/F8 does not postulate any s_Ω satisfying these conditions. If such a stage exists, every identity present there ends, no later stage exists, and no new identity forms at that same stage. Because stage-indexed direct successorship entails predecessor ending and successor formation at the same boundary, and each bearer has one unique ending member, the definition also yields

$$\mathrm{TerminalUniverse}(s_\Omega) \implies \forall A \in \mathcal{S}_{\mathrm{phys}}(s_\Omega)\ \neg\exists B \in \mathcal{U}_{\mathrm{phys}}\ \mathrm{Succ}(A, B).$$

A non-terminal ending need not create a new identity in every physical domain. It must, however, possess a physically continuous outcome rather than becoming an untyped disappearance. The identity-producing branch is a derived ontic classification. Define

$$\boxed{\mathrm{SuccessorProducingEnd}_A(e) \iff \mathrm{End}_A(e) \wedge \exists B \in \mathcal{U}_{\mathrm{phys}}\ \mathrm{SuccAt}(A, B; e)}. \tag{78}$$

The explicit $\mathrm{End}_A(e)$ conjunct records the classification domain, although it is already entailed by $\mathrm{SuccAt}(A, B; e)$ through $\mathrm{TransformAt}^{\mathrm{ont}}$. The definition makes the branch coextensive with the existence of at least one actual direct successor at the same boundary, while leaving the identity, number, and incidence structure of particular successors to the typed production relations.

The extant-recipient branch is defined separately:

$$\begin{aligned}\mathrm{ExtantOutcomeContinuation}_A(e) \iff\ & \mathrm{End}_A(e) \\ & \wedge \exists B \in \mathcal{U}_{\mathrm{phys}} \begin{bmatrix} B \neq A \wedge \mathrm{LaterInHistory}_B(e) \\ \wedge\ \mathrm{ContinuesAfter}(B, e) \\ \wedge\ \mathrm{PhysicalOutcomeLink}(A, e, B) \end{bmatrix}.\end{aligned} \tag{79}$$

This branch states that the ending contributes physically to one or more bearers that were already realized before the boundary and remain realized after it. The condition $\mathrm{LaterInHistory}_B(e)$ prevents a bearer formed for the first time at e from being misclassified as an extant recipient. It covers incorporation, dispersive transfer, reorganization of continuing systems, and other domain-specific outcomes without falsely classifying every recipient as a newly formed successor.

Principle 11.2 (Non-terminal Physical-Outcome Closure)**.** For every non-terminal ending,

$$\boxed{\begin{aligned}&\mathrm{End}_A(e) \wedge \neg\,\mathrm{TerminalUniverse}(e) \\ &\quad \implies \mathrm{SuccessorProducingEnd}_A(e) \vee \mathrm{ExtantOutcomeContinuation}_A(e)\end{aligned}}. \tag{80}$$

The closure principle is an explicit governing physical commitment and does not follow merely from conservation. The successor-producing branch is not a second independent closure principle: it is the derived classification fixed by Equation (78). The disjunction is inclusive, so one ending may both produce one or more new identities and contribute to one or more already extant recipient bearers. For an extant-recipient claim, scientific assertion has the form $\mathrm{OutcomeWarrant}_{P,M}[\mathrm{PhysicalOutcomeLink}(A, e, B)]$; the warrant neither creates nor enters the ontic relation. If physically realized, a universal terminal ending is the only case exempt from non-terminal physical-outcome closure: no successor forms at the terminal stage and no extant recipient continues beyond it.

The ontic equivalence does not collapse distinct epistemic strengths. A warranted particular stage-indexed successor supports the branch classification:

$$\mathrm{Warrant}_{P,M}[\mathrm{SuccAt}(A, B; e)] \implies \mathrm{Warrant}_{P,M}[\mathrm{SuccessorProducingEnd}_A(e)]\,. \tag{81}$$

Warrant for the existential direct-successor proposition supports the derived branch classification:

$$\mathrm{Warrant}_{P,M}[\exists B \in \mathcal{U}_{\mathrm{phys}}\ \mathrm{SuccAt}(A, B; e)] \Longrightarrow \mathrm{Warrant}_{P,M}[\mathrm{SuccessorProducingEnd}_A(e)]\,. \tag{82}$$

Conversely, warrant for the branch classification supports the existential successor proposition:

$$\mathrm{Warrant}_{P,M}[\mathrm{SuccessorProducingEnd}_A(e)] \Longrightarrow \mathrm{Warrant}_{P,M}[\exists B \in \mathcal{U}_{\mathrm{phys}}\ \mathrm{SuccAt}(A, B; e)]\,. \tag{83}$$

Neither existentially adequate warrant nor branch-classification warrant identifies a particular successor by itself:

$$\mathrm{Warrant}_{P,M}[\mathrm{SuccessorProducingEnd}_A(e)] \not\Longrightarrow \exists B \in \mathcal{U}_{\mathrm{phys}}\ \mathrm{Warrant}_{P,M}[\mathrm{SuccAt}(A, B; e)]\,. \tag{84}$$

Thus warrant may establish that at least one new identity was produced at the ending boundary while leaving the particular successor, successor set, or production-incidence edge unresolved. Every such particular attribution still requires its own bearer-specific physical and evidential warrant.

For a scientifically warranted one-predecessor transformation, define

$$\begin{aligned}\mathrm{SuccW}_{P,M}(A, e, \mathcal{Q}) \Longleftrightarrow \exists \mathcal{E}\ \Big[&\mathrm{TransformAt}^{\mathrm{ont}}(\{A\}, e, \mathcal{Q}; \mathcal{E}) \\ &\wedge \mathrm{TransformWarrant}_{P,M}[\mathrm{TransformAt}^{\mathrm{ont}}(\{A\}, e, \mathcal{Q}; \mathcal{E})]\Big].\end{aligned} \tag{85}$$

Thus the adjective "warranted" belongs to the compound epistemically qualified proposition, not to $\mathrm{TransformAt}^{\mathrm{ont}}$ or Succ by definition.

Let $\sigma : \{0, \ldots, n\} \to \mathcal{U}_{\mathrm{phys}}$ denote a finite bearer sequence. The positive finite closure is

$$\begin{aligned}\mathrm{Succ}^{+}(A, B) \Longleftrightarrow\ &\exists n \in \mathbb{N}\ \exists \sigma : \{0, \ldots, n\} \to \mathcal{U}_{\mathrm{phys}} \\ &[n \geq 1 \wedge \sigma(0) = A \wedge \sigma(n) = B \wedge \forall i < n\ \mathrm{Succ}(\sigma(i), \sigma(i+1))]\,.\end{aligned} \tag{86}$$

Strict indirect successorship requires at least two edges:

$$\begin{aligned}\mathrm{IndSucc}(A, B) \Longleftrightarrow\ &\exists n \in \mathbb{N}\ \exists \sigma : \{0, \ldots, n\} \to \mathcal{U}_{\mathrm{phys}} \\ &[n \geq 2 \wedge \sigma(0) = A \wedge \sigma(n) = B \wedge \forall i < n\ \mathrm{Succ}(\sigma(i), \sigma(i+1))]\,.\end{aligned} \tag{87}$$

A direct successor is therefore included in Succ^{+} but excluded from IndSucc unless another path of length at least two is independently established.

11.10 Identity distinction without an invalid domain inference

Successorship entails numerical distinction:

$$\mathrm{Succ}(A, B) \Longrightarrow A \neq B.$$

It does not follow merely from $A \neq B$ that the untagged stage sets I_A and I_B are unequal. Distinct bearers may overlap in all their realized stages and may, in special cases, have extensionally equal untagged stage sets. The correct bearer-preserving distinction is

$$\widetilde{I}_A := \{(A,s) \mid s \in I_A\}, \qquad A \neq B \Longrightarrow \widetilde{I}_A \cap \widetilde{I}_B = \varnothing.$$

Thus same-stage boundary membership, equal domain extension, similarity, record continuity, shared constituents, or a shared name never transfers numerical identity.

11.11 Successor cycles, same-stage cascades, and an independent production-dependence route

Successor acyclicity is not a theorem of time, $\prec_C$, CMA, or same-stage transformation alone. In V28/F8 it follows from the independently adopted same-stage cascade constraint together with the unique formation and ending boundaries and the stage-indexed successor semantics. A transformation model may additionally adopt the production-dependence constraints stated below; they provide a second, independent sufficient derivation and are not the sole basis of cycle exclusion.

Metatheoretic sequence convention.

Finite and countable bearer-sequence constructions in this subsection are carried out in the ordinary classical metatheory with countable dependent choice. This is a transparent mathematical convention used to select a successor at each step of a serial relation; it is not a physical postulate about time, stages, or bearer production.

Constraint 11.3 (No infinite same-stage one-member cascade)**.** A physically admissible successor model excludes an infinite successor sequence—whether injective, non-injective, or periodic—composed wholly of one-stage bearers formed and ended at the same common stage:

$$\boxed{\begin{aligned} \mathrm{NoInfiniteSameStageCascade} \Longleftrightarrow \neg\exists s \in \mathcal{S}_C\ \exists\sigma : \mathbb{N} \to \mathcal{U}_{\mathrm{phys}} \\ \forall n \in \mathbb{N}\ \Big[I_{\sigma(n)} = \{s\} \wedge \mathrm{Succ}\Big(\sigma(n), \sigma(n+1)\Big)\Big] \end{aligned}}. \tag{88}$$

Proposition 11.4 (Successor acyclicity from cascade exclusion)**.** Under Postulates 6.1 and 11.1, Equation (72), and Constraint 11.3,

$$\neg\exists A \in \mathcal{U}_{\mathrm{phys}}\ \mathrm{Succ}^{+}(A, A).$$

Proof. Assume a positive finite successor cycle. By Equation (86), choose a finite sequence $\eta(0), \ldots, \eta(m)$ with $m \geq 1$, $\eta(0) = \eta(m)$, and $\mathrm{Succ}(\eta(i), \eta(i+1))$ for every $i < m$. For each edge choose $s_i \in \mathcal{S}_C$ satisfying $\mathrm{SuccAt}(\eta(i), \eta(i+1); s_i)$, with indices read modulo m. The stage-indexed successor semantics makes s_i the ending member of $\eta(i)$ and the formation member of $\eta(i+1)$. Hence, for every bearer on the cycle, its incoming-edge stage is its unique least identity member and its outgoing-edge stage is its unique greatest identity member. Therefore each incoming stage is equal to or earlier than the corresponding outgoing stage. A strict increase at any point would, after following the finite cycle and using transitivity of $\prec_C$, imply that some stage is earlier than itself. Consequently all edge stages are one stage s. For every bearer on the cycle, the unique least and greatest members are both s, so its identity domain is $\{s\}$. Periodically repeating the finite cycle defines a map $\sigma : \mathbb{N} \to \mathcal{U}_{\mathrm{phys}}$ forbidden by Equation (88).

The assumed cycle is impossible.

Because the sequence σ in Constraint 11.3 is explicitly not required to be injective, periodic repetition converts every finite successor cycle into a prohibited same-stage sequence. The constraint therefore excludes finite cycles as a derived consequence and also blocks an infinite acyclic chain of distinct one-stage bearers at one boundary. It is a well-foundedness-style coherence constraint on the one-stage successor subgraph, stronger than acyclicity alone, while preserving isolated and finite acyclic collections of one-stage bearer histories.

Independent production-dependence route.

A domain model may separately introduce a strict production-dependence relation.

Constraint 11.5 (Strict and transitive production dependence)**.** The relation $\lhd_{\mathrm{tr}} \subseteq \mathcal{U}_{\mathrm{phys}} \times \mathcal{U}_{\mathrm{phys}}$ is irreflexive and transitive:

$$\forall A \in \mathcal{U}_{\mathrm{phys}}\ \neg(A \lhd_{\mathrm{tr}} A), \qquad \forall A, B, C \in \mathcal{U}_{\mathrm{phys}}\ (A \lhd_{\mathrm{tr}} B \wedge B \lhd_{\mathrm{tr}} C) \Longrightarrow A \lhd_{\mathrm{tr}} C.$$

Constraint 11.6 (Direct-successor bridge)**.**

$$\forall A, B \in \mathcal{U}_{\mathrm{phys}}, \qquad \mathrm{Succ}(A, B) \Longrightarrow A \lhd_{\mathrm{tr}} B.$$

Proposition 11.7 (Independent acyclicity from production dependence)**.** Under Constraints 11.5 and 11.6,

$$\neg\exists A \in \mathcal{U}_{\mathrm{phys}}\ \mathrm{Succ}^{+}(A, A).$$

Proof. Every direct successor edge implies production dependence. By transitivity, every positive finite successor path from A to B implies $A \lhd_{\mathrm{tr}} B$. A cycle would imply $A \lhd_{\mathrm{tr}} A$, contradicting irreflexivity.

The two derivations have different roles. Proposition 11.4 follows within the adopted V28/F8 successor model from the same-stage cascade constraint and the already declared boundary semantics. Proposition 11.7 is an independent sufficient route available to a model that additionally adopts $\lhd_{\mathrm{tr}}$. Neither derivation follows from the definition of time, cosmic order, CMA, same-stage membership, or conservation language alone. Neither result establishes a primordial bearer or a finite rooted lineage: a first cosmic stage and successor acyclicity do not prove that every later bearer has a finite predecessor path from a bearer formed at cosmic origin.

Proposition 11.8 (Greatest-stage–terminal-stage equivalence)**.** Under Postulate 11.1, Principle 11.2, Constraint 11.3, Equations (78) and (72), and the metatheoretic sequence convention stated above, every $g \in \mathcal{S}_C$ satisfies

$$\boxed{\mathrm{Greatest}_{\mathrm{C}}(g) \Longleftrightarrow \mathrm{TerminalUniverse}(g)}. \tag{89}$$

Proof. The right-to-left direction follows immediately from Equation (77). For the converse, assume $\mathrm{Greatest}_{\mathrm{C}}(g)$. If $A \in \mathcal{S}_{\mathrm{phys}}(g)$, then $g \in I_A$. Postulate 11.1 supplies the unique greatest identity member $e_A \in I_A$. Since no cosmic stage is later than g, totality of $\prec_C$ forces $e_A = g$; hence every bearer present at g ends there.

Suppose, for contradiction, that some bearer B_0 has $\mathrm{AttainedFormation}_{B_0}(g)$. Greatestness and eventual ending give $I_{B_0} = \{g\}$ and $\mathrm{End}_{B_0}(g)$. The formation of B_0 makes TerminalUniverse(g) false, while no extant-recipient branch can hold at g, because ContinuesAfter(B, g) requires a cosmic stage later than g. Non-terminal physical-outcome closure therefore yields $\mathrm{SuccessorProducingEnd}_{B_0}(g)$, and Equation (78) supplies a direct successor B_1 at g. The stage-indexed successor semantics makes B_1 form at g, and greatestness plus eventual ending again gives $I_{B_1} = \{g\}$. Repeating the serial choice produces a countable successor sequence $B_0, B_1, \ldots$ of one-stage bearers at g, contradicting Constraint 11.3. Thus no bearer forms at g. Together with the established ending of every bearer present there, Equation (77) yields TerminalUniverse(g).

The proposition does not assert that a greatest stage exists. It states that, within the adopted V28/F8 closure package, greatestness and universal terminal ending are coextensive whenever either is realized. Abandoning this equivalence would require revising at least one of the eventual-ending postulate, non-terminal outcome closure, the stage-indexed successor semantics, or the no-infinite same-stage cascade constraint.

11.12 Approximate prediction and conditional cosmic ending

A declared physical model may predict an operational ending window for a bearer or for the universe, but the predicted window belongs to a protocol or model domain and does not make any later cosmic stage attained by the prediction-origin stage. The complete bearer history contains the unique ending member under Postulate 11.1; relative to a reference stage a, its attained status is expressed only by CompletedBy($A; a$). Universal terminal ending remains conditional because no greatest stage is postulated; Proposition 11.8 states only that a greatest stage, if realized, is exactly the terminal stage. The framework therefore distinguishes complete-history ontology, stage-relative attainment, conditional universal termination, and protocol-relative prediction.

12. Observation, Measurement, Records, and Stage Restraint

12.1 Ontic occurrence and observational access

Physical realization and access to it are different propositions:

$$\mathrm{Occurrence}_A(s) \not\equiv \mathrm{AccessToOccurrence}_{P,M}(A, r).$$

These are truth-valued propositions with different meanings and truth conditions. A bearer may undergo physical change without producing an accessible record under the chosen protocol. Nondetection does not establish absence of realization.

12.2 The measurement chain

A valid evidential chain requires a physical occurrence, interaction with an access channel, realization of a record carrier, extraction of a reading, and a validated inference. Each arrow is a declared physical or inferential relation rather than identity:

$$\text{Occurrence} \rightsquigarrow_{\text{phys}} \text{RecordRealization} \rightsquigarrow_{\text{phys}} \text{Reading} \rightsquigarrow_{\text{inf}} \text{Claim}\,.$$

The sample, researcher, apparatus, detector, material record bearer, laboratory supports, and environmental systems are physical systems included in CMA whenever their identities are realized at the stage concerned. For a declared protocol, distinguish the core bearer family from the wider environmental-system family:

$$\mathcal{L}_P^{\text{core}} := \{A_{\text{sample}}, A_{\text{apparatus}}, A_{\text{detector}}, A_{\text{record}}, A_{\text{researcher}}\}, \qquad \mathcal{L}_P^{\text{phys}} := \mathcal{L}_P^{\text{core}} \cup \mathcal{E}_P^{\text{sys}}.$$

Here $\mathcal{E}_P^{\text{sys}}$ contains the declared environmental and support systems relevant to the protocol. The named core symbols denote bearer-distinct systems:

$$X, Y \in \mathcal{L}_P^{\text{core}} \wedge X \neq Y \Longrightarrow \text{BearerDistinct}(X, Y).$$

Bearer distinction does not imply isolation or causal independence. A detector may be a subsystem of a composite apparatus while remaining a distinct bearer:

$$\text{PartOf}(A_{\text{detector}}, A_{\text{apparatus}}; s) \not\Rightarrow A_{\text{detector}} = A_{\text{apparatus}}.$$

For every member whose identity is realized at an actual common stage,

$$X \in \mathcal{L}_P^{\text{phys}} \wedge X \in \mathcal{S}_{\text{phys}}(s) \Longrightarrow \text{PhysReal}_X^+(s).$$

The systems may also enter the experimental process as influencing bearers. Define the declared interaction network and relevant physical-factor family by

$$\begin{aligned}
\mathcal{N}_P(s) &:= \Big\{(X, Y) \mid X, Y \in \mathcal{L}_P^{\text{phys}}, \\
&\qquad\qquad\qquad \text{PhysicalInfluence}_P(X, Y; s)\Big\}, \\
\mathcal{F}_P(s) &:= \Big\{F \mid \text{RelevantPhysicalFactor}_P(F; s)\Big\}.
\end{aligned}$$

An element of $\mathcal{F}_P(s)$ need not be a separate physical system: it may be a state, property, relation, exchange, boundary condition, or mechanism borne by one or more systems. Conversely, a member of $\mathcal{L}_P^{\text{phys}}$ may itself operate as an influencing system through its physical engagements. Thermal, mechanical, electromagnetic, chemical, biological, and environmental influences may therefore coexist and overlap with system-to-system influence. Neither functional integration, part–whole membership, mutual influence, nor overlapping contribution erases bearer identity or turns distinct systems into one bearer. The family is protocol-relative and need not exhaust every physical system or relevant factor in the laboratory. Its members do not undergo identical changes, and their interaction does not make measurement impossible: calibration, isolation, differential design, provenance, intervention analysis, and uncertainty analysis control selected relations among changing and mutually influencing systems. Inclusion under CMA is an internal consequence of the axiom and is not used as independent evidence proving it. There is no physically stationary observer or instrument outside the common cosmic extension.

12.3 Records, stages, and typed realization

A physical record r and a cosmic stage s have different types:

$$\mathrm{Type}(r) = \mathsf{PhysicalRecord}, \qquad \mathrm{Type}(s) = \mathsf{CommonCosmicStage}, \qquad r \not\equiv_{\mathrm{type}} s.$$

Nevertheless, a record may be physically realized in a declared record bearer B_R at a stage:

$$B_R \in \mathcal{U}_{\mathrm{phys}}, \qquad \mathrm{RecordRealizedAt}_{B_R}(r, s).$$

Here B_R identifies the physical bearer in which the record state r is realized. The notation is kept distinct from the protocol-selected record channel $D(P)$. This relation does not turn the record into the stage or make record order identical with cosmic-stage order.

12.4 Operational manifestations and candidate-stage inference

Examination observes noticeable manifestations and compares physical records. ITOF supplies no canonical, identity-preserving, or uniquely determining map from records to cosmic stages. A declared physical model may nevertheless provide a fallible candidate-stage inference:

$$\mathrm{CandidateStages}^{A,\chi}_{P,M}(r) \subseteq \mathcal{S}_C.$$

Here A is the bearer or system to which the reconstruction is attributed, and χ is the target occurrence being reconstructed, such as source realization, emission, arrival, threshold manifestation, identity formation, or identity ending. Such a set may be empty, broad, or non-unique under the available evidence. It remains model- and protocol-dependent and does not identify r with any member of the set.

For a same-bearer comparison,

$$\begin{aligned} &\mathrm{PositiveWitness}^{\Gamma}_{A,k,P,M}(r_1, r_2) \\ &\quad \Longrightarrow \mathrm{ChangeWarrant}_{P,M}\left[\mathrm{NoticeableComponentDifference}^{\Gamma}_{A,k;P,M}(r_1, r_2)\right]. \end{aligned}$$

A positive witness requires valid bearer attribution, a declared comparison criterion, and a difference exceeding accepted measurement uncertainty and operational variation. It warrants a restricted manifestation of change in the identified bearer under the protocol; it does not supply a canonical map from the compared records to every common cosmic stage between them. In particular,

$$\mathrm{RestrictedEmpiricalWitness}_{A;P,M}(r_1, r_2) \not\Rightarrow \mathrm{StagewiseExhaustiveTest}_{A;P,M}(I_A),$$

and

$$\mathrm{RestrictedEmpiricalWitness}_{A;P,M}(r_1, r_2) \not\Rightarrow \mathrm{ExactCosmicStageIdentified}_{A;P,M}(\chi).$$

The first non-entailment blocks conversion of a finite witness into inspection of physical realization at every applicable stage. The second blocks conversion of the stage at which an effect is resolved, recorded, or read into the exact stage at which that effect first became realized or noticeable.

12.5 Exact-stage restraint

The ontic status of a formation boundary, termination boundary, or threshold crossing is distinct from warranted knowledge of its exact stage resolution. A finite record comparison does not justify a unique stage assignment:

$$\mathrm{ValidDifferenceWitness}_{A,P,M}(r_1, r_2) \nRightarrow \mathrm{WarrantedUniqueStageAssignment}_{P,M}(A, r_1, r_2).$$

This is an epistemic limit. It does not assert that no unique ontic threshold stage could exist under any physical model. It states that the finite protocol does not establish that stage exactly. In particular,

$$\begin{aligned} \mathrm{FirstAcceptedDetection}_{P,M}(A; d) \nRightarrow \mathrm{AttainedFormation}_A(d), \\ M_A(d) \geq \theta \nRightarrow \Big(\mathrm{AttainedFormation}_A(d) \vee \mathrm{End}_A(d)\Big). \end{aligned}$$

The second line concerns a declared observable and threshold. Either inference requires an independently validated identity criterion, bearer attribution, measurement model, and record-to-stage bridge. The same restraint applies when change is evident during examination: a first resolved record, first threshold crossing, or first accepted reading is protocol-relative and does not show that physical change began there. Since each sample or laboratory bearer continues to change during and after the act of measurement wherever its identity remains realized, the completion of a test is not an ontological stopping point for change. If a bearer identity ends during the protocol, the ending is itself physical change and any stage-resolved warranted successor identity begins its own identity-forming change at that same common stage.

12.6 Past reconstruction and uncertainty

Past reconstruction may use propagation models, provenance, calibration, decay, stratigraphy, genetic inheritance, or other physical relations. The output is a model-conditioned candidate history or stage set with declared uncertainty. Reconstruction never converts a record into the past occurrence itself and never gives a record the type of a cosmic stage.

13. Clocks, Operational Intervals, Rates, and Comparisons

13.1 Clocks as changing physical systems

Clock bearer and process

A clock is a physical system selected because some repeatable or modelled process can be converted into standardized records and numerical readings. The bearer may be an atom or atomic ensemble undergoing a selected transition, an oscillator, a resonator, a rotating body, a decaying physical system or ensemble, an electronic circuit, or a composite apparatus. The clock does not measure time as defined by ITOF. It realizes physical changes and produces records whose ordering and calibration provide standardized operational measurements. These measurements are valuable to human beings for comparing physical processes, coordinating activities, scheduling events, navigation, communication, and organizing individual and social life.

Let C denote the clock system, let $\mathfrak{H}^{\mathrm{phys}}_{C,J}$ be the domain of admissible physical clock-history segments over a declared operational window J, and let $\Theta_{C,P}$ be the domain of relevant physical and protocol conditions, including environment, control fields, velocity, gravitational setting, coupling, device state, and record convention. For $h_{C,J} \in \mathfrak{H}^{\mathrm{phys}}_{C,J}$ and $\theta_{C,P} \in \Theta_{C,P}$, record production is typed by

$$\mathcal{R}_{C,P} : \mathfrak{H}^{\mathrm{phys}}_{C,J} \times \Theta_{C,P} \longrightarrow \mathfrak{R}_{C,P}, \qquad r_C = \mathcal{R}_{C,P}(h_{C,J}, \theta_{C,P}), \tag{90}$$

where $\mathfrak{R}_{C,P}$ is the clock-record domain. The history-segment input makes accumulation, memory, interrogation cycles, and record-producing dynamics explicit; no isolated instantaneous state is presumed to determine the record.

Reading and calibration

Under protocol P, a clock record is mapped to a numerical codomain:

$$N_{C,P} : \mathfrak{R}_{C,P} \longrightarrow \mathbb{R}_P, \qquad n_C = N_{C,P}(r_C), \tag{91}$$

where $N_{C,P}$ includes counting, scale, unit, interpolation, correction, and reporting rules. Therefore

Clock outputs are operational measures, not time

$$n_C \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}, \qquad r_C \not\equiv_{\mathrm{type}} s, \qquad n_C \in \mathbb{R}_P. \tag{92}$$

Clock outputs support standardized measurement and the organization of human life; they do not measure time as defined by ITOF or count cosmic stages.

Equal readings establish equality only within the declared reading protocol, while unequal readings quantify different physical clock outcomes within the common cosmic extension. The readings warrant protocol-relative numerical comparison and an operational window, while ontic stage identity remains distinct from that warrant.

Clock counts and cosmic-stage order

The succession of cosmic stages is not assumed discrete, countable, equally spaced, or instrumentally isolable. A clock counts selected physical cycles or transforms a continuous signal into a standardized output. It does not count the common cosmic stages. If one oscillator completes more cycles than another under different physical conditions, the result concerns the systems and their processes.

Drift, failure, and missing readings

Clock drift is a deviation of the physical system or its record mapping from the adopted standard. Malfunction, environmental sensitivity, decoherence, ageing, power interruption, or readout failure belongs to the clock and its conditions, not to time. The diagnostic chain is

$$\text{ClockDiscrepancy} \longrightarrow \text{ClockAssessment}(C, \Theta_{C,P}, P, r_C), \tag{93}$$

not a claim that the cosmic extension accelerated, slowed, or became discontinuous.

Ideal and real clocks

An ideal clock is a modelling limit in which the clock output tracks a defined theoretical quantity with stipulated accuracy. A real clock may deviate because of physical conditions. The distinction will be essential in the relativistic sections: proper time is a metric functional, while a real clock is a material system whose output is modelled as approximately or ideally related to that functional. Dynamical analyses of rods and clocks illustrate why material behaviour and metric representation must not be collapsed into one ontological category [11, 12]; ITOF nevertheless rejects their use to establish a relativistic identity of time.

13.2 Operational intervals, rates, and cross-system comparison

Operational order

Records can be ordered by a protocol without being cosmic stages. Let

$$r_1 \lhd_P r_2 \tag{94}$$

mean that protocol P places record r_1 before record r_2. The grounds may be detector architecture, causal chain, storage order, signal sequence, or another validated rule. The relation is epistemic-operational and must not be confused with the foundational cosmic relation $\prec_C$, although a valid physical argument may support consistency between them in a specific case.

Operational interval

For clock C and two clock records $r_{C,1} \lhd_P r_{C,2}$, define

$$\Delta N_{C,P} := N_{C,P}(r_{C,2}) - N_{C,P}(r_{C,1}). \tag{95}$$

This is a numerical interval in the clock's reporting scale. It is not an amount of cosmic extension. It can be compared, transformed, calibrated, and used in laws because the protocol gives it operational meaning.

Rates

Let $\widehat{Q}_{A,P} : \mathfrak{R}_{A,P} \to \mathbb{R}_{Q,P}$ be a protocol-defined measurement or estimation map from sample records to numerical values. For a valid protocol pairing of two sample records with two clock records, define

$$\Delta_P Q_A := \widehat{Q}_{A,P}(r_{A,2}) - \widehat{Q}_{A,P}(r_{A,1}), \tag{96}$$

$$\Delta_P N_C := N_{C,P}(r_{C,2}) - N_{C,P}(r_{C,1}), \tag{97}$$

$$\overline{v}^{\,P}_{Q_A|C} := \frac{\Delta_P Q_A}{\Delta_P N_C}, \qquad \Delta_P N_C \neq 0. \tag{98}$$

The construction operates only on numerical outputs in declared codomains. It neither subtracts complete physical states nor divides by the ITOF temporal denotation.

Cross-system comparison

Two clocks may use different native readings and units. A comparison protocol P_{12} maps them into a common numerical codomain $\mathbb{R}_{P_{12}}$:

$$\Gamma_{i,P_{12}} : \mathrm{Range}(N_{C_i,P_i}) \longrightarrow \mathbb{R}_{P_{12}}, \qquad i \in \{1,2\}. \tag{99}$$

The differential output is

$$\Delta N^{(P_{12})}_{C_1 C_2} := \Gamma_{1,P_{12}}(n_{C_1}) - \Gamma_{2,P_{12}}(n_{C_2})\,. \tag{100}$$

A non-zero value can reflect differing worldlines, environments, mechanisms, calibration, or device behaviour. It does not entail two cosmic extensions:

$$\Delta N^{(P_{12})}_{C_1 C_2} \neq 0 \not\Rightarrow \mathrm{MultipleCosmicExtensions}\,. \tag{101}$$

13.3 Atomic-clock differential outputs and the temporal-attribution boundary

High-precision atomic-clock comparisons instantiate this type boundary directly [25, 26, 27, 28]. A comparison produces two physical clock outputs and one protocol-defined numerical difference:

$$n_{C_1} = N_{C_1,P_1}(r_{C_1}), \qquad n_{C_2} = N_{C_2,P_2}(r_{C_2}), \qquad \Delta N^{(P_{12})}_{C_1 C_2} = \Gamma_{1,P_{12}}(n_{C_1}) - \Gamma_{2,P_{12}}(n_{C_2}). \tag{102}$$

These are, respectively, outputs of two independently realized clock histories and the result of a declared comparison map. The experiment does not additionally deliver an independently observed object called time.

Atomic-clock outputs do not acquire temporal identity

$$n_{C_1} \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}, \qquad n_{C_2} \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}, \qquad \Delta N^{(P_{12})}_{C_1 C_2} \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}. \tag{103}$$

When $\Delta N^{(P_{12})}_{C_1 C_2} \neq 0$, the directly warranted conclusion is that the two clock systems produced different physical outcomes under the stated bearer conditions, trajectories, interactions, calibrations, and protocols. The measurement itself supplies no non-arbitrary rule by which one output becomes "time" while the other becomes a deviation from time. Treating both outputs as distinct times would replace the fixed and irreversible ordering and succession of the common cosmic stages with device-indexed temporal identities, a conclusion neither measured nor licensed by the comparison.

A relativistic or other quantitative model may predict the difference and may attain model-bounded calculational adequacy for the selected records. Such agreement remains a relation among a model, two material clock systems, and their records. It does not transfer the type of time to either output, does not make the difference a physical alteration of time, and does not determine the common cosmic stage. The general ruling on predictive utility is stated in Subsection 17.2, and the detailed clock-experiment reclassification is developed in Subsection F.1.

Operational comparison and common cosmic-stage participation

V28/F8 compares clock records and numerical readings under a declared protocol. Signal exchange and coordinate conventions organise the comparison and delimit operational windows. Common-stage unity belongs to the already defined cosmic domain and order. At every actual common stage, including the first, CMA states that all physical systems whose identities are then realized are present at that same stage and each realizes its own bearer-specific positive physical realization there. Finite clock and signal records remain limited to operational windows and do not, by themselves, warrant a unique common cosmic stage of noticeability.

14. Light, Distance, and Remote Physical Records

14.1 Light as a physical factor and carrier

In the present analysis light is treated as a physical factor and carrier of records rather than as a clock or a temporal substance. A luminous source is a structured physical system. Its physical realizations alter emission properties; radiation propagates; a detector undergoes interaction and produces records. The chain is

$$\begin{aligned}\mathrm{PhysReal}^{+}_{S}(s) &\rightsquigarrow_{\mathrm{phys}} \mathrm{Emission}_{S} \rightsquigarrow_{\mathrm{phys}} \mathrm{Propagation}_{L} \\ &\rightsquigarrow_{\mathrm{phys}} \mathrm{Detection}_{D} \rightsquigarrow_{\mathrm{phys}} \mathrm{RecordState}_{D}(r_D).\end{aligned} \tag{104}$$

Each arrow represents a physical relation requiring a domain model. The emitted radiation is not the source change itself, and the detector record is not the original source state.

14.2 Continuous flux and successive records

Astronomical sources generally supply continuing flux rather than one isolated "light" followed by another as separate substances. Successive portions of that flux carry information about successive physical conditions of the source. The detector samples and integrates the arriving flux according to its response. The source can therefore be observed to change over days, months, or longer after radiation from it becomes available to the detector. Successive variability is governed by the emission spacing together with the differential propagation term between records; propagation contributions common to both records cancel in the difference.

Under protocol P,

$$\Delta t^{(P)}_{\mathrm{arr}} = \Delta t^{(P)}_{\mathrm{emit}} + \Delta\Pi^{(P)}. \tag{105}$$

If successive records follow effectively the same path through sufficiently stable conditions, then

$$\Delta\Pi^{(P)} \approx 0, \qquad \Delta t_{\mathrm{arr}}^{(P)} \approx \Delta t_{\mathrm{emit}}^{(P)}. \tag{106}$$

The approximation is physical and protocol-specific. Lensing, moving media, dispersion, path changes, scattering, and detector processing may make $\Delta\Pi^{(P)}$ non-negligible.

14.3 Remote records and the common stage

The arrival of a record does not bring the source's earlier cosmic stage into the detector. The source system realized its bearer-specific change at the common cosmic stage of emission; the detector realizes its own change at a later common stage when the signal is recorded. The record physically preserves information through propagation, but it does not preserve the stage as an object.

Accordingly, a remote record supports a model-bounded reconstruction window:

$$\mathrm{RemoteRecordOf}(r, S) \wedge \mathrm{ValidPropagationModel}_P \Longrightarrow \mathrm{ConstrainsSourceWindow}_P(r, W_{S,P}). \tag{107}$$

The reconstruction estimates emission coordinates or source history with stated uncertainties and yields a model-bounded source window in the model's coordinate or reconstruction domain. A declared physical bridge may additionally return a non-unique candidate set of cosmic stages, but no such set is canonical and no record becomes a stage. In the general case, the represented history is connected to the declared model by a bearer-indexed bridge $\mathcal{M}_{A,M} : \mathfrak{D}_A^{\mathrm{phys,adm}} \to \mathfrak{R}_A^M$, where $\mathfrak{D}_A^{\mathrm{phys,adm}}$ is the declared admissible occurrence-or-history input domain and $\mathfrak{R}_A^M$ is the model-specific representational codomain. The relativistic bridge $\mathcal{M}_{\mathrm{rel},A}$ is only the specialization obtained when $M = M_{\mathrm{rel}}$. The source's bearer-specific realization at a common cosmic stage remains ontically distinct from the record. A unique exact-stage assignment requires an additional validated uniqueness warrant that the record alone does not supply.

14.4 Distance and the Cosmic Moment Axiom

Distance has no role in whether extant systems are present at the same common cosmic stage or whether each realizes its bearer-specific change under CMA. It governs whether, when, and how another system receives information about that change. Finite signal speed therefore constrains evidence and physical influence. No signal transmits, creates, or causes common-stage presence or the physical change realized by the source.

14.5 Astrophysical variability and identity transformation

Modern surveys and observatories record variable stars, transients, oscillations, stellar activity, and other changing sources across repeated observations [36, 37, 38, 55]. These data strongly demonstrate continuing physical change in remote systems and the usefulness of successive records. They do not enumerate every realization or directly identify cosmic stages. Their role in ITOF is evidential: they show that distance and long propagation do not imply that only one immutable source state can ever be observed.

Stellar evolution supplies a domain-valid identity history. Some massive stars undergo terminal collapse or explosive transformation, with the former stellar identity giving way to one or more successor systems such as a compact remnant and expanding ejecta; the detailed outcome is bearer- and model-dependent [34]. Galactic systems require a different identity criterion. Galaxies do not generally "explode" as single bearers; close interaction, tidal disruption, material redistribution, and merger may preserve, divide, or terminate prior galactic identities and establish successor organizations [35]. In both cases, constituent persistence does not imply persistence of the predecessor identity.

Astrophysical history and successor systems

For a stellar or galactic bearer A under an explicit astrophysical identity criterion, the astrophysical model is distinct from the biological model because its bearer criteria and realization mechanisms are different. Its common ITOF consequences are

$$\begin{aligned}&\mathrm{AdequateAstrophysicalHistoryModel}_{P,M}(A;\widehat{I}_{A;P,M},J)\\ &\quad\Longrightarrow \mathrm{UCC}^{\mathrm{emp}}_{A;P,M}\left(\widehat{I}_{A;P,M},J\right).\end{aligned} \tag{108}$$

The conclusion is the restricted empirical continuity proposition and is confined to the reconstructed bearer window, records, model, and protocol. It does not convert an astrophysical history model into a warrant for every ontic member of I_A^+. When a one-predecessor terminal transformation with declared successor set $\mathcal{Q}$ is warranted, the ontic consequence is

$$\begin{aligned}&\mathrm{SuccW}_{P,M}(A,e_A,\mathcal{Q})\\ &\quad\Longrightarrow \mathrm{EndingReal}_A(e_A)\wedge\forall B\in\mathcal{Q}\left(B\neq A\wedge \mathrm{FormationReal}_B(e_A)\right).\end{aligned} \tag{109}$$

This proposition does not require every stellar or galactic change to terminate identity. Variability, oscillation, mass loss, activity, or morphological evolution may occur while the bearer identity physically persists under the declared evidential judgment. Identity termination is asserted only when the bearer identity is warranted to have physically ceased.

14.6 Source, propagation, and reception differences

For two records emitted by a remote source and received by a detector, the operational difference obeys the accounting relation

$$\Delta_{\mathrm{rec}}=\Delta_{\mathrm{src}}+\Delta_{\mathrm{prop}}. \tag{110}$$

When the propagation contribution is common or independently corrected, the large shared travel interval cancels from the comparison and the residual record separation estimates the source-event separation under the declared model. Light remains a physical carrier of records. It does not carry time or the common cosmic stage, and delayed access to a remote history does not place the remote bearer in a private time.

15. Predictive Use of Individual Physical History

15.1 Ontic history prefix and predictive reconstruction

For an ontic stage $s \in I_A$, define the identity-domain prefix

$$I_A^{\leq s} := \{r \in I_A \mid r = s \ \vee \ r \prec_C s\}, \tag{111}$$

and the corresponding physical-history prefix

$$\mathcal{H}_A^{\leq s} := \left(I_A^{\leq s}, \prec_C|_{I_A^{\leq s}}, X_A|_{I_A^{\leq s}} \right). \tag{112}$$

This is an ontic part of the bearer's actual physical history, not a detector record or an evidential reconstruction.

Prediction ordinarily lacks direct access to that complete prefix. Let u be a declared operational data cutoff in protocol P, and let

$$\widehat{\mathcal{H}}_{A,P,M}^{\leq u} \tag{113}$$

denote the protocol- and model-conditioned reconstruction warranted by records available no later than u. Likewise, $\widehat{\mathcal{G}}_{A,P,M}(u)$ denotes the available reconstruction of the bearer's state, constitution, and actual engagements at that cutoff. Their types remain distinct:

$$\mathrm{Type}\Big(\mathcal{H}_A^{\leq s}\Big) = \mathsf{OnticPhysicalHistoryPrefix}, \tag{114}$$

$$\mathrm{Type}\Big(\widehat{\mathcal{H}}_{A,P,M}^{\leq u}\Big) = \mathsf{ProtocolModelHistoryReconstruction}, \tag{115}$$

so that

$$\widehat{\mathcal{H}}_{A,P,M}^{\leq u} \not\equiv_{\text{type}} \mathcal{H}_A^{\leq s}. \tag{116}$$

The cutoff u and the reconstructed prefix need not assign a unique common cosmic stage. They belong to the evidential layer and are connected to ontic claims only through declared inference bridges.

15.2 Prediction origin, future target window, and outcome variables

At the complete-history ontic level, let $s_\star \in I_A$ be a prediction-origin stage and define an actual later target set by

$$J_A^+(s_\star) \subseteq \mathcal{S}_C \setminus \mathcal{S}_C^{\leq s_\star} = \{v \in \mathcal{S}_{\mathrm{C}} \mid s_\star \prec_C v\}. \tag{117}$$

This set belongs to the complete-history formulation and need not be known or stage-resolved at $s_\star$. In an actual prediction study, the predeclared evaluation window belongs instead to the protocol's native future-order domain:

$$\widehat{J}_{A;P,M}^+(u) \subseteq \mathfrak{I}_P^+(u). \tag{118}$$

No identity-preserving map from $\widehat{J}_{A;P,M}^+(u)$ to one exact subset of $\mathcal{S}_C$ is presumed. A validated model may later constrain candidate stages or ordering bounds, but prediction does not make a later ontic boundary attained at the cutoff. At the complete-history ontic level, define the distinct binary targets

$$Y^{J+}_{\text{fail}}(A) := \mathbf{1}\Big[\exists v \in J^{+}_{A}(s_\star) \cap I_A \;\; \text{FunctionalFailure}_A(v)\Big] \,, \tag{119}$$

$$Y^{J+}_{\text{end}}(A) := \mathbf{1}\Big[\exists v \in J^{+}_{A}(s_\star) \;\; \text{End}_A(v)\Big] \,. \tag{120}$$

Failure and identity cessation are therefore separate predictive outcomes. When cessation is warranted only at an unresolved upper cut rather than at a represented stage, the experimental target must be formulated as a protocol-defined boundary-window outcome and must not claim exact stage resolution.

In an operational implementation, the cutoff u and $\widehat{J}^{+}_{A;P,M}(u)$ are fixed in the protocol's native order. Every predictor, reconstruction, calibration choice, and model-selection operation must use information available at or before u; no record from the future target window may enter model construction, tuning, or preprocessing. After the outcome is observed, any inference from the protocol window to $J^{+}_{A}(s_\star)$, an ending boundary, or a candidate-stage set requires a separately validated record-to-stage bridge.

15.3 Class-only and history-informed models

Let the common baseline information be

$$\mathcal{Z}_{A,P,M}(u) := \Big(\mathfrak{K}_A, \widehat{\mathcal{G}}_{A,P,M}(u), D_A\Big) \,, \tag{121}$$

where $\mathfrak{K}_A$ is class information and D_A contains the declared data, calibration, uncertainty, and admissibility conditions. The two comparison models are

$$M_{\text{class}} := \mathfrak{M}_0(\mathcal{Z}_{A,P,M}(u); D_{\text{train}}) \,, \tag{122}$$

$$M_{\text{hist}} := \mathfrak{M}_1\Big(\mathcal{Z}_{A,P,M}(u), \widehat{\mathcal{H}}^{\le u}_{A,P,M}; D_{\text{train}}\Big) \,, \tag{123}$$

$$M_{\text{abl}} := \mathfrak{M}_1\Big(\mathcal{Z}_{A,P,M}(u), \mathcal{A}\Big(\widehat{\mathcal{H}}^{\le u}_{A,P,M}\Big) \,; D_{\text{train}}\Big) \,. \tag{124}$$

Here $\mathcal{A}$ is a preregistered control that removes, order-disrupts, or replaces historical input while preserving the history-capable architecture, tuning budget, cutoff, and evaluation protocol. The class-only model supplies an external benchmark; the ablation comparison tests the incremental contribution of historical information.

For a predeclared higher-is-better score, define the external benchmark difference and the architecture-controlled history contribution by

$$\Delta_{\text{pred}} := \text{Score}(M_{\text{hist}}; D_{\text{test}}) - \text{Score}(M_{\text{class}}; D_{\text{test}}) \,, \tag{125}$$

$$\Delta_{\text{hist}} := \text{Score}(M_{\text{hist}}; D_{\text{test}}) - \text{Score}(M_{\text{abl}}; D_{\text{test}}) \,. \tag{126}$$

A specific contribution from historical information is accepted only under a predeclared decision rule, for example

$$\Delta_{\text{hist}} > \delta_{\text{hist}}, \qquad \delta_{\text{hist}} \ge 0, \tag{127}$$

with an uncertainty analysis appropriate to the declared score and sampling design. Model-selection and uncertainty procedures must be stated rather than chosen after inspection [19, 18].

The class-only comparison tests the history-informed configuration against a nonhistorical benchmark; the ablation comparison isolates the declared historical input under a fixed architecture. Neither result proves ontological independence, establishes CMA exclusively, or determines an ontic endpoint. Prediction remains conditional on data quality, reconstruction validity, model adequacy, and the target window.

16. Empirical Access, Restricted Testability, and Evidential Architecture

16.1 Test-status discipline

CMA and UCC have universal ontological scope, whereas direct experimental decisions concern declared restricted hypotheses or restricted empirical consequences. No finite protocol can inspect every physical system at every actual common cosmic stage, prove the universal CMA presence-and-realization claim, exhaust every bearer variable, or assign a unique common cosmic stage to every physical realization involved in the measurement chain. The operational programme is therefore a programme of restricted empirical witnesses and adverse tests, not a stagewise exhaustive test of CMA or UCC. The empirical architecture keeps five layers formally distinct.

Throughout this architecture, the protocol P includes a preregistered detector or record channel. For the single-channel protocol instance used in the equations below, let $D(P)$ be the channel selected by P and define

$$\mathfrak{R}_P := \mathfrak{R}_{D(P)}.$$

Thus the channel is not a free undeclared parameter: changing the channel changes the protocol instance. A multichannel study is represented without altering the channelwise equations by a preregistered indexed family

$$\mathbf{P} = (P_d)_{d\in\mathcal{D}_P}, \qquad D(P_d) = d,$$

together with a declared cross-channel validity and combination rule. Each displayed single-channel proposition applies to its corresponding P_d; no family-level conclusion follows without the preregistered combination rule.

1. Preregistered restricted operational hypothesis.

Before evidence inspection, the study declares the bearer A, identity warrant, protocol P including $D(P)$, model M, variables V, study window J, threshold ε, planned comparison indices $\mathcal{J}_P \subseteq \mathcal{I}_P^2$, and comparison-validity conditions. The preregistered no-stasis hypothesis is a prospective claim about the planned observable contrasts:

$$H^{\mathrm{OpNS}}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P} : \exists(i,j) \in \mathcal{J}_P \left[i \neq j \wedge d_{M,V}\left(O_i^*, O_j^*\right) > \varepsilon\right], \tag{128}$$

where O_i^* and O_j^* denote preregistered target outcomes or model-defined contrasts, not records already inspected. The hypothesis does not contain the later decision and is not an ontological restatement of UCC.

2. Study admissibility.

The qualifications required for the study are a separate proposition:

$$\begin{aligned}\mathrm{AdmissibleStudy}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P} \iff\ & \mathrm{StudyQualified}_{P,M}(A)\\ & \wedge \mathrm{IdentityWarrant}_{A,P,M}(J)\\ & \wedge \mathrm{ProtocolAdequacy}_{P}(A, J; \mathcal{J}_P)\\ & \wedge \mathrm{ModelScopeDeclared}_{M}(A, J; V)\\ & \wedge \mathrm{SensitivityAdequate}_{P,M,V,\varepsilon}(A, J)\\ & \wedge \mathrm{ConfoundersControlled}_{P,M,V}(A, J).\end{aligned} \tag{129}$$

Admissibility neither asserts the hypothesis nor predetermines the outcome.

3. Observed evidence and accepted realizations of planned comparisons.

Let

$$\mathfrak{E}_{A,P,M,V,J} := \{r \in \mathfrak{R}_P \mid \mathrm{AcceptedRecord}_{A,P,M,V,J}(r)\}. \tag{130}$$

Here $\mathfrak{R}_P$ is the record domain selected by the preregistered protocol. Let $\iota_P : \mathfrak{R}_P \dashrightarrow \mathcal{I}_P$ assign each accepted record its preregistered sampling or comparison index where that index is defined. The accepted realization of the preregistered comparison plan is

$$\begin{aligned}\mathfrak{P}^{\mathrm{acc|plan}}_{A;P,M,V,J,\mathcal{J}_P} := \Big\{(r_i, r_j) \in \mathfrak{E}^2_{A,P,M,V,J} \ \Big|\ & r_i \neq r_j\\ & \wedge r_i, r_j \in \mathrm{Dom}(\iota_P)\\ & \wedge \big(\iota_P(r_i), \iota_P(r_j)\big) \in \mathcal{J}_P\\ & \wedge \mathrm{ValidComparison}_{A,P,M,V,J}(r_i, r_j)\Big\}.\end{aligned} \tag{131}$$

Post hoc comparisons may be reported as exploratory analyses, but they do not enter the preregistered decision unless a separately declared confirmatory protocol authorizes them. Define the observed operational-difference event by

$$\mathrm{ObservedDifference}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P} \iff \exists (r_i, r_j) \in \mathfrak{P}^{\mathrm{acc|plan}}_{A;P,M,V,J,\mathcal{J}_P} \left[d_{M,V}(O(r_i), O(r_j)) > \varepsilon\right]. \tag{132}$$

Operational stasis means only that at least one valid comparison exists and every accepted valid comparison remains at or below the threshold:

$$\begin{aligned}\mathrm{OperationalStasis}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P} \iff\ & \mathfrak{P}^{\mathrm{acc|plan}}_{A;P,M,V,J,\mathcal{J}_P} \neq \varnothing\\ & \wedge \forall (r_i, r_j) \in \mathfrak{P}^{\mathrm{acc|plan}}_{A;P,M,V,J,\mathcal{J}_P},\ d_{M,V}(O(r_i), O(r_j)) \leq \varepsilon.\end{aligned} \tag{133}$$

Neither observed difference nor operational stasis is a complete bearer-state proposition. In particular,

$$\mathrm{OperationalStasis}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P} \nRightarrow \mathrm{CompletePhysicalStasis}(A).$$

4. Declared decision rule.

A rule fixed before outcome interpretation maps the evidence to one of three restricted statuses:

$$\delta_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\Big(\mathfrak{E}_{A,P,M,V,J}, \mathfrak{P}^{\mathrm{acc|plan}}_{A;P,M,V,J,\mathcal{J}_P}\Big) \in \{\mathsf{support}, \mathsf{adverse}, \mathsf{inconclusive}\}. \tag{134}$$

The rule evaluates the preregistered hypothesis using the observed evidence and the accepted realization of the preregistered comparison plan. Absence of a valid comparison cannot count as support or adversity:

$$\mathfrak{P}^{\mathrm{acc}|\mathrm{plan}}_{A;P,M,V,J,\mathcal{J}_P} = \varnothing \Longrightarrow \delta_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\left(\mathfrak{E}_{A,P,M,V,J}, \mathfrak{P}^{\mathrm{acc}|\mathrm{plan}}_{A;P,M,V,J,\mathcal{J}_P}\right) = \mathsf{inconclusive}. \tag{135}$$

5. Restricted conclusion.

The study conclusion is the output of the declared rule under an admissible study:

$$\begin{aligned} &\mathrm{AdmissibleStudy}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P} \\ &\quad \Longrightarrow \mathrm{StudyConclusion}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P} \\ &\quad\quad = \delta_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\left(\mathfrak{E}_{A,P,M,V,J}, \mathfrak{P}^{\mathrm{acc}|\mathrm{plan}}_{A;P,M,V,J,\mathcal{J}_P}\right). \end{aligned} \tag{136}$$

The conclusion remains restricted to the bearer, identity warrant, variables, model, sensitivity, sampling, window, uncertainty, and protocol. A negative or inconclusive result does not entail $\neg\,\mathrm{PhysReal}^{+}_{A}(s)$ for any declared $s \in I_A$, and a supportive result does not deductively prove CMA or unrestricted UCC.

Restricted witness, exact-stage restraint, and stagewise non-exhaustion

For an admissible study with valid bearer attribution, an accepted observed difference can warrant only a restricted empirical witness:

$$\begin{aligned} &\mathrm{AdmissibleStudy}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P} \\ &\quad \wedge \mathrm{ObservedDifference}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P} \\ &\quad \wedge \mathrm{ValidBearerAttribution}_{A;P,M}(J) \\ &\quad\quad \Longrightarrow \mathrm{RestrictedEmpiricalWitness}_{A;P,M,V,\varepsilon,J}. \end{aligned} \tag{137}$$

The resulting witness has neither of the following stronger consequences:

$$\begin{aligned} &\mathrm{RestrictedEmpiricalWitness}_{A;P,M,V,\varepsilon,J} \not\Rightarrow \mathrm{StagewiseExhaustiveTest}_{A;P,M,J}, \\ &\mathrm{RestrictedEmpiricalWitness}_{A;P,M,V,\varepsilon,J} \not\Rightarrow \mathrm{ExactCosmicStageIdentified}_{A;P,M}(\chi). \end{aligned} \tag{138}$$

The record-pair predicate PositiveWitness identifies a valid local witness at the comparison level, whereas RestrictedEmpiricalWitness records the admissible study-level evidential conclusion supported by one or more accepted comparisons under the declared decision architecture. The latter does not replace or redefine the former. The restricted witness concerns a manifested bearer difference under the declared access chain. It does not claim that the protocol observed every common stage applicable to the bearer during the operational window J, and it does not turn J itself into a subset of $\mathcal{S}_C$. It also does not turn a record index, clock reading, coordinate, threshold crossing, or examination endpoint into the exact common cosmic stage of the underlying realization. This restriction is compatible with the foundational claim that each relevant bearer changes wherever its identity remains realized before, during, and after examination, with identity-ending and successor-forming change classified at one common stage where such a transformation occurs. It prevents the empirical record from being assigned more resolution or scope than it possesses.

16.2 Empirical test programmes retained and applied in V28/F8

The principal programmes are: (i) class-only versus history-informed prediction; (ii) multi-channel examination of apparently stable systems; (iii) formation-boundary observation testing whether identity realization and detectable change are resolved within the same protocol window; (iv) separation of functional failure from identity termination; (v) part–whole and nested-system attribution; (vi) remote-record reconstruction with explicit propagation corrections; and (vii) cross-domain synthesis of physical-system histories with declared class coverage, model dependence, and counterexample obligations.

For every programme, the protocol must state in advance the bearer, identity criterion, variables, model, sensitivity, sampling, uncertainty, adverse result, and allowed model revision. Adding an unconstrained variable only after a negative outcome does not count as confirmation.

16.3 Four levels of empirical claim

The empirical programme distinguishes:

(i) one physical change in one identified bearer;

(ii) continuing change in that bearer across a declared domain;

(iii) continuing change across a defined physical class;

(iv) universal change continuity across all physical systems.

Each level carries its own burden. A genetic variant warrants change in a molecule, cell, organism, or lineage only at the level supported by attribution. A class-level synthesis requires heterogeneous cases. Universal support requires a cumulative programme across classes and explicit treatment of difficult candidates. None of the four evidential levels is a literal stage-by-stage inspection of the complete cosmic domain; the fourth is cumulative support for a universal foundational claim, not experimental exhaustion of its quantifiers.

16.4 Pre-registration of bearer, identity, domain, and adverse outcome

A strong test fixes before interpretation:

(1) the physical bearer A;

(2) the operationally estimated identity window $\widehat{I}_{A;P,M}$, the domain-valid identity criterion, and the evidential bridge used to evaluate identity persistence; the ontic domain I_A itself is not presumed exhaustively known;

(3) the ordered comparison domain J;

(4) the state components and quantities relevant to the claim;

(5) the access variables and detector model;

(6) the protocol P and inference model M;

(7) the uncertainty budget and decision rule;

(8) the outcome that would count against the claim.

The objects used in this test architecture have distinct types:

$$\operatorname{Type}\big(H^{\mathrm{OpNS}}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P}\big) = \mathsf{PreregisteredRestrictedOperationalHypothesis}, \tag{139}$$

$$\operatorname{Type}\big(\mathfrak{P}^{\mathrm{acc|plan}}_{A;P,M,V,J,\mathcal{J}_P}\big) = \mathsf{AcceptedRealizationOfPreregisteredComparisonPlan}, \tag{140}$$

$$\operatorname{Type}\big(\mathrm{ObservedDifference}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P}\big) = \mathsf{ProtocolRelativeOperationalProposition}, \tag{141}$$

$$\operatorname{Type}\big(\mathrm{OperationalStasis}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P}\big) = \mathsf{ProtocolRelativeOperationalProposition}, \tag{142}$$

$$\operatorname{Type}\big(\mathrm{AdmissibleStudy}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\big) = \mathsf{ProtocolRelativeAdmissibilityProposition}, \tag{143}$$

$$\operatorname{Type}\big(\mathrm{AdverseAdmissible}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\big) = \mathsf{StrengthenedAdmissibilityProposition}, \tag{144}$$

$$\operatorname{Type}\big(\mathfrak{E}_{A,P,M,V,J}\big) = \mathsf{PhysicalEvidenceSet}, \tag{145}$$

$$\operatorname{Type}\big(\mathrm{BearerCompleteStasisWarrant}_{\Pi}(A,J)\big) = \mathsf{ProtocolFamilyRejectionWarrant}, \tag{146}$$

$$\operatorname{Type}\big(\mathrm{NontrivialHistoryWarrant}_{\Pi}(A,J)\big) = \mathsf{ProtocolFamilyHistoryWarrant}, \tag{147}$$

$$\operatorname{Type}\big(\mathrm{UCC}^{\mathrm{emp}}_{A;P,M}(\widehat{I}_{A;P,M},J)\big) = \mathsf{ProtocolRelativeEvidentialProposition}, \tag{148}$$

$$\operatorname{Type}\big(\delta_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\big) = \mathsf{DeclaredDecisionRule}, \tag{149}$$

$$\operatorname{Type}\left(\begin{matrix}\mathrm{StudyConclusion}_{A,J,P,M,V,\varepsilon,}\\ \mathcal{J}_P\end{matrix}\right) = \mathsf{RestrictedEvidentialConclusion}. \tag{150}$$

None creates ontic identity, constitutes physical stasis by definition, or changes the universal scope of CMA and UCC. The protocol-family rejection warrant is an evidential status governed by predeclared acceptance criteria, not an ontological predicate. The restricted empirical continuity proposition and planned-comparison coverage adequacy are protocol-relative evidential propositions, not ontological predicates.

Bearer-coverage adequacy.

For a preregistered restricted claim, $\mathrm{BearerCoverageAdequate}_{P,M,V,\varepsilon}(A,J)$ is a protocol-relative evidential proposition asserting that the component, spatial, temporal, mechanism, identity, and attribution coverage required by that claim has been satisfied within the declared model, sensitivity, sampling, and uncertainty limits. Its acceptance criteria must be registered before outcome interpretation and remain specific to the bearer and claim; it does not assert metaphysically exhaustive access to the complete bearer state. Thus

$$\operatorname{Type}\Big(\mathrm{BearerCoverageAdequate}_{P,M,V,\varepsilon}(A,J)\Big) = \mathsf{ProtocolRelativeEvidentialProposition}. \tag{151}$$

Admissibility for an adverse conclusion is a strengthening of, not an alternative to, the general study-admissibility proposition:

$$\begin{aligned}\mathrm{AdverseAdmissible}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P} \iff\ & \mathrm{AdmissibleStudy}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\\ & \wedge \mathrm{IdentityPersistenceWarrant}_{A,P,M}(J)\\ & \wedge \mathrm{BearerCoverageAdequate}_{P,M,V,\varepsilon}(A,J)\\ & \wedge \mathrm{PlannedComparisonCoverageAdequate}_{P,M}(A,J;\mathcal{J}_P)\\ & \wedge \mathrm{InferenceValidated}_{P,M,V}(A,J).\end{aligned} \tag{152}$$

These are test qualifications rather than the adverse conclusion itself. Planned-comparison coverage is required for an adverse conclusion because the preregistered hypothesis is existential over the declared comparison pairs; unobserved or invalid planned pairs cannot be silently treated as null differences. Sensitivity and confounder control are inherited from AdmissibleStudy and are not duplicated in an independent system.

The decision rule must remain minimally compatible with the operational propositions while retaining an inconclusive option for unresolved uncertainty:

$$\begin{aligned}
&\mathrm{ObservedDifference}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P} \wedge \mathrm{AdmissibleStudy}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P} \\
&\quad \Longrightarrow \delta_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\left(\mathfrak{E}_{A,P,M,V,J}, \mathfrak{P}^{\mathrm{acc|plan}}_{A;P,M,V,J,\mathcal{J}_P}\right) \in \{\mathsf{support}, \mathsf{inconclusive}\}, \\
&\mathrm{OperationalStasis}_{A;P,M,V,\varepsilon,J,\mathcal{J}_P} \wedge \mathrm{AdverseAdmissible}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P} \\
&\quad \Longrightarrow \delta_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\left(\mathfrak{E}_{A,P,M,V,J}, \mathfrak{P}^{\mathrm{acc|plan}}_{A;P,M,V,J,\mathcal{J}_P}\right) \in \{\mathsf{adverse}, \mathsf{inconclusive}\}.
\end{aligned} \tag{153}$$

For a preregistered restricted operational no-stasis hypothesis, an adverse conclusion may be stated as

$$\begin{aligned}
&\mathrm{AdverseAdmissible}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P} \wedge \delta_{A,J,P,M,V,\varepsilon,\mathcal{J}_P}\left(\mathfrak{E}_{A,P,M,V,J}, \mathfrak{P}^{\mathrm{acc|plan}}_{A;P,M,V,J,\mathcal{J}_P}\right) = \mathsf{adverse} \\
&\quad \Longrightarrow \mathrm{StudyConclusion}_{A,J,P,M,V,\varepsilon,\mathcal{J}_P} = \mathsf{adverse}.
\end{aligned} \tag{154}$$

This conclusion is adverse to the declared restricted hypothesis, not by itself a proof that unrestricted physical change ceased. An empirical adverse scenario for unrestricted UCC would require warranted identity-preserving complete physical stasis, whereas a finite null record establishes only non-detection within its model, variables, sensitivity, sampling, and window.

Repeated adverse results from independent admissible protocols, broader bearer coverage, higher sensitivity, and different variable sets nevertheless impose cumulative empirical pressure. They narrow the defensible empirical scope of the universal claim and may require revision of auxiliary models or of the foundational claim if a warranted bearer-complete stasis case is established. The framework may not neutralize every adverse result by introducing unspecified hidden change. Thus non-detection does not prove stasis, but it remains scientifically consequential evidence within its declared limits.

16.5 Unrestricted falsifier and cumulative-review discipline

ITOF does not equate finite non-detection with falsification, but neither does it classify the unrestricted bearer-relative claim as immune to adverse evidence. The logical falsifier and the separate protocol-family scientific rejection rule are stated explicitly below.

For an actual physical bearer, the exact classical negation condition for bearer-relative UCC is explicit:

$$\mathrm{PhysicalSystem}(A) \Longrightarrow \left[\neg\,\mathrm{UCC}(A) \Longleftrightarrow \exists s \in I_A \left(\mathrm{LaterInHistory}_A(s) \wedge \neg\,\mathrm{PhysReal}^{+}_{A}(s)\right)\right]. \tag{155}$$

The biconditional follows from the definition of UCC(A) under the stated physical-system condition; it is not an empirical inference from a null record. A finite null record does not by itself establish its existential right-hand side. Because UCC follows from CMA for a bearer present at a common later stage, one warranted ontic counterinstance to bearer-specific physical realization also contradicts CMA at that stage:

$$\mathrm{Later}_{\mathrm{C}}(s) \wedge A \in \mathcal{S}_{\mathrm{phys}}(s) \wedge \neg\, \mathrm{PhysReal}^{+}_{A}(s) \Longrightarrow \neg\, \mathrm{CMA}(s).$$

This is an ontological contradiction condition; the evidential route to warranting its premises remains subject to the protocol, bearer, identity, and coverage constraints stated below. Let Π denote a preregistered family of independent protocols with declared cross-channel, bearer, identity, sensitivity, sampling, and planned-comparison coverage. A scientific rejection rule may be stated as

$$\begin{aligned} &\mathrm{BearerCompleteStasisWarrant}_{\Pi}(A, J) \wedge \mathrm{NontrivialHistoryWarrant}_{\Pi}(A, J) \\ &\qquad \Longrightarrow \mathrm{Reject}_{\Pi}(\mathrm{UCC}(A))\,. \end{aligned} \tag{156}$$

where $\mathrm{BearerCompleteStasisWarrant}_{\Pi}(A, J)$ is a strengthened protocol-family evidential proposition, not a claim of logically exhaustive access to every conceivable description. "Bearer-complete" is relative to the preregistered protocol family, adopted model, declared identity criterion, bearer boundary, variables, mechanisms, sensitivities, and coverage claim under review. Its acceptance criteria must be fixed before outcome interpretation and must include warranted identity persistence, independently validated inference, adequate sensitivity, and no unresolved planned comparison or relevant declared channel. The separate $\mathrm{NontrivialHistoryWarrant}_{\Pi}(A, J)$ requires evidence for at least one valid ordered same-bearer comparison within the represented history; it does not create or exhaust the ontic history. The operator Reject_{Π} records a scientifically warranted, revisable decision and is not itself a deductive identity with $\neg\, \mathrm{UCC}(A)$.

Repeated restricted adverse results do not automatically satisfy the conjunction of these strengthened warrants:

$$\begin{aligned} \mathrm{RepeatedAdverse}_{\Pi}(A, J) \not\Rightarrow\ &\mathrm{BearerCompleteStasisWarrant}_{\Pi}(A, J) \\ &\wedge \mathrm{NontrivialHistoryWarrant}_{\Pi}(A, J). \end{aligned}$$

They nevertheless trigger mandatory review of attribution, auxiliary models, empirical scope, and the foundational claim. Post hoc introduction of an unspecified hidden process is not an admissible automatic rescue. This discipline distinguishes a logical ontological counterexample, a scientifically warranted rejection, and cumulative pressure that has not yet reached the required warrant conjunction.

No post hoc hidden-change rescue

Once the bearer, identity criterion, planned channels, sensitivity, sampling, auxiliary assumptions, and decision rule have been preregistered, an adverse result may not be converted into confirmation by introducing an unspecified unmeasured change solely because the result is adverse. A newly proposed physical route must be stated as a new auxiliary hypothesis with independently specified bearer, mechanism, expected record consequences, and prospective discrimination procedure. It may motivate a new study, but it does not retroactively erase the evidential status of the completed protocol. If the warrant conjunction in Equation (156) is accepted, the required conclusion is rejection of $\mathrm{UCC}(A)$ under Π, not protection of the claim by an unconstrained possibility.

Underdetermination is not confirmation

The ontic–epistemic distinction limits what a finite protocol can establish; it does not convert absence of warrant into support for the axiom. For a declared protocol family,

$$\neg\,\mathrm{AdmissibleDiscriminationRoute}_{\Pi}(A,J) \Longrightarrow \mathrm{EmpiricallyUnderdetermined}_{\Pi}(\mathrm{UCC}(A);J)\,. \tag{157}$$

not $\mathrm{UCC}(A)$ and not $\neg\,\mathrm{UCC}(A)$. Here $\mathrm{AdmissibleDiscriminationRoute}_{\Pi}(A,J)$ means a preregistered, physically credible route capable in principle of discriminating positive bearer realization from complete stasis for the declared bearer and claim. Where no such route exists, the unrestricted proposition is not presented as a directly closed experimental theorem for that domain. It remains a foundational commitment exposed to indirect consequences, cross-domain convergence, and revision if a warranted counterinstance is obtained. This limitation is a scope statement, not an immunity clause.

Application-specific realization-bridge obligations

No universal record-to-ontology rule is introduced by notation alone. For each application class κ, a proposed realization bridge must declare before outcome interpretation: (i) the bearer and numerical-identity criterion; (ii) the physical state or occurrence representation and its domain of validity; (iii) sufficient positive-witness conditions for the declared realization claim; (iv) sufficient claim-relative stasis conditions, including the variables, mechanisms, sensitivities, sampling, uncertainty, and coverage that make the adverse claim bearer-complete relative to κ; and (v) a validated inference rule specifying when the application evidence licenses the target proposition or a scientifically revisable rejection. Schematically,

$$\begin{aligned}&\mathrm{ValidatedRealizationBridge}_{\kappa,P,M}(A,J)\wedge \mathrm{ApplicationEvidence}_{\kappa,P,M}(A,J)\\&\qquad\Longrightarrow \mathrm{Warrant}_{\kappa,P,M}[\mathcal{C}_{\kappa}(A,J)]\,,\end{aligned} \tag{158}$$

where $\mathcal{C}_{\kappa}(A,J)$ is the application-specific positive-realization or claim-relative complete-stasis proposition fixed in advance. The schema never permits a bare null record to entail $\neg\,\mathrm{PhysReal}_A^{+}(s)$, and it never converts a protocol-relative rejection into a deductive identity with the ontological negation. A domain for which these bridge obligations cannot be met remains empirically underdetermined rather than confirmed.

16.6 Positive witnesses

Use $\mathrm{AcceptedBearerRecord}_{A,P,M}(r)$ for the witness-level protocol-relative proposition that $r \in \mathfrak{R}_P$ is an accepted record validly assigned to bearer A under P and M. It does not replace the study-window-indexed $\mathrm{AcceptedRecord}_{A,P,M,V,J}$ used in the evidence set; it abstracts only the record-domain and bearer-assignment conditions required here. Define a same-bearer record pair by

$$\begin{aligned}\mathrm{SameBearerRecords}_{A,P,M}(r_1,r_2) \Longleftrightarrow\ & r_1 \neq r_2 \wedge \mathrm{AcceptedBearerRecord}_{A,P,M}(r_1)\\&\wedge \mathrm{AcceptedBearerRecord}_{A,P,M}(r_2).\end{aligned} \tag{159}$$

Thus the predicate includes record-domain membership, distinctness of the two records, and valid assignment of both records to the same bearer.

A positive witness is a physically attributable record-level difference under a declared comparison criterion. For a bearer component k under protocol P, whose declared record channel is $D(P)$, define

$$\begin{aligned}&\mathrm{PositiveWitness}^{\Gamma}_{A,k,P,M}(r_1,r_2) \iff \mathrm{SameBearerRecords}_{A,P,M}(r_1,r_2) \wedge k \in K(\Gamma_A)\\ &\quad \wedge \mathrm{DeclaredCriterion}(\Gamma_{A,k}, P, D(P)) \wedge \mathrm{ValidRecordAttribution}_{A,P,M}(r_1,r_2;k)\\ &\quad \wedge d_{P,D(P)}(O_{A,k,P}(r_1), O_{A,k,P}(r_2)) > \varepsilon_{A,k,P,D(P)}.\end{aligned} \tag{160}$$

Here $d_{P,D(P)}$ is the declared comparison rule and $\varepsilon_{A,k,P,D(P)}$ includes the accepted measurement uncertainty and operational variation for the record channel selected by P. The relation ValidRecordAttribution is the protocol-relative bridge from the compared records to the declared bearer component; it is distinct from ValidStateComponentAttribution, which is used for component comparisons stated directly over bearer-state members. Neither relation identifies a record with a state or cosmic stage. The witness therefore does not reduce to an arbitrary numerical difference. It requires two distinct accepted records of the same bearer, valid component attribution, a declared criterion, and a difference beyond the accepted uncertainty and operational variation.

The component-level target predicate is used with one canonical signature throughout the paper. Define the corresponding bearer-level proposition by

$$\begin{aligned}&\mathrm{NoticeableBearerDifference}^{\Gamma}_{A;P,M}(r_1,r_2)\\ &\quad \iff \exists k \in K(\Gamma_A)\ \ \mathrm{NoticeableComponentDifference}^{\Gamma}_{A,k;P,M}(r_1,r_2).\end{aligned} \tag{161}$$

The warranted component-level and bearer-level conclusions are

$$\begin{aligned}&\mathrm{PositiveWitness}^{\Gamma}_{A,k,P,M}(r_1,r_2)\\ &\quad \Longrightarrow \mathrm{ChangeWarrant}_{P,M}\left[\mathrm{NoticeableComponentDifference}^{\Gamma}_{A,k;P,M}(r_1,r_2)\right],\\ &\mathrm{PositiveWitness}^{\Gamma}_{A,k,P,M}(r_1,r_2)\\ &\quad \Longrightarrow \mathrm{ChangeWarrant}_{P,M}\left[\mathrm{NoticeableBearerDifference}^{\Gamma}_{A;P,M}(r_1,r_2)\right].\end{aligned} \tag{162}$$

Both noticeable-difference predicates are protocol-relative inferential propositions, not ontic stage predicates. One positive witness is therefore sufficient to warrant a criterion-relevant component difference and, through the displayed existential aggregation, a bearer-level noticeable difference under Γ_A. This conclusion does not assign either record to a cosmic stage and does not identify the exact stage at which the change first became noticeable. The component-consistency condition for Γ_A makes one valid selected-component difference sufficient to defeat equivalence under that criterion.

16.7 Coverage and bearer completeness

Coverage has at least four dimensions:

(a) *component coverage*: which parts, fields, relations, and scales are accessed;

(b) *temporal coverage*: which operational windows and sampling gaps are included;

(c) *spatial coverage*: which regions, cells, tissues, surfaces, or remote source areas are sampled;

(d) *mechanism coverage*: which plausible physical routes could generate a difference outside the measured channels.

A claim of equivalence under the bearer-complete criterion Γ_A^{all} must justify all four dimensions relative to the bearer and declared domain. A null result in one channel supports a bounded statement about that channel.

16.8 Physical variables and access variables

Physical variables belong to the bearer: composition, structure, field values, spatial relations, molecular sequences, energy distributions, correlations, and processes. Access variables belong to the measurement chain: sensitivity, integration duration, calibration, sampling, propagation, alignment, reconstruction priors, selection rules, and model assumptions. Their separation prevents an access limitation from being reported as a bearer property.

16.9 Independent evidential channels

Convergent evidence is strongest when channels depend on different physical aspects and different failure modes. Material tests may combine spectroscopy, microscopy, mass change, mechanical response, chemical products, and surface analysis. Genetic tests may combine sequencing technologies, allele-specific assays, lineage reconstruction, imaging, and functional measurements. Astronomical tests may combine photometry, spectroscopy, timing, polarization, and independent instruments.

Independence is physical and methodological, not merely statistical. Shared sample preparation, calibration, model priors, or propagation assumptions can correlate nominally different records and must be reported.

16.10 Outcome classes

Every test reports one of four principal outcomes:

(a) *validated difference*: one or more witnesses establish bearer-specific non-equivalence;

(b) *bounded equivalence*: selected variables remain equivalent within declared sensitivity and coverage;

(c) *unresolved outcome*: data, attribution, identity, or coverage remain insufficient for either conclusion;

(d) *adverse restricted result*: an admissible null or contrary result defeats a preregistered operational hypothesis relative to its fixed model, variables, sensitivity, sampling, interval, and decision rule.

The fourth outcome challenges the restricted operational hypothesis within its validated scope. It does not convert a bounded null into proof of complete physical stasis. The second and third outcomes delimit present knowledge and guide stronger tests.

16.11 Operational ordering and stage restraint in experiments

Experiments may order records within a declared protocol and compare the noticeable outputs represented by those records. They do not order cosmic stages by measurement and do not identify records with cosmic stages; any candidate-stage inference is model-bounded and non-unique:

$$\begin{aligned} &\mathrm{OperationallyOrdered}_P(r_1, r_2) \wedge \mathrm{ValidatedDifference}^{\Gamma}_{A,P,M}(r_1, r_2) \\ &\implies \mathrm{Warrant}_{P,M}\left[\mathrm{NoticeableBearerDifference}^{\Gamma}_{A;P,M}(r_1, r_2)\right]. \end{aligned} \tag{163}$$

The validated comparison warrants a noticeable, physically attributable difference within the declared protocol and model. A time stamp, exposure interval, sequencing date, clock reading, or arrival coordinate belongs to the operational ordering of records; it does not identify a unique common cosmic stage at which the continuously developing change became noticeable.

16.12 Class-level synthesis

A class synthesis states:

(1) the class definition and bearer criteria;

(2) the tested subclasses and sampling limits;

(3) the physically distinct realization routes;

(4) the strongest supporting evidence;

(5) the difficult and unresolved candidates;

(6) the adverse result capable of revising the class claim.

The synthesis gains force through diversity of mechanisms and independent methods rather than through repetition of similar examples.

Cross-domain coverage predicate.

For the class-level synthesis below, define

$$\mathrm{CrossDomainCoverageAdequate}(\mathfrak{D}_{\mathrm{cov}}, \mathbf{\Pi}_{\mathrm{cov}})$$

as a protocol-relative evidential proposition requiring declared domain and subclass boundaries, bearer-selection and sampling rules, class-indexed protocols, record channels, model assumptions, unresolved candidates, admissible adverse outcomes, and limits of generalization. Formally,

$$\mathrm{Type}(\mathrm{CrossDomainCoverageAdequate}(\mathfrak{D}_{\mathrm{cov}}, \mathbf{\Pi}_{\mathrm{cov}})) = \mathsf{ProtocolRelativeEvidentialProposition}. \tag{164}$$

It neither asserts exhaustive coverage of nature nor converts one exemplar per class into a universal class theorem. Each class-indexed protocol bundle instantiating this predicate must preregister its domain-selection rule, nonredundancy criterion, bearer-class coverage, instrument and model validation, treatment of null and unresolved outcomes, and a stopping or sufficiency rule. No universal adequacy threshold is supplied by the predicate name itself.

16.13 Cross-domain convergence among physical-system histories

An earlier applied work map separated five representative evidential routes: organismal and human life history, standardized clock records, cumulative material manifestation exemplified by an archaeological stone, remote stellar records, and galactic-system reconstruction. V28/F8 retains the valid logic of that map without treating the routes as exhaustive, interchangeable, or as a second foundation. Each route requires its own bearer, identity criterion, record-production history, attribution bridge, uncertainty model, and decision rule; their common role is to support restricted continuing-change claims while preserving the distinction among physical realization, evidence, measurement, and cosmic stage.

The reconstructed evidence concerning the physical histories of systems across the universe is not an archive of one immutable condition. Under explicit observational and model assumptions, cosmic-background measurements, cosmological reconstruction, stellar populations and evolution, galactic interaction, planetary and geophysical records, material transformation, genetic succession, and organismal life histories disclose compared and physically attributable differences across bearer classes and scales [33, 34, 35, 36, 37, 54, 52, 45, 46]. These records are evidential reconstructions, not common cosmic stages, and their model dependence grants no metric, coordinate, or relativistic quantity temporal authority.

The evidential force lies in convergence among physically diverse bearers and methodologically differentiated evidence bundles. The covered classes exhibit both identity-preserving alteration and, in warranted cases, identity-ending transformation with successor formation at one warranted common boundary stage. The latter is not imposed on every change: a bearer may undergo extensive physical alteration or functional failure while its bearer identity physically persists, as warranted under the declared evidential comparison and attribution criteria.

Cross-domain convergence warrant for physical-system histories

Let $\mathfrak{D}_{\text{cov}}$ be the explicitly covered bearer classes. For each $\mathcal{D} \in \mathfrak{D}_{\text{cov}}$, declare a typed protocol bundle

$$\Pi_{\mathcal{D}} := (P_{\mathcal{D}}, M_{\mathcal{D}}), \qquad D_{\mathcal{D}} := D(P_{\mathcal{D}}), \qquad \mathbf{\Pi}_{\text{cov}} := (\Pi_{\mathcal{D}})_{\mathcal{D} \in \mathfrak{D}_{\text{cov}}},$$

where $D_{\mathcal{D}}$ is the detector or record channel selected by the class-indexed protocol, not the bearer class. The indexed family preserves the association $\mathcal{D} \mapsto \Pi_{\mathcal{D}}$ even if two protocol bundles have extensionally equal components. The channel is one component of the complete protocol bundle and cannot alone establish evidential independence. Define $\mathcal{W}_{\text{CD}}$ as a coverage-qualified cross-domain warrant concerning physical-system histories combining declared bearer identities, methodologically adequate independence across the full protocol bundles, CrossDomainCoverageAdequate, and compared noticeable physical differences in the covered classes.

$$\begin{aligned}\mathcal{W}_{\mathcal{D}}(\Pi_{\mathcal{D}}) \iff & \exists A_{\mathcal{D}} \in \mathcal{D}\ \exists k_{\mathcal{D}} \in K(\Gamma_{A_{\mathcal{D}}}) \\ & \exists r_{\mathcal{D},1}, r_{\mathcal{D},2} \in \mathfrak{R}_{D_{\mathcal{D}}}\ \ \mathrm{PositiveWitness}^{\Gamma}_{A_{\mathcal{D}},k_{\mathcal{D}},P_{\mathcal{D}},M_{\mathcal{D}}}(r_{\mathcal{D},1}, r_{\mathcal{D},2}).\end{aligned} \tag{165}$$

Here $\mathfrak{R}_{D_{\mathcal{D}}}$ is the record domain of the declared channel $D_{\mathcal{D}}$. The record variables $r_{\mathcal{D},1}$ and $r_{\mathcal{D},2}$ are not representation maps, and no one protocol or model is silently shared across unlike domains. Methodological independence is assessed over the complete bundles, not inferred from detector nonidentity alone.

$$\begin{aligned}\mathcal{W}_{\mathrm{CD}}(\mathfrak{D}_{\mathrm{cov}}; \mathbf{\Pi}_{\mathrm{cov}}) \iff & |\mathfrak{D}_{\mathrm{cov}}| \geq 2 \\ & \wedge \mathrm{MethodologicalIndependenceAdequate}(\mathbf{\Pi}_{\mathrm{cov}}) \\ & \wedge \mathrm{CrossDomainCoverageAdequate}(\mathfrak{D}_{\mathrm{cov}}, \mathbf{\Pi}_{\mathrm{cov}}) \\ & \wedge \forall \mathcal{D} \in \mathfrak{D}_{\mathrm{cov}}\ \mathcal{W}_{\mathcal{D}}(\Pi_{\mathcal{D}}).\end{aligned} \tag{166}$$

The methodological-independence predicate is a protocol-relative evidential-adequacy proposition. It requires declared analysis of shared data sources, sampling frames, instruments, calibration chains, inference models, and common systematic errors across the bundles; distinct record channels may contribute to this condition but do not establish it by themselves. Without this independence and coverage qualification, one bearer per class yields only a diversity-based exemplar warrant, not class-level coverage.

Identity-ending transformation and successor claims require declared bearers, identity criteria, physical evidence for transformation, and evidence for the formation of each proposed successor. Where the stage-resolved ontic proposition $\mathrm{TransformAt}^{\mathrm{ont}}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E})$ is scientifically warranted under P, M, one physical transformation at the same common cosmic stage e is asserted as ending change for the productive predecessors and formation change for the successors, while $\mathcal{E}$ represents the warranted attribution of direct production incidences. This stage-resolved attribution is conditional and is not generated by the non-terminal physical-outcome closure principle. That closure requires a physically continuous outcome for an attained non-terminal ending and distinguishes identity production from contribution to an already extant recipient bearer without making the two classifications exclusive. Only the identity-producing classification entails at least one successor, and neither classification identifies its exact boundary, successor set, recipient set, or incidence relation without bearer-specific warrant. No closure statement makes predecessor and successor one identity or divides one stage-resolved transformation into temporally separated events. Evidentially, compared records may support transformation, successor formation, or extant-recipient continuation under declared identity and attribution criteria while warranting only a boundary window rather than an exact stage. Cross-domain convergence may therefore warrant outcome histories without converting a sampled, recorded, or reconstructed difference into an exact-stage assignment.

Let $\mathcal{W}^{\mathrm{emp}}_{\mathrm{succ}}$ denote cumulative empirical warrant for identity-ending transformation and successor histories under these restrictions. This warrant remains protocol-, model-, and bearer-bounded and does not establish an exact cosmic-stage boundary.

The UCC warrant does not deductively exhaust the unrestricted universal claim:

$$\mathcal{W}^{\mathrm{emp}}_{\mathrm{UCC,covered}}(\mathfrak{D}_{\mathrm{cov}}) \not\Rightarrow \forall A \Big[\mathrm{PhysicalSystem}(A) \wedge I_A \neq \varnothing \\ \Rightarrow \mathrm{UCC}(A) \Big]. \tag{167}$$

The box states two evidential consequences, not new cosmic axioms and not independent derivations of UCC. Continuing-change warrant does not require an identity-ending transformation witness, and transformation evidence is not imposed on every bearer history. Their force increases with class diversity, independent access routes, explicit identity criteria, adequate sampling and model coverage, and successful treatment of difficult candidates. A proposed exception must identify a physical bearer, preserve its identity across an extended history, and warrant complete physical invariance rather than constancy or non-detection in selected variables. Failure to validate such an exception does not by itself prove UCC; it leaves the positive cross-domain convergence unrebutted within the examined coverage.

16.14 Empirical limits on universal CMA and UCC claims

CMA states the presence and bearer-specific physical realization of every extant physical system at every actual common cosmic stage; the explicit presence conjunct makes common-stage membership semantically visible without adding a second physical mechanism. UCC is the bearer-relative consequence of CMA at every member of a bearer identity domain that is later than another member of that same domain. Identity-domain convexity separately excludes an internal absence of the bearer identity between bounding members. No bounded protocol can directly inspect the complete physical totality at every actual stage. Experimental work therefore tests restricted system-, class-, variable-, and model-bounded consequences.

A finite positive result supplies a restricted empirical witness or cumulative support; it does not prove the universal quantifier, identify the exact common cosmic stage at which the manifested effect first became realized or noticeable, or show that every intervening stage was individually accessed. A finite null result rejects only the declared restricted operational no-stasis hypothesis when its preregistered adequacy conditions are met. Broader pressure requires warranted identity persistence, exceptional bearer coverage, validated sensitivity, controlled confounding, and a physically adequate account of why no unmeasured or subthreshold realization remains. Even then, the evidential conclusion and the ontological claim retain different logical types.

The physical systems constituting the experiment remain within the universal scope under assessment. The sample, apparatus, detector, material record bearer, environmental systems, and researcher remain bearer-distinct and undergo their own bearer-specific changes throughout the protocol. Their distinct identities do not isolate them: they may interact, stand in part–whole or composite relations, and participate as influencing bearers alongside physical factors borne by or realized among them. These interaction and influence relations must be included in attribution, calibration, intervention analysis, and uncertainty control where relevant. This does not independently verify CMA, because inclusion follows from the axiom's scope; it instead constrains experimental interpretation by prohibiting an ontologically fixed apparatus or observer outside the common cosmic extension.

Universal claims remain accountable to internal inconsistency, incompatible physical evidence, and adequately specified adverse physical scenarios. They are not insulated by an unconstrained appeal to hidden change. Difficult systems therefore remain an open research obligation rather than automatic confirmation.

16.15 Present-claim adequacy

V28/F8 states a universal foundational claim and supplies a systematic research programme for cumulative empirical assessment. The theory identifies positive witnesses, restricted operational hypotheses, difficult classes, exact-stage limits, stagewise non-exhaustion, cross-domain convergence, and relativistic boundaries. Reconstructed records from independent physical domains provide cumulative empirical warrant across the covered classes, while unrestricted UCC retains a clear adverse condition—warranted identity-preserving complete cessation of physical change. No finite historical archive exhausts the universal quantifier, no finite protocol inspects every applicable common stage, and no finite null record can exclude every subthreshold, unmodelled, or unsampled difference. This architecture makes evidence cumulative and comparable while preserving the distinction between operational test failure, restricted empirical witness, evidential convergence, exact-stage knowledge, and ontological non-occurrence. For phenomenon classes commonly calculated by relativistic models, ontological rejection does not substitute for a physical calculation: any claimed ITOF account remains subject to the bearer-specific, record-chain, uncertainty, prediction, and tolerance burden stated in Equation (172).

17. Direct Ontological Confrontation with Relativity

17.1 Governing rejection and type boundary

V28/F8 rejects the relativistic conception of time without compatibility, reconciliation, synthesis, or complementary temporal ontology. The rejection is stated respectfully and directly: coordinates, metric intervals, proper-time functionals, spacetime geometry, and clock outputs are not time as defined by ITOF, and the geometrical formalism is not granted confirmed authority over the physical nature of time or of the universe. The foundational sources of special and general relativity and their standard geometrical development are cited to identify the objects under examination [6, 7, 10], not as premises governing ITOF. Representative philosophical discussions of space, time, geometry, and dynamical interpretation are cited to delimit the conceptual terrain under dispute [13, 14, 15], likewise without functioning as premises governing ITOF.

Relativistic formalisms contain distinct mathematical, geometrical, and operational types. Write

$$\mathcal{Q}_{\mathrm{rel}} = \bigsqcup_{\tau \in \mathfrak{T}_{\mathrm{rel}}} \mathcal{Q}_{\mathrm{rel}}^{(\tau)}, \tag{168}$$

where the components may include coordinate values and differences, worldline functionals, metrics, curvature tensors, field-equation objects, frequency relations, and model-defined prediction quantities. Clock records and clock-reading maps retain their physical and protocol-defined types even when a relativistic model is used to predict them.

ITOF assigns time a categorically different type:

$$T_{\mathrm{ITOF}} \in \mathcal{T}_{\mathrm{ITOF}}, \qquad q \in \mathcal{Q}_{\mathrm{rel}} \Longrightarrow q \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}. \tag{169}$$

Here $T_{\mathrm{ITOF}} = (\mathcal{S}_C, \prec_C)$ denotes the universal ordering and succession of common cosmic stages in one common cosmic extension. No numerical agreement, conventional terminology, geometrical unification, or predictive fit supplies a type-preserving identity bridge:

$$\forall q \in \mathcal{Q}_{\mathrm{rel}}, \qquad \neg\exists\, \mathcal{B}_{\mathrm{id}}\ \ \mathrm{TypePreservingIdentityBridge}(q, T_{\mathrm{ITOF}}; \mathcal{B}_{\mathrm{id}}). \tag{170}$$

This formal non-identity and the broader rejection of relativistic temporal ontology are governing ITOF commitments. Relativistic objects remain objects of their own models; they do not become time.

Global foliation, simultaneity, and the location of the disagreement

A relativistic spacetime model may fail to admit a global foliation or a global simultaneity relation under its own geometrical conditions. V28/F8 does not reinterpret that model-internal result as a proof that no actual common cosmic-stage order exists. Such a conclusion would require an independently justified, type-preserving bridge from the model geometry to the actuality, membership, and ordering of $\mathcal{S}_C$; the relativistic formalism does not receive that bridge by definition. Conversely, ITOF does not claim compatibility through an ADM slicing, a preferred relativistic foliation, Shape Dynamics, or any alternative geometrical reconstruction. Its common-stage ordering is a primitive ontological commitment, so the tension with relativistic models that deny or cannot represent a universal ordering is acknowledged as a foundational disagreement rather than dissolved by reconciliation.

17.2 Model-bounded calculation, physical systems, and clocks

A calculation may be useful without defining the physical nature of time. V28/F8 does not deny accepted differential clock readings, frequency-shift records, propagation observations, or other physical outputs merely because relativistic equations predict them. It rejects the further inference that predictive agreement establishes frame-relative time, temporal deformation, or the nonexistence of one actual common cosmic ordering. This is neither compatibility with relativistic temporal ontology nor rejection of the observations; it is a foundational disagreement about the ontology and physical attribution of the recorded effects. For a relativistic model M_{rel}, protocol P, dataset $\mathcal{D}_{\mathrm{data}}$, output type τ_O, and declared model quantity q,

$$\begin{aligned} &q \in \mathcal{Q}_{\mathrm{rel}} \wedge \mathrm{ApproximateFit}(M_{\mathrm{rel}}, P, \mathcal{D}_{\mathrm{data}}, \tau_O, q) \\ &\qquad \Longrightarrow \mathrm{ModelBoundedCalculationalAdequacy}_{P,\mathcal{D}_{\mathrm{data}},\tau_O}(q; M_{\mathrm{rel}}). \end{aligned} \tag{171}$$

The conclusion is restricted to the declared calculation and records. It does not establish the physical completeness or truth of the represented geometry, and it does not transfer change, curvature, dilation, or causal agency to time.

Non-reconciliatory empirical-accounting burden

Rejecting relativistic temporal ontology does not release an ITOF application from accounting for accepted observations. For any declared phenomenon class D—including differential clock readings, frequency shifts, propagation records, or navigation corrections—a claimed ITOF physical account must identify the actual bearers, relevant physical variables and interactions, record chain, protocol, auxiliary model, uncertainty, and a prospectively fixed prediction that meets a preregistered acceptance criterion.

Let $\mathfrak{O}_{D,P}$ be the declared comparison codomain, let $\|\cdot\|_{D,P,M}$ be its declared discrepancy functional, and require

$$\widehat{\boldsymbol{O}}^{\mathrm{ITOF}}_{D,P,M}, \boldsymbol{O}^{\mathrm{obs}}_{D,P} \in \mathfrak{O}_{D,P}, \qquad \varepsilon^{\mathrm{acc}}_{D,P,M} \geq 0.$$

In the schematic definition below, $\mathrm{ProspectivelyDeclaredITOFAccount}_{D,P,M}$ abbreviates the declared bearer, variable, interaction, protocol, auxiliary-model, prediction-map, and uncertainty specification fixed before the evaluation records are inspected, while $\mathrm{ValidatedRecordChain}_{D,P,M}$ states the separate provenance and measurement-chain requirement. Define

$$\begin{aligned}&\mathrm{RestrictedPhysicalAccountingAdequacy}_{D,P,M}\\ &\quad\iff \mathrm{ProspectivelyDeclaredITOFAccount}_{D,P,M} \wedge \mathrm{ValidatedRecordChain}_{D,P,M}\\ &\quad\ \wedge \left\|\widehat{\boldsymbol{O}}^{\mathrm{ITOF}}_{D,P,M} - \boldsymbol{O}^{\mathrm{obs}}_{D,P}\right\|_{D,P,M} \leq \varepsilon^{\mathrm{acc}}_{D,P,M}.\end{aligned} \tag{172}$$

The conclusion is restricted to the declared phenomenon, bearers, protocol, model, comparison codomain, discrepancy functional, uncertainty specification, and tolerance. It neither identifies any relativistic quantity with T_{ITOF} nor establishes compatibility with relativistic temporal ontology. Conversely, where no bearer-specific physical account and quantitatively adequate prospective prediction have been supplied, V28/F8 has stated an ontological rejection and a research burden, not yet a complete alternative calculation for that phenomenon class. This limitation is explicit and does not weaken the rejection of relativistic time.

Let $O^{\mathrm{obs}}_{A,P}$ be a protocol-defined output of bearer A, and let $\widehat{O}^{M_{\mathrm{rel}}}_{A,P}(q)$ be the corresponding model output. A schematic predictive map may be written

$$\widehat{O}^{M_{\mathrm{rel}}}_{A,P}(q) = F_{M_{\mathrm{rel}},P}\Big(q, \mathcal{R}_{A,P}, \widehat{\mathcal{H}}_{A,P,M}, \widehat{\mathcal{G}}_{A,P,M}, \Theta_{A,P}\Big), \tag{173}$$

where the records, reconstructed history, physical grounding, and conditions remain explicit. Neither the observed output nor its prediction is time:

$$O^{\mathrm{obs}}_{A,P} \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}, \qquad \widehat{O}^{M_{\mathrm{rel}}}_{A,P}(q) \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}. \tag{174}$$

Clocks are indispensable physical instruments for organization, comparison, navigation, synchronization protocols, and scientific measurement. Their usefulness is affirmed without granting them temporal identity. A clock registers a selected physical process and produces material records under a declared protocol; it does not measure time in the ontological sense of ITOF. Thus

$$N_{C,P}(r_C) \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}, \tag{175}$$

and unequal clock readings establish unequal physical outcomes of clock systems, not unequal quantities, rates, or deformations of time.

Clocks are useful physical systems that organize and compare processes through standardized outputs. They do not measure time as the universal ordering and succession of common cosmic stages. Predictive utility belongs to calculations and bearer outputs; it does not establish relativistic temporal ontology.

17.3 Categorical rejection of temporal deformation

The ITOF definition supplies no metric, connection, curvature tensor, path integral, geometrical dimension, warping operation, or clock-rate predicate for time. Within the ontology and type system of ITOF, literal attribution of curvature, dilation, contraction, warping, stretching, slowing, acceleration, fragmentation, or additional dimensions to time is therefore a category error. This internal type result does not claim that the relativistic formalism is syntactically inconsistent; it states the foundational incompatibility between its temporal objects and the denotation of time adopted here.

The governing type judgment is

$$\begin{aligned} \mathrm{Type}(T_{\mathrm{ITOF}}) &= \mathsf{ITOFTemporalOrdering}, \\ \mathrm{Type}(g_{\mu\nu}) &= \mathsf{LorentzianMetric}, \\ \mathrm{Type}(R^{\rho}{}_{\sigma\mu\nu}) &= \mathsf{CurvatureTensor}, \\ \mathrm{Type}(\tau[\gamma, g]) &= \mathsf{MetricWorldlineFunctional}, \\ \mathrm{Type}(x^{\mu}) &= \mathsf{CoordinateAssignment}, \\ \mathrm{Type}(N_{C,P}) &= \mathsf{ClockReadingMap}. \end{aligned} \tag{176}$$

Hence

$$\mathrm{IllTyped}\Big(\mathrm{Curved}, \mathrm{Dilated}, \mathrm{Contracted}, \mathrm{Warped}, \mathrm{Deformed}, \mathrm{DimensionallyMultiplied}; T_{\mathrm{ITOF}}\Big). \tag{177}$$

The relevant predicates must be assigned to their actual bearers: curvature to a metric and connection, unequal accumulation to model-defined path functionals, and differential readings to physical clocks. None thereby acquires temporal identity.

ITOF rejects relativistic temporal deformation as a distortion of temporal identity. Time neither curves, dilates, contracts, warps, fragments, nor multiplies. Geometrical and operational quantities retain their own types and predicates.

17.4 Coordinates, Lorentz transformations, and simultaneity

For standard inertial coordinates in one spatial dimension,

$$t' = \gamma_v \left(t - \frac{vx}{c^2}\right), \qquad x' = \gamma_v(x - vt), \qquad \gamma_v = \frac{1}{\sqrt{1 - v^2/c^2}}. \tag{178}$$

These equations transform coordinate components within the special-relativistic model. The symbols t and t' are coordinate values; they are not T_{ITOF}. Formally,

$$\Lambda : x^{\mu}_{F}(e) \longmapsto x^{\mu}_{F'}(e), \qquad T_{\text{ITOF}} \notin \text{Dom}(\Lambda). \tag{179}$$

A change of chart changes the coordinate description assigned to the represented occurrence. It neither transforms the universal cosmic ordering nor creates another cosmic extension.

Coordinate simultaneity in a frame F may be written

$$e_1 \sim_F e_2 \iff t_F(e_1) = t_F(e_2). \tag{180}$$

Its frame dependence is a property of coordinate assignment. Common-stage participation is instead stated by

$$\text{CoStage}(A, B; s) \iff A \in \mathcal{S}_{\text{phys}}(s) \wedge B \in \mathcal{S}_{\text{phys}}(s). \tag{181}$$

The common stage is not constructed by clocks, signals, synchronization conventions, or coordinate equality. At every actual common cosmic stage, CMA states common-stage presence together with bearer-specific physical realization in every extant system. Coordinate relativity neither negates nor replaces that axiom:

$$\text{RelativityOfCoordinateSimultaneity} \not\Rightarrow \neg\,\text{CMA}\,. \tag{182}$$

The Minkowski interval

$$ds^2 = -c^2 dt^2 + dx^2 + dy^2 + dz^2 \tag{183}$$

is a metric invariant of the declared model. It is not the non-metric common cosmic extension:

$$\text{LorentzInvariant}(ds^2) \not\Rightarrow ds^2 \equiv T_{\text{ITOF}}. \tag{184}$$

ITOF does not derive Lorentz transformations from its own axioms. Explaining the bounded calculational success of those relations through independently specified physical mechanisms remains a separate research task and does not alter the rejection of relativistic temporal ontology.

17.5 Proper time, worldlines, and unequal physical histories

For a timelike worldline γ in a Lorentzian metric $g_{\mu\nu}$, proper time is defined within relativity by

$$\tau[\gamma, g] = \frac{1}{c} \int_{\gamma} \sqrt{-g_{\mu\nu}\, dx^{\mu} dx^{\nu}}. \tag{185}$$

It is a metric functional of a declared path and metric:

$$\tau[\gamma, g] \not\equiv_{\text{type}} T_{\text{ITOF}}. \tag{186}$$

If

$$\tau[\gamma_1, g] \neq \tau[\gamma_2, g], \tag{187}$$

the inequality belongs to the model-defined path functionals. It does not establish private times, multiple cosmic extensions, or literal deformation of time.

In twin-type comparisons, physical systems may reunite with different clock readings, physiological states, accumulated damage, or other bearer-specific outcomes. The warranted physical conclusion is that their histories differ:

$$\mathcal{H}_A \neq \mathcal{H}_B \not\Rightarrow \text{DistinctTemporalExtensions}(A, B). \tag{188}$$

Both histories remain restrictions of the same $\prec_C$ to their identity domains. Relativity represents selected differences by unequal proper-time integrals; ITOF rejects that representation as the physical identity or deformation of time.

An idealized relativistic clock relation may be written

$$n_{C,P}^{\text{ideal}} = \alpha_P \tau[\gamma, g] + \beta_P. \tag{189}$$

This relates a modelled reading to a metric functional; it equates neither object with time. A real clock instead has a bearer-specific physical process, condition tuple, device model, and protocol:

$$n_{C,P}^{\text{pred}} = \mathcal{K}_{C,P}(\Xi_{C,P}, \theta_{C,P}, \mathcal{M}_C, P)\,. \tag{190}$$

A model may include $\tau[\gamma, g]$ as an input, but agreement with records establishes only the declared clock calculation. The phrase “the clock measures time” is therefore rejected in ontological use. The precise statement is that a physical clock produces an output or, under a stated model and uncertainty, tracks a defined quantity.

The applicable type boundary is

$$\text{IllTyped}\Big(\text{Dilated}\,;\, T_{\text{ITOF}}\Big). \tag{191}$$

Coordinate intervals, path functionals, and clock outputs may differ; none makes temporal dilation a well-typed predicate of T_{ITOF}.

Frequency and redshift comparisons likewise concern physical emitter–signal–receiver chains and model-defined ratios. For example,

$$1 + z = \frac{\nu_{\text{emit}}}{\nu_{\text{receive}}}, \qquad z \not\equiv_{\text{type}} T_{\text{ITOF}}. \tag{192}$$

High-precision clock and frequency experiments provide precise records of changing physical systems [25, 26, 27, 28]. They do not measure a deformation of ontological time.

17.6 Metric geometry, curvature, and field equations

A relativistic spacetime model introduces a manifold, metric, connection, curvature, fields, and event relations. These are model-defined geometrical and dynamical objects. The line element

$$ds^2 = g_{\mu\nu} dx^\mu dx^\nu \tag{193}$$

does not define time in ITOF. Curvature is assigned to the metric and connection, whereas its application to ITOF time is type-inadmissible:

$$\mathrm{Curved}(g, \nabla, R), \qquad \mathrm{IllTyped}\Big(\mathrm{Curved}\,;\,T_{\mathrm{ITOF}}\Big). \tag{194}$$

The Einstein field equation is

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}. \tag{195}$$

It relates geometrical tensors to a stress–energy tensor within general relativity. ITOF does not accept this equation as a definition of time or as confirmation that time or the universe is a curved spacetime geometry. Mathematical covariance, empirical fit, and practical calculation do not supply temporal identity.

A manifold event, worldline, field configuration, spacelike hypersurface, or foliation leaf remains a model object. In particular,

$$\mathrm{Type}(s) = \mathsf{CommonCosmicStage}, \qquad \mathrm{Type}(\Sigma_t) = \mathsf{GeometricHypersurface}, \qquad s \not\equiv_{\mathrm{type}} \Sigma_t. \tag{196}$$

No foliation or constant-coordinate slice defines the common cosmic stage or furnishes the universal bearer-specific change stated by CMA.

Higher-dimensional geometries may add coordinate or manifold dimensions within their own formalisms, as in the classic constructions of Kaluza and Klein [8, 9]. They neither create additional times nor make time a dimension that can be warped, compactified, or multiplied.

17.7 Causality, propagation, covariance, and final boundary

The cosmic relation $\prec_C$ orders common cosmic stages. A relativistic causal relation classifies or orders model events under metric and signal assumptions. The relations have different domains and cannot be identified. Physical causal claims require warrant from actual processes, interactions, and records; CMA supplies neither a signal mechanism nor an instantaneous communication channel.

Propagation delay affects observational access, not the source system's physical realization at its common stage. A detector record belongs to the detector's later physical history. Coordinate or operational intervals used to model emission and arrival satisfy

$$\Delta t^{(P)} \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}. \tag{197}$$

Distance may delay records and complicate reconstruction without dividing the common cosmic stage or postponing change in the distant system.

General covariance and Lorentz symmetry are formal properties of declared equations and models. They do not establish temporal ontology:

$$\mathrm{Covariant}(\mathcal{E}) \not\Rightarrow \mathrm{TemporalOntology}(\mathcal{E}). \tag{198}$$

ITOF invariance concerns the fixed and irreversible earlier–later ordering and succession of common cosmic stages. It is not a Lorentz scalar, tensor law, symmetry generator, or geometrical invariance claim.

Final relativistic boundary. ITOF asserts no compatibility, reconciliation, synthesis, or ontological coexistence with relativistic time. Relativistic coordinates, metrics, proper-time functionals, causal classifications, spacetime geometries, and clock predictions remain model objects or physical-system outputs. None is identical with time, a common cosmic stage, or the fixed irreversible ordering $\prec_C$. Clocks remain practically indispensable, but they do not measure time in the ontological sense of ITOF.

18. Scope, Limits, and Conclusion

18.1 What V28/F8 adopts, derives, and constrains

V28/F8 states the following connected position. The status of each item remains governed by its formal classification as definition, condition, postulate, axiom, principle, constraint, or derived result; inclusion in this summary is not an external proof of a foundational commitment:

(1) The universe denotes the totality of all actual physical systems without exception and is not an additional bearer.

(2) The canonical time definition in Section 4 (Definition 4.1) governs the entire formulation.

(3) At every actual common cosmic stage, every physical system whose identity is then realized is present there and undergoes its own bearer-specific physically realized change, as stated by Axiom 5.1 and Equation (13).

(4) Every physical-system history is realized within the one common cosmic extension under Definition 8.1 and Equation (27); no system possesses private temporal stages.

(5) UCC is the bearer-relative consequence of CMA across later members of the bearer identity domain, while identity-domain convexity separately constrains identity persistence. The relation FurtherReal records ordered positive realizations but, under CMA, is not an independent witness of unequal realization content.

(6) The framework adopts one actual first cosmic stage at the physical origin of the universe. Universal terminal ending remains conditional because no greatest stage is postulated; under Proposition 11.8, any greatest cosmic stage is exactly the terminal stage at which all then-existing systems end and no new bearer forms.

(7) Every complete bearer history has one unique formation member and one unique eventual ending member. Whether the ending has been attained is reference-stage dependent. Formation and ending are bearer-specific positive physical realizations: formation begins the bearer without presupposing a prior state of that bearer, and ending terminates that numerical identity. Eventual ending remains an explicit full-history postulate rather than an observational theorem; warranted endless persistence of one numerical bearer would contradict it. Every attained non-terminal ending has a physically continuous outcome;

only an ending satisfying the derived identity-producing classification entails one or more successors. The same ending may also contribute to already extant bearers, while a non-identity-producing ending may satisfy closure through the extant-recipient branch alone. Scientific attribution of every particular outcome, successor, recipient, and productive incidence requires separate physical and evidential warrant.

(8) Physical realization is independent of detection under Equation (5); the principal non-detection cases are set out in Subsection 3.2. A noticeable effect supplies only a restricted empirical witness under its protocol: it neither identifies the exact stage at which the manifested effect first became realized or detectable nor exhaustively tests realization at every applicable stage; see Subsection 12.5 and Equations (137)–(138).

(9) For an actual physical bearer, the exact classical negation condition for UCC is an identity-preserving later history member without positive physical realization. Scientific rejection additionally requires both a predeclared bearer-complete protocol-family warrant and a nontrivial-history warrant. Every application must supply a validated realization bridge declaring identity, positive and adverse conditions, coverage, sensitivity, uncertainty, and inference validity; absent such a bridge, the result is underdetermination. Repeated restricted adversity triggers mandatory review, and an unspecified post hoc change route cannot convert an adverse completed protocol into confirmation.

(10) System endings may be predicted only as protocol- and model-bounded windows unless an additional uniqueness warrant supports a stage-resolved claim.

(11) Clock outputs satisfy the type boundary in Equation (92); coordinates, proper-time functionals, metric intervals, event points, and spacetime geometries are likewise not time. Clocks remain practically indispensable instruments, but they do not measure time in the ontological sense of ITOF, and V28/F8 asserts no compatibility or reconciliation with relativistic temporal ontology. Any claimed alternative physical account of accepted relativistically modelled outputs must independently meet the restricted quantitative burden in Equation (172).

18.2 Epistemic limits

The theory does not assign an exact number of cosmic stages, equal stage spacing, or a metric duration to the cosmic extension. It does not claim that every bearer change is directly measurable, that a finite experiment identifies the exact common cosmic stage of a manifested effect, or that any protocol inspects every stage to which CMA or UCC applies. Its unrestricted commitments are approached through restricted, cumulative, and bearer-specific empirical programmes. The sample, apparatus, detector, material record bearer, environmental systems, and researcher remain bearer-distinct changing systems within those programmes rather than stationary observers outside the common cosmic extension. They may interact and contribute overlapping physical influences, while protocol-relevant physical factors may be borne by or realized among them without becoming separate bearers by default. The framework nevertheless states an explicit ontological counterexample condition and a separate protocol-family rejection rule, so evidential limitation is not converted into immunity from revision.

18.3 Final statement

For each $s \in \mathcal{S}_C$, $\mathcal{S}_{\text{phys}}(s)$ denotes the physical systems whose identities are realized at that common stage. At each actual common cosmic stage governed by CMA, every member of that set is present there and undergoes its own bearer-specific physical realization, while its change content and identity-bounded history remain bearer-specific. Identity-forming positive physical realization begins every bearer history at its unique actual formation member without presupposing an earlier state of that same bearer; bearer-specific change is realized throughout every later member of that history; and the unique ending member of the complete history is identity-ending realization rather than identity-preserving continuation. Whether that ending member has been attained by a reference stage is expressed separately. Scientific localization of either boundary remains separately warrant-dependent. A scientifically warranted successor transformation asserts one ontic physical transformation at one common stage, classified as ending for each productive predecessor and formation for each successor, while retaining the distinction between the ontic proposition and its warrant. Time denotes the universal ordering and succession of common cosmic stages in one common cosmic extension. The extension is not an independent container, and time does not cause the changes realized by systems. Noticeable effects may be cumulative and need not have occurred wholly at the stage of detection. A finite examination supplies protocol-relative records of selected manifestations, not a stagewise exhaustive inspection; the sample, apparatus, detector, material record bearer, environmental systems, and researcher remain bearer-distinct, undergo their own changes, and may exert overlapping physical influences wherever their respective identities remain realized before, during, and after the examination. Relevant physical factors may be properties, states, relations, exchanges, or mechanisms borne by or realized among those systems and are not additional bearers by default. Outside universal terminal ending, every attained ending has a physically continuous outcome under the non-terminal closure principle. Identity-producing endings have one or more ontic successors formed at the same ending boundary. Any non-terminal ending may also contribute to continuing extant bearers, and a non-identity-producing ending may satisfy closure through that branch alone. Identifying any particular successor set, recipient bearer, and production or outcome linkage remains separately warrant-dependent, and each successor begins its own identity-forming realization at the common transformation stage. The actual first cosmic stage is supplied by the independent origin postulate. No final stage is postulated; under Proposition 11.8, a greatest stage is realized exactly when the universal terminal conditions are realized. Neither boundary is a relativistic coordinate or metric endpoint.

A. Canonical Definitions, Equations, and Status

Item	Status	Dependency or scope
Universe statement	Governing ontological commitment	The universe denotes the totality of all actual physical systems and is not an additional bearer.

Item	Status	Dependency or scope
Physical-system predicate	Primitive ontological type	PhysicalSystem(A) denotes an actually realized identity-bearing physical bearer; therefore $I_A \neq \varnothing$ follows from the predicate's declared meaning.
Study qualification	Protocol-relative predicate	StudyQualified$_{P,M}(A)$ qualifies a bearer for a declared study and never restricts CMA.
Time definition	Canonical definition	Time denotes the universal ordering and succession of common cosmic stages in one common cosmic extension.
Formal representation	Definition	$T_{\mathrm{ITOF}} = (\mathcal{S}_C, \prec_C)$, with one fixed irreversible strict total earlier–later ordering on distinct common stages.
Cosmic-stage population	Governing domain condition	$\mathrm{CSP} : \forall s \in \mathcal{S}_C,\ \mathcal{S}_{\mathrm{phys}}(s) \neq \varnothing$; this classifies the populated cosmic-stage domain and is not a second change axiom.
Nontrivial cosmic extension	Independent application condition	At least one stage satisfies $s^0_{\mathrm{C}} \prec_C s$; no greatest member follows.
Cosmic boundaries	Origin postulate, terminal definition, and derived equivalence	s^0_{C} is the unique actual least stage. No greatest stage is postulated; under Proposition 11.8, a greatest stage exists exactly when universal terminal ending is realized.
CMA	Governing universal axiom	At every actual common cosmic stage, including s^0_{C}, all then-extant systems are present there and each realizes bearer-specific positive physical change.
ECP	Derived bearer instance	CMA instantiated for one bearer at one actual common cosmic stage.
Identity-domain convexity	Independent persistence principle	If the same identity is realized at two bounding stages, it is realized at each common stage ordered between them; the unique formation and eventual ending members are supplied by independent postulates.
UCC	Derived bearer-relative proposition	CMA entails UCC for every physical bearer; UCC$^+$ additionally requires a nontrivial bearer history and therefore excludes vacuous continuity language.

Item	Status	Dependency or scope
UCC adverse condition	Logical falsifier with a separate evidential rejection rule	One bearer-relative later member without positive physical realization falsifies UCC(A). Protocol-family rejection requires both a predeclared bearer-complete stasis warrant and a nontrivial-history warrant; cumulative pressure below that conjunction is not itself rejection. An unspecified post hoc mechanism is not an admissible rescue of a completed adverse protocol.
Formation and ending boundaries	Ontic boundary postulates plus one-way occurrence-exclusivity conditions and separate epistemic estimates	Every complete bearer history has one unique formation member and one unique eventual ending member. Each independently adopted condition constrains the occurrence predicate to the least or greatest member; the reverse implication is already contained in the derived boundary definition. Stage-relative attainment and protocol-relative windows localize those boundaries without replacing them. Eventual ending is an explicit full-history commitment; warranted endless persistence of one numerical bearer would contradict it.
Physical-origin relation	Domain-dependent ontic relation with separate epistemic warrant	A stage-resolved origin claim requires positive realization of direct contributors and prior contributor histories; scientific attribution additionally requires an independently warranted physical-origin link.
Production specification	Formal typed domain	Λ_{prod} constrains the stage, bearer sets, disjointness, incidence typing, and left/right totality; membership is neither an ontic linkage nor evidence.
Physical-production linkage	Primitive ontic typed relation	PhysicalProductionLink entails membership of its tuple in Λ_{prod}; the converse is invalid.
Transformation and warrant	Derived ontic relation plus separate epistemic predicate	$\text{TransformAt}^{\text{ont}}$ classifies ending of productive predecessors and formation of successors at one common stage; $\text{TransformWarrant}_{P,M}[\cdot]$ separately licenses scientific assertion.

Item	Status	Dependency or scope
Outcome and successor relations	One independent non-terminal closure principle, derived ontic classifications and relations, and separate warrant	Every attained non-terminal ending has a physically continuous outcome through at least one of two non-exclusive branches. The successor-producing branch is derived from the existence of at least one stage-indexed direct successor at the same boundary; DirectOutput, SuccAt, Succ, Succ^{+}, and IndSucc classify incidence, stage-indexed direct successorship, its stage projection, and finite paths. Scientific attribution requires separate warrant; existential branch warrant does not by itself identify a particular successor, and unindexed successor warrant does not localize an exact stage.
Successor cycles, same-stage cascades, and terminal greatestness	Adopted coherence constraint plus derived propositions; optional independent domain-model route	The no-infinite same-stage one-member cascade constraint, together with unique formation and ending boundaries and stage-indexed successorship, excludes finite successor cycles and infinite same-stage one-member sequences. With eventual ending and non-terminal outcome closure, it also yields the greatest-stage–terminal-stage equivalence. Strict transitive $\lhd_{\mathrm{tr}}$ with the successor bridge remains a second sufficient route to acyclicity. None of these results follows from time, $\prec_C$, CMA, or conservation language alone.
Record and stage	Typed distinction	A record is not a common cosmic stage, although a record bearer may be physically realized at a stage.
Restricted operational hypothesis	Prospective protocol-bounded proposition	Preregistered before evidence inspection and kept distinct from the observed-difference event, evidence set, decision rule, and conclusion. It tests selected manifested contrasts and is not a stagewise exhaustive test of CMA or UCC.

Item	Status	Dependency or scope
Restricted empirical witness and realization bridge	Protocol- and model-bounded evidential conclusion with application-specific bridge obligations	A valid attributed difference can warrant manifested bearer change only through a preregistered, validated bearer-specific bridge. The bridge must declare positive and adverse conditions, identity, coverage, sensitivity, uncertainty, and inference validity; it neither identifies the exact cosmic stage nor turns a null record into ontological stasis.
Laboratory-system inclusion and interaction	Consequence of universal scope with protocol-relative influence analysis, not independent proof	The sample, apparatus, detector, material record bearer, environmental systems, and researcher are bearer-distinct changing systems under CMA whenever their identities are realized. They may interact and contribute overlapping influences; physical factors may be borne by or realized among them without becoming separate bearers by default. Calibration, intervention analysis, provenance, and uncertainty control selected relations among them.
Relativistic formula	External model object	Its calculational use does not transfer temporal identity to a coordinate, metric, worldline functional, event point, or clock output.
ITOF empirical-accounting burden	Restricted protocol- and model-bounded research requirement	A claimed ITOF physical account of an accepted output class must specify bearers, interactions, a validated record chain, a shared comparison codomain, model and uncertainty, a prospective prediction, discrepancy functional, and preregistered tolerance. Restricted adequacy neither identifies a relativistic quantity with time nor establishes compatibility with relativistic temporal ontology.

Canonical equations

$$
\begin{aligned}
T_{\mathrm{ITOF}} &= (\mathcal{S}_C, \prec_C), && (199)\\
s_{\mathrm{C}}^0 &\in \mathcal{S}_C, && (200)\\
\neg\exists r &\in \mathcal{S}_C\,(r \prec_C s_{\mathrm{C}}^0), && (201)\\
I_A &= \{s \in \mathcal{S}_C \mid \mathrm{ExistsAs}(A, s)\}, && (202)\\
\mathcal{H}_A &= (I_A, \prec_C|_{I_A}, X_A), && (203)\\
\mathrm{Later}_{\mathrm{C}}(s) &\iff s \in \mathcal{S}_C \wedge s_{\mathrm{C}}^0 \prec_C s, && (204)\\
\mathrm{LaterInHistory}_A(s) &\iff s \in I_A \wedge \exists r \in I_A\,(r \prec_C s), && (205)\\
\mathrm{FormationReal}_A(f) &\iff \mathrm{AttainedFormation}_A(f) \wedge \mathrm{PhysReal}_A^+(f), && (206)\\
\mathrm{EndingReal}_A(e) &\iff \mathrm{End}_A(e) \wedge \mathrm{PhysReal}_A^+(e), && (207)\\
\mathrm{CSP}: &\quad \forall s \in \mathcal{S}_C,\ \mathcal{S}_{\mathrm{phys}}(s) \neq \varnothing, && (208)\\
\mathrm{NCEC}: &\quad \exists s \in \mathcal{S}_C\,(s_{\mathrm{C}}^0 \prec_C s), && (209)\\
\mathrm{CMA}: &\quad \forall s \in \mathcal{S}_C, && (210)\\
&\quad \forall A \in \mathcal{S}_{\mathrm{phys}}(s)\Big(\mathrm{Present}_{\mathrm{C}}(A; s) \wedge \mathrm{PhysReal}_A^+(s)\Big), && (211)\\
\mathrm{UCC}(A) &\iff \mathrm{PhysicalSystem}(A) && (212)\\
&\quad \wedge \forall s \in I_A[\mathrm{LaterInHistory}_A(s) \Rightarrow \mathrm{PhysReal}_A^+(s)], && (213)\\
\mathrm{UCC}(A, s) &\iff A \in \mathcal{S}_{\mathrm{phys}}(s) && (214)\\
&\quad \wedge \mathrm{LaterInHistory}_A(s) \wedge \mathrm{PhysReal}_A^+(s), && (215)\\
\mathrm{NontrivialHistory}(A) &\iff \exists r, s \in I_A\ (r \prec_C s), && (216)\\
\mathrm{UCC}^+(A) &\iff \mathrm{UCC}(A) \wedge \mathrm{NontrivialHistory}(A). && (217)
\end{aligned}
$$

The universal CMA statement is Equation (13); identity-domain convexity is Equation (24); complete-domain attainment is governed by Equations (7) and (8); formation and ending boundaries, their independently adopted one-way occurrence-exclusivity conditions, and their positive-realization classifications are governed by Equations (18), (19), (20), (60), (61), (62), (22), (23), (65), and (66); the greatest-stage definition, terminal definition, and their derived equivalence are Equations (76), (77), and (89); the ontological UCC falsifier and protocol-family rejection rule are Equations (155) and (156); the origin, production-specification, ontic transformation, stage-indexed direct-successor, unindexed direct-successor, successor-warrant projection and nonconverse, derived successor-producing classification, non-terminal physical-outcome closure, successor-classification warrant bridges, finite-closure, and warranted successor-set relations are Equations (25), (68), (69), (71), (72), (73), (74), (75), (78), (80), (81), (82), (83), (84), (86), (87), (85), and (88); successor acyclicity from the adopted cascade constraint and the independent production-dependence route are Propositions 11.4 and 11.7, while Proposition 11.8 establishes greatest-stage–terminal-stage equivalence under the full closure package; the application-specific realization-bridge schema, restricted empirical continuity bridge, and stagewise-restraint relations are Equations (158), (50), (137), and (138); the non-reconciliatory quantitative burden for any claimed ITOF physical account of an accepted relativistically modelled output class is Equation (172).

Claim–warrant matrix

Claim	Required warrant	Invalid shortcut
Bearer changed	Physical witness or adequate bearer model	Treating time, a stage, or a clock reading as the cause.
Bearer remained the same system	Declared identity criterion and persistence evidence	Assuming the same name, composition, or function guarantees the same identity.
Formation boundary was scientifically localized exactly	Identity criterion, formation evidence, and an exact-boundary warrant	Converting a protocol-relative formation window or first detected record into the location of the ontically unique first member.
Bearer ended at an attained member	Identity-ending evidence, an attained-boundary warrant, and the declared identity criterion	Functional failure, loss of observation, or a termination window alone.
Successor-producing ending scientifically attributed	Warrant that at least one stage-indexed direct successor exists at the ending boundary; identifying a particular successor requires separate edge-specific warrant	Inferring the branch from ending or conservation alone, or treating existential branch warrant as identification of a particular bearer.
Particular unindexed successor formed	New identity criterion and a warranted physical-origin or transformation relation supporting $\mathrm{Succ}(A, B)$	Calling every changed state a new system, inferring a particular successor from ending or conservation alone, or treating unindexed warrant as exact-stage localization.
Extant recipient received an ending contribution	A typed PhysicalOutcomeLink, evidence that the recipient existed before the ending boundary and continued after it, and $\mathrm{OutcomeWarrant}_{P,M}$	Treating material continuity, proximity, formation at the boundary, or conservation alone as a specific extant-recipient linkage.

Claim	Required warrant	Invalid shortcut
Stage-indexed production incidence asserted	A typed ontic transformation proposition plus protocol- and model-relative warrant for the specific edge and ending stage	Treating a well-formed tuple, set co-membership, an unindexed successor claim, or a many-to-many transformation as exact pairwise stage-resolved production.
Contributor persisted after formation boundary	Physical-origin evidence plus a separate later identity-domain member for that contributor	Inferring persistence from contribution at the formation stage alone.
Noticeability assigned to one exact stage	A model-specific uniqueness warrant beyond finite record comparison	Identifying a clock value, coordinate, or first resolved record with the cosmic stage.
Stagewise exhaustive access claimed	An independently warranted stage-access architecture capable of covering every applicable common stage, not merely dense sampling or repeated records	Treating one observed difference, a finite record series, or an operational window as inspection of all applicable stages.
Candidate-stage set inferred	Declared physical model, provenance, uncertainty, and non-identity restraint	Treating a candidate set as a canonical record–stage map.
Remote source state inferred	Source, propagation, reception, and reconstruction model	Treating a received signal as the source's present state.
Clock difference attributed	Complete physical comparison protocol	Calling the difference a deformation of time.
Relativistic formula ontologically interpreted	Independent identity and physical arguments	Inferring temporal ontology from numerical fit or notation alone.
ITOF physical account claimed for a relativistically modelled output class	Bearer-specific variables and interactions, validated record chain, shared comparison codomain, prospectively declared protocol, model and prediction, uncertainty, discrepancy functional, and preregistered tolerance satisfying Equation (172)	Treating ontological rejection, type non-identity, or criticism of relativity as a substitute for a quantitatively adequate physical account.

Sequential historical-critical inheritance boundary

V28/F8 is governed by sequential historical-critical review. Earlier versions remain documented stages in the development of ITOF [5, 4, 3, 2, 1], but no formulation, equation, or claim enters the present version merely because it appeared earlier. For every candidate element q,

$$\text{Inherited}_{V_n \to V28}(q) \Longrightarrow \text{Revalidated}_{V28}(q).$$

The governing inheritance conditions are: agreement with the canonical time definition and the all-stage CMA; preservation of one complete common stage domain with stage-relative attained prefixes and the independently postulated first stage; no private system time; non-inevitable universal terminal ending, with greatest-stage existence equivalent to terminal-stage existence under Proposition 11.8; one unique formation member and one unique eventual ending member for every complete bearer history; non-terminal physical-outcome closure with successor production restricted to identity-producing endings; bearer- and type-preserving equations; separation of ontological facts from records and decisions; and no claim of compatibility or reconciliation with relativistic temporal ontology.

B. Dependency Map

The formal dependency order is:

(i) the time definition fixes $T_{\text{ITOF}} = (\mathcal{S}_C, \prec_C)$ and the denotation of time;

(ii) PhysicalSystem(A) denotes an actually realized bearer, so its identity domain is nonempty by the declared type meaning;

(iii) identity-domain convexity constrains persistence between bounding identity-domain members, while the formation and eventual-ending postulates independently supply the unique endpoints and CompletedBy$(A; a)$ states stage-relative attainment of the ending;

(iv) CSP is the governing population condition on the primitive cosmic-stage domain, while NCEC is the independent application condition for non-vacuous succession; neither entails CMA;

(v) CMA independently states common-stage presence and bearer-specific positive physical realization at every actual cosmic stage, including s^0_{C}; mere presence does not define PhysReal, while formation and ending bridges only classify boundary subtypes;

(vi) ECP is the bearer-level instantiation of CMA;

(vii) the stage-indexed and universal bearer forms of UCC follow from CMA and the bearer-relative later predicate; UCC^{+} additionally requires NontrivialHistory(A);

(viii) formation and ending are bearer-specific positive-realization classifications with unique boundaries supplied by their governing postulates and one-way boundary-exclusive occurrence conditions; the reverse boundary-to-occurrence implications are contained in the derived definitions; non-terminal outcome closure distinguishes successor-producing from extant-recipient continuation without making the branches mutually exclusive; Λ_{prod} supplies only formal typing, PhysicalProductionLink and $\text{TransformAt}^{\text{ont}}$ state ontic production and transformation, and $\text{TransformWarrant}_{P,M}$ separately licenses scientific assertion; stage-indexed direct successorship, its stage projection, the successor-producing ending classification, and finite successor relations are derived without identity conflation; the adopted no-infinite same-stage one-member cascade constraint, together with the unique boundary semantics, entails finite successor acyclicity; together with eventual ending and non-terminal outcome closure it also makes any greatest cosmic stage exactly the universal terminal stage, while strict transitive production dependence with the direct-successor bridge supplies an independent optional acyclicity derivation; non-terminal physical-outcome closure remains the single independent ending-outcome closure principle in this dependency chain;

(ix) records, clock readings, coordinates, and model outputs enter only through separately typed observational and inferential relations;

(x) rejection of relativistic temporal ontology and type non-identity do not themselves supply an alternative physical calculation; any claimed ITOF account of an accepted output class must separately satisfy the restricted bearer, record-chain, comparison-domain, model, uncertainty, prospective-prediction, discrepancy, and tolerance burden in Equation (172);

(xi) an admissible attributed difference may yield a restricted empirical witness only through an application-specific validated realization bridge; neither exact-stage identification nor stagewise exhaustive access follows from that witness, and absence of such a bridge yields underdetermination rather than confirmation; inclusion of the bearer-distinct sample, apparatus, detector, material record bearer, environmental systems, and researcher under CMA is a consequence of universal scope and not independent proof of the axiom. Their system-to-system interactions and overlapping physical influences must be modelled or controlled where relevant, without merging their identities or treating every physical factor as a separate bearer.

The mandatory nondependencies are:

$$\text{definition of time} \not\Rightarrow \text{physical causation}, \qquad \text{stage unity} \not\Rightarrow \text{equal bearer states},$$

$$\text{clock output} \not\Rightarrow \text{identity of time}, \qquad \text{non-detection} \not\Rightarrow \text{physical stasis},$$

$$\text{finite record comparison} \not\Rightarrow \text{unique exact cosmic-stage assignment},$$

$$\text{UCC}(A) \not\Rightarrow \text{an endpoint or warranted transformation-successor set for } A.$$

$$\langle e, \mathcal{P}, \mathcal{Q}, \mathcal{E} \rangle \in \Lambda_{\text{prod}} \not\Rightarrow \text{TransformAt}^{\text{ont}}(\mathcal{P}, e, \mathcal{Q}; \mathcal{E}).$$

C. Identity Lifecycle Audit

For each bearer A, the audit asks:

(i) What physically individuates A, and what identity criterion is being used?

(ii) Is A an actual physical system, and is it separately study-qualified for the present protocol?

(iii) Is the ontic formation boundary attained, non-attained, or unsettled, and what separate protocol-relative window is actually supported?

(iv) What warrants persistence of the same identity across the relevant common stages?

(v) Which alterations remain changes of A, and which physically terminate that identity?

(vi) Does functional failure occur without identity ending?

(vii) Is the ontic termination boundary attained, non-attained, or unsettled, and what separate protocol-relative window is actually supported?

(viii) Is each particular successor, extant recipient, or transformation linkage physically warranted, rather than inferred from the general outcome-closure principle alone?

(ix) If multiple predecessors or successors are involved, are their identities and physical links represented without forced one-to-one pairing?

(x) Is each proposed production incidence an ontic claim with separate evidential warrant, rather than an inference from tuple typing or set co-membership?

(xi) If a contributor is said to persist, is continuation after the boundary independently established rather than inferred from contribution alone?

(xii) Is common-stage overlap stated without merging bearer identities or physical histories?

A lifecycle claim is invalid when it changes the bearer without notice, treats a part as the whole, treats a class description as an individual history, infers identity termination from functional failure alone, or converts an evidential boundary into an exact cosmic-stage assertion without a uniqueness warrant.

D. Observation, Record, and Reconstruction Audit

Five-level separation

Every observational claim should distinguish at least five levels:

(i) physical realization in the bearer;

(ii) manifestation of an effect available to interaction;

(iii) interaction with detector or observer;

(iv) material or digital record;

(v) reading, model fit, or inference.

Collapsing these levels produces common errors: treating absence of a record as absence of change, treating a record as the original state, or treating a model coordinate as the observed physical stage.

Record provenance

A record claim should report the chain

$$\mathcal{P}_r = (A, \chi, D, \Theta_D, P, r), \tag{218}$$

where A is the bearer, χ the physical interaction or effect, D the detector, Θ_D detector conditions, P the protocol, and r the record. The tuple is a provenance template rather than a universal formal requirement. Missing provenance weakens attribution.

Direct and mediated records

A direct record is produced through a comparatively short and controlled physical chain. A mediated record may pass through propagation, transformation, storage, reconstruction, and model correction. Directness is a matter of chain structure, not ontological immediacy. Even a local detector record is later than the interaction that formed it and remains physically distinct from the sample realization.

Threshold conditions

For a claimed null result, report:

$$\epsilon_D, \qquad \mathcal{B}_D, \qquad \mathcal{S}_D, \qquad J, \tag{219}$$

where ϵ_D is sensitivity, $\mathcal{B}_D$ bandwidth or coverage, $\mathcal{S}_D$ selectivity, and J the observation domain. A null outside the covered domain cannot support equivalence under a bearer-complete criterion.

Noise and confounding

A record difference does not establish bearer change if the difference is attributable to detector noise, processing, drift, or another source. The inference requires

$$\mathrm{Difference}(r_1, r_2) \land \mathrm{AttributableToBearer}_P(r_1, r_2; A) \implies \mathrm{Warrant}_P[\mathrm{WitnessOfChange}_A]\,. \tag{220}$$

Without the second premise the record difference remains ambiguous.

Reconstruction uncertainty

A reconstructed past quantity should be reported as

$$\widehat{q}^{\,\mathrm{past}}_{A,P} \pm \nu_{A,P}, \tag{221}$$

where $\nu_{A,P}$ summarizes uncertainty under the adopted convention. If Bayesian or frequentist structures are used, their interpretation must be stated rather than mixed. Standards for measurement uncertainty provide useful discipline [16, 17].

Delayed-manifestation conditions

When an effect becomes visible at record r_k, do not write that the change "occurred at" r_k unless the physical model supports that conclusion. Prefer:

$$\text{EffectResolvedAt}(r_k) \not\Rightarrow \text{ChangeBeganAt}(r_k). \quad (222)$$

The distinction is mandatory for ageing, cumulative damage, genetic evolution, geological processes, and remote astrophysical records. The same record also does not establish that every applicable stage was individually accessed:

$$\text{EffectResolvedAt}(r_k) \not\Rightarrow \text{StagewiseExhaustiveTest}_{A;P,M,J}\,. \quad (223)$$

Change in the sample and in the physical systems of the measurement chain continues during and after the record-producing interaction wherever each relevant identity remains realized; if one ends, its ending and any warranted successor formation are physical change at the same common stage. The record marks a protocol-relative manifestation, not an ontological start or stop of change.

Operational windows and limits on exact notice-stage warrant

No finite record claim may use a clock reading, coordinate, or reconstructed date as a uniquely warranted identification of the exact common cosmic stage without an additional validated physical model that supplies a uniqueness condition. Such quantities locate or order records, readings, and reconstructed coordinates within a model and protocol. High precision within an operational scale remains distinct from a canonical ITOF stage identification. A model may return a candidate-stage set, but the record does not become a stage and uniqueness is not presumed.

Researcher and laboratory inclusion

Experimental prose should not describe the apparatus as fixed while the sample alone changes. Fixed means controlled relative to selected variables. The researcher, sample, apparatus, detector, material record bearer, supports, electronics, air, building, Earth, and other declared environmental systems remain bearer-distinct physical systems throughout the portions of their respective identity histories realized before, during, and after examination. Their distinctness does not imply isolation. They may interact, influence one another, and stand in subsystem, part–whole, composite, source–receiver, or control relations. Some of these systems participate as influencing bearers alongside other relevant physical factors—including temperature, pressure, radiation, fields, mechanical loading, chemical conditions, and biological activity—that may be states, properties, relations, exchanges, or mechanisms borne by or realized among systems rather than additional bearers by default. Overlapping influence does not merge identities. This interacting plurality does not make measurement impossible; it motivates calibration, isolation, differential design, intervention control, provenance analysis, and uncertainty control. Their change and interaction are not independent empirical proof of CMA, because their inclusion is already a consequence of its universal scope.

D.1 Clock and Operational Comparison Audit

Clock construction checklist

For each clock model, state:

(1) bearer system C;

(2) physical process or transition used;

(3) record-producing mechanism;

(4) record-production map $\mathcal{R}_{C,P}$ and numerical reading map $N_{C,P}$;

(5) unit and scale convention;

(6) relevant physical and protocol conditions $\Theta_{C,P}$;

(7) uncertainty and drift model;

(8) relation, if any, to a relativistic prediction.

The clock is not fully specified by naming an oscillation frequency.

Record-to-reading map

The valid direction is

$$(h_{C,J}, \theta_{C,P}) \xrightarrow{\mathcal{R}_{C,P}} r_C \xrightarrow{N_{C,P}} n_C \in \mathbb{R}_P. \tag{224}$$

The map is not reversed to make the reading the cause of the physical clock state. Nor is r_C treated as a common cosmic stage.

Comparison protocol

A two-clock comparison requires a pairing rule. The mere existence of two readings does not define which records are compared. The protocol may use reunion, signal exchange, common detector, transported records, or coordinate reconstruction. The pairing map can be written

$$\Pi_{12}^P : (r_{C_1,i}, r_{C_2,j}) \longmapsto \text{comparison pair}. \tag{225}$$

The map belongs to the experiment, not to the cosmic-stage ontology.

Native and common codomains

If clocks report different native units or scales, comparison requires transformations $\Gamma_{i,P_{12}}$ as in Equation (99). A subtraction made before unit and scale reconciliation is formally invalid. The common codomain is numerical and conventional; it is not the common cosmic stage.

Clock-rate statements

A statement that clock C_1 "runs slower" than C_2 must specify the ratio or difference:

$$\mathcal{R}_{12}^P := \frac{\Delta_P \Gamma_{1,P}(n_{C_1})}{\Delta_P \Gamma_{2,P}(n_{C_2})}, \qquad \Delta_P \Gamma_{2,P}(n_{C_2}) \neq 0, \tag{226}$$

where each finite difference is constructed from record pairs selected by the same declared comparison protocol. The phrase does not mean that T_{ITOF} has two rates.

Relativistic prediction conditions

When a clock is predicted by proper time, distinguish:

$$\tau[\gamma, g] \quad \text{metric functional,} \tag{227}$$

$$n^{\mathrm{pred}}_{C,P} \quad \text{predicted numerical clock reading,} \tag{228}$$

$$n^{\mathrm{obs}}_{C,P} \quad \text{observed numerical reading,} \tag{229}$$

$$\delta n_C := n^{\mathrm{obs}}_{C,P} - n^{\mathrm{pred}}_{C,P} \quad \text{residual.} \tag{230}$$

Agreement concerns the model and physical clock. It does not prove $\tau \equiv T_{\mathrm{ITOF}}$.

Drift and residual conditions

A drift model may write

$$n^{\mathrm{obs}}_{C,P} = n^{\mathrm{ideal}}_{C,P} + b_C + s_C + \eta_C, \tag{231}$$

where b_C is bias, s_C systematic correction, and η_C stochastic contribution, with meanings fixed by the experiment. The decomposition is illustrative. Every term belongs to clock performance and analysis.

Clock records and stage succession

Any sentence claiming that a clock counts stages must be rejected. A clock counts or estimates cycles, transitions, phase increments, pulses, or other physical outputs. Cosmic stages are not instrumentally discretized. If the manuscript uses "stage count" as a metaphor, replace it with the actual clock variable.

Clock coherence condition

A coherent clock analysis must identify the material bearer, the selected physical process, the record-producing dynamics, the numerical reading map, the environmental and device conditions, and the comparison protocol. Its logical direction is

$$(h_{C,J}, \theta_{C,P}) \xrightarrow{\mathcal{R}_{C,P}} r_C \xrightarrow{N_{C,P}} n_C, \qquad n_C \not\equiv_{\mathrm{type}} T_{\mathrm{ITOF}}, \qquad r_C \not\equiv_{\mathrm{type}} s. \tag{232}$$

The reading is a macroscopic accumulated record of selected physical transitions or signals. It neither counts common cosmic stages nor measures time as an independent physical object. A relativistic functional may enter only through an explicitly declared model-specific prediction, never as the ontological identity of the clock output or of time. This criterion applies equally to laboratory clocks and to astrophysical "clocks" such as pulsations, rotations, or orbital periodicities.

E. Difficult Systems and Test Protocols

Why the principle needs an architecture

The derived statement that all physical systems realize bearer-specific physical change at every later member of their identity domains is broader than any single experiment. Its scientific credibility depends on separating deductive structure, physical routes, class evidence, and unresolved candidates. The architecture is not a formal proof from a finite premise set that enumerates nature. It is a disciplined programme for supporting or defeating a universal physical principle.

Route I: persistent effective processes

For many systems, known internal processes and external engagements provide continuing routes to realization. The route has the form

$$\begin{aligned} &\mathrm{IdentityPersistenceWarrant}_{A,P,M}(J) \wedge \forall s \in J_{\mathrm{C}},\ \mathrm{EffectiveRealizationRoute}_A(s) \\ &\quad \Longrightarrow \forall s \in J_{\mathrm{C}} \cap I_A\ \mathrm{PhysReal}^{+}_{A}(s). \end{aligned} \tag{233}$$

The premise must be physically supported. It cannot be replaced by the generic phrase "everything interacts" if exact isolation is under consideration.

Route II: cumulative manifestation

Some changes are individually unresolved but cumulatively detectable. Let δ_k denote physically attributable contributions whose combined effect is D_n. Schematically,

$$D_n = \mathcal{A}(\delta_1, \ldots, \delta_n), \tag{234}$$

where $\mathcal{A}$ is a domain-specific accumulation rule and need not be simple addition. If the final effect and model validly require prior contributions, the evidence supports later-history realization over the accumulation domain.

Route III: class exclusion of complete stasis

A class may be supported by showing that every admissible member satisfying identity conditions necessarily has at least one physically active route. The form is

$$\forall A \in \mathcal{C}, \quad \mathrm{PhysicalSystem}(A) \wedge \mathrm{IdentityPersists}(A) \Longrightarrow \bigvee_{k=1}^{m} \mathrm{ActiveRoute}_k(A). \tag{235}$$

The disjunction must cover the class without assuming the conclusion. If a member can evade all routes, it remains a difficult candidate.

Route IV: direct positive witnesses

Longitudinal records can directly establish changes in representative systems. The evidence is strong for those systems and changes. Universal use requires a class argument showing why the sample and physical routes cover the proposed domain. Statistical generalization alone may be insufficient when rare exact-stasis candidates are conceptually possible.

Route V: theoretical dynamics with empirical support

A well-tested dynamical theory may imply continuing evolution under specified conditions. The implication supports ITOF only if the model variables and bearer are physically adequate. Effective theories may omit sectors relevant to a bearer-complete criterion. The theory's success therefore contributes evidence without automatically closing ontology.

Permanent cancellation

Opposing processes can produce a constant selected quantity. To support complete stasis through permanent cancellation, one must show not merely that net outputs vanish but that the opposing processes themselves produce no state difference. In many cases the existence of cancellation already implies continuing physical processes.

Approximate isolation

Isolation is always relative to specified couplings and sensitivity. An approximately isolated system can still undergo internal realization. An exactly isolated ideal in a model must be examined separately. The proof architecture records whether the universal claim depends on excluding exact isolation or on showing internal routes within it.

Finite windows

No finite observation window demonstrates indefinite continuation, and a finite null window does not demonstrate cessation. An apparently unchanged stone may undergo minute changes whose accumulated manifestation becomes visible only after years or centuries. The later visible effect does not imply that the complete alteration occurred once at the moment of detection. Evidence from finite windows supports or challenges restricted hypotheses through physical theory, repeatability, and class synthesis, while the unrestricted derived UCC result remains dependent on the revisability of its foundational physical premises.

Continuing realization throughout identity persistence

The phrase "static tail" denotes a hypothetical identity-preserving continuation after all change ends. It is not admitted as compatible with the universal principle. To challenge the principle, the tail must be physically established, not inferred from a quiet record. The manuscript avoids using the static tail as a hidden object in equations.

Universal synthesis

A responsible synthesis reports:

- classes with strong direct evidence;
- classes supported by well-tested dynamics;
- classes supported by exclusion of complete stasis;

- difficult candidates with unresolved bearer-complete questions;
- possible adverse outcomes and revision rules.

This is more rigorous than both dogmatic universal assertion and premature suspension based on one idealized stationary model.

History-informed prediction audit

A comparative prediction study must pre-register the class-only model, the history-informed model, training and validation sets, performance metric, uncertainty procedure, and adverse result. Improvement must be evaluated out of sample. A successful result supports the relevance of bearer history but is not presented as exclusive proof of the complete cosmic ontology.

E.1 Difficult-System and Class Matrix

Matrix purpose

The matrix translates broad universal claims into class-specific proof obligations. It treats realization mechanisms as class-specific and requires each class to state its own physical routes. For each candidate, the investigation identifies the bearer, state description, identity criterion, reported constancy claim, plausible realization routes, evidence channels, and domain-qualified challenge.

Class	Bearer and identity	Reported constancy claim
Constructed material	Declared specimen, composition, and structural continuity	Measured properties remain within declared tolerances
Atomic system	Atom or ion under species and confinement criterion	Stationary internal state
Molecular system	Molecule under bonding and composition criterion	Ground or equilibrium state
Open quantum system	System plus declared boundary and coupling	Steady density operator
Ground-state candidate	Physical bearer under Hamiltonian and boundary conditions	Exact lowest-energy stationarity
Vacuum or field configuration	Declared field domain and boundary conditions	Vacuum invariance
Classical equilibrium	Material system under thermodynamic constraints	Constant macroscopic variables and zero net flux
Fixed-point model	Physical system represented by $\dot{\boldsymbol{x}} = 0$	Exact model stationarity
Periodic system	Oscillator, orbit, or recurrent process	Exact return of selected state variables

Class	Bearer and identity	Reported constancy claim
Stable particle	Particle under species identity	Species identity and internal observables remain invariant
Geological object	Rock, mineral, or landform under structural identity	Apparent macroscopic permanence
Planetary system	Planet or subsystem under gravitational and material identity	Stable orbit or structure
Stellar system	Star under astrophysical identity	Long stable phase
Living system	Cell, organism, or lineage under biological identity	Homeostasis or phenotypic stability
Genetic bearer	Molecule, cell, tissue, or lineage	Sequence and expression remain equivalent within declared coverage
Clock	Device under functional identity	Stable calibrated rate
Stationary spacetime model	Metric solution with symmetry	Adapted-chart metric components remain constant

Class	Required realization analysis	Qualified adverse condition
Constructed material	Thermal, chemical, radiative, mechanical, and microstructural channels	Equivalence under a bearer-complete criterion with robust multichannel coverage.
Atomic system	Coupling, emission, absorption, field interaction, recoil, and environmental channels	Identity persists with equivalence under a bearer-complete criterion in adequately isolated conditions.
Molecular system	Vibrational, rotational, electronic, collision, and radiative routes	Equivalence under a bearer-complete criterion across every physically relevant sector.
Open quantum system	Quantum trajectories, exchange, decoherence, jumps, and correlations	Equivalence under a bearer-complete criterion throughout continuing identity and declared open coupling.
Ground-state candidate	Representation, environment, detector coupling, and physically meaningful observables	Equivalence under a bearer-complete criterion in the fully specified physical model.
Vacuum or field configuration	Field observables, boundary changes, detector response, interaction, and representation dependence	The physical bearer satisfies the declared bearer-complete criterion across field and boundary coverage.

Class	Required realization analysis	Qualified adverse condition
Classical equilibrium	Microscopic processes, fluctuations, exchange, and omitted degrees of freedom	Equivalence under a bearer-complete criterion rather than net balance.
Fixed-point model	Completeness of variables, physical instantiation, perturbations, and hidden sectors	The model variables are shown to exhaust the bearer-complete criterion and remain equivalent at a later stage.
Periodic system	Intermediate states, environment, phase, dissipation, and complete-state comparison	The complete bearer state and relevant surroundings satisfy a bearer-complete criterion at a later stage.
Stable particle	Interaction, propagation, field relations, and exact isolation claim	Identity persists with equivalence under a bearer-complete criterion.
Geological object	Radiometric, chemical, mechanical, erosion, thermal, and surface channels	Comprehensive evidence supports equivalence under a bearer-complete criterion over the declared domain.
Planetary system	Rotation, orbit, tides, atmosphere, interior, radiation, and impacts	Equivalence under a bearer-complete criterion across every relevant planetary sector.
Stellar system	Fusion, transport, oscillation, magnetic, emission, and mass-loss channels	Equivalence under a bearer-complete criterion throughout the identity-valid observation domain.
Living system	Metabolism, repair, exchange, expression, mutation, and turnover	Equivalence under a bearer-complete criterion with continuing biological identity.
Genetic bearer	Mutation, repair, epigenetics, copy number, and sampling coverage	Equivalence under a bearer-complete criterion across molecular and organizational components.
Clock	Oscillation, control, environment, drift, readout, and relativistic conditions	Equivalence under a bearer-complete criterion throughout continuing clock identity, including the physical process required for operation.

Class	Required realization analysis	Qualified adverse condition
Stationary spacetime model	Distinguish metric symmetry from material systems and cosmic extension	A physical bearer, not geometry alone, satisfies an identity-preserving bearer-complete criterion at a later stage.

Constructed materials

Materials offer controlled exposure and multichannel analysis. A strong programme combines mechanical, spectroscopic, chemical, and imaging evidence. Accelerated tests do not simply compress "time"; they alter physical factors such as radiation, temperature, humidity, or stress. Extrapolation to service conditions requires a model and uncertainty statement.

Atomic and molecular systems

Precision spectroscopy can resolve extremely small changes, but resolution is not complete-state access. Preparation and measurement place the system in an experimental environment. The strongest stationary claims should be tested under clearly defined isolation and Hamiltonian assumptions. Observation of quantum jumps demonstrates discrete recordable transitions in some systems, not a universal cosmic-stage order.

Ground states and vacuum candidates

These classes require special restraint because formal language can outrun physical attribution. The investigation should distinguish exact mathematical state, approximate laboratory preparation, environmental coupling, detector interaction, and interpretation. Neither "zero-point activity" nor "stationarity" should be used as a slogan. The claim must be attached to a bearer and evidence.

Stable particles

For a particle regarded as exactly stable, decay is not the only possible form of realization. Motion, scattering, field interaction, and participation in composite structures may supply change. An exactly isolated free particle in a state treated as invariant remains a difficult limiting case. The protocol must distinguish theoretical stability, a lower bound from non-observation, and the much stronger ontological claim of endless persistence of the same numerical bearer. V28/F8 records the bearer-complete obligation rather than disguising it with an unspecified mechanism; warranted endless persistence would count directly against the eventual-ending postulate.

Geophysical and planetary systems

Earth materials, glaciers, atmosphere, crust, mantle, oceans, and planetary orbits provide multiple independent records of change [51, 52, 53, 54]. The evidential strength lies in convergence across physical channels. These domains also demonstrate that apparent stability over a human interval can coexist with later-history realization at smaller scales or longer accumulation windows.

Stellar and remote systems

Remote systems require propagation modelling and record reconstruction. A variable signal establishes source or path change only after alternatives are analysed. Stable luminosity in a band is not complete stellar-state equivalence. Surveys and asteroseismology provide rich change witnesses while preserving the distinction between emission and arrival. Terminal stellar transformations and galactic interactions add identity-lifecycle tests: the investigation must distinguish continuing evolution under one bearer criterion from cessation of a predecessor and formation of successor systems.

Living and genetic systems

Biological identity is organizational and lineage-dependent. Molecular turnover can be extensive while organism identity persists. Conversely, a mutation can be physically real without changing phenotype. Sampling and tissue heterogeneity must be incorporated. Longitudinal genomics and somatic-mutation studies illustrate both the power and limitations of present access. Organismal life histories additionally provide ordered domain models from identity formation through development, health, disease, recovery, ageing, and identity termination. Disease is a criterion-relative failure candidate, not an automatic identity-end condition.

Clock systems

A functioning clock necessarily produces physical transitions and records. Its stable operation therefore supplies a direct example of stability through change. Clock comparisons are not evidence that time as defined by ITOF changes; they are evidence that physical processes and outputs depend on conditions in predictable ways.

Class synthesis obligation

Universal support requires a reasoned synthesis of classes, not a list of examples. The synthesis should state which physical routes are common, which are class-specific, which candidates remain difficult, and what adverse result would revise the claim. This is stronger than asserting that "everything changes" as an unexamined maxim.

Empirical class	Primary bearer	Evidential contribution
Small-scale, genetic, and cellular	Molecule, cell, tissue, organism, or lineage under an explicit attribution rule	Localized mutations, turnover, regulation, and molecular or cellular differences show later-history realization under persisting higher-level identity.
Organismal life history	Organism under a declared biological identity criterion	Development, disease, recovery, recurrence, ageing, and terminal change provide ordered witnesses across an identity-bounded history.

Empirical class	Primary bearer	Evidential contribution
Geophysical and planetary	Glacier, crustal region, atmosphere, ocean, mantle, planetary interior, or orbital system	Independent monitoring channels show cumulative and multi-scale change beneath apparently stable macroscopic descriptions.
Stellar and remote	Star, compact object, galaxy, or other remote source	Variability, terminal stellar transformation, galactic interaction, and merger provide witnesses of continuing change and possible successor-system formation when source, propagation, arrival, and reconstruction are distinguished.
Laboratory and clock systems	Material device, transition, oscillator, detector, or controlled ensemble	Repeated physical transitions and records demonstrate stable operation through change and permit calibrated numerical comparison.
Difficult idealized candidates	Stationary quantum model, exactly stable particle, or ideally isolated free particle	These cases expose the strongest bearer-completeness and omitted-variable obligations and therefore serve as stress tests.

Empirical class	Necessary limit on inference
Small-scale, genetic, and cellular	A sampled difference supports only the bearer and level to which it is validly attributed; it does not assign an exact cosmic stage.
Organismal life history	Biological phases are coarse-grained state classifications; disease or functional failure does not by itself establish identity termination, and no fixed calendar age defines the endpoint.
Geophysical and planetary	Stability over a human window or in one observable is not equivalence under a bearer-complete criterion.
Stellar and remote	Arrival records constrain source windows rather than exact stages; identity termination requires an explicit stellar or galactic criterion and is not inferred from variability alone.
Laboratory and clock systems	Numerical output is neither time nor a count of common cosmic stages; model fit remains model-bounded.
Difficult idealized candidates	No unspecified hidden mechanism may be invented; a genuine adverse result requires warranted identity-preserving equivalence under a bearer-complete criterion at a later stage.

The synthesis is cumulative and revisable. Heterogeneous evidence can support universal change continuity across classes, but it is not a direct observation of every actual common cosmic stage and does not by itself prove the Cosmic Moment Axiom for every system in the universe.

F. Relativistic Reclassification and Type Boundaries

Purpose

Whenever a relativistic formalism is cited, its notation is reproduced according to the model that defines it and then subjected to ITOF type criticism. The following classification does not accept or validate the equations; it prevents an unsupported transfer of temporal identity. Type non-identity establishes only the absence of a type-preserving identity with ITOF time. The broader rejection of relativistic geometry as the ontology or definition of time is an independent governing commitment of V28/F8 and is not presented as a theorem derived from type separation alone. Neither type non-identity nor ontological rejection supplies a bearer-specific alternative prediction. Where such an account is claimed, Equation (172) governs the separate quantitative burden.

Ontological participation and the representation bridge

The relation $A \in \mathcal{S}_{\mathrm{phys}}(s)$ states that bearer A is a physical system whose identity is realized at cosmic stage s. It is the membership condition used by CMA; ECP is merely its bearer-level instantiation and introduces no second primitive participation relation. Relativistic representation has a different typed form:

$$\mathcal{M}_{\mathrm{rel},A} := \mathcal{M}_{\mathrm{rel}}\big|_{\mathfrak{D}_A^{\mathrm{phys,adm}}} : \mathfrak{D}_A^{\mathrm{phys,adm}} \longrightarrow \mathfrak{R}_A^{\mathrm{rel}}. \tag{236}$$

Its codomain contains coordinate, metric, causal, worldline, field, and prediction objects. It represents a physical history or occurrence range and does not define the common cosmic stage. The operational marker u_{obs} constrains manifestation and recording windows; it is neither an event-to-stage map nor a stage variable.

Coordinate type boundary

For every coordinate expression, ask:

(1) Which chart or observer convention defines the coordinates?

(2) Is the statement about an event, a coordinate value, or a coordinate difference?

(3) Which transformations preserve the claimed relation?

(4) Has a coordinate component been called time without clarifying its type?

(5) Has coordinate equality been confused with the common cosmic stage?

The correct type statement is

$$x_F^{\mu}(e) \in \mathbb{R}_F^4, \tag{237}$$

not $x_F^0(e) \in \mathcal{S}_{\mathrm{C}}$ and not $x_F^0(e) \equiv T_{\mathrm{ITOF}}$.

Lorentz-transformation type boundary

Equation (178) relates coordinate assignments (t, x) and (t', x'). The transformation domain excludes T_{ITOF}; therefore the cosmic extension is neither transformed, mixed with space, nor made observer-dependent by this equation.

A safe summary is

$$\Lambda \in \text{Aut}(\mathcal{M}_{\text{Mink}}), \qquad T_{\text{ITOF}} \notin \text{Dom}(\Lambda), \tag{238}$$

where the first relation is schematic and the second is a type restriction, not a new mathematical theorem about Lorentz groups.

Proper-time type boundary

A proper-time passage must state:

- the worldline γ is timelike;
- the metric and sign convention are fixed;
- τ is a scalar functional of (γ, g);
- a real clock's relation to τ requires a physical model;
- unequal values do not imply unequal cosmic extensions.

The sentence "the clock measures time" should be replaced by "the clock output tracks proper time under the stated idealization" or by an equally explicit physical statement.

F.1 Clock-experiment type boundary

The general temporal-attribution boundary for atomic-clock outputs is established in Subsection 13.3.

Relativistic clock experiments commonly compare frequencies or accumulated readings. Their type structure separates

$$\text{metric prediction} \longrightarrow \text{device prediction} \longrightarrow \text{observed record} \longrightarrow \text{comparison residual.} \tag{239}$$

A paper reporting centimetre-scale gravitational redshift, for example, provides high-precision evidence for the relation among clocks, height, and metric prediction. The result remains evidence about physical outputs, not direct observation of the cosmic stage.

Frequency-shift type boundary

For every redshift or Doppler equation, identify:

(a) emitter process;

(b) emitted frequency definition;

(c) propagation conditions;

(d) receiver process;

(e) received frequency extraction;

(f) observer or coordinate assumptions.

Frequency belongs to a physical process or signal; it is not a property of time in ITOF.

Metric and curvature type boundary

Curvature is a predicate of a declared geometric object: metric, connection, Riemann tensor, Ricci tensor, scalar curvature, or geodesic deviation. The predicate remains exclusively in that geometric domain. Since V28/F8 defines no metric or connection on the cosmic extension, curvature is ill-typed when applied to T_{ITOF}. The manuscript therefore rejects "curved time" rather than treating it as an optional interpretation.

The type relation is

$$\mathrm{Curvature} : (M, g) \longmapsto R^{\rho}{}_{\sigma\mu\nu}, \tag{240}$$

with the explicit canonical boundary

$$\mathrm{Curvature} \notin \mathrm{PrimitiveOperations}(T_{\mathrm{ITOF}}). \tag{241}$$

This does not deny that an independently added mathematical representation may carry geometric structure; it denies that such structure belongs to the governing definition of ITOF time.

Field-equation type boundary

The Einstein field equation may be cited as the equation defined by general relativity, with its geometrical and stress–energy objects. Citation or calculation does not endorse its physical adequacy or temporal interpretation. No ITOF term is inserted into it. If an application speaks of the "effect of time" on matter, replace the phrase with the actual metric, field, trajectory, or environmental relation.

Spacetime type boundary

Spacetime is a geometrical model whose claimed physical interpretation depends on explicit assumptions and inferential links to records. Four-dimensional or higher-dimensional coordinate arrangements are not the ontology of time; a manifold point is not a physical realization; a hypersurface is not the common cosmic stage; and warped, compactified, or multiply timelike geometries do not multiply or deform the common cosmic extension common to all physical systems. V28/F8 does not endorse the geometry as the confirmed physical nature of the universe and categorically rejects its identity with time.

Coordinate synchronization boundary

V28/F8 replaces the V24/F4 pairwise relation $\sim_{\text{abs}}$ with direct common cosmic-stage membership and a derived co-stage relation. The formal distinction is:

$$\text{Sync}_{F,P}(e_1, e_2) \quad \text{coordinate or protocol relation,} \tag{242}$$

$$\text{CMA} \quad \text{foundational common-stage axiom.} \tag{243}$$

The relations are formally distinct. Coordinate synchronization organizes coordinate assignments under a protocol; at every actual common stage, CMA states the presence and bearer-specific positive physical realization of all physical systems extant there.

Causal-order boundary

No relativistic causal classification is adopted as a governing constraint on ITOF. Any representation used in an application must be checked against independently warranted physical interactions and record order. Ontological participation is stated by $A \in \mathcal{S}_{\text{phys}}(s)$, while records and u_{obs} constrain operational windows rather than assigning an exact stage by themselves.

Covariance boundary

Covariance is a formal property claimed for relativistic equations under coordinate change. ITOF does not treat it as evidence that the equations describe temporal reality. Ontological participation occupies a non-numerical relational type and introduces no coordinate assignment or relativistic correction term; the common cosmic stage is asserted through $A \in \mathcal{S}_{\text{phys}}(s)$ independently of covariance.

Relativistic classification table

Object	**Relativistic role**	**ITOF type boundary**
t_F	Coordinate component in chart F	Coordinate type distinct from T_{ITOF}
Δt_F	Coordinate interval	Coordinate interval distinct from cosmic extension
ds^2	Metric interval	Metric interval distinct from time
$\tau[\gamma, g]$	Timelike worldline functional	Metric functional distinct from time and stage count
$N_{C,P}$	Reading map from clock records to numbers	Clock-map type distinct from time and stage
n_C	Numerical clock output	Clock-output type distinct from time and stage
z	Frequency ratio	Frequency-ratio type distinct from temporal ontology
$g_{\mu\nu}$	Metric field	Metric-field type distinct from temporal order

Object	Relativistic role	ITOF type boundary
$R^\rho{}_{\sigma\mu\nu}$	Curvature tensor	Curvature predicate remains attached to metric geometry
(M, g)	Spacetime model	Spacetime-model type distinct from T_{ITOF}
Σ_t	Hypersurface or foliation leaf	Hypersurface type distinct from common-stage type
$\mathrm{Sync}_{F,P}$	Coordinate synchronization relation	Synchronization relation distinct from the axiom
$A \in \mathcal{S}_{\mathrm{phys}}(s)$	Extant bearer at a common stage	Direct membership in the bearer domain of the shared stage
$\mathcal{M}_{\mathrm{rel},A}$	Relativistic representation bridge	Representation bridge with bounded evidential output

Object	Required clarification
t_F	State chart and synchronization convention.
Δt_F	State endpoints and frame.
ds^2	State signature and invariant role.
$\tau[\gamma, g]$	State path and metric.
$N_{C,P}$	State clock process, record domain, codomain, and protocol.
n_C	State the generating record and reading map.
z	State emitter, receiver, and model.
$g_{\mu\nu}$	State geometrical and dynamical role.
$R^\rho{}_{\sigma\mu\nu}$	State connection and metric.
(M, g)	Distinguish representation and ontology.
Σ_t	State foliation dependence.
$\mathrm{Sync}_{F,P}$	State physical procedure and convention.
$A \in \mathcal{S}_{\mathrm{phys}}(s)$	State bearer identity and stage domain.
$\mathcal{M}_{\mathrm{rel},A}$	State model codomain and evidential limits.

Relativistic classification conclusion

The relativistic critique is complete only when each cited equation has an explicit domain, codomain, assumed bearer or record chain, and ontological type. Agreement with selected records establishes at most model-bounded calculational adequacy; it does not establish the represented geometry as physical reality or grant temporal identity. V28/F8 cites the equations for examination and states the identity rejection directly.

G. Worked Applications and Formal Propositions

Atomic emission or absorption

Let A be an atom or ion whose identity remains valid across an interaction. Two compared state descriptions may differ in an attributable electronic, nuclear, motional, or coupled condition. That difference can witness a physical alteration, but it does not define change through stage-order terminology. The attribution bridge is Equation (57); where $\mathrm{LaterInHistory}_A(s)$ also holds, the occurrence is classified by $\mathrm{LaterReal}_A(s)$. A photon emitted or absorbed is part of the physical engagement and may later produce a detector record. The photon record is not the atomic realization, and the detector reading does not identify the exact common stage of the atomic transition.

If the transition is used as a clock process, the protocol counts or estimates repeated atomic records. The clock's stability concerns the reproducibility of the transition frequency and apparatus, not absence of physical change. The common cosmic stage is shared with all other existing systems throughout the process.

Localized material change

Let a polymer specimen A undergo localized oxidation in region k. The macroscopic dimensions may remain within tolerance while chemical bonds and local composition change. Let $q_{A,k} := q^{\mathrm{map}}_{A,k} \circ X_A$ be a declared spectroscopic component projection selected by Γ_A, with comparison criterion $\Gamma_{A,k}$. Then

$$
\begin{aligned}
&\forall s \in I_A\ \forall t \in I_A, \quad \forall k \in K(\Gamma_A),\\
&\quad \Big[s \prec_C t \wedge q_{A,k}(s) \not\equiv_{\Gamma_{A,k}} q_{A,k}(t)\\
&\quad \wedge \mathrm{ValidStateComponentAttribution}_{A,P,M}(k; s, t) \wedge \mathrm{IdCont}_A(s,t) \Big]\\
&\Longrightarrow \mathrm{Warrant}_{P,M}[X_A(s) \not\equiv_{\Gamma_A} X_A(t)]\,.
\end{aligned}
\tag{244}
$$

The conclusion is evidential support for physical change in the specimen, not merely change in the spectrum, provided the projection, instrument model, identity continuity, and attribution are independently validated. The state comparison is a witness, not the ontological definition. The later visible crack may be a delayed manifestation of accumulated realizations.

Genetic difference in a continuing cell lineage

Let A be a cell lineage under a valid lineage identity criterion. A molecular record indicates a sequence substitution in a descendant. The correct chain is

$$
\text{molecular transition} \longrightarrow \text{sample interaction} \longrightarrow \text{sequencing record} \longrightarrow \text{variant inference}. \tag{245}
$$

If alternative technical artefacts are excluded and attribution is valid, the genetic component differs and the lineage has undergone physical change. No claim follows that phenotype changed at the same stage or that the sequencing date identifies the stage of mutation onset.

Clock-system change

Let C be an optical clock. Laser fields, trapped atoms or ions, control electronics, thermal environment, and readout apparatus form an interacting physical system. Each interrogation cycle produces records. The reported reading is

$$n_C = N_{C,P}(r_C), \qquad N_{C,P} : \mathfrak{R}_{C,P} \longrightarrow \mathbb{R}_P. \tag{246}$$

A gravitational comparison with another clock predicts a frequency ratio through the relativistic model. Agreement can support only the bounded adequacy of the declared calculation and device description for the selected records; it does not confirm the metric geometry as physical reality. It also does not imply that the common cosmic stage has a frequency or that each clock possesses a local time.

Remote astrophysical record

Let S be a variable star and D a terrestrial detector. Source realization affects emitted flux; propagation carries the record; detection produces a time-series sample. The detector can infer variability under calibration and propagation assumptions. The inference remains

$$\widehat{X}^{\text{emit}}_{S,P} \not\equiv_{\text{type}} X^{\text{emit}}_{S}. \tag{247}$$

The relation is an identity boundary: the reconstruction represents but is not the original state. The source's common cosmic-stage participation is not delayed until detection.

Stationary quantum representation

Let a model assign ρ_A such that

$$\mathcal{L}(\rho_A) = 0. \tag{248}$$

The equation establishes stationarity under generator $\mathcal{L}$. To infer complete physical stasis, the investigator must establish that ρ_A is bearer-complete, that no physically relevant coupling or trajectory information is omitted, and that the represented state remains exactly instantiated. If quantum-jump records occur, change is directly established. If no records occur, the result is classified by coverage, not declared stasis.

Periodic observable return

For a periodic observable,

$$Q_A(\lambda + T) = Q_A(\lambda), \tag{249}$$

where λ is a model or operational parameter. The system realizes intermediate physical conditions before the selected quantity returns to the same value. The repeated value does not satisfy $s = q$. The period T is not an amount of cosmic extension; it is a quantity in the model or clock scale.

Identity termination

Suppose a star undergoes a stage-resolved terminal transformation in which the original stellar identity physically ceases, as judged through a declared astrophysical criterion and evidence, and one or more successor systems are independently warranted. For the attained ending stage e_A and an independently warranted successor set $\mathcal{Q}$, the valid conditional statement is

$$\mathrm{SuccW}_{P,M}(A, e_A, \mathcal{Q}) \Longrightarrow \mathrm{EndingReal}_A(e_A) \wedge \forall B \in \mathcal{Q}\ \mathrm{FormationReal}_B(e_A). \tag{250}$$

This is one stage-resolved terminal transformation, not two successive occurrences: the original stellar identity ends through identity-ending change and each successor identity appears through identity-forming change at the same common stage. The physical history $\mathcal{H}_A$ ends when the identity of A ends; no local time or private temporal extension terminates. The successor bearers have their own identity domains and physical histories within the same common cosmic extension, and no predecessor identity is carried into them. The derived successor-producing classification holds only where at least one ontic direct successor exists at that same ending boundary. Any non-terminal ending may additionally have extant outcome continuation, while a non-identity-producing ending may satisfy physical-outcome closure through that branch alone. Scientific identification of the displayed successor set still requires the stated stage-resolved warrant; a boundary that is not exactly resolved must remain window-localized.

Subthreshold difference

Let a predicted material change satisfy $0 < |\delta q| < \epsilon_D$. A null record is expected under detector D. The scientific statement is

$$\mathrm{NoResolvedDifference}_D \wedge \mathrm{InsufficientCoverage}_D \Longrightarrow \mathrm{InconclusiveNull}, \tag{251}$$

not proof of change and not proof of stasis. Independent higher-sensitivity channels can revise the classification.

Dynamic equilibrium

Let opposing fluxes J_+ and J_- satisfy

$$J_+ + J_- = 0, \qquad J_+ \neq 0, \qquad J_- \neq 0. \tag{252}$$

The net quantity is stable while processes continue. This is a direct demonstration that equality of a macroscopic derivative can coexist with physical realization. If instead each flux is modelled as zero, other state components still require domain-complete assessment before complete stasis is inferred.

Terrestrial rest

Let a sample be fixed in a laboratory so that $\boldsymbol{v}_{A/R_{\mathrm{lab}}} = 0$. The sample shares Earth's rotational and orbital motion and may undergo internal processes. The example supports two separate conclusions: the kinematic rest statement is reference-relative, and physical realization is not conditional on translational motion. Neither conclusion uses cosmic-stage observation.

Spacetime model with a stationary metric

Let a metric admit a Killing field and coordinates in which $\partial_t g_{\mu\nu} = 0$. The geometrical statement is captured by

$$\partial_t g_{\mu\nu} = 0 \nRightarrow \text{NoPhysicalRealization}(A). \tag{253}$$

for every system represented in that spacetime. Nor does it imply that cosmic succession ceases or that the common cosmic extension loses its order. The model symmetry and the temporal ontology remain distinct.

Pattern summary

Every worked application follows the same order:

$$\boxed{\text{bearer} \to \text{state} \to \text{actual difference} \to \text{physical realization} \to \text{record and inference if available}} \tag{254}$$

The common cosmic stage and time are not inserted into the physical mechanism. They enter through the foundational cosmic relation and extension.

G.1 Formal Propositions and Proof Sketches

Purpose and limit

The propositions in this appendix are consequences of the adopted definitions, identity-domain convexity, CMA, bearer-relative UCC, conditional formation and ending classifications, domain-dependent ontic physical-origin or transformation relations with separately stated warrants, and declared bridge assumptions. They do not replace domain dynamics or establish the physical truth of the foundational commitments by logic alone. A proof sketch displays the dependency of a claim and makes hidden premises visible.

Proposition G.1 (Selected-quantity insufficiency)**.** For a physical system A, equality of a selected quantity at two records does not entail physical equivalence of the complete state unless the quantity is proven complete for the claim.

Proof sketch. By Section 7, $X_A \not\equiv_{\text{type}} Q_A$. Equality $Q_A(s) = Q_A(t)$ constrains the selected map only. A difference may remain in another component of X_A. To infer $X_A(s) \equiv_{\Gamma_A} X_A(t)$, one must add the premise that the selected description is complete for every physically relevant difference. Without that premise the inference is invalid.

Proposition G.2 (Local-difference sufficiency)**.** If a physically real difference occurs in a component or relation validly attributable to A, and identity persists, then the system states are physically non-equivalent.

Proof sketch. The complete state includes the attributable component or relation. If that component differs physically, the state descriptions cannot be equivalent under a physical-equivalence relation that respects attributable components. The result does not require global reconfiguration.

Proposition G.3 (Realization–record non-identity)**.** A record caused by or physically linked to a realization is not identical with that realization.

Proof sketch. The realization may be a stage-resolved identity-forming change, later-history physical change, or identity-ending change in A; the record is a distinct physical configuration in detector or storage system D. They have different functions and positions in the measurement chain. The laboratory family defined in the measurement audit treats the sample, apparatus, detector, material record bearer, and researcher as bearer-distinct. The record configuration is a result or representation in its declared material carrier, not the physical change realized by the investigated bearer.

Proposition G.4 (Common-stage content non-identity)**.** The realization of change by systems A and B at the same common cosmic stage does not entail equality of their states, changes, or mechanisms.

Proof sketch. The common cosmic domain supplies the common cosmic stages; at every actual common cosmic stage, CMA states the presence and bearer-specific physical realization of every physical system whose identity is then realized there. Equality of stage is not defined as equality of state. Therefore the conclusion does not follow.

Proposition G.5 (No private temporal extension)**.** No physical system possesses an independent temporal extension within V28/F8.

Proof sketch. The only temporal-stage domain is the universal common cosmic-stage domain. Systems bear states and realize physically diverse changes, but no system bears a private temporal stage or a private temporal order. Each identity domain restricts the same relation $\prec_C$, which orders the common stages in one fixed and irreversible succession; no independent system time is formed.

Proposition G.6 (Historical plurality)**.** Plural common cosmic stages refer to their ordered succession within the common cosmic extension, not to multiple private system stages corresponding to the same common stage.

Proof sketch. At every actual common cosmic stage, the axiom supplies the presence of extant systems there and bearer-specific physical realization in every such system. Common cosmic stages belong to one fixed irreversible ordered succession within the common cosmic extension; the plurality is the succession of common stages along $\prec_C$, not a plurality of private temporal containers or system times.

Proposition G.7 (Non-recurrence of stage)**.** Recurrence of a system quantity does not imply recurrence of the common cosmic stage.

Proof sketch. Q_A is a selected physical quantity, whereas a common cosmic stage is a distinct actual member of the fixed irreversible ordering. If $r \prec_C s$, then $r \neq s$ independently of whether $Q_A(r) = Q_A(s)$ under a declared criterion; at the later stage, CMA states bearer-specific physical realization for every then-existing system. Recurrence of a quantity or state therefore does not reproduce, reverse, or identify the cosmic stage.

Proposition G.8 (Clock-output diversity under common-stage presence and bearer-specific change). Unequal clock readings can occur while clock systems are co-present at the same common cosmic stage and realize their own bearer-specific changes.

Proof sketch. Clock readings depend on clock states, trajectories, conditions, and protocols. At every actual common stage, CMA states both common-stage presence and bearer-specific positive physical realization; neither states equality of state, change content, or output. Therefore a non-zero differential reading does not alter common-stage unity.

Proposition G.9 (Coordinate non-identity). A coordinate component used to order or label events is not thereby identical with time in ITOF.

Proof sketch. A coordinate is defined within a chart and transforms under chart changes. Under the canonical time definition in Section 4 (Definition 4.1), time is not a coordinate object; $\prec_C$ is the fixed and irreversible earlier–later relation on the common cosmic stages. Use and nomenclature do not supply an identity bridge.

Proposition G.10 (Proper-time non-identity). The relativistic proper-time functional is not identical with time in ITOF.

Proof sketch. Proper time is defined by an integral of metric line element along a timelike worldline and depends on (γ, g). The ITOF time definition is non-metric and common rather than path-dependent. The objects have different defining properties and types.

Proposition G.11 (Categorical curvature exclusion). Curvature is not a predicate of time in ITOF.

Proof sketch. Curvature is defined for a connection or metric on a manifold. No metric or connection is assigned to T_{ITOF} under the canonical definition and type discipline. The application of curvature to time is therefore ill-typed and is rejected by V28/F8.

Proposition G.12 (Synchronization independence). A coordinate synchronization relation neither creates nor refutes the common cosmic stage.

Proof sketch. Synchronization is protocol- and frame-dependent and relates coordinate assignments. The common cosmic stage is asserted under the Cosmic Moment Axiom and makes no coordinate prediction. The two relations have different domains and functions.

Proposition G.13 (Distance-access separation). Spatial distance can delay observational access without delaying the system's physical realization at the common cosmic stage.

Proof sketch. Common-stage presence and bearer-specific physical realization are jointly foundational under CMA. Access requires physical propagation, which has finite speed and path dependence. The latter changes record arrival, not original occurrence. No signal-exchange protocol is therefore treated as a direct measurement of co-stage membership; such protocols constrain propagation, reception, and reconstruction only.

Proposition G.14 (Rest non-stasis). Kinematic rest relative to a selected reference does not entail complete physical stasis.

Proof sketch. Rest constrains relative position or velocity. Complete physical state contains additional components and processes. Therefore state equivalence does not follow.

Proposition G.15 (Equilibrium non-stasis)**.** A zero net macroscopic flux does not entail absence of physical realization.

Proof sketch. Opposing non-zero fluxes may cancel, and unmeasured microscopic processes may continue. The net condition is a relation among selected quantities, not a complete-state identity.

Proposition G.16 (Delayed-manifestation separation)**.** The operational record or observation window in which an effect first becomes detectable does not, by itself, identify one exact common cosmic stage at which the underlying continuing change began or first crossed the declared noticeability criterion.

Proof sketch. A detector has threshold and integration conditions; effects may accumulate or propagate while bearer-specific change continues across later members of the bearer history. Detection therefore establishes a protocol-dependent manifestation within an operational window, not an exact common cosmic stage of beginning or noticeability.

Proposition G.17 (Common-stage presence and bearer-specific realization)**.** At every actual common cosmic stage, CMA states that every physical bearer then existing is present at that same stage and realizes its own bearer-specific change there.

Proof sketch. CMA quantifies over $\mathcal{S}_{\text{phys}}(s)$ and requires both $\text{Present}_{\text{C}}(A; s)$ and $\text{PhysReal}^{+}_{A}(s)$ for each member. Neither equates their states, mechanisms, magnitudes, or manifestations. The bearer-relative UCC result follows directly from CMA at every stage s for which $A \in \mathcal{S}_{\text{phys}}(s)$ and $\text{LaterInHistory}_{A}(s)$ holds. Identity-domain convexity separately constrains persistence between bounding members. The actual formation member and cosmic-origin postulate are independent commitments; neither is used as a cause of the bearer-specific realization derived here.

Proposition G.18 (Change warrant without uniquely warranted exact-stage assignment)**.** A valid same-bearer record comparison may warrant a noticeable, physically attributable difference without by itself warranting one unique common cosmic stage of noticeability.

Proof sketch. Valid attribution and a same-bearer warrant can support a noticeable physical difference between the compared records within the declared protocol. The records are not stages. A declared model may return candidate stages, but the record comparison alone does not establish a unique exact common cosmic stage of noticeability.

Proposition G.19 (Finite-record stagewise non-exhaustion)**.** A finite experimental record or accepted series of records may warrant a protocol-relative manifestation of bearer change without constituting an exhaustive test of physical realization at every applicable common cosmic stage.

Proof sketch. Accepted records arise through a finite measurement chain and are indexed by protocol operations rather than by a canonical record-to-stage map. Valid attribution can therefore warrant a manifested bearer difference, but it does not establish that every applicable member of the bearer identity domain was individually accessed. The sample, apparatus, detector, material record bearer, environmental systems, and researcher remain bearer-distinct physical systems undergoing bearer-specific change wherever their identities are realized. They may also interact and contribute overlapping physical influences, and those relations must be included in attribution, calibration, and uncertainty analysis where relevant. This universal inclusion follows from CMA and does not convert the measurement chain into independent stagewise proof of CMA or UCC.

Proposition G.20 (Cross-domain convergence without unrestricted proof)**.** Reconstructed records concerning distinct physical systems across cosmological, biological, astrophysical, and geophysical domains can jointly provide cumulative empirical warrant for formation boundaries, succession, continuing change, identity termination, and warranted successor-system claims without deductively proving CMA or UCC for every physical bearer in the universe.

Proof sketch. Each covered domain supplies declared bearer criteria, ordered records, valid attribution, and class-specific physical routes. Independence of mechanisms and access channels strengthens convergence and transformation witnesses extend the evidence beyond persistence of one identity. The unrestricted claims quantify over all physical bearers and applicable stages, whereas the archive remains finite, model-conditioned, and class-bounded. The result is therefore cumulative empirical warrant rather than deductive exhaustion of the universal quantifier.

Proposition G.21 (Finite-record limit on exact notice-stage assignment)**.** A finite protocol may identify a qualitative operational onset of detectability, but the physical record alone does not warrant one unique common cosmic stage at which a continuing change became noticeable or crossed the declared threshold.

Proof sketch. For an already realized bearer, continuing change may precede and pass through detection, while the instrument, integration process, threshold, storage system, and observer are themselves physical processes. The actual formation member requires no earlier same-bearer state, but a finite record need not resolve its exact cosmic location. A record therefore warrants a thresholded manifestation and its comparison within the declared operational domain. A model may narrow candidate stages, but exact epistemic localization requires additional validated premises.

Proposition G.22 (One time and many physical histories)**.** Distinct bearer-specific histories do not entail distinct temporal extensions.

Proof sketch. Each history $\mathcal{H}_A$ is defined on an identity domain $I_A \subseteq \mathcal{S}_{\mathrm{C}}$ and inherits the restriction of the same cosmic order $\prec_C$. Differences in state, path, rate, clock output, or proper-time accumulation therefore remain differences within the common cosmic extension.

Proposition G.23 (No temporal prediction from the axiom alone)**.** The Cosmic Moment Axiom does not by itself predict a coordinate value, clock reading, duration, frequency, or gravitational effect.

Proof sketch. The axiom contains no metric, coordinate, device, field, or dynamical term. Such predictions require additional physical theories and models.

Empirical propositions versus definitional propositions

The preceding propositions divide into definitional, axiomatic, and empirical consequences. CMA states universal common-stage presence and bearer-specific positive physical realization at every actual stage, while the derived UCC result states the corresponding bearer-relative realization across later members of each identity domain and organizes domain-specific testing. The formal dependency does not derive physical change from the definition of time and does not assign causal agency to the stage or order. System-specific change remains distinct from the cosmic order and from the common-stage co-presence stated by CMA.

Proof-sketch conditions

The following hidden premises are excluded from every proof sketch:

- every physical difference is observable;
- every record difference is attributable to the bearer;
- every stationary equation describes a complete physical state;
- every coordinate called temporal is time;
- every system possesses an independent domain of stages;
- the universe is enumerable;
- coordinate synchronization identifies the common stage;
- relativistic success decides temporal ontology.

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