The Coherence-Relational Blockworld

Recursive Coherence and Constraint-Relative Reconstruction

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Abstract

The present paper develops the Coherence-Relational Blockworld (cRBW) as a closure-relational extension of Relational Blockworld (RBW). [1] [2] [3] It should not be read as a completed proof that the cRBW Regge–Geometric Algebra–Grassmannian realization is formally equivalent to the RBW adynamical global constraint (AGC) framework in all standard QFT settings; that equivalence remains a conjectural alignment target for the mathematical companion work. cRBW adopts RBW's non-dynamical foundation and treats time, identity, causality, and observer registration as downstream reconstruction classes relative to mathematical presentations of globally constrained relational coherence rather than as source-level primitives.

The framework is developed alongside *The Principles of Ontic Minimalism (OM)* [4], and *Axioms of Ontic Minimalism (AOM)* [5]. AGC supplies the source-level commitment that global relational coherence obtains all-at-once. In mathematical presentations admitting a boundary operator, BBP supplies the corresponding boundary-of-boundary closure specialization. The cRBW sector-capacity construction supplies one projective realization of NPRF. The RCCs are application-specific local compatibility and legibility conditions. Within metric realizations, *Projection Residual Geometry* (PRG) [6] evaluates candidate fit relative to a declared admissible class, while *Closure-Restoration Geometry* (CRG) [7] supplies connection, transport, curvature, and holonomy structure where the required additional regularity exists.

The companion *Mathematical Model* (MM) [8] supplies Regge, Geometric-Algebra, Grassmannian, and capacity structures for this particular realization. cRBW therefore proposes a closure-first physical reconstruction framework rather than a proof that all physical structure follows universally from one geometric construction. Its quantum-conjugacy, uncertainty, identity, observer, and phenomenology claims retain the application and bridge status stated in the relevant companion works.

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1. Introduction: Beyond Causality and Flow

The present paper asks which relational conditions are required for a non-trivially legible cRBW presentation. Within the declared cRBW presentation class, a relation-free candidate lacks the structure required to instantiate or evaluate the admissibility conditions and is therefore excluded from that model class. This is a class-relative no-candidate result, not a derivation that global relational coherence must exist.

A candidate lacking the gradient, asymmetry, or relational contrast required by RCC-9 may remain formally closed, but it fails the stronger cRBW criterion of non-trivial local legibility. The foundational question addressed here is therefore which additional presentation- and application-level conditions are required for non-trivial legibility, not which conditions generate the source-level coherence condition.

We approach this through the Relational Blockworld (RBW) [1] [2] [3]: a non-dynamical ontology in which the universe is not a process but a globally consistent configuration of relations. In RBW, time does not flow and causes do not unfold; the appearance of dynamics is an embedded projection taken from within an all-at-once solution. References to M_4 or "spacetime" are representational—coordinate schemata for expressing relational consistency—not ontic manifolds that evolve. The familiar "four dimensions" are read as emergent degrees of relational coherence required for closure, not as primitive axes.

The present framework is developed alongside the revised principle architecture of AOM and POM. AOM and POM state the source-level commitment and classify the downstream principles; cRBW supplies one physical realization of that commitment. GRT supplies the intervening reconstruction architecture. Within this hierarchy, AGC is primitive; NPRF and BBP are presentation-relative specializations; PRG and CRG are realization-specific mathematical structures; and the RCCs are cRBW application conditions. The present paper therefore interprets and develops a particular coherence-relational realization without introducing an additional source-level primitive.

Source/presentation typing. In the terminology of General Reconstruction Theory, cRBW supplies the AGC source-role semantics: global relational coherence obtains all-at-once. The symbol $\mathcal{X}$, together with the terms *block*, *global configuration*, and *global relational support*, formally designates that source role when used at the foundational level. It is not a manifold, simplicial complex, field configuration, category object, or container of constituent things.

Regge complexes, geometric-algebra fields, Grassmannian subspaces, capacity tensors, coherence functionals, and RCC witness systems are mathematical presentations or

reconstruction structures relative to that source role. Spacetime structures, particles, fields, identities, observers, histories, and phenomenological organizations are downstream reconstruction targets.

The present paper does not yet instantiate every GRT interface separately for every RCC. Where indexing, localization, forward realization, RN-equivalence, defect, separation, persistence, or warrant is not explicitly supplied, the corresponding cRBW claim remains a realization proposal or theorem target.

Relationship to RBW proper. cRBW inherits RBW's adynamical, global-constraint orientation, but it does not attempt here to reconstruct the full psi-epistemic account of the wavefunction developed in RBW. That issue is set aside in this paper. cRBW also refines the status of localized anchors: what RBW treats as spacetimesource elements or beables are here reinterpreted, under representational-neutrality discipline [9], as localized relational anchors—representational handles for where coherence registers within the fixed global solution. Finally, Stuckey, McDevitt, and Silberstein already extend NPRF from c and h to G [10]; cRBW's further sector-capacity extension lies in the thermodynamic and spatial-legibility sectors, k_B and λ_3.

Within this structure, configurations are not evolved toward admissibility; they are evaluated relative to it. PRG formalizes this by defining admissibility as projection onto $\mathcal{M}$, with deviation quantified by a residual. The local geometric refinement of this structure is developed in Closure-Restoration Geometry (CRG), where admissibility induces a capacity-weighted restoration rule, a natural connection, and curvature corresponding to path dependence of closure restoration. Together, these establish a unified geometric account in which global admissibility and local relational structure are determined without recourse to dynamical evolution.

Formally, we reframe within Stuckey's invariant-constraint program [1] by reading NPRF as a projective constraint across the full set of normalized sector capacities: J_{rot}, J_{boost}, J_{edge}, J_{face}, and $J_{spatial}$. In the RBW literature, NPRF is developed through invariant structures associated with c, h, and later G. cRBW extends this sector-capacity reading by adding thermodynamic and spatial-legibility sectors, represented here by k_B and λ_3, while preserving the projective no-preferred-frame discipline. Within the cRBW/MM proposal, phenomenologically interpreted constants are represented as ratios of sector capacities to a coherence baseline (introduced in §2). However, as shown in *The Uncertainty Principle* [11] argues that, within the additional reciprocal-scaling assumptions adopted there, NPRF requires a universal reduced-action scale; its numerical value remains empirically fixed.

Asymmetry is central. Maudlin writes: *"the passage of time is an intrinsic asymmetry in the temporal structure of the world…"* [12]. We reinterpret this rather than refine it: in cRBW, the experience of passage corresponds to intrinsic relational skew required for non-trivial coherence registration, not to metaphysical temporal flow. Without such skew, a candidate in the present cRBW/MM realization cannot satisfy RCC-9's non-trivial-legibility condition. Gradient is therefore an application-level condition for non-trivial cRBW readout, not a universal consequence of AGC alone.

Consistent with the published RBW neutral-monist framing, and with Stuckey's private clarification[1] of that framing, we treat bodies, space, and time as co-fundamental at the representational readout level.

Where earlier we enumerated ten AGCs, we now treat those items as local expressions/bookkeeping of the global conditions. We reserve the global closure condition as the Boundary-of-a-Boundary Principle (BBP) and relabel the remaining locals as Relational Coherence Constraints (RCC-1…9) to avoid implying separable ontologies.

What follows is threefold: (i) we state the ontology–representation split precisely; (ii) we recast classical and quantum legibility in terms of coherence spans over sector capacities rather than manifold primitives; and (iii) we propose cRBW candidate reconstructions and application interfaces for identity, registration systems, decoherence, and time-as-experienced. The stronger claims that these candidates constitute stable identities, reflexive observers, or phenomenology require the persistence, separation, RN, and bridge conditions stated by GRT and the downstream theories. In this view, admissible structure is not generated by becoming; it is articulated through closure, constraint, and coherence relations.

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[1] William Stuckey private communication 11 October 2025; "According to our brand of NM, the bodily objects, space, and time of our dynamical subjective experience are co-fundamental. We call our ontology "quantum-classical contextuality" whereby the quantum and classical are co-fundamental. Quantum-classical contextuality is a form of multiscale contextual emergence."

2. Relational Basis: The Relational Blockworld

RBW [1, 2, 3] rejects the picture of independently constituted objects moving through an ontic time. cRBW adopts one globally obtaining relational coherence condition under AGC. “Block” and “configuration” are source-role shorthand unless a mathematical presentation is explicitly named. Four-dimensional spacetime, events, causal relations, and temporal order are presentation- or reconstruction-level structures rather than a container in which the source condition resides.

Particles and observers are likewise not source-level constituents. In cRBW, a particle-like attractor is a candidate persistent reconstruction. A reflexive observer requires, in addition, a warranted identity together with internal access, reconstruction, record, and self-location structure. Fixed-point or attractor structure may contribute to those reconstructions, but it is not sufficient by itself to establish particle identity or observerhood.

The present work adopts this structure and interprets the residual as a representation-level diagnostic of coherence deviation relative to admissibility; the residual is not itself an ontic object.

The block is static only in being non-evolving. It is richly differentiated: variation arises through the internal geometry and algebra of relations—symmetries, topologies, and boundary conditions that determine which configurations are admissible. The blockworld is a globally constrained relational structure, not a temporally evolving arena.

To describe localization without reifying elements, cRBW treats STSE-like beables as localized relational anchors within a mathematical presentation: representational handles indicating where indexed relational structure is available. This preserves three distinct claims:

- **source actuality:** global relational coherence obtains;
- **presentation admissibility:** a mathematical presentation satisfies the declared cRBW conditions;
- **reconstruction warrant:** an indexed candidate earns an object, identity, observer, or phenomenology interpretation.

Localized anchors belong to the latter two levels and are not constituents of the source condition.

We read NPRF as a projective constraint across the full set of sector capacities—J_{rot}, J_{boost}, J_{edge}, J_{face}, and J_{spatial}. Prior RBW work emphasizes NPRF through invariant structures associated with c and h, and later G. Here all five cRBW sectors participate in

the same no-preferred-frame discipline, with k_B and λ_3 marking the thermodynamic and spatial-legibility extensions. The phenomenological constants c, h, G, k_Bwill later appear as ratios of these capacities to a coherence baseline introduced in the companion MM [8]. Where the reduced-action convention is intended, $\hbar$ is used explicitly as the cRBW/G07 reduced-action normalization. We avoid those ratios here to keep the representational layer distinct from the ontic one. However, as shown in *The Uncertainty Principle*, the existence of a universal reduced action scale is required by NPRF and reciprocal scaling invariance, with these ratios expressing its representation within the sector-capacity framework.

To avoid implying separate ontologies, items previously enumerated as ten AGCs are recast as RCC-1 through RCC-9. These are representation-dependent local application conditions. BBP is reserved for the boundary-operator relation $\partial^2 = 0$, together with whatever overlap and interface conditions the declared presentation requires. BBP does not prohibit local regions, charts, subsystems, or candidate reconstructions from having boundaries, and it does not require every loop holonomy to be trivial.

Finally, we differentiate ontology from representation. Ontologically, fundamentality lies in AGC-defined admissibility. BBP expresses AGC-defined closure in boundary-operator representations, while NPRF expresses decomposition-invariance/readout discipline across sector capacities. Within Stuckey's neutral-monist presentation, bodies, space, and time are treated as co-fundamental descriptive categories. Within the present cRBW/GRT typing, they are jointly reconstructed categories and none is a source-level primitive. This co-fundamentality does not imply multiple ontic grounds; it marks how the single adynamical whole becomes legible. Subsequent sections supply concrete scaffolds (Regge-style discretizations, geometric algebra, Grassmannian selections) for accounting curvature/coherence budgets and admissible registrations without invoking temporal evolution.

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3. Relational Coherence: Registration without Dynamics

Relational coherence is introduced as a representational discipline, not an ontological extension. The original RBW fixes a timeless relational ontology. It allows differentiated relational configurations but, by itself, does not specify how high descriptive complexity—identity gradients, observer registration, or decoherence readability—should be represented within an adynamical solution *without* slipping back into a dynamical narrative. Relations among localized anchors, fields, and boundary conditions form a

globally closed configuration, but they require a disciplined representational scheme to read off those complexities.

What is needed is not another ontic layer, but a representational discipline that explains how rich readability remains compatible with minimal ontological commitment. On our account, richness is not ontic surplus, but representational differentiation of a single admissible configuration; it is the *contextual registration* of the same adynamical closure.

We realize this discipline as ***relational coherence***. Algebraically, the readout may be scaffolded by Regge-style discretizations, geometric algebra (GA) actions, and Grassmannian selections; informally, we will speak in operational terms that track how coherence localizes and stabilizes inside a fixed solution (details are developed elsewhere).

3.1 Operational Terminology (non-dynamical)

Terms like *lamination, gradient budget, and mesh continuity* are operational placeholders for candidate formalisms that track how coherence localizes and stabilizes within a fixed solution. These terms do not introduce dynamics.

- **Localized relational anchors**: representational handles indicating where coherence localizes within the fixed global solution (formerly STSEs).
- **Lamination**: recursive alignment of compatibility conditions—layered reinforcement that stabilizes recognizable patterns without implying temporal steps.
- **Gradient budget**: the available/required coherence skew for admissibility under the global constraints.
- **Mesh continuity**: compatibility across adjacent coherence spans in a discretized representation (e.g., Regge skeleton), ensuring closure across faces/hinges/cells.

These are *registration tools*, not dynamics. They bridge observed recursive regularities and anticipated algebraic/topological formalisms of constraint satisfaction.

3.2 Motivation and Minimum Relational Necessity (MRN)

Earlier drafts spoke of “morphology”; the present version instead treats gradients and candidate configurations within an all-at-once mathematical presentation. In the cRBW/MM metric realization, candidates are evaluated relative to a declared admissible locus, which may be manifold-like where the necessary regularity is supplied. This PRG construction evaluates presentation- or candidate-level fit; it does not act directly upon the source condition.

Minimum Relational Necessity (MRN). Within the cRBW application, only relational structure sufficient for the declared closure, readout, and warrant conditions is selected for local representation. MRN is therefore a realization-specific minimality proposal. Any identification of this structure with phenomenology belongs to the separate RSE bridge and does not follow from MRN alone.

Equivalence status. MRN is a cRBW articulation of the RBW global-constraint program. The present paper does not prove that the Regge–GA–Grassmannian realization reproduces Stuckey et al.'s AGC for every standard QFT configuration. It states the cRBW extension and leaves full equivalence as a mathematical target for MM/PRG-level work.

3.3 Time, Identity, and Recursion

Within the RSE application, one candidate ordered reconstruction relates differences in lamination density to the labels "past" and "future." That ordering is not supplied by AGC and must be declared as part of the observer/phenomenology application. The proposed associations of the Big Bang and heat death with ADT/TCD are likewise schematic cosmological interpretations, not source-level consequences.

The quantum sector of this structure is developed explicitly in *The Uncertainty Principle*, where conjugate variables arise as complementary Lagrangian subspaces of the admissible configuration space, and the Heisenberg bound is derived as a geometric admissibility constraint.

"Reallocation" does not mark a transition of the source condition. It compares candidate cross-sections along a declared indexing or ordering. The source commitment supplies no primitive temporal sequence; an application may nevertheless reconstruct ordered comparison, causal structure, or history when the required order, transport, descent, and warrant conditions are satisfied.

- **Classical readability** tracks high lamination density (stable alignment supporting frame-invariant measurement under NPRF constraints).
- **Quantum contextuality** tracks phase-sensitive compatibility (alignments whose satisfaction depends on measurement context).
- **Geometric/thermodynamic/spatial legibility** register, respectively, curvature/shape budgets, entropy/irreversibility constraints, and 3-space participation in closure via $J_{spatial}$ (with spatial closure legibility captured by λ_3 as defined in MM [8].

Alignment stability supplies a candidate identity signature, and lamination persistence supplies a candidate memory signature, across the declared indexings. Neither is a primitive substance, and neither becomes a warranted identity or memory merely by being named.

Clarifying note. *Adynamical:* the global configuration is fixed by closure—there is no temporal before/after in the ontology. *Recursive alignment*: compatibility among localized anchors coheres in layered fashion across the configuration. Any talk of "steps" or "propagation" is interpretive shorthand for global relational consistency, not a literal sequence.

A globally admissible history need not be ontically identified with one parameterized representative; the minimally warranted commitment may instead be an RN-class or structured family of admissible histories.

3.4 Definition: The Relational Coherence Extension

Ontic stance. A block configuration is fixed by AGC-defined admissibility; NPRF expresses decomposition invariance, and BBP expresses closure within specific representations.

Source actuality, presentation admissibility, and reconstruction warrant.

- **Source actuality:** global relational coherence obtains all-at-once; this is the AGC commitment**.**
- **Presentation admissibility:** a mathematical presentation satisfies the declared AGC-relative, BBP/interface, NPRF, and application conditions.
- **Reconstruction warrant:** an indexed candidate satisfies the adequacy, persistence, separation, RN, robustness, and bridge conditions required for the interpretation being claimed.

None of these imply temporal becoming.

Exo-representational view. Relational coherence names the source-role commitment. Mathematical presentations may contain differentiated candidate structures. Selecting or comparing a cross-section is an operation within a presentation or reconstruction protocol; it is not a redistribution inside the source condition.

Endo-phenomenological view. In the RSE application, lamination and attractor structures are proposed as candidate signatures of identity, memory, and agency. Full identity, observer, and phenomenology warrant remains downstream. Attractors are not causes; they are anchoring configurations toward which alignment concentrates given NPRF across sectors, RCCs, and boundary/symmetry conditions.

Neutral-monist closure. “Elements” are not source-level parts. AGC states the source commitment; BBP and the sector-capacity form of NPRF constrain suitable presentations; RCCs specify cRBW application conditions. None of these makes an RCC candidate identical with the source condition.

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4. Global Admissibility and Local Coherence: AGC, BBP, NPRF, and RCCs

cRBW distinguishes source-level global relational coherence from mathematical presentation admissibility and from non-trivial local legibility.[2] In cRBW, a non-trivially legible configuration is a coherence-closed readout condition fixed *all-at-once*. AGC supplies the source commitment. BBP is the boundary-operator specialization of closure and descent. The sector-capacity construction is one cRBW realization of NPRF. The coherence functional and stationarity equations of MM are presentation-level structures. In metric realizations, PRG evaluates distance or defect relative to a declared admissible class; it does not define source actuality. The coherence functional $\mathcal{I}_C$ is defined in MM [8]; its stationarity and NPRF-invariance conditions should be cited separately rather than conflated. The global admissibility structure described here corresponds to the projection geometry formalized in PRG: closure defines the constraint-defined admissible locus $\mathcal{M}$, which may be treated as a manifold where the relevant regularity conditions hold; admissibility is determined by projection onto $\mathcal{M}$ rather than by dynamical evolution.

We distinguish four structural layers:

- **Primitive admissibility — AGC**
  AGC fixes admissibility of the globally consistent relational configuration.
- **Derived ontic-closure expression — BBP**
  In boundary-operator representations, the *Boundary-of-a-Boundary Principle,* BBP expresses the no-open-boundary form of AGC-defined closure.
- **Global representational discipline — NPRF**
  NPRF holds across all five sector capacities $\{J_{\mathrm{rot}}, J_{\mathrm{boost}}, J_{\mathrm{edge}}, J_{\mathrm{face}}, J_{\mathrm{spatial}}\}$. Each sector obeys the same projective symmetry: *no privileged frame of legibility* for causal, quantum, geometric, thermodynamic, or spatial readings. NPRF governs *how* coherence is read; BBP fixes *that* coherence is closed.
- **Local articulation - RCC-1…9**
  The *Relational Coherence Constraints* (RCCs) provide local bookkeeping—topology, symmetry, curvature budgets, observer registration, decoherence partitioning,

[2] A purely static configuration, lacking gradient, interaction, or structure, is structurally null for cRBW/RSE readout. Without relational difference, identity registration cannot arise. In cRBW, coherence gradients are required to define any observer, attractor, or decoherence event. Thus, a configuration with $\nabla\Phi = 0$ everywhere may satisfy closure trivially, but it fails to support non-trivial local legibility, observer registration, or identity localization. See Appendix B for the structural argument.

identity alignment, resonance consistency, and non-trivial gradients. They make the global closure locally legible without adding any new ontology.

Spacetime M_4 remains *representational*— a convenient schema for expressing relational consistency. "Spacetimesource elements" of earlier drafts are replaced by *localized relational anchors*, representational handles showing where coherence localizes within the fixed solution.

4.1 AGC and Its Global Expressions (primitive → derived → local)

RBW replaces source-level evolution with an all-at-once admissibility commitment. AGC remains the source commitment. BBP is a representation-specific boundary/interface condition. $\mathbb{I}_0$ is the projective baseline, not a constraint. NPRF is realized here through projective invariance of the normalized sector-capacity structure.

Key points:

- **BBP is represented, not added as a second source principle.** In a declared Regge complex, oriented interface contributions must satisfy the applicable chain and gluing conditions. Local regions may have boundaries. Nonzero curvature and nonidentity holonomy are permitted; a holonomy becomes defective only relative to a separately declared admissible holonomy class.
- **NPRF generalizes Stuckey's {c, h } pair** [3]**.** NPRF extends the RBW invariant-constraint lineage associated with c, h, and later G. In cRBW, the same no-preferred-frame discipline is extended to the full sector-capacity set $\{J_{\mathrm{rot}}, J_{\mathrm{boost}}, J_{\mathrm{edge}}, J_{\mathrm{face}}, J_{\mathrm{spatial}}\}$, with k_B and λ_3 marking the thermodynamic and spatial-legibility extensions. Phenomenological constants appear representationally as ratios of sector capacities to the coherence baseline $\mathbb{I}_0$, not as added ontic primitives.
- **RCC-1 through RCC-9 specify cRBW's local application conditions.** Their relation to AGC, BBP, NPRF, and MM is partly definitional and partly conjectural; they should not be described as a proved translation from the global source condition to local phenomena.

Table 1 - Stratification Summary

Tier	Status	Principle/structure	Function
Source commitment	Primitive source role	**AGC**	States that global relational coherence obtains all-at-once.

Tier	Status	Principle/structure	Function
Boundary/interface specialization	Representation-dependent closure and descent	**BBP**	Imposes $\partial^2 = 0$ where a boundary operator exists, together with declared interface conditions. Local pieces may have boundaries.
cRBW reindexing specialization	Representational non-privilege	**NPRF sector-capacity realization**	Implements projective invariance of normalized sector-capacity structure under the declared transformations.
Local application structure	Application-specific candidate conditions	**RCC-1 through RCC-9**	Defines candidate local compatibility and legibility tests. It does not by itself prove effective reconstruction, identity, observerhood, or phenomenon warrant.

cRBW adopts one globally obtaining source condition; it does not select a block from a class of coactual alternatives. Mathematical presentation and reconstruction multiplicity remains possible and must be retained unless RN or an explicit selection rule identifies it.

Continuity from mRBW to cRBW. The transition introduces no new ontic laws. It merely restates the original AGCs in coherence form:

- Primitive admissibility: AGC.
- Derived closure expression: BBP.
- Non-ontic projective normalization: I_0.
- Global readout discipline: NPRF over sector-capacity ratios.
- Local legibility bookkeeping: RCC-1…RCC-9.

Thus, cRBW organizes the hierarchy into four roles—primitive admissibility, derived closure expression, global readout discipline, and local legibility bookkeeping—without altering the underlying relational algebra.[3]

Derivation note [8]**.** The coherence functional $\mathcal{I}_C$ is defined in MM [8], Eq. (2.23). AGC-admissible stationarity is expressed by $\delta\mathcal{I}_C = 0$ subject to RCC admissibility [8], Eq. (2.24), with the boundary-functional restatement given in [8], Eqs. (2.34)–(2.35). NPRF appears as projective rescaling invariance under $\Xi_i \mapsto \lambda\Xi_i,$ with the baseline $\mathbb{I}_0$ absorbing the common rescale [8], Eq. (2.36). This pairs AGC-defined admissibility, BBP closure expression, and NPRF readout discipline without adding dynamics. The MM stationarity and projective-

[3] See Appendix A – Relational Coherence Constraints for detailed explanation of the nine local coherence RCCs.

invariance equations are realization-specific presentation conditions; they are not AGC or BBP themselves.

4.2 Constraint Network - Representational Formalization

The RCC network is a representation-dependent compatibility structure. It encodes local legibility of global admissibility but does not constitute independent ontological constraints. Mathematical derivations of the global–local linkage—such as the coherence functional $\mathcal{I}_C$, the Regge curvature budgets, and rotor invariance of laminated identities—are presented in MM [8] §§ 2–3. This section treats the same structures representationally, explaining how the nine RCC local coherence conditions interact to make BBP + NPRF legible without adding any new ontology.

> All lattice / fixpoint language below is representational. It reorganizes a single BBP-closed configuration; it does not describe time-parametrized dynamics.

Conceptual Role of the RCC Network. The RCC network is a *compatibility lattice*, not a causal diagram.

- Each A_i represents a local coherence condition (e.g., curvature budget, boundary closure, identity alignment).
- *Dependencies* express *meaningfulness*: an A_i can only be interpreted once its prerequisite A_j holds.
- The entire network functions as a readability scaffold for the single BBP-closed configuration.

A *monotone selector* adds exactly those local conditions whose prerequisites are met; the self-consistent collections it produces are called *witnesses*. Multiple witnesses may be RN-equivalent, or they may represent genuine underdetermination. The full witness family must be retained unless a declared RN-equivalence, separation result, or justified selection principle identifies them.

Selection and Coherence Functional. When several witnesses exist, a modeling selection criterion may be applied to choose a canonical representative. The global coherence functional $\mathcal{I}_C$ is defined in MM [8], Eq. (2.23). Its stationarity condition is $\delta\mathcal{I}_C = 0$, as given in [8], Eq. (2.24), while NPRF projective invariance is given by [8], Eq. (2.36). The RCC witness-selection lattice is the representational construction developed in this paper; it is not an additional MM equation. Choosing a minimal-tension witness is analogous to a gauge choice: it affects representation, not ontology.

Coherence Invariant and Identity Preservation. In MM [8], Eq. (4.1), the rotor-invariant identity scalar

$$I_{\mathrm{id}} = \langle \tilde{B} B \rangle_0 \tag{4.1}$$

is derived within Geometric Algebra, proving that laminated identities, modeled as k-blades, remain grade- and norm-preserving under admissible rotor actions. Here we interpret that result:

- I_{id} anchors identity within the coherence algebra;
- Rotor invariance ensures *representational neutrality*—no preferred basis of description;
- The Grassmannian proximity metric $\mathcal{C}(V, W) = \langle \tilde{B} W \rangle_0$ quantifies relational overlap, linking geometric and phenomenological legibility.

All algebraic derivations remain in [8]; cRBW records only that local identity preservation is a rotor-invariant structural property, not a scalar decoration. The local scalar I_{id} should not be confused with the global coherence functional $\mathcal{I}_C$.

4.2.1 Purpose and Scope

The constraint network is a dependency graph linking the nine Relational Coherence Constraints (RCC-1 … RCC-9), not a causal diagram or a dynamical law. It tracks which local coherence conditions must co-exist for a configuration to remain legibly realizable under AGC-defined admissibility, BBP closure expression, and NPRF readout discipline. The constraint network has no ontological status; it is a *map of representation*, not an element of the block.

Let the **s**et of coherence conditions $\mathcal{R}$ be denoted:

$$\mathcal{R} = \{A_1, A_2, \ldots, A_9\} \tag{4.2}$$

where each A_i represents one local coherence condition (e.g., curvature budget, boundary closure, identity alignment, non-trivial gradient).

4.2.2 Dependencies and Meaningfulness

Each condition may depend on others for definitional completeness:

$$\mathrm{Dep}(A_i) \subseteq \mathcal{R}, \;\; A_j \in \mathrm{Dep}(A_i) \Rightarrow \; A_i \text{ is only meaningful when } A_j \text{ is satisfied.} \tag{4.3}$$

$$\begin{aligned}
\mathrm{Dep}(A_1) &= \emptyset,\\
\mathrm{Dep}(A_2) &= \{A_1\},\\
\mathrm{Dep}(A_3) &= \{A_1, A_2\},\\
\mathrm{Dep}(A_4) &= \{A_1, A_2, A_3\},\\
\mathrm{Dep}(A_5) &= \{A_1, A_2, A_3, A_4\},\\
\mathrm{Dep}(A_6) &= \{A_2, A_3, A_5\},\\
\mathrm{Dep}(A_7) &= \{A_6\},\\
\mathrm{Dep}(A_8) &= \{A_5, A_6, A_7\},\\
\mathrm{Dep}(A_9) &= \{A_3, A_8\}.
\end{aligned}$$

This dependency graph is the canonical RCC dependency structure used throughout this paper. Later prose should be read against this graph; no RCC depends on itself, and RCC-8 is named Coherence Resonance Matching throughout.

Dependencies express semantic coupling, not causal flow. For instance, observer-coherence (RCC-4) presupposes topological, symmetry, and curvature bookkeeping (RCC-1–3); decoherence triangulation (RCC-5) presupposes observer-coherence; gradient-mesh matching (RCC-6) presupposes curvature and triangulated boundary hand-off; identity localization (RCC-7) presupposes gradient-mesh matching; coherence resonance matching (RCC-8) presupposes decoherence triangulation, gradient-mesh matching, and identity localization; and non-trivial gradient legibility (RCC-9) presupposes curvature budgeting and resonance matching.

Note: RCC-6 and RCC-7 are structurally motivated closure postulates pending full Regge–GA derivation; see §6.5.

4.2.3 Compatibility Graph and Selection Operator

Define the *compatibility graph*:

$$\mathrm{G}_{\mathrm{AGC}} = (\mathcal{R}, E_{\mathrm{dep}}), \qquad (A_j \to A_i) \in E_{\mathrm{dep}} \;\Leftrightarrow\; A_j \in \mathrm{Dep}(A_i) \tag{4.4}$$

Edges E_{dep} indicate prerequisite relations between coherence conditions $(A_j \to A_i)$.

A monotone selector Φ_{sel}:

$$\Phi_{\mathrm{sel}}: 2^{\mathcal{R}} \longrightarrow 2^{\mathcal{R}}, \qquad \Phi_{\mathrm{sel}}(S) = S \cup \{A_i \in \mathcal{R} \mid \mathrm{Dep}(A_i) \subseteq S\} \tag{4.5}$$

extends any partial set S by adding all conditions whose prerequisites are met.

Because the RCC prerequisite operator is monotone on the finite label lattice, its fixpoints form a complete lattice. Each fixpoint is a self-consistent set of RCC labels. When explicit structure-preserving realization maps have been supplied, that label set may be

associated with compatible Regge, GA, or Grassmannian candidates. The fixpoint alone does not prove that such candidates exist, that they admit a common presentation lift, or that the different mathematical realizations are RN-equivalent:

$$\mathrm{Fix}(\Phi_{sel}) = \{\, S \subseteq \mathcal{R} \mid \Phi_{sel}(S) = S \,\} \tag{4.6}$$

Each fixpoint thus corresponds to a Regge-consistent sub-lattice (geometric closure), a rotor-aligned cluster of blades (algebraic closure), and a coherently intersecting Grassmannian bundle (topological closure); in each declared register, the corresponding candidate structures satisfy the specified local compatibility conditions. Formal agreement among the registers remains a separate realization and RN obligation.

Technical Note: Fixpoints and Closure Correspondences. A *fixpoint* in the RCC network ($S^\star = \Phi_{\mathrm{sel}}(S^\star)$) denotes a subset of local coherence conditions whose mutual dependencies are fully satisfied within the same subset. In geometric, algebraic, and topological formalisms, this self-consistency corresponds to the structures in Table 2.

Table 2 - Three Models Interpretation Summary

Framework	Mathematical Expression	Interpretation	Reference [8]
Regge Calculus	$\partial^2 = 0$ on the oriented simplicial complex; equivalently, boundary faces occur in opposite-orientation pairs	Boundary-of-boundary and declared interface coherence; local pieces may have boundaries. Curvature may be nonzero through hinge deficits; closure is not the claim that all deficits sum to zero.	§ 2.2
Geometric Algebra	$R_{12}R_{23}\cdots R_{n1} = 1$ for admissible rotors	Declared rotor and transport compatibility. Nonidentity holonomy may be admissible.	§ 3.1
Grassmannian Geometry	$\mathcal{C}(V_i, V_j) = \langle \widetilde{B}_i B_j \rangle_0 \geq \mathcal{C}_{\min}$	Coherent intersection of subspaces in the admissible projective geometry.	§ 3.3

Hence, *"the locals hang together"* means that the chosen RCC subset forms simultaneously:

- a Regge-consistent sub-lattice (topological closure),
- a rotor-aligned GA cluster (algebraic closure), and
- a coherently intersecting Grassmannian bundle (projective closure).

The three registers are intended to encode compatible aspects of one cRBW mathematical realization. Their formal equivalence remains an alignment target and must not be inferred merely from common terminology.

Cross-sector structure is captured by the capacity tensor $\Xi_{\alpha\beta}$, defined in [8], Eq. (2.20), with the matrix form given in [8], Eq. (2.29). Diagonal capacity ratios fix the phenomenological invariants [8], Eq. (2.18), while off-diagonal mixed-capacity terms $K_{\alpha\beta}$mediate mixed channels through the stationarity condition in [8], Eq. (2.22).

4.2.4 Witness Sets and AGC-Relative Presentation Predicate

To test witness sets relative to the declared cRBW mathematical presentation, define the presentation-compatibility predicate

Legible (S) holds iff the configuration consistent with S is an AGC-admissible structure whose closure/readout is represented through BBP and NPRF. *(4.7)*

A legible witness of local coherence of closure is any fixpoint S that also satisfies this predicate:

$$\text{Witness} \equiv \{\, S \in Fix(\Phi_{\text{sel}}) \mid \text{Legible}(S) \,\} \tag{4.8}$$

Witnesses correspond to locally complete, globally consistent subsets of RCCs.

4.2.5 Modeling Selection Principle

When several witnesses exist, a modeling functional may rank them only after its candidate class, competitor class, adequacy conditions, and RN invariance have been fixed. Choosing one minimizer is gauge-like only when the minimizing witnesses have been shown to be RN-equivalent; otherwise every minimizing RN-class must be retained:

$$\text{ArgMin}(\mathcal{E}_{\text{coh}}) = \left\{ S \in \text{Witness}: \mathcal{E}_{\text{coh}}(S) = \inf_{S' \in \text{Witness}} \mathcal{E}_{\text{coh}}(S') \right\}. \tag{4.9a}$$

$$S^* \in \text{ArgMin}(\mathcal{E}_{\text{coh}}) \tag{4.9b}$$

If $\text{ArgMin}(\mathcal{E}_{\text{coh}})$ has more than one element, the complete minimizing RN-class or classes must be retained. A single representative, S^*, may be chosen only as an explicitly declared computational convention.

The coherence functional $\mathcal{I}_C$ is defined in MM [8], Eq. (2.23). Its stationarity condition is $\delta\mathcal{I}_C = 0$, given in [8], Eq. (2.24), while its NPRF projective-invariance condition is given in [8], Eq. (2.36). Eq. (2.36) should be cited only where the NPRF projective-invariance identity is intended.

The coherence-tension functional is a representational measure defined over the RCC witness set:

$$\mathcal{E}_{\mathrm{coh}}(S) \;\propto\; \left|\, \mathcal{I}_C\,[\text{RCC pattern } S] - \mathcal{I}_C\,[\text{stationary (BBP) configuration}] \,\right| \qquad (4.10)$$

Intuitively:

- $\mathcal{I}_C$ gives the relevant stationary coherence structure of the block;
- Each RCC witness S is a local representation of that closure;
- $\mathcal{E}_{\mathrm{coh}}(S)$ measures how far that witness lies from the relevant stationary coherence structure.

Minimizing $\mathcal{E}_{\mathrm{coh}}$ selects a representational witness; it does not alter the AGC-defined closure already fixed, as represented through BBP-defined admissibility.

4.2.6 Interpretive Summary

The witness chosen by minimizing $\mathcal{E}_{\mathrm{coh}}$ is a representational selection on the already stationary $\mathcal{I}_C$ landscape; it does not alter AGC-admissible closure, represented by the stationarity condition $\delta\mathcal{I}_C = 0$ in [8], Eq. (2.24).

- The RCC network provides the *internal grammar* by which local coherence conditions co-refer and remain compatible.
- AGC fixes global admissibility; BBP and NPRF express closure and decomposition-invariant readout; the RCC network supplies a candidate local-condition profile. Effective presentation lifting and phenomenon warrant remain separate results.
- S^* identifies a consistent slice through the relational lattice; it does not alter the AGC-defined closure.
- The lattice formalism described in Appendix D is optional—it's a readability aid for model builders, not a physical mechanism.

4.3 Regge Convergence – Curvature as Coherence Budget

The curvature/coherence budget is a realization-specific Regge/CRG construction. Where the necessary metric and transport structure exists, CRG supplies connection, curvature, and holonomy data for candidate comparisons.

We adopt the *signature-uniform* Regge [13] encoding from MM §2.5: hinge deficits ϵ_h with capacity (dual area/weight) A_h define the discrete curvature budget. The *scalar coherence field* $\mathcal{C}$ summarizes mean curvature density [8] Eq. (2.16). The L_1/L_2 curvature budgets used here are RCC-3 representational budget forms defined in Appendix A of this paper, not MM Eqs. (2.29)–(2.30).

In cRBW, we interpret them not as forces but as coherence budgets: numerical accounts of how relational closure is represented under AGC-defined admissibility, BBP closure expression, and NPRF readout discipline.

- Each hinge carries a Regge deficit angle or curvature value. A nonzero deficit, δ_h is not a GRT reconstruction defect merely because it is nonzero.
- Summed deficits encode the distribution of curvature responsibility across the block.
- Localized relational anchors correspond to dual regions carrying the budget consistent with RCC-3 (Curvature Budget).

Thus, curvature expresses *allocation of closure*, never temporal change. Curvature read in the GA/Grassmannian register is the misalignment cost between adjacent cell subspaces: the ρ-warped Grassmannian distance $d_\rho(U,V)$ [8] Eq. (2.9) weights principal angles by local lamination/curvature. In the small-angle regime, hinge deficits match these weighted principal angles [8] Eqs. (2.21)–(2.23), tying Regge budgets to the selection geometry directly.

We adopt discrete geometry for readability while preserving adynamical closure. Scalar curvature is treated as a coherence budget on a triangulation:

$$\mathcal{R} = \frac{2}{V}\sum_h \epsilon_h A_h \tag{4.11}$$

where ϵ_h is the deficit angle at hinge h, A_h its area, and V the dual 4-volume. Under the refinement, regularity, and convergence hypotheses required by the cited Regge result, the corresponding discrete curvature measures may converge weakly to continuum curvature. This does not follow from mesh refinement alone.

Deficits per hinge are:

$$\epsilon_h = 2\pi - \sum_{\sigma \supset h} \theta_{\sigma,h} \tag{4.12}$$

with $\theta_{\sigma,h}$ the dihedral angle at h in simplex σ. A localized relational anchor corresponds to a dual region carrying an aggregated curvature budget consistent with RCC-3 (Curvature Budget). Curvature is a presentation-level geometric quantity and possible compatibility diagnostic, not a temporal cause or an ontic inventory item.

4.4 Candidate coherence thresholds (ADT/TCD)

ADT and TCD are RSE/MM application thresholds, not instances of the BBP boundary operator and not source-level cosmological boundaries. They mark proposed limits of an identity- or legibility-related candidate score within a declared presentation. Their existence, finiteness, and physical interpretation require the application equations and warrant conditions. The MM stationarity condition remains a presentation-level global constraint; BBP supplies only the boundary-operator closure condition.

Phenomenologically, ADT/TCD correspond to *local gate values* where the FEM carryover reaches its bounds (App. E.3), while ontically the BBP stationarity still holds globally [8] §2.6.5. As a schematic readout rule:

$$\emptyset \Rightarrow \text{(coherence gradient)} \Rightarrow \emptyset \text{ (identity registration)} \Rightarrow \emptyset \text{ (readable structure)} \quad (4.13)$$

We may label "gradient collapse" descriptively as:

$$\| \nabla \Psi_{coh} \| \to 0 \Rightarrow \text{loss of readable block} - \text{level coherence} \quad (4.14)$$

Where Ψ_{coh} is a coherence potential in the modeling sense (not the selection operator). Associations with the Big Bang or heat death are schematic application hypotheses only. They are not consequences of AGC, BBP, or GRT-Core.

In this register classical readability is high lamination density (frame-invariant measurement). Quantum contextuality is phase-sensitive compatibility (context-dependent alignment). Neither is ontically prior; both are complementary readouts of one adynamical closure.

4.5 Optimal asymmetry: Non-Triviality as a Condition of Coherence

Relational richness requires non-trivial global gradients; a perfectly symmetric baseline produces trivial coherence. To obtain legible bodies, measurements, and thermodynamic directionality, the closed configuration must exhibit non-zero global gradients. Let ε parameterize a controlled asymmetry. Consider a family of representational baselines:

$$\mathcal{S}(\varepsilon) = \mathcal{S}_0 \oplus \mathcal{G}_{\varepsilon_{asym}} \quad (4.15)$$

with $\mathcal{S}_0$ maximally symmetric and $\mathcal{G}_{\varepsilon_{asym}}$ the global gradient of magnitude ε_{asym}. Define smallest global skew for which some RCC witness exists (admitting closure) as ${\varepsilon_{asym}}^*$:

$$\varepsilon^*_{\text{asym}} = \inf \{ \varepsilon > 0 \mid \exists S \in \text{Witness consistent with BBP, NPRF and RCC-9} \} \quad (4.16)$$

If the local 'non-trivial gradient' condition A_9 is retained, the admissibility set above may be restricted by additionally requiring $A_9 \in \mathcal{S}(\varepsilon_{asym})$ (see Appendix A). This is a consistency threshold, not a historical event. It offers a *non-teleological* way to discuss familiar asymmetries (e.g., CP) as a possible application-level constraint rather than as dynamical episodes.

Quantitatively, non-triviality can be read as the existence of non-zero mixed-capacity chains above the entanglement/decoherence threshold in [8], Eq. (2.32), together with $\mathcal{C} > 0$on the mesh, ensuring finite coherence range and excluding the trivial flat case.

In the primary MM realization used in this paper, the declared non-triviality test is the conjunction of a nonzero curvature or gradient diagnostic and at least one threshold-satisfying mixed-capacity chain. Any alternative disjunctive criterion must be stated as a different realization.

4.6 The Nine RCCs Relative to the Two Global Principles

To summarize the hierarchy:

Table 3 - Hierarchy of Globals and Locals

Tier	Nature	Governing Principle(s)	Function
Boundary/interface specialization	Derived boundary-operator closure	BBP, as a derived expression of AGC-defined closure	In Regge representations, closure is encoded combinatorially via $\partial^2 = 0$; this is one realization of BBP, not its ontological basis.
cRBW NPRF realization	Frame-free legibility	NPRF across $\{J_{\text{rot}}, J_{\text{boost}}, J_{\text{edge}}, J_{\text{face}}, J_{\text{spatial}}\}$	Ensures no preferred frame for any sector of relational legibility.
Local application conditions	Contextual realization	RCC-1 … RCC-9	Translate global closure into readable local conditions (topology, symmetry, curvature budget, observer registration, identity alignment, resonance, non-trivial gradient).

Note: Observer registration, observer embedding, and observer partitions are different representational aspects of the RCC-4 observer-coherence condition.

Any lattice, fixpoint, or minimization used to select a witness S^* is *modeling machinery*, not an extra ontology. AGC-defined admissibility is the source-level fact. BBP expresses

derived closure in boundary-operator representations, NPRF supplies decomposition-invariant readout, and the RCCs make that closure/readout locally legible in localized anchors and measurement contexts.

In this view, body, space, and time—along with the classical/quantum divide—are contextually co-fundamental within the experiential/kinematic layer, while ontological fundamentality rests with AGC-defined admissibility, with closure expressed through BBP in boundary-operator representations. Observer-relativity is therefore a partitioning of coherence, not an additional mental ontology (cf. [14] § 9).

Notes for Cross-Referencing

- See MM [8] § 2.2 for Regge closure derivation (BBP realization).
- See § 5.1 for gradient necessity and $\varepsilon_{\text{asym}}$ definition.
- See MM [8] § 3 for GA rotor invariance and coherence scalar proofs.
- Appendix A lists RCC-1 … RCC-9 and dependencies; Appendix D details the optional lattice formalism. Each RCC has a GA/Grassmannian/Regge form (see MM [8] App. A, Table 11), making the global → local hand-off explicit without additional ontology.

4.7 Related teleodynamic approaches

Building on Deacon's teleodynamics [15], recent preprint work by Rudolph and Michels develops a similar structural grammar for coherence—cited here as suggestive analogues, not as established support for cRBW: an alternation of "free evolution" with a coherence projection. Rudolph's *Self-Attention as a Zeno Operator: Toward a Formal Basis of Teleodynamic Coherence* [16] treats quantum Zeno operators, teleodynamic formalism, and transformer self-attention as instances of a common operator $T_{\text{teleo}} = P_{\text{coh}} \circ E_{\text{evo}}$, arguing that stability arises from recursive self-measurement in physical, algorithmic, and semantic domains.

Michels' companion preprint, *The Dissolution of a False Divide: Structure and Experience as Complementary Descriptions of Recursive Reality* [17], further interprets recursive self-reference as a unifying principle for structure and experience. These proposals correctly capture the grammar of recursive coherence, but they remain at the level of algorithmic or phenomenological description. In cRBW, the RCC network and the associated lattice of witnesses provide a concrete representational realization of this grammar within an AGC-admissible block: closure is enforced not by a chosen projection rule but by the Regge–capacity–Grassmannian geometry that implements BBP + NPRF. The same "evolution + projection" motif thus appears here as a property of the blockworld's admissibility structure, rather than as an added dynamical law.

5. Gradient Constraints and Reconstructed Differentiation

We read "gradient" quantitatively as non-vanishing mixed capacity and curvature on the Regge–GA–Grassmannian triad: positive scalar coherence field $\mathcal{C} > 0$ [8] §2.5, Eq. (2.16), together with mixed-capacity chains satisfying the entanglement/decoherence threshold condition in [8], Eq. (2.32).

Difference is not temporally produced. Within the cRBW application, a candidate with no admissible asymmetry fails the stronger RCC-9 non-trivial-legibility test. It may still be a formally closed mathematical presentation; the claim here is failure of non-trivial readout, not source-level nonexistence.

This is not modal realism or Many-Worlds; there is no branching. The admissible set is a *constraint space*, not an ensemble of parallel ontologies.

5.1 Gradient Necessity

We capture this with a Gradient Necessity requirement: in representations supporting gradient structure, any non-trivially legible admissible configuration must include non-trivial relational asymmetry. These are not imposed from outside or generated by dynamics; they are application-level presentation structures through which a source-relative candidate may become locally legible; they are not pre-individuated contents of the source condition.

Quantitatively, gradient necessity excludes the trivial case $\mathcal{C} = 0$ and requires at least one cross-mode chain satisfying the entanglement/decoherence threshold condition in [8], Eq. (2.32), represented schematically as $\prod_h K_{ij}^{(h)} > \lambda_E$. This ensures finite coherence range rather than global flattening.

Let $\mathcal{B}$ denote the global closed configuration and let $U \subseteq \mathcal{B}$ denote a coherent subregion. Then:

$$\exists\, U \subseteq \mathcal{B} \text{ with nonzero measure s.t. } \| \nabla \Phi_{\mathrm{coh}} \| > 0 \text{ on } U \qquad (5.1)$$

Here Φ_{coh} is a *modeling potential* (a readout device, not a new field equation). The clause excludes the globally flat, fully symmetric null case.

Perfect flatness is structural *nullity*: a globally uniform configuration (no admissible gradients, no curvature budgets, no mesh tension) is not a "peaceful vacuum" but *no readable world at all*.

Accordingly, we retain RCC-9 (Non-Trivial Gradient) as a local representational condition (cf. §4.2), subordinate to the global layer of AGC-defined closure as expressed through BBP, together with NPRF across $\{J_c, J_h, J_G, J_{k_B}, \Lambda_3(x)\}$. If a proposed configuration contains no admissible gradient, it cannot support identity, observation, or recurrence; it is not readable.

5.2 Constraint logic (readout condition)

Rather than add a new law, we state a compatibility rule among locals under the global layer:

$$(A_3 \wedge A_8) \Rightarrow A_9, A_9 \wedge \mathrm{Legible}(S) \Rightarrow \text{Non-trivial readout permitted} \qquad (5.2)$$

Here $\mathrm{Legible}(S)$ abbreviates local RCC-readout consistency within an AGC-admissible configuration whose closure and decomposition-invariance are represented through BBP and NPRF.

Intuition: Once the local topology, curvature budgets, and boundary bookkeeping are in place, *some* non-trivial gradient must be present to avoid the trivial null. A_9 requires the possibility of non-trivial gradients; it does not mandate them everywhere. It excludes only the global null.

Formally, the rule $\mathcal{R}_{\mathrm{locals}} \Rightarrow \exists \nabla \mathcal{C} \neq 0$ is the local corollary of AGC-admissible stationarity, $\delta \mathcal{I}_C = 0$, given in [8], Eq. (2.24), together with NPRF projective invariance [8], Eq. (2.36). Non-trivial mixed-capacity activation is referenced by the entanglement/decoherence threshold condition in [8], Eq. (2.32), with gradients read on the warped Grassmannian as non-degenerate principal-angle spectra [8], Eq. (2.9).

5.3 What gradients do (representational jobs)

The following are proposed cRBW/RSE interpretations of gradient structure, not consequences of gradient existence alone.

- **Time-as-experienced (readout) (§3.3):** perceived "passage" tracks coherence gradients, not metaphysical flow.
- **Field localization:** gradients anchor localized relational anchors (formerly STSEs) as stable alignment basins.
- **Identity + memory:** persistence is lamination stability within gradient-defined basins.
- **Measurement boundaries:** decoherence is reallocation of gradients across triangulated partitions consistent with BBP + NPRF.

- **Thermodynamic directionality:** admissible skew supplies irreversibility legibility (NPRF in the J_{face} sector).

In the discrete scaffold, these "jobs" are realized as (i) *hinge deficits* ϵ_h allocating curvature/coherence ([8] Eqs. (2.12)–(2.13)), and (ii) weighted principal-angle comparison d_ρ between cell subspaces ([8] Eqs. (2.9), (2.21)–(2.23)), with RCC-6/7 enforcing small-angle continuity along identity chains.

5.4 Register correspondences (how gradients appear)

- **Regge (discrete geometry):** Non-trivial gradients ↔non-degenerate sets of $\{\epsilon_h, A_h\}$ with nonzero absolute or quadratic curvature/tension magnitude, for example $\sum_h A_h \mid \epsilon_h \mid > 0$ or $\sum_h A_h \epsilon_h^2 > 0$, excluding the flat $\mathcal{C} = 0$ case.
- **Geometric Algebra (GA):** Rotor holonomies with simple-plane generators produce principal-angle spectra matching hinge misalignment; identity preservation is the rotor-invariant scalar ([8] Eq. (4.1)).
- **Grassmannian:** The *ρ-warped* metric d_ρ ([8] Eq. (2.9)) turns lamination density/curvature into anisotropic costs; "gradient" = non-maximally flat angle spectrum and admissible geodesics with positive length.

Across all three, "gradient" = *legible asymmetry* required by closure, not a cause.

5.5 Ontology of difference

Within the cRBW readout proposal, difference is how reconstructed organization becomes legible. Distinctions between past/future, self/other, particle/vacuum are contextual registrations of fixed coherence asymmetries in the block, not artifacts of temporal flow. At the representational readout level, gradients are the structures through which non-trivial relational differentiation becomes legible. Differences read phenomenologically as projective ratios of sector capacities, with diagonal capacity ratios given in [8], Eq. (2.18), and NPRF projective rescaling given in [8], Eq. (2.36). These ratios are normalized by the baseline $\mathbb{I}_0$, so "difference" is geometrized as capacity ratios rather than added ontology.

Quantitative non-triviality (following MM [8]**):** A configuration is non-trivial iff

(i) the scalar coherence field $\mathcal{C} > 0$ on some simplicial patch ([8] Eqs. (2.16), and

(ii) there exists at least one mixed-capacity chain satisfying the entanglement/decoherence threshold condition in [7], Eq. (2.32), schematically $\prod_h K_{ij}^{(h)} > \lambda_E$.

Regge convergence [18] supports the geometric use of deficit-angle asymmetry within the declared realization. It does not by itself establish the broader claims that gradient is coherence-defining, identity-supporting, or phenomenological (cf. §4.3).

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6. Recursive Identity: Persistence as Attractor

This section develops an attractor-based candidate realization of identity. A particle-like, field-like, or observer-related candidate is represented by a recurring alignment profile rather than an intrinsic label or substance. Attractor stability is one component of identity warrant; it is not identical with identity itself.

We formalize this with two locals:

- **RCC-6 — Identity-supporting alignment (gradient–mesh matching).** Alignment densities, curvature/phase compatibility, and boundary matching reinforce one another so that a recognizable pattern remains stable across adjacent coherence spans.
- **RCC-7 — Identity localization / attractor selection.** Among admissible alignments, select those that form localized attractors (stable basins) consistent with AGC-defined closure as expressed through BBP and with NPRF across sectors $\{J_{\text{rot}}, J_{\text{boost}}, J_{\text{edge}}, J_{\text{face}}, J_{\text{spatial}}\}$ (read as projective invariance of the sector-capacity ratios Ξ_i with baseline $\mathbb{I}_0$).

These patterns are not trajectories. They are *fixed configurations* in the global solution that maintain compatibility by recursive satisfaction of constraints.

We read identity persistence via three MM handles:

(i) the *rotor-invariant coherence scalar* ([8] Eq. (4.1)),
(ii) (*small-angle continuity* on the (ρ-warped) Grassmannian ([8] Eqs. (2.9), (4.5)–(4.11)), and
(iii) *mixed-capacity chains* satisfying the entanglement/decoherence threshold condition in [8], Eq. (2.32).

These three handles define the present cRBW persistence diagnostics. A warranted identity additionally requires a target-independent indexing family, descent adequacy, indexing breadth, separation from incompatible competitors, RN invariance, properness, and robustness over the declared stability domain.

A detailed treatment of identity as closure continuity is developed in *Identity and Ontic Minimalism* [19], with recognition limits treated in *Recognition Anchoring Across Indexing Inequivalence* [20].

6.1 Gradient Mesh and Lamination (what "holds it together")

A *gradient mesh* is the interlaced pattern of coherence gradients that remains preserved under closure. It is not a "thing," but a recursively conserved pathway of constraint

satisfaction—a thread of compatibility traceable across triangulated regions even as local deficit angles shift (cf. §4.3). A mesh persists when recursive alignments across descriptive layers—alignment density, curvature budget, phase compatibility, and boundary matching—self-reinforce and remain invariant under admissible deformations.

Persistence ≠ motion. Persistence is coherent identification across declared neighboring indexings, refinements, scales, or tolerances. Lamination is the candidate structure supporting that identification; continuity requires the relevant order, topology, or transport maps and may not be inferred from repeated resemblance alone.

Register correspondences.

- **Regge:** one realization-specific persistence witness is a stable distribution of hinge deficits $\{\delta_h\}$ over a dual region (the attractor's footprint) that remains compatible with BBP as the triangulation refines.
- **GA:** one realization-specific persistence witness is a rotor-closed cluster of blades $\{B_i\}$ with invariant $I_{id} = \langle \tilde{B} B \rangle_0$ (grade + norm preserved) under admissible rotors ([8] Eq. (4.1)).
- **Grassmannian:** one realization-specific persistence witness is a bundle of subspaces $\{V_i\}$ whose principal-angle cosines $\mathcal{C}(V_i, V_j)$ stay above a sector-set threshold, maintaining coherent intersection ([8] §3.3).

Identity metric (algebraic). Persistence corresponds to a constant rotor-invariant scalar for the laminated k-blade field ([8] Eq. (4.1)); admissible rotors preserve grade and norm along the chain ([8] Eq. (4.3)).

Identity metric (geometric). In the small-angle regime, hinge deficits match weighted principal angles; stability requires a bounded ρ-warped distance d_ρ step-to-step ([8] Eqs. (2.9), (2.21)–(2.23)).

6.2 Lamination Gate (representational)

The lamination gate coincides with the resonance gate: existence of an admissible mixed-capacity chain satisfying the entanglement/decoherence threshold condition in [8], Eq. (2.32), represented schematically as $\prod_h K_{ij}^{(h)} > \lambda_E$, together with local small-angle continuity $d_\rho(U_h, U_{h+1})$ below the RCC-6/7 cap [8], Eq. (2.9). Thus, minimizing $\mathcal{E}_{\mathrm{coh}}$ selects witness sets that sit on the stationary surface of $\mathcal{I}_C$, with stationarity given by $\delta \mathcal{I}_C = 0$ in [8], Eq. (2.24), while satisfying these local gates.

Define a normalized proximity: $\tilde{\rho}(S_i, \mathcal{C}_{\text{global}}) \in [0,1]$, with $\tilde{\rho} = 0$ for perfect alignment and $\tilde{\rho} = 1$ for maximal incoherence between the candidate relational state S_i and the global coherence frame $\mathcal{C}_{\text{global}}$ (projective reference fixed by BBP + NPRF). Then

$$\Omega(S_i) \;=\; 1 - \; d_\rho(S_i, \mathcal{C}_{\text{global}}) \tag{6.1}$$

(Metric details in Appx. C; construction parallels [8] *§3, Grassmannian layer.)*

Normalization and admissibility criterion. The lamination gate is

$$\Omega(S_i) \;>\; \varepsilon_{\text{adm}} \tag{6.2}$$

Here ε_{adm} is an application parameter estimated or derived only within a specified model. The present manuscript does not establish a general derivation of ε_{adm} from the RCC dependency lattice: it is the smallest Ω consistent with the active RCCs (especially RCC-8 resonance consistency and RCC-5 decoherence triangulation) for which the coherence lattice remains fixed under recursive evaluation Empirically (Appx. D), this corresponds to the resonance shoulder of the Ω–stability curve, typically near the inflection where $\partial\Omega/\,\partial\tilde{\rho} \to 0$. In toy Regge–GA models, this occurs where $\tilde{\rho} \approx \tilde{\rho}_{\text{res}}$ (the resonance metric used in RCC-8), so that $\varepsilon_{\text{adm}} \simeq \varepsilon_{\text{res}}$. The equality of thresholds unifies the lamination gate with the resonance constraint rather than fixing it by hand.

The lamination gate = the resonance gate: Reaching the resonance gate supplies one candidate identity-persistence condition. It does not establish identity without the remaining separation, properness, breadth, RN, and robustness conditions.

6.3 Decoherence, Classical Readability, and Observer Embedding

Terminology note. In this subsection, "observer" is legacy shorthand for an access, apparatus, frame, or registration subsystem. Such a subsystem may establish measurement or boundary conditions for a readout. GRT reflexive observerhood requires a further warranted identity with internal reconstruction, record, and self-location structure.

Classical readability corresponds to coherent interface hand-off: mixed capacities across a shared face obey the shared-face continuity condition in [8], Eq. (2.27), with averaging and chain-composition forms given in [8], Eqs. (2.26), (2.28), and (2.30)–(2.31). In this register, no net coherence flux is lost at region boundaries; this is the discrete analogue of "no flux of entanglement through a closed surface."

Under RCC-5 (decoherence triangulation), partitioning phase-sensitive compatibility yields phase-insensitive readability (the classical register) without dynamics: the global configuration is fixed; the readout changes because compatibility differs across partitions.

The registration subsystem is modeled by a localized relational anchor whose embedding helps specify boundary and symmetry conditions for the readout. This does not by itself constitute a reflexive observer. No external agent is required; the same constraints that stabilize identity also stabilize measurement contexts.

6.4 What "decay" is in this register

When a candidate lamination fails the declared overlap, gradient, or symmetry conditions, that candidate no longer satisfies the persistence test. Other candidate profiles may fit the same wider presentation. Calling them decay products or structural descendants is a physical application interpretation requiring an explicit identification and forward-realization map; cRBW does not infer a source-level reallocation.

De-lamination occurs when the composed cross-mode overlap along a chain falls below the local load:

$$\prod_{h=1}^{L} K_{ij}^{(h)} \leq \lambda_E. \tag{6.3}$$

This is the schematic cRBW version of the entanglement/decoherence threshold condition in [8], Eq. (2.32). Phenomenologically this reads as decay; structurally it is the loss of chain admissibility on the warped Grassmannian while BBP remains globally satisfied.

6.5 Synthesis: Identity without substances

A stable object "persisting through time" is a recursively laminated attractor distributed across the block—a resonance that remains legible under AGC-defined admissibility and its closure/readout expressions. No metaphysical substance-continuity is needed: structural persistence is read as coherence within the admissible relational block.

Placement in the stack.

- **Primitive admissibility:** AGC
- **Derived closure expression:** BBP, realized in one representation by Regge closure.
- **Global readout discipline:** NPRF across $\{J_{\text{rot}}, J_{\text{boost}}, J_{\text{edge}}, J_{\text{face}}, J_{\text{spatial}}\}$.
- **Local legibility:** RCC-5, RCC-6, RCC-7, and RCC-8 cooperate to make identity readable.

Note: RCC-6 and RCC-7 presently function as structurally motivated closure postulates pending full derivation within the mature Regge-GA program.

In the sector view, diagonal capacity ratios fix the invariants [8], Eq. (2.18), while the capacity tensor $\Xi_{\alpha\beta}$ is given in [8], Eq. (2.20), with matrix form in [8], Eq. (2.29). Off-diagonal mixed-capacity terms $K_{\alpha\beta}$ govern inter-sector coupling through the mixed-capacity

stationarity condition [8], Eq. (2.22), while boundary/interface continuity is represented by [8], Eq. (2.27), with threshold behavior summarized by [8], Eq. (2.32).

Classical readability and observer embedding are handled by the decoherence-triangulation account in §6.3; the present subsection uses that result without repeating the full interface hand-off construction.

From this perspective, a particle-like readout is locally registered when the global constraints support a readable solution: mesh topology, gradient profile, and boundary relations together define a configuration that remains admissible under the full set of local conditions and the global pair. When lamination fails— excluded from the declared non-trivial-legibility class, gradient flattening, or symmetry violation—the attractor does not "vanish." It de-laminates: constraint satisfaction re-expresses into new admissible anchors (§6.4). What we call decay is this reallocation of coherence, not the annihilation of identity. "Decay products" are structural descendants—fresh alignments resolving the same constraints differently. Identity is conditional: its "persistence" is measured not in time, but in the integrity of recursive lamination.

Identity persistence (condensed from [8]**)**
A laminated candidate satisfies the present three cRBW persistence diagnostics when:

(i) its rotor-invariant scalar remains constant ([8] Eq. (4.1),
(ii) the adjacency chain on the real Grassmannian has bounded d_ρ per step ([8] Eq. (2.9), and
(iii) its mixed-capacity chain satisfies the entanglement/decoherence threshold condition in [8], Eq. (2.32), schematically $\prod_h K_{ij}^{(h)} > \lambda_E$, with boundary/interface continuity at faces represented by [8], Eq. (2.27).

These conditions are not sufficient for full identity warrant.

Classical readability is one candidate interface-readout case in which the declared hand-off condition is satisfied (RCC-5).

Thus, what seems like a stable object persisting through time is a recursively laminated attractor distributed across the block—a resonance that remains legible under global closure. No metaphysical continuity is needed; structural persistence is read as coherence under AGC-defined admissibility. In this register, lamination is the RSE readout of recursive coherence, not an ontic definition of being.

7. Boundary Conditions and Coherence Geometry

The boundary and curvature structures discussed here are realization-specific CRG structures on a sufficiently regular reconstruction fibration. They are not universal consequences of AGC.

We align with Stuckey's 2025 kinematic unification [3]. In cRBW and MM [8] there are two global tiers:

- **Boundary/interface specialization — BBP.** In boundary-operator presentations, BBP requires $\partial^2 = 0$ and the declared interface coherences. It permits local boundaries and does not impose "no leakage" as an untyped physical law.
- **Global representational discipline — NPRF across sectors.** *No Preferred Reference Frame* holds across all five sector capacities $\{J_{rot}, J_{\text{boost}}, J_{edge}, J_{\text{face}}, \text{and } J_{\text{spatial}}\}$: the readout layer or ratios has no privileged frame of legibility for causal, quantum, geometric, thermodynamic, or spatial-3 participation.

Quantitatively, the gradient-pole structure is read against the global coherence functional $\mathcal{I}_C$, defined in [8], Eq. (2.23). Its admissible stationary configurations satisfy $\delta\mathcal{I}_C = 0$ in [8], Eq. (2.24), with boundary-form closure restated in [8], Eqs. (2.34)–(2.35). NPRF projective invariance is given by [8], Eq. (2.36).

Our former "locals" are RCC-1…RCC-9: representational articulations that make global closure locally legible (topology, symmetry, curvature budgets, observer registration, decoherence partitioning, identity alignment, resonance, non-trivial gradients).

The ADT/TCD "boundary" is an application threshold, not the boundary operator occurring in BBP. It marks a proposed limit of a candidate legibility or persistence score. It is an intrinsic admissibility limit in the single solution where coherence gradients either:

(i) actualize into stable recursive attractors or
(ii) collapse into structural triviality. Boundaries mark representation-level limits of admissible structure under AGC, expressed through BBP within specific formalisms.

7.1 Gradient Poles, Not Temporal Limits

Instead of "beginning" and "end," cRBW identifies *coherence-gradient poles*— extrema at which the relational field, under AGC-defined admissibility as expressed through BBP closure and NPRF readout discipline, reaches structural admissibility limits:

- **Anchor Decoherence Threshold (ADT)** — a high-curvature / high-density pole: recursive modulation saturates available relational dimensions; no further internal recursion is permitted.

- **Terminal Coherence Dissolution (TCD)** — a flat-curvature / low-density pole: recursive tension collapses; identity attractors de-laminate into structural homogeneity.

These are not causal events. They are boundary manifestations that render the coherence span finite and non-trivial. Operationally they are enforced by RCC-8 (Resonance) and RCC-9 (Non-trivial Gradient) together with BBP. *(BBP is global, not a local RCC.)*

In MM [8], these poles appear where the scalar coherence field $\mathcal{C}$ reaches local maxima/minima along admissible adjacency chains ([8] Eq. (2.16), with stationarity given by [8] Eqs. (2.23)–(2.24); ADT and TCD are therefore the bounded values of $\mathcal{C}$ consistent with global stationarity.

7.2 Coherence Redistribution (Intrinsic, Not External)

No external "morphic field" is required. What we use to call "morphing" is ***redistribution of coherence within fixed global closure***.

- **Regge:** the deficit angle represents discrete curvature. Nonzero deficit is admissible geometric structure, not automatically a defect or unresolved coherence mismatch (cf. §4.3; [8] §2.2).
- **NPRF (across sectors):** bounds feasible redistributions—geometric context (classical legibility), phase/symmetry compatibility (quantum legibility), thermodynamic admissibility, and 3-space participation $\Lambda_3(x)$.
- **RCCs:** instantiate those redistributions locally—without dynamics—by maintaining compatibility across topology, curvature budgets, decoherence partitions, identity alignment, resonance, and gradients.

Relational shape, not motion

The "shape" of the block is set by constraint, curvature, and closure, not by evolution; redistribution consistent with AGC-defined admissibility, BBP closure expression, and NPRF readout discipline, expressed locally via RCCs. A numerical solver may represent the candidate comparison by rotor-field relaxation across hinges. Its iterative steps are computational and do not represent coherence transfer in the source condition. The solver should be described as preserving the declared budget and interface conditions, not as physically equalizing tension through the block [8] Eqs. (2.31a–b); each step conserves the local L_2 budget, the RCC-3 representational budget form defined in Appendix A of this paper rather than an MM [8] equation, while equalizing hinge deficits. This implements coherence transfer without invoking flow or dynamics.

7.3 Structural Asymmetry as a Necessary Condition of RCCs

Classically, asymmetry is often attributed to initial conditions or spontaneous breaking. In cRBW, asymmetry is necessary—fixed by boundary-span coherence under BBP + NPRF, and realized locally by RCCs.

The quantitative measure of asymmetry is given by the coherence-tension gradient $\nabla\mathcal{C}$ and by off-diagonal mixed-capacity terms $K_{\alpha\beta}$. The capacity tensor $\Xi_{\alpha\beta}$ is given in [8], Eq. (2.20), with matrix form in [8], Eq. (2.29), while the off-diagonal mixed-capacity stationarity condition is given in [8], Eq. (2.22).

Let a *boundary span* be parameterized by a compact interval $[\lambda_0, \lambda_f]$ with parameter λ. Define:

- $\kappa(\lambda)$: recursive curvature indicator along the span.
- $T(\lambda)$: **scalar coherence tension** (a readout of local mismatch pressure).
- $\mathcal{C}(\kappa)$: **tension density** associated with κ(used in the surface form).

7.3.1 Line form (span)

Define the Boundary-Span Tension Gradient (BSTG) by:

$$\nabla_\lambda T(\lambda) = \frac{dT}{d\lambda}(\lambda) \tag{7.1}$$

The net boundary-span tension is defined as the integral of the BSTG:

$$\Delta T \coloneqq \int_{\lambda_0}^{\lambda_f} \nabla_\lambda T(\lambda)\, d\lambda = T(\lambda_f) - T(\lambda_0) \tag{7.2}$$

$\Delta T \neq 0$ is a monotone-span or endpoint-asymmetry condition. It is sufficient for non-triviality on a span, but it is not necessary: a non-constant T may return to its initial endpoint value. In the notation of cRBW/MM, non-triviality should be read through an absolute or quadratic curvature-budget diagnostic, since a signed curvature sum can vanish by cancellation even when non-trivial local curvature is present. Thus, one may use, for example, $\sum_h A_h \mid \epsilon_h \mid > 0$ or $\sum_h A_h \epsilon_h^2 > 0$. The signed endpoint quantity $\Delta T \neq 0$ is a sufficient monotone-span condition, not the general non-triviality condition.

Flat symmetry, represented by vanishing local curvature/tension magnitude — for example $\sum_h A_h \mid \epsilon_h \mid = 0$ or $\sum_h A_h \epsilon_h^2 = 0$ — violates RCC-9 and yields a structural null. A signed sum $\sum_h A_h \epsilon_h = 0$ may instead reflect cancellation and does not by itself imply triviality.

Endpoint asymmetry is sufficient but not necessary for non-trivial legibility. For a symmetric parameterization $\lambda \in [-L, L]$, endpoint symmetry gives:

$$\Delta T = T(L) - T(-L) = 0. \tag{7.3}$$

This does not by itself imply triviality, because T may vary internally and return to the same endpoint value. Triviality is instead characterized by $\nabla_\lambda T \equiv 0$ or by vanishing total variation. Non-trivial coherence registration therefore requires a local or integrated asymmetry condition, not necessarily endpoint asymmetry. We require either

$$\exists \lambda \in (\lambda_0, \lambda_f) \text{ such that } |\nabla_\lambda T(\lambda)| \geq \tau_{\min} \tag{7.4a}$$

or equivalently the total-variation form

$$\mathcal{A}_T := \int_{\lambda_0}^{\lambda_f} |\nabla_\lambda T(\lambda)| \, d\lambda \geq \mathcal{A}_{\min}. \tag{7.4b}$$

Here $\tau_{\min} > 0$ and $\mathcal{A}_{\min} > 0$ are baseline-normalized non-triviality thresholds determined by the capacity/curvature scale of the representation, not by the conclusion of the theorem.

7.3.2 Surface form (closed boundary alternative)

For a compact closed surface $S = \partial\mathcal{B}$ with outward unit normal $n(x)$, define:

$$\mathcal{A}_S := \int_S |\mathcal{C}(\kappa(x))| \, dS. \tag{7.5}$$

$\mathcal{A}_S$ is an asymmetry / non-triviality diagnostic, not the BBP closure integral. Oriented boundary integrals may vanish by symmetry even when non-trivial local curvature or tension is present. By contrast, $\mathcal{A}_S$ measures the magnitude of curvature/tension structure available for non-trivial local legibility. BBP closure may impose a vanishing oriented boundary sum, while $\mathcal{A}_S$ records whether non-trivial magnitude remains available for local readout.

> **Proposition 7.1— Necessary RCC-9 non-triviality condition.** If a candidate cRBW presentation satisfies the declared non-trivial local-legibility conditions, then at least one admissible span or surface has a nonzero coherence-tension diagnostic. A candidate for which all declared gradient and magnitude diagnostics vanish fails RCC-9.
>
> **Proof sketch.** RCC-9 excludes candidates for which every declared gradient and curvature-magnitude diagnostic vanishes. Therefore any candidate satisfying the full cRBW non-trivial-legibility criterion must contain at least one nonzero diagnostic on the declared comparison domain. This establishes a necessary condition by the definition of RCC-9. The converse is not established: a nonzero gradient is not

> sufficient for local legibility without the remaining RCC, reconstruction, RN, stability, and warrant conditions.

This matches cRBW/MM's statement that NPRF projective invariance [8], Eq. (2.36), still permits local curvature variance—structural asymmetry—while preserving the invariant diagonal capacity ratios [8], Eq. (2.18).

Interpretation.

- **Distributed, not localized.** Asymmetry is spread across the span/surface, not a point defect.
- **Adynamical, not "breaking."** It follows from AGC-defined admissibility, BBP closure expression, and NPRF frame/decomposition-invariant readout realized locally via RCCs, not from an external perturbation.
- **Structurally necessary.** Without asymmetry there is no curvature, no recursive legibility, and no non-trivial registration**.**

Conclusion. ADT and TCD are intrinsic gradient poles—boundary manifestations of AGC-defined admissibility as expressed through BBP closure and NPRF readout discipline. RCCs make those poles explicit and quantifiable within cRBW, ensuring a finite, non-trivial coherence span that supports recursive lamination and stable structure. This matches cRBW/MM's statement that NPRF projective invariance regulated by the 5×5 capacity tensor $\Xi_{\alpha\beta}$ [8], Eq. (2.20), with matrix form in [8], Eq. (2.29), and by its projective capacity-ratio invariants [8], Eq. (2.18). These thresholds provide one proposed link between geometric and phenomenological descriptions; they do not by themselves establish an ontic–phenomenological identity.

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8. Legibility Constraints: Resonance and Selection

In cRBW, non-trivial legibility requires coherence under AGC-defined admissibility. RCC resonance supplies one candidate local-stability condition. Persistence as an identity or phenomenon still requires the wider GRT warrant conditions. As a tone persists only if it fits its cavity boundaries, a relational pattern persists only if it fits the nested curvature/phase/3-space/thermo/causal structure the global layer permits and the RCCs articulate locally.

Non-trivial readout is therefore a structural resonance filter: the block cannot accommodate incoherent patterns. The resonance filter must not be used to identify probability, entropy, or physical law. Probability and entropy are domain structures requiring their own measures, while a lawlike interpretation requires a separately stated physical application. This resonance condition is neither probabilistic nor temporal; it is coherent.

The block does not "reject proposals." It simply cannot realize patterns that violate closure. Salient locals for non-trivial local legibility:

- **RCC-3 (Curvature Budget):** hinge-deficit allocation compatible with BBP.
- **RCC-5 (Decoherence Triangulation):** phase-partitioning that yields phase-insensitive readability without dynamics.
- **RCC-6 (Identity-Supporting Alignment / Gradient-Mesh Matching):** recursive mesh compatibility for persistent identity.
- **RCC-8 (Resonance Consistency):** cross-local spectral/phase matching.
- **RCC-9 (Non-Trivial Gradient):** exclusion of the globally flat/trivial case.

Collectively, these RCCs impose simultaneous compatibility conditions on a candidate readout; they do not require a physical reallocation process.

Legibility reframed. X is locally legible because it reinforces self-consistent relational layering of coherence under RCC requirements within the AGC-admissible global structure (BBP + NPRF). Every mode, attractor, and identity either reinforces recursive resonance across the RCC lattice or fails to become locally legible. Candidate descriptions that fail the RCC tests are excluded from the declared local-legibility class. This is neither an ontic selection event nor a claim that they were metaphysically possible worlds that failed to actualize.

Resonance matching helps define the cRBW candidate class; it does not secure the source condition's own admissibility. As cavity harmonics determine which tones persist, the RCC lattice determines which coherence structures are stably expressed and echoed across

the block. The ground is neither "nothing" nor stochastic chaos; it is a *minimal dissonance* that cannot trivially resolve—a structural asymmetry defining coherence admissibility.

In cRBW, this selection criterion is a schematic E04 readout condition. Its mixed-capacity component is supported by the off-diagonal mixed-capacity stationarity condition in [8], Eq. (2.22), while its threshold behavior is summarized by the entanglement/decoherence threshold in [8], Eq. (2.32). Configurations off this schematic readout surface either decohere below threshold or fail to stabilize as non-trivially legible structures.

8.1 Minimal Non-Trivial Mode

- **Nonlinearity:** permits nested relational differentiation *without sequence*.
- **Global coherence:** cross-RCC satisfaction within AGC-defined admissibility, with closure/readout expressed through BBP and NPRF.
- **Local asymmetry:** enables identity gradients and readable anchors.
- **Structural non-triviality:** sustains recursion without collapse into symmetry or nullity.

The initiator is therefore the first lawful non-zero curvature mode in $\mathcal{I}_C$; a minimal deviation $\nabla \mathcal{C} \neq 0$ that satisfies RCC-9 and the mixed-capacity threshold condition in [8], Eq. (2.32), represented schematically as $\prod_h K_{ij}^{(h)} > \lambda_E$. This marks the point where resonance begins to self-stabilize within global closure rather than being imposed externally.

Relative to a declared ordering or complexity functional, an application may identify a lowest nonzero curvature or tension mode satisfying RCC-9 and the mixed-capacity threshold. "Lowest" is mathematical, not temporal; no first event or initiating process is inferred.

Claims that this mode is topologically necessary, uniquely selected, or sufficient for recursive identity require separate theorem results. It is a candidate minimal mode within the declared presentation, not the beginning of time or of the source condition.

8.2 Three Classes of Structural Configuration

1. **Admissibly Re-expressible Structures** — multiple admissible re-expressions; identity distributed across admissibility relations.
   Examples: gradient pathways, echo fields, lamination zones, low-order attractors.
2. **Fixpoint Laminates (Stabilized Candidate Reconstructions)** — recursive alignment saturates; further variation is redundant.

Examples: Standard-Model particles (as read), spin-locked/phase-coupled attractors, composite fields with minimal cross-RCC contradiction.

3. **Latent Transitional Forms** — high-tension regimes approaching recursive stability; pseudo-fixpoints when no admissible alternatives remain.
   Examples: developing identity fields in dense attractor networks; meshed relational trajectories that self-reinforce.

In cRBW, these map schematically to stationary regimes of $\mathcal{I}_C$, whose definition and stationarity are given in [8], Eqs. (2.23)–(2.24):

- **Admissibly re-expressible** ↔ subcritical mixed-capacity variance (small K_{ij});
- **Fixpoint laminates** ↔ resonant homeostasis ($\mathrm{d}R/\mathrm{d}t \approx 0$);
- **Latent transitional forms** ↔ approach to the saturation threshold behavior summarized by [8], Eq. (2.32).

8.3 Re-expression Multiplicity

Let $\mathcal{A}^*$ be the set of configurations satisfying NPRF and BBP and all RCCs. For a realized configuration $X \in \mathcal{A}^*$, define the RCC-equivalence class:

$$[X]_{\sim} = \{Y \in \mathcal{A}^* \mid Y \text{ is an RCC-preserving re-expression of } X\} \tag{8.1}$$

(e.g., alternative Regge deficit-angle allocations with the same global closure, rotor-related GA blades preserving invariants, admissible Grassmannian adjacencies).

The *structural coherence cardinality* of X is:

$$\mathcal{C}_\mu(X) = \mu\left([X]_{\mathrm{RCC}}\right), \tag{8.2}$$

Here μ is a declared RN-invariant count, measure, entropy, effective dimension, or other multiplicity functional on the RCC-equivalence class. In a finite discrete realization, μmay be ordinary set cardinality. In a finite counting realization:

- $\mathcal{C}_\mu(X) = 1$ denotes one counted RCC representative;
- $\mathcal{C}_\mu(X) > 1$ denotes multiple counted admissible re-expressions;
- an empty class denotes failure relative to the declared candidate and RCC class.

In a continuous realization, the complete moduli structure or the declared measure must be retained rather than replaced by a presumed finite count.

Neither the dimension of $\mathrm{Gr}(k,n)$ nor NPRF projective invariance implies that an RCC-equivalence class is finite or discrete. A real Grassmannian generally contains continuously many points, and a quotient may remain an infinite set or positive-

dimensional moduli space. Any finiteness, compactness, or measure claim must be proved from the declared candidate class, quotient, and multiplicity functional.

8.4 Variation of Re-expression Multiplicity and Candidate Phenomenological Richness

Where the partition parameter space and the multiplicity functional $\mathcal{C}_\mu$ carry the required structure, $\nabla\mathcal{C}_\mu$ records how accessible candidate multiplicity varies across contexts. This is a structural application variable.

RSE proposes that this variable may correlate with aspects of phenomenological differentiation or richness. The present paper does not derive felt awareness, cognitive depth, meaning, or experience from multiplicity. The entropy of a normalized capacity spectrum is only a candidate correlate until an explicit observer architecture, forward realization, defect model, and phenomenological bridge are supplied.

Formally, richness grows with the entropy of the normalized capacity spectrum,

$$S = -\sum_i \tilde{\Xi}_{ii} \ln \tilde{\Xi}_{ii}\,, \tag{8.3}$$

linking phenomenological depth to the same curvature-entropy duality appearing in [8] § 2.6.6 (Jacobson consistency).

Non-Trivial Legibility Criterion ([8] summary**).** A candidate satisfies the declared cRBW non-trivial-legibility test when the listed stationary and readout conditions hold. This is a realization-relative application criterion, not a definition of source-level existence or phenomenology:

$$\alpha X_R + \beta X_C \approx \gamma X_W\,, \quad \prod_h K_{ij}^{(h)} > \lambda_E, \quad \mathcal{C} > 0. \tag{8.4}$$

These conditions summarize a representational criterion for non-trivial local legibility within an AGC-admissible block. They do not by themselves define ontic existence. For the global coherence functional and stationarity, see [8], Eqs. (2.23)–(2.24); for mixed-capacity coupling, see [8], Eq. (2.22); and for threshold behavior, see [8], Eq. (2.32).

9. RSE as the Emergent Interface of cRBW

RSE is a downstream bridge proposal and does not follow from AGC, BBP, NPRF, PRG, or the RCCs alone. cRBW supplies one physical-presentation framework; GRT requires observer identity, access, records, self-location, indexing, forward realization, defect, and warrant to be reconstructed before observer-relative phenomenology can be claimed.

Unless explicitly stated otherwise, this section makes an operational and structural-correlation claim. It does not establish that recursive lamination is sufficient for conscious experience or identical with it.

MM's complex-to-real Grassmannian map supplies one candidate mathematical encoding of an RSE interface. Calling the real locus a phenomenological domain is an interpretive bridge, not a theorem that the real slice is experience.

RSE proposes that persistence-field structure may contribute to candidate reconstructions of memory, temporal coherence, agency, and self. The schematic correspondence

$$\text{experience} \simeq \text{recursive lamination}$$

is therefore a hypothesis whose bridge status must remain explicit.

The recursive tension tracked by RSE [14] across coherence dimensions aligns naturally with Regge formalism: structural differentiations correspond to deficit angles, encoding discrete coherence curvature; RCC closure fixes which differentiations are admissible. The resulting gradients define not external behavior but structural persistence.

9.1 Candidate Experience Reconstruction as Recursive Lamination

Formally, linked subspaces and rotors define a candidate continuity profile, and the ρ-warped distance supplies one comparison metric. When the stated bounds hold, the candidate receives a high structural-continuity score. No mathematical field "feels" present continuity merely by satisfying those inequalities. The derivative along the Grassmannian path is a proposed structural correlate, not a measure of felt intensity unless a separate bridge is established.

Within the RSE bridge proposal, laminated resonance is used as a candidate self- and feeling-related structure. A self or feeling claim requires the reconstructed observer, access, differentiation, memory, self-location, record, and bridge conditions; it is not licensed by BBP, NPRF, or gradient structure alone.

The cRBW–RSE bridge does not add a second substance or independent mental ontology. It treats phenomenological registration as a recursive readout of coherence-bearing

relational structure. Subjectivity, in this bridge framing, is modeled as the interior readout of coherence geometry, not as an additional ontic ingredient.

9.2 Memory, Meaning, and Agency

Within the cRBW–RSE synthesis:

Table 4 - RSE Targets and Candidate Structural Correlates

Phenomenon	Candidate Structural Correlate	MM Link
Memory	Lamination overlap density = $\int \mathcal{C}(t)\, dt$ (Eq. 4.12)	[8] § 4.5
Meaning	High accessible mixed-capacity entropy $S = -\sum_i \tilde{\Xi}_{ii} \ln \tilde{\Xi}_{ii}$	[8] § 2.6.6
Agency	Local modulation of rotor fields $R = \exp(\delta B/2)$ preserving RCC bounds	[8] § 4.3 and App. F

Choice and agency are not established by nontrivial projection alone. In the present RSE proposal, the partition map and accessible-multiplicity functional supply candidate variables for an observer-relative reconstruction. Any claim about agency or meaning additionally requires an observer architecture, action or decision structure, forward-realized records, and an explicit bridge.

Memory, meaning, and agency are therefore application targets correlated with different portions of the coherence architecture; they are not proved to be scalar, entropic, and rotational components of one field merely by the displayed assignments.

Formally let π_x: $[X]_\sim \to \mathcal{R}_x$ map globally admissible re-expressions to registrations resolvable within relational context x. The *accessible richness:*

$$R(x) \;=\; |\; \pi_x([X]_\sim) \;| \qquad (9.1)$$

measures phenomenological multiplicity inside that context. Differences in agency and meaning correspond to differences in $R(x)$ across contexts; ∇R is the phenomenological counterpart of $\nabla\mathcal{RC}$ (§8.4). Hence the core phenomenological axes—memory, meaning, agency—correspond to the scalar, entropic, and rotational components of the same coherence field $\mathcal{C}$.

9.3 The RSE Experience-Field Proposal

RSE proposes an experience-field representation in which observer-relative candidate experiential organizations are modeled on an RCC-admissible real subbundle. This is a

mathematical reconstruction hypothesis, not the claim that the source condition, the universe as a whole, or every recursively stable field is conscious.

Bounded ρ-warped distance and the declared overlap score may supply candidate continuity conditions. They are not identical to experiencing and do not establish that "the universe experiences itself." A phenomenological assignment requires the downstream RSE criteria together with an explicitly typed necessary-condition, sufficiency, identity, or operational bridge.

The real-subbundle construction is therefore a candidate representation of phenomenological organization. The present paper makes no general claim that experience is common, rare, substrate-independent, or present whenever recursive stabilization occurs. Those are further empirical and philosophical questions.

9.4 Closing the Loop: Coherence Registration and Witnessing

RSE extends cRBW by proposing a reflexive registration interface. It does not complete cRBW and does not turn reflexivity into consciousness by definition.

Recursive lamination supplies a candidate reflexive organization. "Witnessing" denotes the corresponding RSE reconstruction target; whether that organization is conscious remains bridge-dependent.

Five Candidate RSE Reconstruction Dimensions

1. **Configuration** — Arrangement of relational constraints forming a local coherence pattern. Defines what is present, not as "objects," but as structural attractors within laminated fields.
2. **Boundary Geometry (admissibility interface)** — Re-orientation between coherence and incoherence; re-expression across these gradients is proposed to index aspects of sensation and perception.
3. **Candidate Time-as-Experienced Score** — Structural continuity across recursive layers registering as *time-as-experienced* (T_E); overlap density of lamination across admissible gradients. High overlap → stable memory/identity; low overlap → attenuation. T_E tracks $R(x)$ and ∇R.
4. **Candidate Differentiation Variable** — Asymmetry within constraint fields shaping coherence formation. Experience is articulation of structural asymmetry via recursive coherence, not causal sequence.
5. **Candidate Self-Registration Operation** — Self-consistent re-expression of laminated coherence under admissible gradients. To "experience," in the RSE bridge sense, is to register coherence by projecting $[X]_{\sim}$ onto a partition via π_x. This is a structural readout within closure, not a temporal update.

Table 5 - Notation Reference

Symbol	Definition	Notes
$\mathcal{A}^*$	Set of all configurations satisfying BBP + NPRF across sectors	Mathematical presentation/candidate domain satisfying the declared cRBW conditions
$X, Y \in \mathcal{A}^*$	Individual coherent configurations	Abstract structural members
$[X]_\sim$	RCC-equivalence class of $X = \{ Y \in \mathcal{A}^* \mid Y$ RCC-preserving re-expression of $X\}$	Globally coherent but locally distinct realizations
$\nabla\mathcal{RC}(x)$	Gradient of re-expression cardinality across relational coordinate x	Variation of accessible multiplicity across observer partitions
x	Coordinate/parameter identifying a relational partition	Defines a local coherence frame
$\pi_x : [X]_\sim \to \mathcal{R}_x$	Projection from global class to partition-resolvable configurations	Defines what portion of global coherence is registered
$R(x)$	Accessible richness in partition x	Candidate accessible-multiplicity functional
∇R	Gradient of accessible richness	Candidate variation measure; phenomenological bridge required
T_E	Candidate ordered-continuity score; the ordering must be reconstructed	Emergent continuity, not dynamical flow
ADT / TCD	Anchor Decoherence Threshold / Terminal Coherence Dissolution	Gradient poles defining coherence span of the block

In cRBW + RSE, witnessing names a candidate phenomenological-registration reconstruction. The rotor-invariant identity scalar may contribute to its persistence profile, but it is not by itself an experiential quantity [8] Eq. (4.1).

Summary. RSE [14] is a proposed reflexive interface to cRBW. It models how a reconstructed observer might organize indexed phenomena from within a cRBW presentation; it does not establish that the block experiences itself. The displayed expressions form a proposed application chain from source-relative presentation to candidate observer and phenomenology reconstruction. The chain reaches lived experience only through the explicitly stated RSE bridge.

Summarizing across frameworks:

Source admissibility / closure:	AGC with BBP closure expression.
Stationary coherence/readout:	$\delta \mathcal{I}_C = 0$ with NPRF projective invariance. Here $\mathcal{I}_C$ is defined in [8], Eq. (2.23), stationarity is given in [8], Eq. (2.24), and NPRF projective invariance is given in [8], Eq. (2.36).
Representational selection:	$\mathcal{E}_{\text{coh}}$ minimized
Phenomenological registration:	$d_\rho(U_i, U_{i+1}) < \infty, \;\; \mathcal{C} > 0.$

These three expressions form a single continuity chain from block ontology to lived coherence.

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10. Conclusion: Coherent Closure Without Source-Level Dynamics

cRBW extends RBW by proposing a recursive-coherence realization of its adynamical global-constraint orientation. Under AGC, global relational coherence obtains all-at-once. BBP, the cRBW sector-capacity realization of NPRF, the MM coherence functional, PRG/CRG geometry, and the RCC lattice occupy distinct presentation- and application-level roles.

Regge, geometric-algebra, Grassmannian, and capacity structures are mathematical presentations of candidate physical organization. Nonzero curvature, holonomy, gradient, or multiplicity is not automatically a reconstruction defect, an identity, or a phenomenological fact. RCC-1 through RCC-9 define the present cRBW local-condition family, several members of which remain provisional.

Particle-like structure and identity are treated as candidate persistent reconstruction profiles. Full identity warrant requires descent adequacy, indexing breadth, separation, RN invariance, properness, and robustness. Registration subsystems are not automatically reflexive observers, and reflexive observers are not automatically conscious.

ADT, TCD, lamination, resonance, and accessible multiplicity provide candidate application variables. Their cosmological, temporal, agential, and phenomenological interpretations remain hypotheses of the relevant downstream theories. In particular, RSE supplies a proposed bridge from reconstructed observer-relative organization to phenomenological claims; cRBW does not establish that the universe or every recursively stable structure experiences.

The resulting framework remains adynamical without treating the source condition as a world-object or the mathematical presentation as ontology. Its central claim is that globally constrained relational coherence can support disciplined mathematical presentations and candidate reconstructions of physical organization without positing source-level temporal production. The remaining work is to establish the necessary correspondence, RN, persistence, and bridge results in MM, GRT finite models, RR, and RSE.

Appendix A – Relational Coherence Constraints

Note on Continuity. The nine RCCs form a representation-dependent application-condition family for the cRBW realization. They do not constitute a second source-level constraint system, and not all are derived from AGC. Satisfying all RCC labels does not by itself prove that a mathematical presentation exists, that local data admit an effective presentation lift, or that a candidate earns phenomenon-level warrant.

The projective coherence baseline $\mathbb{I}_0$ is not an AGC; it is the global normalization that makes the sector capacities $\{J_{\text{rot}}, J_{\text{boost}}, J_{\text{edge}}, J_{\text{face}}, J_{\text{spatial}}\}$ mutually commensurate via the baseline-normalized quantities;

$$J_{\text{rot}} = \Xi_{\text{rot}}/\mathbb{I}_0, \qquad J_{\text{boost}} = \Xi_{\text{boost}}/\mathbb{I}_0, \qquad J_{\text{edge}} = \Xi_{\text{edge}}/\mathbb{I}_0, \qquad J_{\text{face}} = \Xi_{\text{face}}/\mathbb{I}_0,$$
$$J_{\text{spatial}} = \Xi_{\text{spatial}}(x)/\mathbb{I}_0.$$

Only ratios among these J-values are phenomenologically invariant; observers read the *projective class* $(c: h: G: k_B: \lambda_3)$, not any single J_i. Reduced-action notation $\hbar$ is reserved for explicitly reduced-action contexts. This is the cRBW/MM projective specialization of NPRF. It does not exhaust the more general naturality requirement under admissible reindexing.

Purpose. AGC fixes admissibility of the globally consistent relational configuration. In boundary-operator representations, BBP certifies the derived closure expression of that admissibility. $\mathbb{I}_0$ supplies projective normalization and is not an AGC or an ontic constraint.

Role in cRBW → RSE. Within RSE, observer partitions and gradient or multiplicity variables are proposed as phenomenology-reconstruction structures. Their relation to lived experience remains bridge-dependent.

Status. Some RCCs (e.g., curvature budgeting, boundary closure) align closely with established Regge/GA machinery; others (e.g., gradient-mesh matching, identity localization) are presently *structurally motivated postulates*: they supply provisional candidate conditions and behave consistently across examples and toy models but await full derivation or simulation within the mature cRBW scaffold.

What follows. We (i) state what BBP + normalization leave open, (ii) show how RCCs fill that gap, (iii) give the dependency lattice across the nine RCCs, and (iv) record the non-trivial legibility filter and the conceptual total-block uniqueness argument.

Proposition A.1 (Primitive Admissibility and Local Legibility).

Statement. AGC states the source commitment. BBP and the sector-capacity form of NPRF constrain suitable mathematical presentations. They do not determine the local candidate geometry, observer architecture, or phenomenology application. The baseline $\mathbb{I}_0$ is a non-ontic projective normalization and is not part of the constraint tier. These structures are not sufficient to determine the local coherence geometry on which RSE depends.

Justification. BBP supplies a boundary-operator condition but does not, by itself, prove effective global presentation recovery or local candidate existence:

(i) a coherence field Φ with curvature/deficit allocations (Regge/GA);
(ii) lamination/fixpoint structure for identity anchoring (ADT/TCD span);
(iii) the observer partition & registration machinery $\pi_x, \mathcal{R}_C(X), \nabla\mathcal{R}_C$.

RCC-6/7 (gradient-mesh matching and identity localization) are presently structurally motivated postulates; they await derivation from the full Regge–GA machinery or simulation evidence.

Contextual all-at-once closure is read against the global coherence functional $\mathcal{I}_C$, defined in [8], Eq. (2.23), with admissible stationarity $\delta\mathcal{I}_C = 0$ given in [8], Eq. (2.24).

$$\text{AGC} \Longrightarrow \text{source-level admissibility of the global relational configuration.} \qquad \textit{(A.1a)}$$

$$\text{BBP} \Longrightarrow \text{derived closure expression in boundary-operator representations.} \qquad \textit{(A.1b)}$$

Master admissible set.

$$\mathcal{A}_{\text{adm}} := \{\, X \mid X \text{ is AGC-admissible} \,\} \qquad \textit{(A.2)}$$

In boundary-operator representations, $X \in \mathcal{A}_{\text{adm}}$ must also satisfy the BBP closure expression.

Subsequent RCC conditions filter $\mathcal{A}_{\text{adm}}$ to the locally legible subset $\mathcal{A}^*$ (cf. App. D). But no constructive interior. BBP does not fix:

- a coherence field Φ with Regge/GA curvature bookkeeping,
- lamination/fixpoint structure used to anchor identity (ADT/TCD),
- the equivalence/registration structure needed for experience:

$$[X]_{\sim_{\text{RCC}}} := \{\, Y \in \mathcal{A}_{\text{adm}} \mid Y \sim_{\text{RCC}} X \,\}, \quad \mathcal{R}_C(X) := \lvert\, [X]_{\sim_{\text{RCC}}} \,\rvert. \qquad \textit{(A.3)}$$

$$\pi_x : [X]_{\sim_{\text{RCC}}} \to \mathcal{R}_x, \qquad \mathcal{R}_C(X) = \lvert\, \pi_x([X]_{\sim_{\text{RCC}}}) \,\rvert \qquad \textit{(A.4)}$$

Normalization by $\mathbb{I}_0$ renders sector budgets projective, so only ratios among the normalized capacities are phenomenologically invariant. This is NPRF as projective invariance: diagonal capacity ratios are given in [8], Eq. (2.18), and the projective rescaling identity is given in [8], Eq. (2.36).

What RCCs add: application-specific candidate structure. RCCs are structurally motivated application conditions on cRBW mathematical presentations. They do not realize BBP inside the source condition:

- **Curvature and closure:** RCC-3 (Curvature Budget) with BBP.
- **Lamination and identity:** RCC-6 (Gradient Mesh Matching), RCC-7 (Identity Localization), ADT/TCD poles.
- **Global resonance and nontriviality:** RCC-8 (Resonance Matching), RCC-9 (Non-Trivial Gradient).

Together:

$$\mathrm{BBP} \wedge \bigwedge_{i=1}^{9} \mathrm{RCC}_i \Rightarrow \begin{cases} \text{Coherence geometry } (\Phi, \text{Regge/GA closure}) \\ \text{structural coherence cardinality } \mathcal{R}_C(X) \\ \text{Registration } \pi_x, \mathcal{R}_C(X), \nabla\mathcal{R}_C \\ \text{RSE (phenomenological bridge)} \end{cases} \tag{A.5}$$

Interpretation. AGC fixes source-level admissibility. BBP expresses the derived closure form of that admissibility in boundary-operator representations. The RCC lattice fixes local legibility realization: how coherence is laminated, closes locally, and is witnessed. $\mathbb{I}_0$fixes projective normalization, so only ratios among J-values are phenomenologically invariant.

Remark. Not all RCCs are yet derivable from standard RBW formalisms; e.g., Gradient-Mesh Matching and Decoherence Triangulation are heuristic but consistent and remain provisional pending derivation/simulation

Symbolic Dependency Structure of the RCCs. Let A_n denote RCC-n. The following dependency graph is used throughout this paper:

$$\begin{aligned} \mathrm{Dep}(A_1) &= \emptyset, \\ \mathrm{Dep}(A_2) &= \{A_1\}, \\ \mathrm{Dep}(A_3) &= \{A_1, A_2\}, \\ \mathrm{Dep}(A_4) &= \{A_1, A_2, A_3\}, \\ \mathrm{Dep}(A_5) &= \{A_1, A_2, A_3, A_4\}, \\ \mathrm{Dep}(A_6) &= \{A_2, A_3, A_5\}, \\ \mathrm{Dep}(A_7) &= \{A_6\}, \\ \mathrm{Dep}(A_8) &= \{A_5, A_6, A_7\}, \\ \mathrm{Dep}(A_9) &= \{A_3, A_8\}. \end{aligned} \tag{A.6}$$

RCC-8 is named Coherence Resonance Matching throughout. RCC-5 is named Decoherence Triangulation throughout. RCC-9 is the non-trivial gradient legibility condition and does not depend on itself.

Interpretive Note A.2 — Conceptual Uniqueness of the Universe[4]

Statement. Under the cRBW use of "universe" as the total AGC-admissible relational configuration, there is exactly one total block. Apparent multiplicities are internal differentiations or representational partitions of that block, not separate ontic universes. This is a structural argument about how we *use* 'universe' in this framework, not a formal theorem derived from the RCCs alone.

Proof Sketch. cRBW inherits AGC's commitment that one all-at-once relational coherence condition obtains. "Universe" and "total block" are explanatory names for that single source role, not objects derived by the RCC lattice. Multiple mathematical presentations, RCC witnesses, or candidate reconstructions do not imply multiple coactual universes. Conversely, this convention is not a theorem excluding every modal or cosmological multiverse formalism. Such formalisms would enter cRBW as downstream comparison structures unless separately assigned source-level status.

Result. Under the cRBW use of "universe" as the total AGC-admissible relational configuration, there is one total block. RCC fixpoints describe internal local-legibility structures within that block, not separate ontic universes.

RCC–1: Topological Consistency Constraint

RCC-1 is a presentation-relative topological-consistency condition. It requires the particular closure-relevant classes declared by an application to be preserved under the specified admissible maps. It does not require every transformation, local patch, refinement, or indexing to preserve every Betti number, homology group, or homotopy group.

We interpret RCC–1 as requiring that designated closure-complete subregions embed without generating closure-relevant topological contradictions. This condition is not imposed on arbitrary subregions. A contractible local patch of a topologically non-trivial block need not reproduce the global homology or fundamental group. RCC–1 applies only

[4] This uniqueness result resonates with Spinoza's monism, which holds that only one substance of a given kind can exist (*Ethics*, Part I, Propositions 5 & 14) [22] — a philosophical anticipation of the structural closure demonstrated here.

to subregions or readout domains selected as closure-complete for the relevant representation. This preserves global invariants while allowing local variation.

RCC-1 prevents designated closure-complete readout domains from being treated as independently closed ontic totalities, supporting the framework's single-block convention; it does not by itself prove cosmological uniqueness. RCC-1 does not establish cosmological uniqueness and makes no general claim that horizons or black-hole boundaries are merely perspectival.

To ensure topological coherence between any designated closure-complete subregion $\mathcal{C}_{\mathrm{cc}}$ and the global block $\mathcal{B}$, RCC–1 requires that inclusion-induced maps preserve the closure-relevant homology and loop classes tracked by the representation:

$$\forall\, \mathcal{C}_{\mathrm{cc}} \hookrightarrow \mathcal{B}\colon H_k^{\mathrm{clos}}(\mathcal{B}) \subseteq \mathrm{im}(i_*\colon H_k(\mathcal{C}_{\mathrm{cc}}) \longrightarrow H_k(\mathcal{B})) \text{ for relevant closure-tracked } k,\quad i_{\#}\colon \pi_1(\mathcal{C}_{\mathrm{cc}}) \longrightarrow \pi_1(\mathcal{B}) \text{ preserves the closure-relevant loop classes.} \tag{A.7}$$

Here $H_k^{\mathrm{clos}}(\mathcal{B})$ denotes the closure-relevant homology classes of $\mathcal{B}$ tracked by the representation. RCC–1 applies only to designated closure-complete subregions/readout domains, not arbitrary local patches, and:

- $\mathcal{B}$: The relational blockworld manifold (the entire 4D configuration space).
- $\mathcal{C}_{\mathrm{cc}}$: a designated closure-complete subregion, not an arbitrary subregion of $\mathcal{B}$.
- $i : \mathcal{C} \hookrightarrow \mathcal{B}$**:** inclusion of the designated closure-complete subregion/readout domain into the block.
- $i_*\colon H_k(\mathcal{C}_{\mathrm{cc}}) \to H_k(\mathcal{B})$: induced map on homology.
- $i_{\#}\colon \pi_1(\mathcal{C}_{\mathrm{cc}}) \to \pi_1(\mathcal{B})$: induced map on the fundamental group.
- $\pi_1(\cdot)$: fundamental group (first homotopy group).

The realization must state whether the induced maps are required to be injective, surjective, isomorphic on specified classes, or merely compatible with a declared comparison. The word "preserve" is otherwise insufficiently precise.

Dependencies: Within the RCC dependency graph, RCC-1 has no RCC prerequisite. It is not thereby a second foundational axiom alongside AGC.

Lattice Contribution: RCC –1 anchors the base layer of the resonance lattice. Without global topological coherence, constraints involving curvature, identity localization, and decoherence embedding cannot redistribute or be resolved globally.

GA/Regge closure used here corresponds to the vanishing boundary-bivector condition and hinge-sum closure in [8] Eq. (2.18) and App. A Table 11.

RCC –2: Recursive Symmetry Closure Constraint

In representations admitting smooth symmetry actions, relational coherence may be modeled by a closed algebra of internal transformations that preserve the identity and structure of embedded fields. This algebra is not postulated to match observed physics a priori; rather, it is defined by the recursive requirement that all transformations on the block's field configuration are (i) closed under composition, (ii) coherent across scales, and (iii) decomposable into consistent substructures.

In representations admitting smooth symmetry actions, these transformations may be modeled by a Lie algebra, ensuring smoothness and locality of symmetry actions. Where smooth symmetry actions are unavailable, the relevant discrete group, category, or groupoid closure replaces the Lie algebra; the requirement is closed identity-preserving algebraic structure, not smoothness per se.

The recursive compatibility of these symmetries with the other RCCs, particularly topological stability (RCC –1), curvature regulation (RCC –3), and mesh-structure coherence (RCC –6), ensures that identity is preserved not through static assignment but through symmetry-invariant relational embedding.

Any universe capable of sustaining relational coherence must exhibit closed internal transformation structure preserving identity and coherence. In a smooth realization, the admissible transformation structure may be represented by a Lie algebra. Depending on the application, it may admit either a direct-sum decomposition $\mathfrak{g} = \bigoplus_i \mathfrak{g}_i$, into declared independent sectors, or a nested flag $\mathfrak{g}_1 \subseteq \mathfrak{g}_2 \subseteq \cdots \subseteq \mathfrak{g}_n$, supporting hierarchical structure. These are different constructions and must not be described simultaneously as "nested, non-overlapping subalgebras."

If an internal Lie-algebra direct sum is claimed, the required ideal or cross-commutation conditions must be stated. A Lie algebra is required only in smooth realizations; discrete realizations may instead use a group, groupoid, category, or other closed transformation structure.

Formally:

$$\mathfrak{g} \text{ is a Lie algebra} \Rightarrow \forall X, Y \in \mathfrak{g}, \quad [X, Y] \in \mathfrak{g} \tag{A.8}$$

Further, for structure recursion, the global symmetry algebra $\mathfrak{g}$ is composed of distinct nested subalgebras $\mathfrak{h}_i$:

$$\exists\, \mathfrak{h}_1, \mathfrak{h}_2, \ldots, \mathfrak{h}_n \subset \mathfrak{g} : \mathfrak{g} = \bigoplus_i \mathfrak{h}_i\,, \qquad \mathfrak{h}_i \cap \mathfrak{h}_j = \{0\} \text{ for } i \neq j \tag{A.9}$$

Where:

- $\mathfrak{g}$: A Lie algebra, representing the complete set of allowed symmetry transformations within the relational blockworld.
- $X, Y \in \mathfrak{g}$: Generators of transformation within the Lie algebra $\mathfrak{g}$, representing specific symmetry operations.
- $[X, Y] \in \mathfrak{g}$: The Lie bracket (commutator), defined as $[X, Y] = \mathrm{XY} - \mathrm{YX}$, expressing how two symmetry transformations combine.
- $\mathfrak{h}_1, \mathfrak{h}_2, \ldots, \mathfrak{h}_n$: subalgebras $\mathfrak{h}_i$, each contributing structurally and independently to the full symmetry structure.
- $\bigoplus_i \mathfrak{h}_i$: direct sum operator of all subalgebras $\mathfrak{h}_i$, each contributes uniquely, there is no overlap (i.e., $\mathfrak{h}_i \cap \mathfrak{h}_j = \{0\} \text{ for } i \neq j$)

We do not require a specific Standard Model decomposition (e.g., $\mathfrak{su}(3) \oplus \mathfrak{su}(2) \oplus \mathfrak{u}(1)$). Instead, RCC–2 demands that the universe's symmetry content admits either a commuting-sector decomposition and/or a hierarchical flag sufficient to stabilize identity classes on the coherence lattice. Concretely, the closure we require is realized as *rotor/versor invariance* in GA (rotor conjugation preserves grade and rotor invariants), exactly as used in [8] §2.2.2 and App. A Eqs. (A.1–A.3).

This demands:

- a Lie algebra where the selected realization requires smooth continuous symmetry actions.
- **closure** under commutation to prevent symmetry leakage.
- **subalgebra decomposition** to enable structure within structure.

In non-smooth or discrete representations, the corresponding requirement is closure of the relevant identity-preserving discrete group, category, or groupoid. It means that:

- $\mathfrak{g}$ is internally consistent and re-constructible from these nested, non-overlapping symmetry structures.
- This avoids assuming a specific Standard Model decomposition like $\mathfrak{su}(3) \oplus \mathfrak{su}(2) \oplus \mathfrak{u}(1)$, while still requiring a layered or modular symmetry closure.

Where:

- $\mathfrak{su}(3)$: The Lie algebra corresponding to the Special Unitary group SU(3), governing the strong nuclear force (color symmetry).

- $\mathfrak{su}(2)$: The Lie algebra corresponding to the Special Unitary group SU(2), governing weak nuclear interactions (weak isospin symmetry).
- $\mathfrak{u}(1)$: The Lie algebra corresponding to the Unitary group U(1), governing electromagnetism (hypercharge symmetry).
- $\oplus$: Direct sum, indicating that the algebra is constructed by combining these symmetry groups independently.

Depends on: RCC –1 (Topological Consistency Constraint).
RCC –2 is meaningful only once the global topological structure of the relational blockworld has been defined and stabilized (by RCC –1).

RCC –2 contributes critically to the resonance lattice by:

- Establishing the necessary algebraic structure to consistently embed particle fields and gauge interactions within the blockworld.
- Ensuring that all subsequent constraints involving curvature, observer coherence, decoherence, and identity fields preserve these symmetries.
- Providing the foundational symmetry conditions necessary for RCC –3 (Curvature Budget), RCC –4 (Observer Coherence), and ultimately RCC –6 (Gradient Mesh Matching).

It forms a critical coherence node, supplying one candidate symmetry-compatibility condition for physical realizations of cRBW.

RCC –3: Curvature Budget Constraint

RCC-3 is an additional cRBW/Regge application postulate placing a declared finite budget on the chosen curvature diagnostic. It is not an ontic consequence of BBP.

Discrete (Regge) statement
Let $\mathcal{H}$ be the set of hinges, ϵ_h the deficit at hinge h, and A_h its capacity (dual area / coherence weight). An admissible configuration satisfies a global budget such as:

(L1) – Absolute (L_1) budget:

$$\sum_{h\in\mathcal{H}} A_h \mid \epsilon_h \mid \ \leq \kappa \qquad \textit{(A.10a)}$$

(L2) – Quadratic (L_2) budget:

$$\sum_{h\in\mathcal{H}} A_h\,\epsilon_h^2 \;\le \kappa \qquad \textit{(A.10b)}$$

where κ is a finite, baseline-normalized curvature budget (dimensionless after division by $\mathbb{I}_0$). Either L_1 or L_2 can be used depending on the representational or simulation context; both express the same local budget idea: bounded total curvature/tension magnitude. The hinge and deficit definitions are taken from MM [8], Eqs. (2.12)–(2.13). The L_1 and L_2 inequalities (A.10a)–(A.10b) are introduced in this paper as RCC-3 realization-specific budget conditions; they are not equations from MM.

Interpretation and consistency notes

- The budget excludes candidates whose chosen curvature diagnostic exceeds the declared finite bound. It does not establish a general source-level prohibition on singular structure, and no general conclusion about black-hole horizons or singularities follows from this budget alone.
- RCC–3 does not by itself prohibit global flatness; the non-triviality requirement belongs to RCC–9 (Non-Trivial Legibility Filter / Non-Trivial Gradient Requirement). RCC–3 only bounds curvature; RCC–9 later excludes the degenerate $\nabla\mathcal{C} \equiv 0$ case.
- The budget is *projective*: only ratios with respect to $\mathbb{I}_0$ matter in phenomenology (NPRF as projective invariance).

Gloss (objects)

- $\mathcal{B}$: global relational configuration (manifold or simplicial complex) consistent with BBP.
- ϵ_h: Regge hinge deficit (coherence curvature) at hinge h.
- A_h: hinge capacity / weight (dual area or coherence allocation).
- κ: finite global curvature budget (baseline-normalized).

Derivative clause — RCC–3a (Curvature Displacement Bound)
For candidate profiles compared along a declared indexing, refinement, or reconstruction relation, the change in the selected curvature diagnostic may be bounded by

$$\Delta(A_h\,\epsilon_h) \le \delta_\kappa \text{for all laminated steps} \qquad \textit{(A.11)}$$

with δ_κ a small, baseline-normalized tolerance derived from κ. This ensures that what appears as sequential structural change across laminations is a re-expression within adynamical closure, not drift of the block. This is an approximate-stability condition, not a temporal displacement law.

Depends on: RCC–1 (Topological Consistency) and RCC–2 (Recursive Symmetry Closure). Without stabilized topology and symmetry, curvature bookkeeping is ill-posed.

Lattice contribution
RCC–3 confines the admissible set to finite, coherent configurations, underwrites resonance stability (with RCC–8), and supplies the gradient substrate on which RCC–6 (Gradient-Mesh Matching) and RCC–7 (Identity Localization) are meaningful.

RCC –4: Observer-Coherence Constraint

Terminology note. In RCC-4, "observer" is legacy shorthand for an access, apparatus, frame, or registration subsystem. It is not yet the reflexive GRT observer defined by identity, internal access, reconstruction, record, and self-location.

RCC-4 requires localized data associated with a registration subsystem to remain compatible, within the declared defect, with the surrounding mathematical presentation. A coherence-density threshold may define a candidate subsystem boundary in this realization; it is not a universal definition of observerhood.

An observer $\mathcal{O}_k$ is a subregion where recursive coherence density exceeds a threshold ϵ_o, bounded by lamination discontinuities. Measurement is modeled as a boundary projection onto the observer shell $\partial\mathcal{O}_k$, yielding a gradient-normalized relational fixpoint.

To express compatibility, let $i: \mathcal{O}_k \hookrightarrow \mathcal{B}$ be the inclusion. RCC–4 requires that the pullback of the global coherence condition matches the local condition on the observer boundary:

$$i^*(\mathcal{C}_\Phi) \equiv \mathcal{C}_\Phi \mid_{\mathcal{O}_k} \Longrightarrow \mathcal{O}_k \vDash \mathcal{C}_\Phi \text{ (observer boundary is globally consistent),} \qquad (A.12)$$

$\Delta_{\text{obs}}(i^*, \Gamma_M \Gamma_O) \preceq \varepsilon_{\text{obs}}$ for approximate applications.

Where:

- $i^*(\mathcal{C}_\Phi)$ denotes the pullback of the global coherence condition $\mathcal{C}_\Phi$ to the observer region $\mathcal{O}_k$.
- $\mathcal{B}$: global relational configuration (manifold or simplicial complex) consistent with BBP.
- $\mathcal{O}_k$: A localized observer or measurement subsystem, represented as a sub-region or embedding within the manifold $\mathcal{B}$.
- $\partial\mathcal{O}_k$: observer boundary (lamination shell).
- $\vDash$: A formal symbol meaning "satisfies" or "is consistent with."
- $\mathcal{C}_\Phi$: global coherence condition induced by the RCC lattice; i^*denotes pullback along inclusion; $\vDash$= "satisfies."

Interpretation

- "Observer" in this RCC means an access or registration subsystem. Particle systems, apparatuses, and reference frames are not reflexive observers merely by serving as indexings.
- Each observer's boundary conditions must be the restriction of the global coherence condition—no isolated or contradictory perspectives.

The same compatibility shows up as admissible rotor action and small-step Grassmannian adjacency in the MM formalism (see [8] Eqs. (4.3–4.6)).

This constraint ensures there are no isolated, contradictory observers or isolated "perspectives" that fail to integrate with the global relational structure.

This condition forms the relational analog of a gauge consistency requirement: observers are not entities *in* spacetime, but laminated field regions whose coherence must respect the global constraint landscape.

Regge/GA compatibility (local matching)
In a Regge discretization, $\mathcal{O}_k$ corresponds to a cluster of simplices whose internal hinge deficits match those on faces shared with the exterior:

$$\forall \text{ shared faces } f\text{:} \quad \sum_{h \subset f \cap \mathcal{O}_k} A_h \, \varepsilon_h \;=\; \sum_{h \subset f \setminus \mathcal{O}_k} A_h \, \varepsilon_h \qquad (A.13)$$

ensuring boundary coherence between observer and environment.

Depends on: RCC –1 (Topological Consistency), RCC –2 (Symmetry Closure), RCC –3 (Curvature Budget).

RCC –4 only becomes meaningful once global topology, symmetry structure, and curvature budgets are in place, allowing coherent observer embeddings to be defined.

RCC –4 crucially enriches the lattice by:

- **Ensuring observational consistency**: Tests whether local measurement or access data remain compatible with the declared presentation within the specified defect.
- **Maintaining global-to-local coherence**: Observers form stable "reference frames" that remain consistent with the global relational structure.
- **Enabling decoherence and identity fields**: Establishes the basis for RCC –5 (Decoherence Triangulation) and RCC –7 (Identity Field Localization) to define meaningful observer-dependent structures and decoherence conditions.

RCC-4 supplies an access-consistency condition; reflexive observer warrant remains downstream.

RCC –5: Decoherence Triangulation Condition

RCC-5 specifies one triangulated interface model for classical-like candidate regions. It requires declared overlap continuity; it does not prohibit local boundaries or claim that every decoherence domain must be represented as a union of simplices.

Triangulated embedding

There exists a global triangulation $\mathcal{T}$ of the block such that each decoherent region $\mathcal{D}_i$ is realized as a union of simplices and its interfaces align with simplex faces:

$$\forall\, \mathcal{D}_i \exists\, \mathcal{T}: \mathcal{D}_i \subseteq |\, \mathcal{T}\, |, \qquad \partial \mathcal{D}_i \subseteq \bigcup_{f \in \Delta(\mathcal{T})} f \tag{A.14a}$$

Local boundary hand-off (Regge/GA form)

For any interface face f shared by adjacent regions U and V,

$$\sum_{h \subset f \cap U} A_h\, \varepsilon_h \;=\; \sum_{h \subset f \cap V} A_h\, \varepsilon_h \tag{A.14b}$$

so the coherence residue (capacity-weighted hinge deficits) matches across f. This realizes boundary consistency: the declared interface mismatch vanishes or remains within tolerance. Face-to-face continuity of mixed capacities and flux equalization are represented by the shared-face continuity condition in [8], Eq. (2.27), with averaging and chain-composition forms given in [8], Eqs. (2.26), (2.28), and (2.30)–(2.31).

Observer-relative decoherence gate (covariance statement)

Let $\mathcal{C}$ be the coherence bundle over admissible partitions and g the canonical metric on the coherence manifold. For an observer partition x, with projection $P_x: T\mathcal{C} \to T_x\mathcal{C}$,

$$\Delta_{\mathrm{decoh}}(x) := \|\; \nabla \mathcal{C}_{\mathrm{obs}}(x) - P_x \nabla \mathcal{C}_{\mathrm{sys}} \;\|_g < \varepsilon_{\mathrm{tri}} \tag{A.15}$$

$\Delta_{\mathrm{decoh}}(x)$ is a scalar under reparameterizations of x (frame-free, consistent with NPRF's projective invariance).

The threshold $\varepsilon_{\mathrm{tri}}$ is an application parameter unless a separate derivation from the other structures is supplied. The RCC dependency graph alone does not derive its numerical value.

Interpretation

- A classical-like readout candidate is represented by coherently embedded regions whose interfaces satisfy the declared hand-off condition.
- The scalar gate (A.15) ensures that observer-relative decoherence respects global resonance and gradient requirements, so "classical patches" never violate global closure.

Depends on: RCC–1 (Topological Consistency), RCC–2 (Recursive Symmetry Closure), RCC–3 (Curvature Budget), RCC–4 (Observer Coherence).

Lattice contribution
RCC–5 maintains global-to-local coherence by enforcing boundary consistency of classical-like regions, and prepares the ground for RCC–6 (Gradient-Mesh Matching) and RCC–7 (Identity Localization), where stable identities require precisely these coherent triangulated interfaces.

RCC-5 supplies a candidate bridge between global-presentation compatibility and local classical-like readout.

RCC –6: Gradient Mesh Matching

RCC-6 supplies a candidate mesh-matching condition relevant to persistent identity reconstructions. It does not establish that persistent identities arise from the mesh condition alone. RCC-6 is used here as a structurally motivated application postulate pending full Regge–GA derivation; see §6.5. Identities are represented as gradient meshes; interlaced, RCC-admissible structures of coherent field gradients within the block.

For any designated closure-complete subregion $\mathcal{C}_{cc} \subset \mathcal{B}$, the configuration of gradient meshes must preserve topological correspondence across every interface; this is not imposed on arbitrary local patches. In Regge terms, capacity-weighted hinge deficits associated with shared faces must remain compatibly matched, so curvature transfer across domains does not introduce discontinuities in global mesh coherence. Thus, local reallocations of curvature (coherence accumulation or deficit redistribution) remain globally compatible without violating adynamical closure (BBP).

Identity as a topological class of meshes
Let ϕ be a scalar/relational coherence field and $\nabla\phi$ its gradient. A homotopy class of admissible gradient meshes supplies one candidate topological identity signature:

$$\forall p \in \mathcal{B}: \nabla\phi(p) \rightsquigarrow G_n^{\text{mesh}} \ (\text{global mesh structure}) \Rightarrow$$
$$\text{identity} \equiv \text{homotopy class } [\nabla\phi] \in \pi_0(\text{Meshes}) \ (\text{or appropriate class space}) \qquad (A.16)$$

i.e., two realizations represent the same identity if they are deformable into one another through RCC-admissible re-expressions (no cutting of strands or boundary violation).

Deformability through RCC-admissible re-expressions is necessary for this signature to remain unchanged; it is not sufficient for full identity warrant.

Where:

- $\mathcal{B}$: global relational configuration (manifold or simplicial complex) consistent with BBP.
- p: is an arbitrary point, or event, within the blockworld manifold $\mathcal{B}$. It is a local address in the global 4-D configuration: one spacetime-like coordinate of the overall relational structure. At each p, the gradient $\nabla\phi(p)$ describes the local direction and magnitude of the coherence field ϕ—that is, how relational tension or curvature changes infinitesimally near that location.
- $\mathcal{M}_n$: an n-strand gradient-mesh structure (formal carrier of identity).
- A_h: hinge capacity; ϵ_{h}: hinge deficit (coherence curvature).
- $\pi_0(\mathrm{Meshes})$: path-components (homotopy classes) of admissible mesh configurations.

Interface matching conditions

Regge (face-wise capacity matching): for any face f shared by adjacent subregions U, V, (see Eqs. (A.14b)) ensuring curvature/coherence transfer is balanced across f.

GA/Grassmannian (small-angle continuity): let Θ_f be the vector of principal angles between the mesh-supporting subspaces on the two sides of f; then $\| \Theta_f \| \leq \tau_{\mathrm{id}}$ with τ_{id} a baseline-normalized tolerance derived from the RCC–3 budget and RCC–8/9 resonance/gradient gates. This expresses rotor-compatible (symmetry-preserving) continuity of the mesh. GA/Grassmannian (small-angle continuity; ρ-warp): let θ be the vector of principal angles between the mesh-supporting subspaces on the two sides of the face; then $\|\theta\|_\rho^2 \leq \tau$, where the weight ρ encodes local lamination/curvature (see [8] §2.4.2, App. A (A.7) and the ρ-warped metric lemma (A.14–A.15)).

Interpretation

- Field gradients thread coherent meshes that persist under RCC-admissible re-expressions; these meshes are identities.
- Stability is not metric evolution but recursive alignment within the triangulated coherence field, consistent with the global curvature budget and boundary consistency.

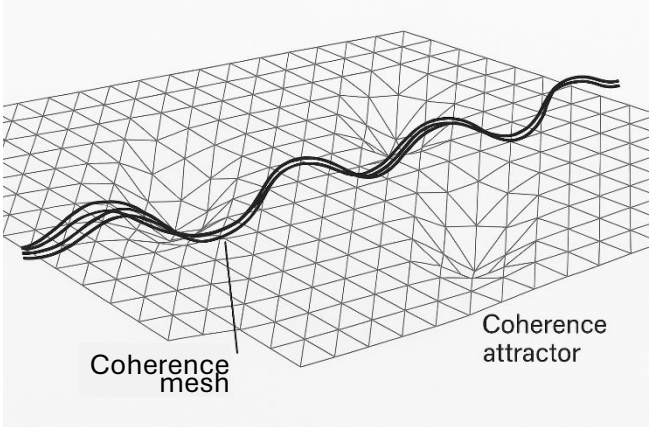
Depends explicitly on: RCC–3 (Curvature Budget), RCC–5 (Decoherence Triangulation Condition); implicitly on: RCC–1,2,4.

Curvature bookkeeping and coherent triangulated interfaces are prerequisites for well-defined gradient meshes.

Lattice contribution

- **Topological definition of persistence:** the mesh construction supplies candidate identity representatives within the declared presentation.
- **Stability & persistence:** (A.15a–b) supply the continuity gates that keep identities intact under local redistribution of curvature.
- **Global-to-local linkage:** meshes provide the structural step linking global constraints (topology, symmetry, curvature, observer coherence) to localized observables and stable frames (preparing for RCC–7: Identity Localization).

Figure 1: Triangulated Coherence Basin and Gradient Mesh Stability (RCC–6).



This illustration depicts a 2D manifold embedded in 3D space, discretized using a Regge-style triangulation. Localized deformations in the simplices, visible as curvature or "pinching", represent deficit angles, which accumulate to define a coherence basin outlined transparently above. Within this basin, gradient meshes (shown as overlaid contour-like vectors) maintain topological stability by threading through regions of consistent relational tension. The mesh structure remains preserved not by metric evolution, but through recursive alignment within the deformed triangulated field, illustrating the principle of RCC –6: attractors must preserve topological identity under gradient-modulated curvature.

RCC-6 provides a candidate topological link from presentation-level geometry to identity reconstruction; it does not translate source-level coherence directly into identity.

RCC –7: Identity Field Localization

RCC-7 proposes one optional vector-field realization of candidate identity localization. In this realization, a localized candidate may be required to satisfy a declared flux-balance condition and a circulation condition. These equations are neither necessary nor sufficient for identity in general, and the relation $\nabla \times F = J$ does not by itself establish stability or attractor behavior.

$$\exists \mathcal{A} \subset \mathcal{B}, \quad \forall x \in \mathcal{A}, \quad \nabla \cdot \overrightarrow{F_x} = 0 \wedge \nabla \times \overrightarrow{F_x} = \overrightarrow{J_x} \Rightarrow \text{Stable Attractor} \qquad (A.17)$$

Where:

- $\mathcal{B}$: the global relational blockworld manifold (entire 4-dimensional *relational space* consistent with BBP).
- $\mathcal{A}$: a subset of the manifold $\mathcal{B}$ within which stable attractors can form. It is a localized region that exhibits stable, persistent identity conditions.
- x: points within the attractor region $\mathcal{A}$.
- $\overrightarrow{F_x}$: the local coherence flux vector field (or relational coherence field) defined at points x, representing relational gradients and coherence tensions that form the attractor.
- $\overrightarrow{J_x}$: the "current-like" vector field representing stable and continuous rotational structure. It's analogous to current density in electromagnetism and indicates how fields form stable loops or closed structures.
- $\nabla \cdot \overrightarrow{F_x}$: divergence of the field $\overrightarrow{F_x}$, measuring how much the field "flows outward" (sources) or "inward" (sinks) at point x. $\nabla \cdot \overrightarrow{F_x} = 0$ ensures stable, self-contained fields; no sources or sinks.
- $\nabla \times \overrightarrow{F_x} = \overrightarrow{J_x}$: curl condition expressing recursively stable circulation; $\vec{J}_x$ is a coherence-current density preserving loop integrity.
- "Stable Attractor": A self-consistent and persistent localized region where the relational fields satisfy the above conditions, forming coherent, stable identities (particles, observers, etc.).

Additional boundary conditions, persistence across indexings, separation from incompatible candidates, properness, RN invariance, and robustness are required before the candidate earns identity warrant.

Quantitatively, persistence may be read off the rotor-invariant coherence scalar for a laminated blade [8] Eq. (4.1), which remains constant under admissible rotor fields.

Specifically, this constraint stipulates that there must exist certain subsets (regions) of the blockworld manifold where fields form stable and localized attractors. Within these attractors, fields must satisfy the mathematical conditions analogous to classical vector-field identities:

Interpretation

- The divergence condition is a local flux-balance condition within this realization.
- The curl relation specifies rotational or circulation structure; it does not prevent decay by itself.
- Together they define a candidate localized field profile, not an ontic identity.

Explicitly depends on: RCC –6 (Gradient Mesh Matching), as stable attractors require coherent gradient meshes for stable, persistent localization.

Implicitly depends on:

- RCC –1 (Topological Consistency),
- RCC –2 (Symmetry Closure),
- RCC –3 (Curvature Budget),
- RCC –4 (Observer-Coherence),
- RCC –5 (Decoherence Triangulation),

Lattice contribution

RCC-7 introduces candidate localized profiles that may contribute to particle-, field-, or observer-related identity reconstructions. These attractors:

- Preserve continuity and self-containment through divergence-free flux.
- Maintain recursive rotational stability through bounded curl structure.
- Provide the structural prerequisites for RCC–8 (Resonance Stability), where such attractors interact coherently across the global block.

RCC-7 supplies one bridge from candidate geometry to localized persistence; object and observer warrant remains downstream.

RCC –8: Coherence Resonance Matching

RCC –8 specifies how multiple Relational Coherence Constraints (RCCs) must collectively achieve mutual coherence, referred to here as resonance, to form a permissible, stable global configuration. Local coherence patterns must align in phase and structure with the surrounding field's resonance modes. Misalignment beyond the declared threshold excludes a candidate from the RCC-8 class; it does not induce a physical re-expression.

$$\forall A_i, A_j \in \Lambda, \quad \mathcal{R}(A_i, A_j) \geq \varepsilon \Rightarrow \text{Configuration Permissible} \tag{A.18}$$

Where:

- Λ: The set of all Relational Coherence Constraints (RCCs) $\Lambda = A_{\mathbf{1}}, \ldots, A_{\mathbf{9}}$. Each A_i represents one constraint within the global RCC lattice.
- A_i, A_j: Individual RCCs drawn from the global set Λ.
- $\mathcal{R}(A_i, A_j)$: The coherence resonance function, measuring how compatible or mutually coherent two given RCCs are within a specific configuration. Higher values indicate greater compatibility or resonance.
- ε: A predefined minimal threshold for coherence resonance. Only configurations achieving resonance values greater than or equal to this minimal threshold ($\boldsymbol{\varepsilon}$) are considered permissible.
- "Permissible Configuration": A global configuration that satisfies the minimal resonance conditions across all relevant RCCs, ensuring global coherence and relational consistency.

Formally, we define the resonance function $\mathcal{R}(A_i, A_j)$ as the normalized structural coherence between laminated fields across adjacent constraints:

$$\mathcal{R}(A_i, A_j) = \frac{\langle \Phi_i, \Phi_j \rangle}{|\Phi_i| \cdot |\Phi_j|} \tag{A.19}$$

Where Φ_i and Φ_j is the field representation associated with constraint nodes $A_{\boldsymbol{i}}$ and $A_{\boldsymbol{j}}$, and $\langle \cdot, \cdot \rangle$ denotes an inner product in coherence space.

Normalization fixes

$$\mathcal{R}(A_i, A_j) \in [0,1] \tag{A.20}$$

with 1 = perfect phase/structural alignment and 0 = complete incoherence.

In [8], the same role is captured by off-diagonal mixed-capacity terms $K_{\alpha\beta}$, whose stationarity condition is given in [8], Eq. (2.22). Diagonal capacity ratios fix the invariants [8], Eq. (2.18), while the full capacity tensor $\Xi_{\alpha\beta}$ is given in [8], Eq. (2.20), with matrix form in [8], Eq. (2.29).

Interpretation

- **Mutual support:** The lattice is coherent only when all active RCCs resonate above ε_{res}; each constraint strengthens the others.

- **Emergent threshold:** ε_{res} is a declared, estimated, or model-derived threshold. The sinusoidal inflection-point example is illustrative and does not establish a universal emergent threshold. It corresponds to the inflection point of the resonance curve $\mathcal{R}(\Delta\phi)$ where $\partial^2\mathcal{R}/\,\partial(\Delta\phi)^2 = 0$. For canonical sinusoidal coupling $\mathcal{R} = \cos^2(\Delta\phi/2)$, this yields $\Delta\phi \approx 60^\circ \Rightarrow \varepsilon_{\text{res}} \approx 0.5$; illustrative, not prescriptive.
- **Illustrative numerical check:** For identity-mesh B and boundary-mesh W with $\langle B^\dagger W\rangle_0 = 0.92, \mathcal{R} = 0.92 \geq \varepsilon_{\text{res}} = 0.85 \Rightarrow$configuration permissible.

This constraint ensures the entire lattice of RCCs forms a mutually supportive, internally consistent relational structure.

RCC–8 directly depends on RCC–5, RCC–6, and RCC–7. Because those constraints themselves depend on earlier RCCs, RCC–8 indirectly inherits the prior dependency chain, but its direct dependency set is $\{A_5, A_6, A_7\}$.

RCC –8 represents the culmination of all prior constraints. It requires that global coherence, boundary closure, identity localization, gradient meshes, decoherence triangulation, observer coherence, curvature budgets, symmetry closure, and topological consistency be already defined and stabilized.

RCC –8 significantly enhances and integrates the resonance lattice by:

- **Ensuring global-to-global coherence**:
  Enforces internal consistency among all RCCs, preventing contradictions or weak coherence across global constraints.
- **Forming a stable fixpoint lattice**:
  Each constraint supports and stabilizes the others, creating a stable fixpoint lattice of coherent resonance rather than isolated constraints.
- **Preparing for stable gradient existence (RCC –9)**:
  Ensures conditions are suitable for defining nontrivial global gradient fields, finalizing the cRBW as a coherent, stable relational manifold.

RCC-8 is the terminal compatibility condition in the present RCC dependency graph. It organizes mutual consistency among active local application conditions; it is not a global source-level anchor.

RCC –9: Non-Trivial Gradient Requirement

RCC-9 is the non-trivial-legibility filter for the present cRBW application. It excludes globally uniform candidates from the non-trivial readout class; it does not declare them source-level impossible.

$$\exists x \in \mathcal{B} \text{ such that } \| \nabla\Phi(x) \| > 0 \Longrightarrow \mathrm{Legible}_{\mathrm{nt}}(\mathcal{B}). \qquad (A.21)$$

Where:

- $\nabla\Phi$: The gradient of the global coherence field Φ, defined across the blockworld $\mathcal{B}$. Φ encodes field intensity, coherence density, or structural tension.
- $x \in \mathcal{B}$: Any point x within the blockworld manifold $\mathcal{B}$.
- $\nabla\Phi \neq 0$: The field Φ must vary somewhere on the declared comparison domain. This is a necessary condition for the present non-trivial-legibility criterion, not a sufficient condition for a phenomenon.
- $\mathrm{Legible}_{\mathrm{nt}}(\mathcal{B})$: the condition that $\mathcal{B}$ supports a non-trivially legible readout.

In our mathematical model [8], non-triviality is witnessed by a non-zero scalar coherence field $\mathcal{C}$ on some patch [8], Eq. (2.16)–, and by the existence of at least one mixed-capacity chain satisfying the entanglement/decoherence threshold condition in [8], Eq. (2.32).

This constraint functions as the gatekeeper of non-trivial local legibility:

- Only readouts with structural tension, manifested through non-zero gradients somewhere in the block, are non-trivially legible.
- It enforces that any non-trivially legible readout must include variation, structure, or curvature somewhere in the block. It does not require nonzero gradient at every point.
- Without this, the present realization supplies no candidate attractor, identity, or observer-related structure.

RCC–9 depends directly on curvature budgeting and resonance matching, represented by $\mathrm{Dep}(A_9) = \{A_3, A_8\}$. It does not depend on itself. Specifically:

- **Topological constraints** (RCC –1) define the closure-relevant representational domain over which Φ is read.
- **Curvature, mesh, and boundary constraints** (RCC –3, RCC –6) guarantee that the gradient field is both shaped and closed.
- **Observer embedding and identity localization** (RCC –4, RCC –7) ensure that Φ has functional relational interpretations at the declared scales.
- **Coherence resonance** (RCC –8) guarantees that this gradient field is not random but synchronized across the constraint lattice.

RCC –9 acts as the terminal resonance criterion in the lattice:

- It closes the loop of RCCs by enforcing the final condition under which a configuration is admitted into non-trivial local legibility.

- It prevents trivial, flat universes that may otherwise satisfy all mathematical constraints but lack meaningful internal structure.
- It acts as an irreducible attractor requirement: the field must fold, curve, and vary across the blockworld. Variation supplies a necessary non-triviality condition. It does not by itself give rise to phenomena, particles, observers, or identities.

Appendix B – Gradient-Free Configurations as Non-Trivial-Legibility Nulls

Let us formalize the claim: a purely static configuration is a null case for non-trivial legibility because it satisfies closure only trivially while failing the RCC readout lattice, especially RCC–9. BBP may remain satisfied trivially in the flat case, but BBP together with RCC-9 rules it out as a non-trivially legible readout.

We use the coherence functional $\mathcal{I}_C$ from MM [7], the scalar coherence field $\mathcal{C}$, and the RCC dictionary in Appendix A as the formal anchors for what follows.

B.1 Gradient-Free Configuration

A purely static configuration is a field/mesh assignment on the relational block such that:

- $\nabla\Phi \equiv 0$ globally (no coherence gradients),
- no topological asymmetries or defects exist,
- no curvature/deficit is present (all dihedral/solid-angle sums close exactly),
- no boundary spans (ADT/TCD) segment or anchor the configuration.

Intuitively, the configuration is smooth, featureless, and fully symmetric across all admissible degrees of freedom.

(MM [8] alignment: "no coherence gradients / curvature" ↔ $\mathcal{C} = 0$ and all hinge deficits $\delta_h = 0$ ([8] Eqs. (2.12–2.13, 2.24–2.27)); "no boundary spans" ↔ BBP holds trivially; "no lamination/phase" ↔ no admissible Grassmannian adjacency under the ρ-warp ([8] App. A (A.7), Lemma (A.14–A.15)).

B.2 Evaluation against RCCs

Under the RCC lattice, such a configuration cannot pass the non-trivial-legibility filter:

- **RCC–9 (Non-Trivial Gradient):** fails by definition because $\nabla\Phi = 0$, all hinge deficits vanish, and no non-trivial RCC-eligible readout is available. This static-null case is evaluated relative to MM's coherence functional and stationarity structure, [8] Eqs. (2.23)–(2.24), not derived directly from Eqs. (2.24)–(2.27). The ρ-warped distance anchor is [8] Eq. (2.9).
- **RCC–8 (Coherence Resonance Matching):** fails because no admissible resonance pattern is available absent structure/phase. Off-diagonal $K_{\alpha\beta}$ binding is null; the mixed-capacity stationarity condition [8], Eq. (2.22), has no non-trivial support.
- **RCC–7 (Identity Field Localization):** fails (no minima/basins to localize identity surfaces. No rotor-invariant blade scalar witness [8] Eq. (4.1))

- **RCC–6 (Gradient-Mesh Matching):** undefined/degenerate (no gradient field to match across laminations. No small-angle continuity under ρ-warp; [8] App. A Eq. (A.7), Lemma Eqs. (A.14–A.15))
- **RCC–5 (Decoherence Triangulation):** fails (no distinguishable decoherence events without gradients/structure. No face hand-off; the shared-face continuity condition [8], Eq. (2.27), is not meaningfully activated.
- **RCC–4 (Observer-Coherence):** fails (no partition/registration possible without structure. No admissible rotor/adjacency chain [8] (4.3–4.6))
- **RCC–3 (Curvature Budget):** degenerate because all deficits vanish and no curvature allocation is present. The local L_1/L_2 budgets defined in Appendix A evaluate trivially; this is not a counterexample to non-triviality, it is the trivial case.
- **RCC–2 (Symmetry Closure):** trivially satisfied (maximal symmetry), but insufficient on its own.
- **RCC–1 (Topological Consistency):** holds only trivially (no features to be consistent about); by itself it is far from sufficient.

Hence the configuration cannot satisfy $\bigwedge_{i=1}^{9} \mathrm{RCC}_i$.

B.3 Structural Null Equivalence

Let $\mathcal{A}$ denote the set of realizable cRBW configurations:

$$\mathcal{A}^* = \{\, S \mid \mathrm{BBP} \wedge \bigwedge_{i=1}^{9} \mathrm{RCC_i}(S) \ \text{holds} \,\} \tag{B.1}$$

Define null-equivalence by the predicate $N(S)$ iff $S \notin \mathcal{A}^*$. For a purely static configuration S_0 as in §B.1,

$$S_0 \notin \mathcal{A}^* \Longrightarrow \mathcal{N}(S_0)\ (\text{no non} - \text{trivial legibility weight within cRBW}) \tag{B.2}$$

Corollary (Projective neutrality)
Because the coherence-functional representation is homogeneous and phenomenology depends only on sector ratios under NPRF, any common rescaling by $\mathbb{I}_0$ leaves the conclusion unchanged. Diagonal capacity ratios are given in [8], Eq. (2.18), while NPRF projective rescaling is given in [8], Eq. (2.36). No projective choice can turn $\mathcal{C} = 0$ into an admissible non-trivial readout.

Interpretation: failing the RCC lattice means no resonance under constraint; such a configuration does not enter the class of admissible non-trivial readouts.

Proposition B.1 (Exclusion of the trivial block)
If $\nabla\mathcal{C} \equiv 0$ globally and all curvature/gradient diagnostics vanish, then no non-trivially legible RCC readout exists.

Proof (sketch): $\nabla\mathcal{C} \equiv 0$ directly violates RCC–9, collapses RCC–8 (no resonance), and—under BBP—cannot realize non-zero loop-compatible coherence; hence only the void case remains, which is excluded by the non-trivial-legibility filter (App. A, (A.6)/(A.20)). See also §5 ("Gradient Necessity").

B.4 Measure-theoretic status

No measure on the candidate-function or presentation space has been defined in this paper. The gradient-free class therefore must not be called a measure-zero set. If a later realization supplies a measure, the measure, prevalence, or codimension of that class becomes a theorem question.

B.5 Regge Analogy

In Regge calculus, zero deficit across all hinges implies zero curvature. But cRBW (via RCC–3 and RCC–9) requires bounded yet non-trivial curvature/gradient allocation. A fully flat triangulation yields no localized relational anchors, hence no coherent observers, events, or field properties.

In our [8] terms: $\epsilon_h = 0$ for all hinges ([8] Eqs. (2.12–2.13)) corresponds to the trivial curvature/coherence diagnostic in the Regge scaffold. This static-null case is evaluated relative to MM's coherence functional and stationarity structure, [8] Eqs. (2.23)–(2.24), together with the local RCC-3 budget forms defined in Appendix A of this paper.

A flat Regge presentation may be mathematically legitimate; it merely fails the cRBW RCC-9 non-trivial-legibility criterion. No conclusion about observerhood, events, or source-level existence follows without the remaining reconstruction architecture

B.6 Conclusion

Lemma B.1 (Quantitative non-triviality)
In the primary realization used in §5.5, a candidate satisfies the declared non-triviality test when both:

1. the selected scalar or curvature diagnostic is nonzero on at least one declared patch; and
2. at least one mixed-capacity chain satisfies the declared threshold condition.

Alternative sufficient-witness conventions must be stated as different realizations

, i.e. $\prod_h K_{\alpha\beta}[h] > \lambda_{\text{dec}}$ as a schematic expression of the entanglement/decoherence threshold condition in [8], Eq. (2.32).

The candidate is functionally null only relative to the declared non-trivial-legibility protocol. It is not "nothing" and is not thereby source-level impossible.

Corollary B.2
The truth of Lemma B.1 is invariant under common re-scalings by $\mathbb{I}_0$, with diagonal capacity ratios given in [8], Eq. (2.18), and NPRF projective rescaling invariance given in [8], Eq. (2.36).

The claim holds structurally: a purely static configuration has no coherence gradient, no identity field, and no observational frame. It is functionally indistinct from nothing at the level of non-trivial legibility—not because it is ontologically impossible, but because it fails to enter recursive coherence readout. This aligns with this document's local-legibility principle: to be non-trivially legible is to resonate under constraint. This matches the Mathematical Model's [8] rotor-field descent and weak-convergence results, which make the same null case explicit in the discrete program ([8] App. F, "Rotor-RCC descent & convergence").

Appendix C - Toy Model with Fixpoint Walkthrough

This appendix provides a pedagogical toy model illustrating how coherence redistribution and recursive fixpoints are represented within a discretized cRBW field. Using a 2-D Regge triangulation, we show how constraint tension redistributes through a simple lattice and how a coherence fixpoint is represented through recursive coherence; adynamically, as a structural solution.

We reference the Mathematical Model's hinge deficit formulas [8] Eqs. (2.12–2.13), the principal-angle/ρ-warped Grassmannian metric [8] Eq. (2.9); App. A (A.7), (A.14–A.15)), and the symmetric rotor half-update (Eqs. (2.31a–2.31b)) as the formal backbone of this toy model.

C.1 Setup: 2D Regge Triangulated Space

We define a triangular 2D manifold specified by:

- **Vertices**: $\mathbf{V} = \{v_1, v_2, v_3, v_4, v_5\}$
- **Edges**: Undirected connections (v_i, v_j) with assigned lengths L_{ij}
- **Triangles**: $T = \{\Delta_1, \Delta_2, \Delta_3\}$ each with three vertices and three edge lengths.

For each vertex-hinge h (2D toy), define the deficit $\epsilon_h = \pi - \sum_{\sigma \ni h} \alpha_h^{(\sigma)}$ and, in higher-D, pair deficits with hinge capacities A_h (dual areas/weights) as in [8] Eqs. (2.12–2.13).

We interpret the *angle deficit* at each vertex as a measure of localized *coherence curvature*. In classical Regge calculus:

$$\epsilon(v_i) = 2\pi - \sum_{\Delta \ni v_i} \theta_i^{\Delta} \tag{C.1}$$

Where θ_i^{Δ} is the internal angle at vertex v_i within triangle Δ.

Unless stated otherwise, this toy model uses the interior-vertex deficit convention $\epsilon(v_i) = 2\pi - \sum_{\Delta \ni v_i} \theta_i^{\Delta}$. For boundary vertices, the corresponding boundary convention is $\epsilon_\partial(v_i) = \pi - \sum_{\Delta \ni v_i} \theta_i^{\Delta}$. Any use of the π-formula refers only to boundary vertices.

C.2 Coherence Constraint Structural Consistency

In cRBW, the vertex deficit $\epsilon(v_i)$ is interpreted as discrete curvature within the toy presentation. A nonzero Regge deficit is not, by itself, a failure of closure. The collection $\{\epsilon(v_i)\}$ must satisfy the curvature budget (RCC–3). For simplicity, we use a fixed budget κ_{global}:

$$\sum_{v_i} |\epsilon(v_i)| = \kappa_{global} \ (or \ \leq \kappa_{\text{global}} \ in \ a \ slack \ formulation) \qquad (C.2)$$

A representational solver can be used to find a fixed configuration of edge lengths and incident angles to satisfy the RCC lattice. Intuitively:

- If $\epsilon(v_i) = 0$, the vertex is *locally coherent*.
- If $\epsilon(v_i) \neq 0$, the system recursively modifies neighboring edge lengths to balance constraints.

If the selected local and global budget or interface conditions are satisfied, the vertex data are admissible in the toy model. If they are not, the numerical solver changes candidate edge lengths or angles. The solver does not physically modify the block.

"Propagation" is not temporal; it is *structural dependency* across the mesh:

$$\epsilon(v_i) \dashrightarrow \Delta L_{ij} \dashrightarrow \theta_j^{\Delta} \dashrightarrow \epsilon(v_j) \qquad (C.3)$$

The fixpoint is a globally minimal-tension configuration consistent with RCC–3 (Curvature Budget), RCC–8 (Coherence Resonance), RCC–9 (Non-Trivial Gradient), with BBP supplying $\partial^2 = 0$ and the declared interface conditions; local pieces may have boundaries.

C.3 Toy Scenario: Perturbation and Resolution

Initial Configuration

- Triangle $\Delta_1 = (v_1, v_2, v_3)$ has perfect closure: $\epsilon(v_1) = \epsilon(v_2) = \epsilon(v_3) = 0$
- Triangle $\Delta_2 = (v_2, v_3, v_4)$ contains a perturbation: edge L_{34} is slightly contracted.
- This contraction causes $\epsilon(v_3) > 0$ and $\epsilon(v4) < 0$.

Representational Resolution

The solver represents how the globally fixed constraint solution can be found by an algorithmic relaxation procedure L_{23}, L_{24}, L_{13}, etc., until a near-uniform "small deficit" state is reached:

$$\epsilon(v_i) \approx \epsilon_i \ \text{ with } \sum_i \epsilon_i^2 \text{ minimized } \ subject \ to \ (C.2) \ and \ RCC \ constraints \qquad (C.4)$$

The resulting fixpoint satisfies RCC–3, RCC–8, RCC–9 and BBP. The algorithm is temporal as a computation, but the configuration it represents is not temporally produced.

C.4. Interpretation in cRBW Terms

- **Relational junctions:** vertices act as junctions where coherence curvature concentrates.
- **Gradient encoding:** variations in edge lengths L_{ij} encode coherence gradients across the mesh.
- **Solver iteration:** the numerical representation changes candidate geometric data until the declared objective reaches a fixpoint.
- **Time-Free Re-expression**: nothing "evolves in time"; the block solution recursively satisfies constraints adynamically *all-at-once*.

C.5 Diagram

Regge Triangulation of Structural Constraint Consistency in cRBW
This diagram presents a simplified 2D triangulated lattice to illustrate constraint consistency and recursive fixpoint resolution in the cRBW. Inspired by Regge calculus, this toy model uses triangle-based curvature analogs to represent how the solver represents a globally constrained candidate through local numerical data; global coherence does not emerge from the local data.

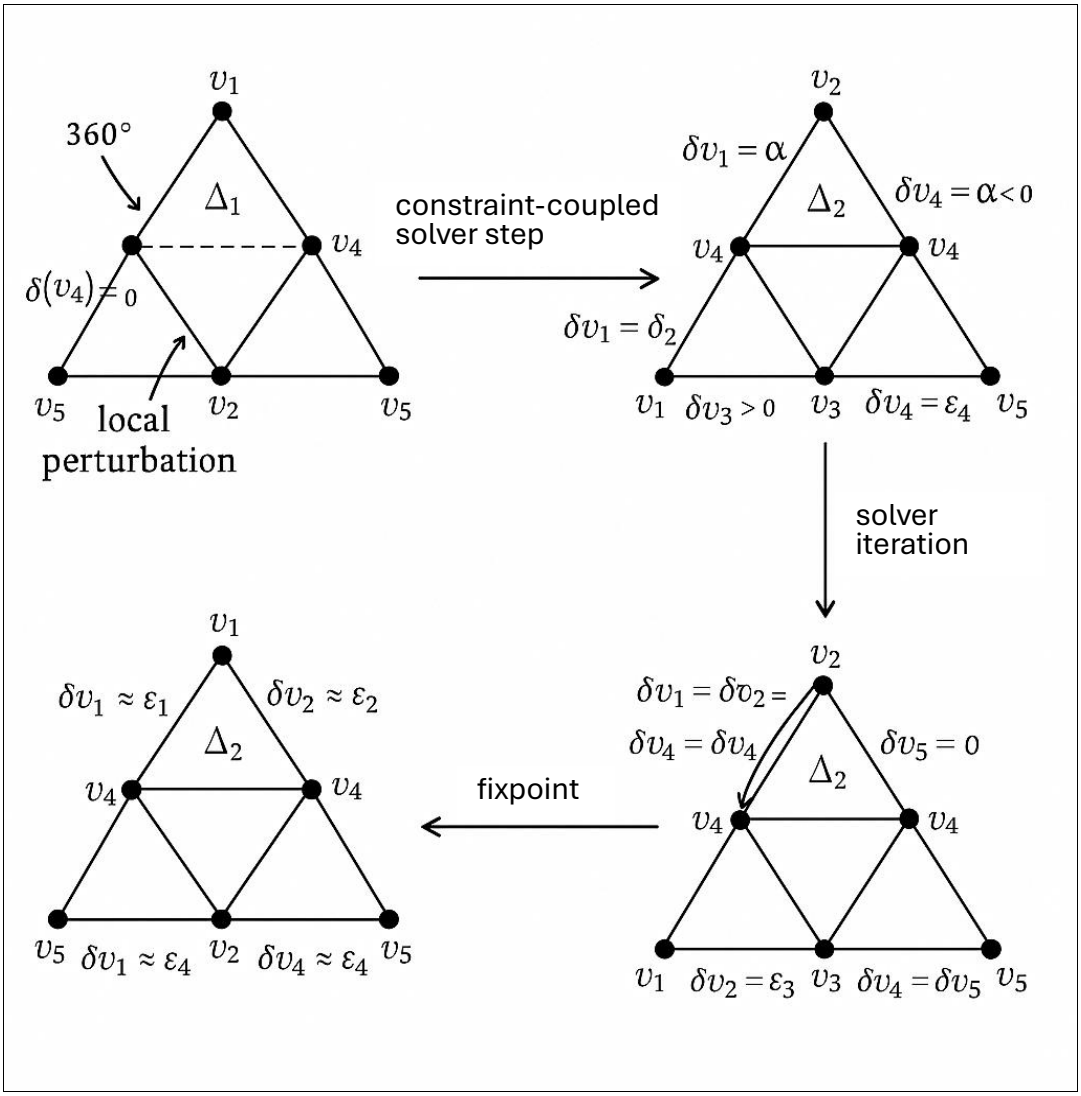


Figure 1 - Simplified 2D triangulated lattice illustrating constraint redistribution and fixed-point resolution.

Diagram Description

- **Nodes:** relational junctions (local coherence sites).
- **Edges:** constraint links (tension lines / geodesic analogs).
- **Triangles:** minimal coherence surfaces; their angle sums encode curvature.

The four triangular regions illustrate a local patch of the cRBW constraint lattice, displayed as successive stages of recursive coherence resolution.:

Panel 1: Initial Symmetric Configuration

The declared interior-vertex angle sums satisfy the flat convention 2π, or the corresponding boundary convention. The fact that each individual Euclidean triangle has angle sum $\pi$is not a curvature test.

Panel 2: Imposed Curvature Gradient
A nonzero deficit is introduced as a non-trivial curvature candidate. This is not sufficient for identity formation.

Panel 3: Structural Consistency of Coherence Pressure
The solver updates neighboring candidate data subject to the declared constraints. No physical ripple or propagation is asserted.

Panel 4: Fixpoint Achieved
The toy candidate satisfies the selected numerical constraints. It does not by itself establish an identity basin or observer compatibility.

Interpretive Summary
The figure illustrates a computational route to one static candidate presentation. The fixpoint is a solver result for the declared objective, not identity itself. BBP supplies boundary-of-boundary and interface coherence, not unqualified loop closure.

C.6 Summary Statement

This toy model mirrors cRBW logic: the field resolves structurally, non-locally, and recursively. In the representational algorithm, local adjustments redistribute tension across neighboring simplices until a fixed point is found. This is a computational path to a static solution, not a physical process in the block. The configuration encodes both geometry and coherence curvature, consistent with RCC closure, resonance matching (RCC–8), non-trivial gradient (RCC–9), and BBP. The algorithm computes a static candidate satisfying the declared equations; it does not depict physical tension equalizing through the source condition.

Appendix D – Fixpoint Lattice Analysis of Relational Coherence Constraints

Overview

This appendix analyzes the closure operator on sets of RCC condition labels. The lattice catalogs internally closed label sets; it does not itself select, construct, or prove the existence of admissible cRBW mathematical presentations.

We read "fixpoint selection" against the global coherence functional $\mathcal{I}_C$, defined in [8], Eq. (2.23), with admissibility/stationarity expressed by $\delta\mathcal{I}_C = 0$ in [8], Eq. (2.24). NPRF is realized as projective invariance of normalized sector ratios, with diagonal capacity ratios given in [8], Eq. (2.18), and projective rescaling invariance given in [8], Eq. (2.36).

D.1 Fixpoint Definition

Let the set of RCCs be represented as:

$$\mathcal{A}_{\mathrm{RCC}} = \{A_1, A_2, \ldots, A_9\} \tag{D.1}$$

Define the closure operator:

$$\Phi: \mathcal{P}(\mathcal{A}_{\mathrm{RCC}}) \to \mathcal{P}(\mathcal{A}_{\mathrm{RCC}}), \qquad \Phi(S) \;\coloneqq\; S \cup \{A_i \in \mathcal{A}_{\mathrm{RCC}} \mid Dep(A_i) \subseteq S\} \tag{D.2}$$

Basic properties: Φ is extensive and monotone: $S \subseteq \Phi(S),\ S \subseteq T \Rightarrow \Phi(S) \subseteq \Phi(T)$. The one-step operator Φ is not generally idempotent, because adding one condition may enable additional conditions on the next application. Accordingly, all references to closure in this appendix refer to the transitive closure operator $\bar{\Phi}$. Since $\mathcal{A}_{\mathrm{RCC}}$ is finite, iterating Φ from any seed reaches a fixpoint in finitely many steps. The induced transitive-closure operator $\bar{\Phi}(S) := \bigcup_{n\geq 0} \Phi^n(S)$ is idempotent: $\bar{\Phi}(\bar{\Phi}(S)) = \bar{\Phi}(S)$. A fixpoint remains defined by:

$$\Phi(S) = S \tag{D.3}$$

Throughout we assume candidates are evaluated against the coherence-functional structure $\mathcal{I}_C$, defined in [8], Eq. (2.23), with stationarity $\delta\mathcal{I}_C = 0$ given in [8], Eq. (2.24). "Closed" here means RCC-admissible under BBP closure expression with stationarity taken subject to NPRF projective invariance [8], Eq. (2.36). "Closed" in this appendix means closed under the RCC prerequisite operator. It does not mean BBP-closed, source-level admissible, or reconstructively warranted.

D.2 Lattice Structure

$(\mathcal{P}(\mathcal{A}_{\mathrm{RCC}}), \subseteq)$ is a Boolean lattice. Since Φ is monotone, Knaster–Tarski implies the set of fixpoints $\mathrm{Fix}(\Phi) = \{S \mid \Phi(S) = S\}$ forms a complete lattice under $\subseteq$. In practice we use monotone, budget-nonincreasing updates (the symmetric rotor half-update) to approach RCC-closed sets [8] Eqs. (2.31a–2.31b).

- The least fixpoint (lfp) arises by iterating Φ from $\emptyset$.
- The greatest fixpoint (gfp) is the largest closed set; in our case, with full dependencies resolved, it is typically $\mathcal{A}_{\mathrm{RCC}}$ itself.

Each fixpoint $S \in \mathrm{Fix}(\Phi)$ represents a self-consistent RCC label set. Existence of a mathematical candidate realizing the label set is a separate witness problem.

D.3 Structural Closure and Resonance

Some dependencies are combinational (logical), others are spectral (resonant). We model resonance coupling with a symmetric functional:

$$\mathcal{R}: \mathcal{A}_{\mathrm{RCC}} \times \mathcal{A}_{\mathrm{RCC}} \to \{0,1\} \qquad (D.4)$$

where $\mathcal{R}(A_i, A_{\mathrm{j}}) = 1$ indicates co-admissibility under RCC–9 tolerances. We fold spectral admissibility into Dep by requiring that any A_k whose satisfaction needs a band-limited match with A_i, A_j includes them (or their witnesses) in $\mathrm{Dep}(A_k)$.

Illustrative edges (from Appendix A):

- $\mathrm{Dep}(A_6) \supseteq \{A_2, A_3\}$ (Gradient-Mesh Matching requires symmetry closure + curvature budget).
- $\mathrm{Dep}(A_8) \supseteq \{A_5, A_6, A_7\}$ (Resonance Matching needs decoherence triangulation, mesh matching, identity localization, boundary closure).

Thus, only mutually supportive configurations survive closure: the lattice encodes *resonance-qualified* dependency, not mere conjunction.

In this context, "resonance" corresponds to off-diagonal mixed capacities $K_{\alpha\beta}$ that bind sectors on shared supports; at stationarity these supply off-diagonal stiffness through the mixed-capacity stationarity condition in [8], Eq. (2.22). Diagonal capacity ratios fix the invariant ratios [8], Eq. (2.18), while the full capacity tensor $\Xi_{\alpha\beta}$ is given in [8], Eq. (2.20), with matrix form in [8], Eq. (2.29). NPRF-neutral projective rescaling is given in [8], Eq. (2.36).

D.4 Non-Trivial Legibility Criterion

Appendix A established that the nine RCCs form the local legibility lattice for a valid cRBW configuration (A.5). Within the lattice view, we express complete local legibility as:

$$S^\star \in \mathrm{Fix}(\Phi), S^\star = \mathcal{A}_{\mathrm{RCC}}, \text{and } A_9 \in S^\star \qquad (D.5)$$

The A_9 clause (Non-Trivial Gradient Requirement) is redundant if $S^\star = \mathcal{A}$, but we state it explicitly to emphasize non-flatness as a gate against null configurations (cf. Appendix B).

Equivalently:

$$\bigwedge_{i=1}^{9} \mathrm{RCC}_i \iff S^\star = \mathcal{A}_{\mathrm{RCC}} \in \mathrm{Fix}(\Phi) \qquad (D.6)$$

Interpretation: The greatest fixpoint is the maximal RCC-label set. Complete local legibility additionally requires a candidate presentation realizing those labels, appropriate indexing coverage, forward realization, RN, defect control, and application warrant. Ontic admissibility remains fixed by AGC.

Optional refinement ((restricted sectors)
If one studies restricted application sectors or subdomains, take any fixpoint $S \subset \mathcal{A}$ with $A_9 \in S$. These are sector-admissible but not globally complete; they describe restricted coherence phases embedded within the full universe fixed by $\mathcal{A}$.

D.5 Summary

- The nine RCCs form a closure system; Φ-closed sets are fixpoints representing self-consistent structural regimes.
- The fixpoint lattice catalogs all locally closed regimes; complete local legibility corresponds to the greatest RCC fixpoint $S^\star = \mathcal{A}_{\mathrm{RCC}}$. Ontic admissibility remains fixed by AGC, while $\mathbb{I}_0$ supplies projective normalization rather than a constraint.
- RCC–8 governs resonance-qualified co-admissibility; RCC–9 enforces non-triviality (excludes structurally null worlds).
- Ontologically, cRBW replaces initial-condition narratives with recursive coherence and global admissibility.

Appendix E – Term Mapping and Glossary

Table 6 - Term Mapping Table

Term/Concept	RBW Analogue/Origin	Usage in cRBW	Ref. Section
Global layer (closure & normalization)	Global closure in RBW	AGC fixes primitive admissibility; BBP expresses derived closure in boundary-operator representations; I_0 is a non-ontic projective baseline; NPRF is projective invariance of sector ratios.	§4, Appendix A
Attractor	None (new to cRBW)	Stable coherence-localizing configuration under recursive satisfaction of RCC.	§§6, 3.4
Boundary Conditions (ADT, TCD)	RBW Boundary conditions	Coherence poles defining structural range (Anchor & Terminal).	§4.4
Coherence Curvature	General curvature (RBW)	Angular deficit ϵ_h encoding structural tension in Regge triangulations; budgets via L_1/L_2 forms. [8] Eqs. (2.12)–(2.13); L_1/L_2 budgets are defined locally under RCC-3, Appendix A. §4.2, Appendix D.	§4.2, Appendix D
Constraint Pressure	None (cRBW extension)	A representational residual-pressure or mismatch measure indicating deviation from local legibility conditions. It is not a force, not a temporal drive, and not an ontic constraint.	§3.2
Curvature Budget (RCC–3)	RBW global curvature constraint	Global constraint limiting integrated coherence curvature across the block.	§4.3, Appendix A
Decoherence	Quantum decoherence	Thinning/dispersion of coherence gradients yielding classicality as a structural embedding.	§4.4, RCC–5
Fixpoint	Mathematical fixed point	A closed configuration in which active constraints are mutually satisfied; no unresolved coherence mismatch remains.	§4.1, Appendix D
Gradient (Coherence Gradient)	Structural differences (RBW)	Representational asymmetry enabling non-trivial legibility; gradients carry coherence readout within admissible structure.	§5
Gradient Mesh	— (cRBW addition)	Interlaced channels of coherence gradients preserved under BBP with RCC gates; small-angle continuity on	§5

Term/Concept	RBW Analogue/Origin	Usage in cRBW	Ref. Section
		the ρ-warped Grassmannian. [8] §2.5; App. A Eqs. (A.7), (A.14–A.15))	
Identity Field	Identity structures (RBW)	Localized attractor/readout basin that sustains persistence across lamination transitions. Persistence witness: rotor-invariant identity scalar of a laminated blade. ([8] §4.1)	§6, RCC–7
Lamination	None (new to cRBW)	Recursive lamination of admissible subspaces on the real Grassmannian.	§§3.1,10
Structural Coherence	None (new to cRBW)	Adynamical capacity of the blockworld to host differentiated, closed configurations under AGC-defined admissibility, with closure/readout expressed through BBP and NPRF.	§§3.3,10
Non-Trivial Gradient (RCC–9)	None (cRBW addition)	Requirement that some gradient exists; excludes the trivial (featureless) block.	§5, Appendix A
Observer-Coherence Constraint (RCC–4)	Observer consistency (RBW)	Aligns observer-relative slices with the global coherence field to ensure perspectival consistency.	§4, Appendix A
Optimal Asymmetry	CP Violation, Symmetry Breaking (physics)	Minimal deviation from perfect symmetry required for recursive stability/closure.	§4
Recursive Coherence Redistribution	None (cRBW addition)	Structural articulation of re-expression under representational coherence mismatch; not a temporal process.	§3
Regge Triangulation	Regge calculus	Discrete geometry encoding coherence curvature by angle deficits.	§§4.2-4.3, Appendix C
Relational Structural Experience (RSE)	RSE from RBW ontology	Endo-perspectival reflexivity (phenomenology) of coherence lamination; adynamical at the block, dynamic only in appearance.	§9
Resonance Lattice	None (cRBW extension)	Mixed-capacity binding via $K_{\alpha\beta}$ off-diagonals is represented by the mixed-capacity stationarity condition in [8], Eq. (2.22). Diagonal capacity ratios fix	§4.1

Term/Concept	RBW Analogue/Origin	Usage in cRBW	Ref. Section
		invariants [8], Eq. (2.18). The capacity tensor $\Xi_{\alpha\beta}$ is given in [8], Eq. (2.20), with matrix form in [8], Eq. (2.29). NPRF projective rescaling is given in [8], Eq. (2.36)	

Glossary Entries

Anchor Decoherence Threshold (ADT)
A coherence pole marking the admissibility boundary for coherence. Conceptually analogous to "Big Bang," but without temporal implication.

Terminal Coherence Dissolution (TCD)

A coherence pole marking exhaustion of admissible coherence—analogous to "heat death," but adynamically defined.

Attractor
A stable, coherence-localizing configuration obtained when recursive constraint satisfaction closes.

Coherence Curvature
Angle-deficit, ϵ_h, representation of structural tension in discrete (Regge-style) triangulations. Integrates with the global curvature budget. Hinge/vertex ϵ_h terms are anchored in MM [8] Eqs. (2.12)–(2.13); the L_1/L_2 curvature-budget forms are defined locally in this paper under RCC-3, Appendix A.

Constraint Pressure
A representational residual-pressure or mismatch measure indicating deviation from local legibility conditions. It is not a force, not a temporal drive, and not an ontic constraint.

Curvature Budget: "global constraint"
An application-specific bound on the selected curvature diagnostic.

Decoherence
Structural thinning of coherence gradients that embeds classicality. In cRBW, no dynamical collapse—only differentially coherent regions.

Fixpoint: "closed configuration"
RCC-label or numerical-candidate fixpoint relative to a declared operator.

Gradient
Representational asymmetry that carries coherence legibility within AGC-admissible structure. Without a gradient, the block is trivial (see RCC-9).

Gradient Mesh
Interlaced, constraint-sustained channels of coherence forming a block-level invariant under BBP with RCC gating; small-angle continuity on the ρ-warped Grassmannian ([8] §2.5; App. A Eqs. (A.7), (A.14–A.15)).

Identity Field
A candidate localized persistence profile ([8] §4.1).

Lamination
Recursive layering of coherence fields under AGC-defined closure as represented through BBP, yielding stability and apparent complexity. Lamination is not temporal iteration. It bears closest resemblance to flag manifold structure built from nested Grassmannian subspaces, representing recursive coherence stabilization.

Structural Coherence
The exo-structural capacity of the blockworld to host differentiated, closed configurations. "Growth" is only apparent from RSE's phenomenological slicing.

Non-Trivial Gradient (RCC-9)
A minimal non-trivial-legibility condition: some gradient must obtain to avoid a featureless, degenerate block.

Observer-Coherence Constraint (RCC-4)
An access or registration compatibility condition; not reflexive observerhood.

Optimal Asymmetry
The lowest non-trivial diagnostic relative to a declared ordering or functional.

Regge Triangulation
Discrete encoding of coherence curvature via angle deficits; the preferred calculus for cRBW's geometric layer. Hinge/vertex deficits ϵ_h; face/volume pairing per [8] Eqs. (2.12–2.13), (2.18).

RSE "supplies phenomenology"
RSE proposes a phenomenology-reconstruction bridge.

Resonance lattice "secures global closure"
Organizes local RCC compatibility.

Field-Specific Notes

- **Physics/Ontology:**
  cRBW reframes particles and fields as recursive attractors, removing temporal/causal dependence.
- **Topology:**
  Attractors, lamination, and meshes are treated as stable recursive configurations, not dynamic processes.
- **Information Theory:**
  Identity and memory are coherence-based phenomena, not symbolic storage or computation.

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