INFORMATION RELATIONAL MANIFESTATION THEORY

IRMT CORE SPECIFICATION v1.0

Primitive Structure, Microscopic Dynamics, Observables, and Evidentiary Status

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FRONT MATTER + PART I

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Source corpus	IRMT Papers I–XVI and the associated experimental records

Specification Status

STATUS NOTICE

This document is the drafting basis for IRMT Core Specification v1.0.0. It is not yet the frozen specification. When v1.0.0 is released, it will supersede earlier definitions wherever they conflict with the present specification. It does not claim that every structure defined here has been derived from a deeper principle. Each substantive structure is assigned an explicit evidentiary status.

The purpose of the specification is to make the current theory auditable. It freezes definitions, separates fundamental and effective layers, identifies imported results, preserves negative findings, and states unresolved derivational bridges without filling them by implication.

Current authority. During drafting, the seven preliminary records govern terminology, claim status, actions, coefficients, dependencies, and exclusions. They are working normative controls, not substitutes for the final prose specification.

Current scientific posture. IRMT v1.0 is an audited research specification. It is not a declaration that the quantum, Standard Model, gravity, cosmology, measurement, or charged-lepton sectors have all been derived from one microscopic action.

Authority and Precedence

Once v1.0.0 is frozen, conflicts are resolved by the following order of authority. Historical papers remain part of the record, but they do not override the active specification.

Order	Authority	Function
1	**Frozen Core Specification**	Definitions, ontology, action architecture, symmetries, observables, and explicit status assignments in the latest compatible release.
2	**Normative appendices and referenced ledgers**	Versioned records incorporated by reference, including the seven preliminary house-cleaning records.
3	**Published errata and patch releases**	Corrections that do not alter the primitive ontology, action, or physical interpretation.
4	**IRMT Papers I–XVI and experimental notes**	Historical sources, derivations, experiments, and superseded proposals interpreted through the current specification.

Relationship to the Six Preliminary Records

The records are not six competing summaries. Together they form the audit layer beneath the specification. Their function is to prevent ambiguity, hidden tuning, disconnected actions, broken dependency chains, and superseded claims from re-entering the active theory.

Record	Name	Normative function
Record 1	**Claim Ledger**	Controls the present status and permissible wording of major claims.
Record 2	**Definition and Notation Ledger**	Controls canonical symbols, types, domains, dimensions, transformations, and lifecycle status.
Record 3	**Action Ledger**	Separates actions, flows, constraints, update rules, imported targets, and missing couplings.
Record 4	**Coefficient Ledger**	Records the source and status of every constant, fitted value, constitutive coefficient, and numerical control.
Record 5	**Dependency Graph**	Tracks central conclusions as labelled arrows and assigns each conclusion the status of its weakest unresolved dependency.
Record 6	**Retired and Superseded Claims**	Excludes invalidated mechanisms and withdrawn closure language from active use while preserving historical traceability.

Until exact page and equation references are completed, the ledgers remain working drafts. Their classifications nevertheless control the present drafting language.

Versioning and Change Control

IRMT uses semantic versioning. A version number has the form MAJOR.MINOR.PATCH. Pre-release drafts remain in the 0.x series and do not carry the authority of a frozen specification.

Version class	Meaning	Change threshold
0.x.y	**Pre-release drafting**	Working drafts, internal reconciliation, and audit integration before the first frozen release.
1.0.0	**First frozen specification**	Initial authoritative statement of the active ontology, action architecture, observables, status taxonomy, and open gates.
1.1.0	**Compatible addition**	Adds a compatible definition, theorem, dataset, test, or effective module without altering the frozen primitives or interpretation.
1.1.1	**Correction**	Fixes wording, notation, citation, arithmetic, metadata, or implementation details without changing the theory.
2.0.0	**Major theoretical change**	Alters primitive ontology, the fundamental action, field content, symmetry content, physical interpretation, or a conclusion that changes active dependencies.

Revision History

Version	Date	Status	Description
0.1.0	29 June 2026	Working draft	Initial front matter drafted after completion of Records 1-6.
0.2.0	3 July 2026	**Working draft**	Added Part I: Foundational Status, including formal claim boundaries, controlled terminology, evidentiary taxonomy, dependency inheritance, and status-governance rules.
1.0.0	Pending	**Frozen release**	First authoritative Core Specification after the primitive, action, observable, sector-status, governance, and appendix sections are completed and reconciled.
0.2.1	3 July 2026	Working draft	Integrated QREV-2026-07-03-01: Record 7 authority, Q-series conditionality rules, premise-explicit imported theorem language, and no-change-to-completion-gates notice.

Change Governance

- No definition, coefficient, action term, or claim status may change silently.
- Every change proposal must identify the affected definitions, actions, papers, predictions, dependency arrows, and tests.
- A failed or superseded claim is demoted immediately and remains visible in the historical record.
- A constitutive or open claim is promoted only after its recorded completion gate is met.
- A change to primitive ontology, the fundamental action, or physical interpretation requires a major version.

Reading Guide

The specification is organized by evidentiary layer rather than by the chronology of the papers. Readers should therefore distinguish the status of a structure from the precision of its mathematics.

Layer	Typical labels	How it should be read
Core specification	[DEF] [THM] [OPEN]	Primitive objects, canonical definitions, declared symmetries, the currently proposed action architecture, observables, and exact consequences. An object may be part of the core even when a required derivation remains open.
Effective constructions	[CON] [THM]	Reduced packet, holonomy, cosmological, or phenomenological models that are internally coherent but are not yet derived from one frozen microscopic action.
Experimental and numerical results	[NUM]	Findings tied to specified ensembles, algorithms, controls, tolerances, and datasets. Their scope does not automatically extend beyond the tested implementation.
Imported results	[EXT]	Established mathematical or physical results used conditionally, such as causal-set, heat-kernel, continuum field-theory, or Standard Model inputs.
Open derivations	[OPEN] [CONJ]	Precisely stated missing bridges, conjectures, and completion gates. They are part of the research program but are not counted as achieved results.
Historical and superseded material	[SUP]	Earlier mechanisms and closure claims retained for traceability but excluded from every active derivation.

Status Labels

Every major equation, theorem, physical identification, numerical conclusion, or completion statement must carry one of the following labels. The full evidentiary taxonomy is formalized in Part I, Section 2.

Code	Name	Meaning
[DEF]	**Definition or Axiom**	Introduced as part of the theory; not a derivation.
[THM]	**Exact Mathematical Result**	Follows deductively from explicit assumptions and within a stated domain.
[EXT]	**Imported External Result**	Established elsewhere and used conditionally by IRMT.
[NUM]	**Numerical Result**	Obtained in a specified computational model, dataset, or ensemble.
[CON]	**Effective Constitutive Law**	Adopted to close an effective model but not derived from the core action.
[CONJ]	**Conjecture**	A proposed relation not yet demonstrated.

Code	Name	Meaning
[SUP]	**Superseded Claim**	Retained only for historical traceability and excluded from active derivations.
[OPEN]	**Open Problem**	A precisely stated derivation or test still required.

Rules of Interpretation

DEPENDENCY RULE

A downstream calculation may be exact while the full physical conclusion remains conditional. A conclusion inherits every unresolved, constitutive, imported, numerical, failed, or open dependency on its path.

Definition is not derivation. Introducing an event set, projector, action term, response variable, or representation does not establish that the deeper theory uniquely selects it.

Exact mathematics is not automatically physical selection. A theorem within an assumed effective model remains conditional when its physical premises are constitutive or open.

Numerical exactness is not evidentiary status. A long decimal or exact algebraic composite inherits the status of every coefficient and identification used to construct it.

Absence of target fitting is not sufficient for first principles. A model may avoid direct use of charged-lepton masses while still relying on matched, external, or constitutive inputs.

Imported compatibility is not emergence. Recovering a standard continuum action under suitable assumptions does not prove that the active IRMT substrate uniquely produces that limit.

Negative results remain official results. A failed route is preserved, its dependency descendants are reclassified, and it may not return through unmarked wording changes.

Scope Boundary Notice

Inclusion in this specification means that an object, equation, model, result, or open problem is part of the audited IRMT program. It does not mean that every included structure is fundamental, derived, empirically confirmed, or physically selected. The detailed non-claims and sector boundaries are stated in Part I, Section 1.

Preferred Citation

WORKING DRAFT CITATION

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IRMT CORE SPECIFICATION v1.0

PART I

FOUNDATIONAL STATUS

Purpose, Scope, Claim Boundaries, and Evidentiary Taxonomy

NORMATIVE ROLE OF PART I

Part I controls how every later definition, equation, theorem, numerical result, effective law, and open problem may be described. It does not decide the content of the primitive ontology or action; it fixes the epistemic rules under which those later structures are admitted into the specification.

The specification is designed to preserve exact mathematics, useful effective models, genuine numerical achievements, and official negative results without allowing any of them to be misrepresented as a deeper derivation than the evidence supports.

Working Draft 0.2.1 · 3 July 2026

1. Purpose, Scope, and Claim Boundaries

This section defines what IRMT Core Specification v1.0 is intended to control, what counts as part of the active program, and which conclusions remain outside the present evidentiary boundary.

1.1 Purpose

IRMT is defined here as a relational research framework that investigates whether quantum, gauge, gravitational, cosmological, measurement, and matter structures can arise from a discrete relational substrate. The specification does not assume that such emergence has already been demonstrated. **[DEF]** IRMT research framework.

The immediate purpose of v1.0 is not to enlarge the theory. It is to freeze a single auditable statement of the theory that presently exists, including its exact results, effective constructions, imported bridges, numerical findings, failed routes, and unresolved derivations.

1. **Definition control.** Every recurring object, symbol, transformation, action term, observable, coefficient, and status label shall have one canonical definition.
2. **Dynamical control.** The document shall state the full action architecture presently proposed, including terms that are absent, merely effective, imported, or still open.
3. **Claim control.** Every substantive physical claim shall be limited to the warrant actually supplied by its assumptions and dependency chain.
4. **Testing control.** Numerical and empirical claims shall be tied to specified implementations, datasets, ensembles, tolerances, and pass/fail criteria.
5. **Historical control.** Superseded and failed mechanisms shall remain visible but shall not participate in active derivations.
6. **Research control.** Open problems shall be stated as precise completion gates rather than being filled by interpretive language.

CENTRAL OBJECTIVE

The specification shall make it possible for an independent reader to determine, for any IRMT conclusion: what was assumed, what was defined, what was proved, what was imported, what was computed, what was fitted or matched, what remains constitutive, what failed, and what must still be done.

1.2 What the Specification Does

Core Specification v1.0 is normative with respect to the active IRMT program. “Normative” means that later IRMT papers, code releases, datasets, and experimental notes must use its definitions and status assignments unless a versioned amendment explicitly changes them.

Normative domain	Controlled content
Primitive structure	Defines the event, causal, state-space, field, and transport objects treated as primitive, derived, effective, or numerical.
Kinematics and symmetries	States composition laws, transformation laws, gauge or frame redundancies, orientation rules, and admissibility conditions.
Dynamics	Collects the currently proposed action, flow, update, constraint, and coarse-graining structures and identifies which variables are varied.
Observables	Defines operational probabilities, spectral observables, packet variables, holonomies, continuum estimators, and empirical comparison quantities.
Layer separation	Distinguishes the fundamental layer from reduced effective models, numerical algorithms, imported continuum targets, and historical proposals.
Coefficient provenance	Records whether each coefficient is mathematical, symmetry-derived, dynamical, external, matched, constitutive, free, or numerical.
Dependency control	Represents central conclusions as labelled chains and prevents exact downstream algebra from concealing an unresolved upstream bridge.
Testing and governance	Defines falsifiability, reproducibility, versioning, retirement, promotion, and change-control requirements.

1.2.1 Normative force

- A structure marked [DEF] is part of the specified theory even when its physical selection remains [OPEN].
- A theorem marked [THM] is authoritative only within its stated assumptions, domain, and branch.
- A constitutive relation marked [CON] may be used inside its declared effective model, but it may not be cited as a theorem of the fundamental action.
- A numerical result marked [NUM] may support or reject a specified implementation, but it does not acquire universal status without additional evidence.
- A superseded item marked [SUP] is excluded from active derivations regardless of its historical importance.

1.2.2 Relationship to the corpus

Papers I-XVI remain the historical and technical source corpus. The specification does not erase their derivations, experiments, or conceptual development. It controls how those materials are interpreted after the later audits. When a paper conflicts with the frozen specification, the specification governs the active theory and the paper is cited as historical context.

1.3 What the Specification Does Not Claim

BOUNDARY NOTICE

Inclusion in Core Specification v1.0 does not mean that a structure has been derived from a deeper principle, uniquely selected by nature, experimentally established, or accepted outside the IRMT program. Inclusion means that its current definition, use, status, and dependencies are being stated openly.

Unresolved claim	Present reason	Status	Permissible statement
Complete quantum probability law	No positive, normalized operational law P(a,b|x,y) has yet been derived from the substrate.	[OPEN]	IRMT contains an exact finite-coherence distribution and an effective visibility-modulated correlator, not a closed quantum theory.
Tsirelson bound and quantum-set boundary	The attainable probability set, no-signalling marginals, and exclusion of supraquantum boxes remain unproved.	[OPEN]	CHSH algebra is conditional on the adopted cosine correlator.
Standard Model gauge group	Generic local unitary covariance does not select SU(3)xSU(2)xU(1).	[OPEN]	IRMT has a generic discrete gauge-covariant transport framework.
Observed matter representations	Chirality, hypercharges, generation representations, and anomaly cancellation are not derived.	[OPEN]	Representation and grading structures are available but not physically selected.
Einstein gravity from the specific IRMT operator	Spectral-action and causal-set routes are imported or conditional; controlled convergence and joint matter backreaction are absent.	[EXT] [OPEN]	IRMT is compatible with candidate gravity bridges, not yet a derivation of gravity.
Complete measurement theory	The Paper VI threshold, projector, preferred-basis, and Born-rule mechanism depend on retired spectral assumptions.	[SUP] [OPEN]	Measurement as relational consistency remains a research direction.
Complete cosmology	Network growth, dark energy, and early-universe mechanisms are not combined into a closed background and perturbation theory.	[CONJ] [OPEN]	A bounded temperature-coherence CMB target survives numerically.
Complete charged-lepton mechanism from one action	The effective packet, determinant bundle, Wilson response, and phase invariant are coherent, but the response-to-connection current and its protection are constitutive or open.	[CON] [OPEN]	The mass construction is a constrained effective model, not microscopic closure.

1.3.1 Reserved closure language

The following words carry controlled meanings in this specification. They shall not be used rhetorically or as synonyms for "compatible with," "suggestive of," or "numerically successful."

Controlled term	Required meaning
Derived	Every non-definitional step follows deductively from declared assumptions or by controlled computation, and no required physical identification is merely constitutive.
First-principles	The result follows from the frozen primitives, state space, action, symmetries, and quantization or probability rules without importing the target quantity or matching to it.
Predicted	The observable and its uncertainty were fixed before comparison with the data used to assess it. Calibration data and validation data are distinguished.
Emergent	A lower-level specified dynamics selects and stabilizes the higher-level structure; mere mathematical availability or representation embedding is insufficient.
Unique	All admissible competitors under the stated assumptions have been excluded or shown equivalent.
Closed	Every dependency needed for the claim is active and none is [CON], [CONJ], [SUP], or [OPEN]; imported inputs are explicitly allowed only if the claimed level of closure permits them.
Solved	A well-defined problem has been resolved at the stated layer and no indispensable part of that problem is deferred to another unproved mechanism.
Parameter-free	No free, fitted, matched, hidden normalization, discrete choice, tolerance-dependent physical coefficient, or target-selected branch affects the stated output.

1.4 Active and Historical IRMT

The IRMT corpus contains several evidentiary layers that must coexist without being merged. The active theory is therefore defined by status and lifecycle, not by publication date alone.

Lifecycle layer	Meaning	Permitted use
Active core specification	Canonical primitives, state spaces, symmetries, actions or action gaps, observables, exact theorems, and completion gates admitted into v1.0.	May be used in all active derivations with its assigned status.
Active effective constructions	Internally coherent reduced models such as packet stabilization, determinant-line phase locking, and the locked CMB kernel.	May support conditional conclusions only within their stated domain.
Active numerical evidence	Reproducible results tied to specified code, ensembles, data, estimators, and tolerances.	May establish behavior of the tested implementation, not universal substrate dynamics.

Lifecycle layer	Meaning	Permitted use
Imported external structure	Established causal-set, heat-kernel, continuum field-theory, Standard Model, or statistical results.	May be used conditionally and must never be called an IRMT derivation.
Open research directions	Precisely stated missing actions, probability laws, selection principles, convergence theorems, and replication tasks.	May guide research but may not be counted as achieved progress.
Historical proposals	Earlier ideas preserved to explain the program's development.	May be discussed only with their current status disclosed.
Falsified or superseded mechanisms	Routes such as native chGUE universality, Marchenko-Pastur/BBP generations, and the dependent Paper VI measurement mechanism.	Excluded from active derivations and claim language.

1.4.1 Active-theory admission rule

A structure belongs to active IRMT only when it appears in the current specification or a normative referenced record and is not marked [SUP]. Active status does not imply fundamental status. An effective or imported structure may be active because the program presently uses it, provided its layer and limitations are explicit.

1.4.2 Historical citation rule

Historical claims may be quoted or reconstructed for audit purposes, but the same passage shall state the active correction or cite Record 6. No superseded mechanism may be revived through an unmarked change of terminology.

1.4.3 Promotion and retirement

- Promotion requires satisfaction of the completion gate recorded in the Claim, Coefficient, Dependency, or Retired Claims ledger.
- Demotion occurs immediately when a dependency fails, an implementation is falsified, or a supposed derivation is shown to rely on an unmarked external or constitutive input.
- Retirement does not delete the historical record. It removes the item from the active derivation graph.
- A materially revised mechanism receives a new identifier and dependency chain; it does not inherit the evidentiary status of the retired mechanism.

2. Evidentiary Taxonomy

Every substantive statement in Core Specification v1.0 shall carry an evidentiary status. The status describes the source of warrant for the statement; it does not describe how attractive, precise, or useful the statement appears.

Code	Class	Warrant	Permitted verbs	Prohibited implication
[DEF]	Definition or Axiom	The theory introduces an object, rule, domain, or primitive.	define, stipulate, adopt	derive, prove, predict
[THM]	Exact Mathematical Result	The conclusion follows deductively from explicit assumptions within a stated domain.	prove, imply, equal, follow	physically select, uniquely explain - unless separately proved
[EXT]	Imported External Result	An established external theorem, dataset, or physical framework is used conditionally.	import, use, assume from	derive within IRMT
[NUM]	Numerical Result	A specified computation, simulation, fit, or data analysis supports the statement.	observe numerically, reproduce, reject in the tested model	prove universally, derive analytically
[CON]	Effective Constitutive Law	A relation is adopted to close an effective model but does not follow from the core action.	postulate effectively, close conditionally, model	derive microscopically, force uniquely
[CONJ]	Conjecture	A proposed relation is plausible or structurally motivated but unproved.	conjecture, propose, hypothesize	establish, demonstrate
[SUP]	Superseded Claim	The statement or mechanism is historical and excluded from active derivations.	historically proposed, later retired	use as an active premise
[OPEN]	Open Problem	A required derivation, selection theorem, experiment, or replication has not been completed.	require, remain open, completion gate	assume silently, count as achieved

2.1 [DEF] Definition or Axiom

A [DEF] statement introduces part of the formal system. It may specify a primitive object, a mathematical type, an admissibility condition, a convention, a notation, an action term, or a declared identification. Definitions are authoritative for interpretation but do not carry explanatory force by themselves.

Required disclosure. A definition shall state the object's type, domain, codomain or range, dimensions, transformation law, lifecycle, and whether it is primitive, derived, effective, imported, or numerical.

Misuse to avoid. The sentence "let M=Π_TΦ_subΠ_T" defines a projected operator. It does not prove that nature selects Π_T or Φ_sub.

Example. [DEF] The Diamond-Wilson action is defined as a traced sum over minimal causal diamonds. The value and physical selection of its coupling remain separate questions.

2.2 [THM] Exact Mathematical Result

A [THM] statement is a theorem, identity, exact representation result, or deductive consequence of stated assumptions. Its status applies only on its declared branch, approximation order, truncation, representation, and domain.

Required disclosure. A theorem shall list the assumptions that are not themselves proved in the same chain and shall identify any effective or imported premise.

Inheritance rule. An equation may be [THM] while the physical conclusion built from it is [THM|CON] or [THM|EXT].

Example. [THM] On the positive-amplitude circular branch, transverse amplitude $\sqrt{2}$ implies $K=2/3$. [CON] The identification of that amplitude with the physical flavor packet is not supplied by the theorem.

2.3 [EXT] Imported External Result

An [EXT] statement relies on mathematics, physical constants, observational inputs, or established frameworks not derived by IRMT. Importation is legitimate when declared. It becomes an overclaim only when compatibility is described as emergence or derivation.

Required disclosure. The source, convention, domain of applicability, and role in the dependency chain shall be stated. If a measured quantity fixes an absolute scale, the specification shall say so.

Examples. The electroweak scale used in the charged-lepton construction is [EXT]. Benincasa-Dowker and heat-kernel results used in candidate gravity bridges are [EXT].

2.4 [NUM] Numerical Result

A [NUM] statement is warranted by a specified computational or empirical procedure. Numerical status is attached to the implementation and test domain, not automatically to every mathematical interpretation placed upon the output.

Required disclosure. Code version, dataset or ensemble, parameter controls, seeds where relevant, estimators, tolerances, uncertainty, negative controls, and pass/fail criteria shall be recorded.

Scope rule. A numerical result may reject a tested route or support a mechanism within its ensemble. It does not establish universality unless independent scaling, robustness, and replication criteria are met.

Examples. The native relational operator's localized/Poisson spectral behavior is [NUM]. The locked CMB kernel's C2/C3 performance is [NUM|CON] because the kernel was calibrated in C1.

2.5 [CON] Effective Constitutive Law

A [CON] statement supplies a response law, identification, normalization, source term, or closure relation used by an effective model but not generated by the current core action. Constitutive laws may be mathematically clean and empirically useful; their status records the missing microscopic derivation.

Required disclosure. The effective domain, free or fixed coefficients, competing symmetry-allowed forms, and microscopic promotion gate shall be stated.

Example. [CON] $J_\Omega=\Omega_{DW} H_{supp}$ closes the charged-lepton holonomy model. Paper XVI shows that the present action does not generate this source and that symmetry alone does not fix the identity response map.

> **CONSTITUTIVE LAWS ARE NOT DEFECTS TO CONCEAL**
>
> A constitutive law is a legitimate scientific object when its scope is explicit. The defect arises only when it is described as though it had already been derived from a more fundamental action.

2.6 [CONJ] Conjecture

A [CONJ] statement proposes a relation motivated by analogy, symmetry, dimensional reasoning, partial computation, or conceptual coherence. It has not met the proof or numerical-support standard required for [THM] or [NUM].

Required disclosure. A conjecture shall be formulated so that a proof, counterexample, or discriminating test is possible. The document shall distinguish a conjectured mechanism from a merely suggestive interpretation.

Example. A density-biased causal attachment law may be listed as [CONJ] until its transition probabilities, normalization, and continuum consequences are specified and tested.

2.7 [SUP] Superseded Claim

A [SUP] statement is preserved for historical traceability but excluded from the active theory. Supersession may result from falsification, failed dependency, corrected mathematics, replacement by a later model, or withdrawal of closure language.

Required disclosure. The retired statement, decisive correction, surviving narrower content, active replacement wording, and reactivation gate shall be recorded in Record 6.

Examples. Native chGUE universality, Marchenko-Pastur/BBP generation, the dependent Paper VI quantitative measurement mechanism, and the claim that Paper IX closed the program are [SUP].

2.8 [OPEN] Open Problem

An [OPEN] statement identifies a required derivation, theorem, coupling, observable, experiment, or replication that is not presently available. Open problems are normative components of the research program: they define what must be achieved before a claim can be promoted.

Required disclosure. Each open problem shall state the input objects, desired output, admissible assumptions, pass condition, failure condition, and the claims whose status depends on it.

Examples. The joint probability law, Standard Model representation selection, joint matter-geometry action, untuned packet action, and compact protected determinant-current interaction are [OPEN].

2.9 Multi-label Statements and Dependency Inheritance

Many IRMT statements require more than one status label. Multi-labeling shall be used when exact downstream mathematics depends on an imported, constitutive, numerical, or open premise.

Composite label	Meaning	Representative use
[THM | CON]	An exact consequence of an adopted effective law.	q_K=1/R_K is exact after compatibility with the Koide crossing is imposed.
[THM | EXT]	An exact consequence using an imported theorem or constant.	A continuum coefficient follows from an imported causal-set or heat-kernel result under stated assumptions.
[NUM | CON]	A numerical result for a calibrated or constitutive model.	C2/C3 performance of the locked CMB kernel.
[THM | OPEN]	A theorem whose physical application requires an unresolved identification.	The exact exterior-square metric is available, while its dynamical protection remains open.
[NUM | SUP]	A numerical result documenting failure of a retired route.	Native chGUE tests that retire the early random-matrix architecture.

2.9.1 Weakest-dependency rule

NORMATIVE DEPENDENCY RULE

A conclusion may not be assigned a stronger physical status than the weakest indispensable arrow in its active dependency path. Exact algebra downstream of a constitutive or open bridge remains a conditional physical conclusion.

1. **No status laundering.** A [CON] identification cannot disappear merely because later manipulations are [THM].
2. **No import laundering.** An [EXT] continuum result cannot be described as an IRMT derivation unless the bridge from the active substrate is itself derived.
3. **No numerical laundering.** A [NUM] regularity or fit does not become a theorem because an exact curve can be drawn through it.
4. **No historical laundering.** A [SUP] premise invalidates every active chain that still depends on it.
5. **No omission laundering.** An [OPEN] arrow cannot be treated as implicitly satisfied by the coherence of later sections.

2.10 Assignment, Promotion, and Demotion Procedure

Step	Required action
1. Identify the statement	Separate definitions, equations, physical identifications, numerical findings, and completion claims. A single paragraph may contain several statements with different statuses.
2. Trace dependencies	Locate every indispensable arrow in Record 5 and every coefficient source in Record 4.
3. Assign the warrant	Choose [DEF], [THM], [EXT], [NUM], [CON], [CONJ], [SUP], or [OPEN]. Use multiple labels where necessary.
4. Bound the language	Use only verbs and nouns permitted by the assigned status and controlled-term rules in Section 1.3.1.
5. Record a promotion gate	For [CON], [CONJ], and [OPEN], state the exact theorem, experiment, or action-level result required for promotion.
6. Demote on failure	If an indispensable dependency fails or is retired, immediately reclassify the statement and every descendant conclusion.
7. Version the change	Any status change shall update the relevant records, dependency graph, prose specification, revision history, and affected tests.

2.11 Equation and Claim Tagging Convention

Status tags shall appear at the first substantive use of a major equation, theorem, physical identification, or numerical conclusion. Repeated algebra need not carry the tag on every line when the governing status remains unambiguous.

Status	Representative statement	Correct interpretation
[DEF]	$M=\Pi_T\ \Phi_{sub}\ \Pi_T$	Defines the projected operator; does not select Π_T or Φ_{sub}.
[THM]	$R_K=(1+\sqrt{2})/3$	Exact solution of the pair-symmetric Koide equation.
[THM|CON]	$q_K=1/R_K=3(\sqrt{2}-1)$	Exact after the effective fixed point is matched to R_K.
[CON]	$J_\Omega=\Omega_{DW}\ H_{supp}$	Effective determinant-current closure law.
[NUM|CON]	$F_\ell=1-\alpha_{CMB}\exp[-(\ell-2)/L_H]$ with locked α_{CMB},L_H	Calibrated kernel later tested without refitting.
[SUP]	Native D_{rel} is chGUE	Historical premise excluded after the numerical spectral audit.
[OPEN]	$S_{mix}[p,h,A_{det}]$	Required compact mixed interaction not present in the current action.

2.12 Part I Compliance Statement

COMPLIANCE CONDITION FOR LATER PARTS

Parts II-XI and all normative appendices shall follow the claim boundaries and taxonomy defined here. A later section is noncompliant if it uses an unlabelled constitutive bridge, cites a superseded premise as active, suppresses an imported input, presents calibration as prediction, or assigns a conclusion a stronger status than its weakest indispensable dependency.

Part I does not evaluate the truth of IRMT as a whole. It establishes the discipline required to evaluate each component separately. This is the basis on which the primitive ontology, kinematics, dynamics, observables, sector status, tests, and completion gates are specified in the remaining parts.

END OF PART I

Part I Q-Series Integration Amendment

This amendment incorporates QREV-2026-07-03-01 into the front-matter authority model and the evidentiary rules. It does not alter the primitive ontology, does not promote the quantum sector to complete, and does not convert imported or conditional theorems into native derivations.

AUTHORITY UPDATE During drafting, Records 1–7 now form the working audit layer. Record 7 controls version progression, revision package status, and package-integration history. Records 1–6 continue to control claim status, definitions, actions, coefficients, dependencies, and exclusions.

Imported theorem rule for Q-series results

The BBBEW bipartite quantum-boundary result is incorporated only as an imported theorem [EXT]. It may be used by IRMT only under the explicit premise bundle LQ-POVM + AX1J + operational no-signalling + bipartite scenario. It shall not be cited as a derivation from Part II alone.

Conditional-theorem inheritance rule

A theorem proved inside the declared projective interface [DEF-G0] inherits the status of its declared composite, state, projectors, and probability rule. The in-framework probability, no-signalling, cosine, Bessel-dephasing, and CHSH calculations may be exact while the first-principles physical conclusion remains conditional.

Q-series integration summary

Package	Accepted progress	Mandatory boundary	Completion effect
WN-Q1–Q3	Operational domain, declared projective interface, conditional P, no-signalling and cosine–Bessel correlator.	The interface, state and projectors remain declared/imported.	No gate passes.

WN-Q4	Aggregation and diffusion are separated into distinct exact ensemble laws.	Universal κ=N and deterministic universal 1/N deficit remain excluded.	No universal prediction promoted.
WN-Q5	Bipartite boundary is conditionally secured by BBBEW under explicit premises.	Part II fibers alone are insufficient; multipartite boundary remains open.	Quantum boundary claim remains conditional.
WN-Q6	Pure-state rank-one Born weights are localized to RA1/RA2 and frame covariance.	Full POVMs, mixed states, updates and preferred basis remain open.	Born rule not complete.

IRMT CORE SPECIFICATION v1.0

PART II

PRIMITIVE STRUCTURE

Primitive Ontology, Global State Space, Kinematics, Symmetries, and Redundancies

NORMATIVE ROLE OF PART II

Part II defines the objects and equivalence relations that exist before the specification introduces the relational Dirac operator, packet dynamics, Wilson action, effective matter constructions, continuum bridges, or observables. It intentionally does not infer dynamics from kinematics.

The ontology is deliberately minimal. Objects are admitted as primitive only where the current program cannot yet derive them and where later active constructions require them to be present.

Abdulaziz Abdi · Toronto · 3 July 2026

Standalone Working Draft 0.3.1

Document Control

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Supersession scope	This draft supersedes earlier IRMT ontology and notation only where it states an explicit normative decision.

Part II Status Statement

WORKING ONTOLOGY

This document freezes a provisional primitive ontology for specification purposes. “Primitive” means admitted as input to the present theory, not established as metaphysically ultimate. The causal order, local fibers, link transports, and substrate field remain subject to promotion, reduction, or replacement in a future major version if a deeper action derives them.

Contents

Normative Decisions Introduced in Part II

1. **Strict causal order.** The primitive causal relation is a locally finite strict partial order. Event labels carry no physical meaning.

2. **Links are covers.** The directed link graph is the Hasse diagram of the causal order and is not identical to the full transitive order.
3. **Finite complex fibers.** Each event carries a finite-dimensional complex Hilbert space. Unitary transport is admitted only between equal-dimensional linked fibers in the minimal core.
4. **Direct-sum global kinematics.** The global one-record state space is the Hilbert direct sum, not an automatic tensor product of all event fibers.
5. **Frame redundancy is not the Standard Model.** The maximal local unitary frame group is kinematic redundancy. A physical gauge group requires an additional selection theorem and matter representations.
6. **Orientation reversal is formal.** The inverse of a transport map along a reversed path need not correspond to a reverse causal link and is not identified with physical time reversal.

3. Primitive Ontology

This section specifies the minimal relational objects admitted before dynamics. Every object is assigned a status under Part I. The section distinguishes a primitive configuration variable from a derived construction, an effective response, and a numerical control.

ONTOLOGY RULE

No later physical conclusion may be inferred merely from the existence of an object in the ontology. A local Hilbert fiber does not select a physical gauge group; a determinant line does not generate its connection; and a causal diamond does not by itself fix the Wilson coupling or continuum theory.

3.1 Relational Events

[DEF] Event set. The primitive relational substrate contains a set of events

[DEF] $\mathscr{C} = \{x_i\}$.

The index i is a bookkeeping label only. A physical statement shall be invariant under every admissible relabelling of the events. Events are not assigned pre-existing coordinates, distances, field values, or particle identities at the primitive level.

[DEF] Causal order. The event set is equipped with a strict partial order $\prec$ satisfying:

- Irreflexivity: not $x \prec x$.
- Transitivity: $x \prec y$ and $y \prec z$ imply $x \prec z$.
- Local finiteness: for $x \prec y$, the interval between x and y contains finitely many events.

[DEF] $I^\circ(x,y) = \{z \in \mathscr{C} : x \prec z \prec y\}, \quad |I^\circ(x,y)| < \infty.$

The open-interval notation I° is canonical in Part II. When endpoints are included, the specification shall write $I[x,y]=I^\circ(x,y)\cup\{x,y\}$.

[DEF | OPEN] Primitive status. For v1.0, $\mathscr{C}$ and $\prec$ are primitive kinematic data. The specification does not yet decide whether causal order is fixed, summed over, grown sequentially, or generated by a deeper action. Any such dynamics belongs to Part III and is presently [OPEN].

[DEF] Finiteness. A computational realization may use a finite causal set. The conceptual core permits a countable locally finite set, provided the global state space and every operator domain are completed as stated in Section 4.

> **LABELS ARE NOT OBSERVABLES**
>
> The integers i and j do not denote positions or physical identities. Only order relations, incidence, invariant field data, spectra, traced holonomies, and other relabelling-invariant structures may enter physical observables.

3.2 Causal and Relational Links

[DEF] Cover relation. The canonical causal-link set is the Hasse-diagram edge set

[DEF] $\mathscr{E} = \{(i,j) : x_i \prec x_j \text{ and no } z \text{ satisfies } x_i \prec z \prec x_j\}.$

The notation $x_i \prec\!\cdot\, x_j$ may be used for a cover relation. A link e=(i,j) is oriented from its causal source x_i to its causal target x_j.

[THM] Order versus link graph. The transitive closure of $\mathscr{E}$ reconstructs $\prec$. The graph $\mathscr{E}$ therefore encodes the order, but it is not identical to the set of all causally related pairs.

[DEF] Directed causal path. A path γ from x_{i0} to x_{in} is a finite sequence of cover links

[DEF] $\gamma = (i_0, i_1, \ldots, i_n), \quad (i_{r-1}, i_r) \in \mathscr{E}.$

Path concatenation is defined only when the target of the first path equals the source of the second. The empty path at x_i is the identity path.

[DEF] Formal reversal. For algebraic transport, γ^{-1} denotes the oppositely oriented sequence. It defines an inverse map where one exists, but it does not assert $x_j \prec x_i$ or create a reverse causal link.

Object	Contains	Status	Normative interpretation
Causal order $\prec$	All transitively related event pairs	Primitive kinematic relation	Strict partial order
Link set $\mathscr{E}$	Cover relations only	Derived from $\prec$	Directed Hasse graph
Relational path γ	Composable sequence of links	Derived	Finite ordered chain
Formal reverse γ^{-1}	Opposite traversal of a path	Algebraic operation	Not a reverse causal history
Noncausal comparison edge	Additional graph edge not fixed by $\prec$	Not in minimal core	Requires a future major-version definition

3.3 Local State Spaces

[DEF] Local fiber. Each event x_i carries a finite-dimensional complex Hilbert space $\mathscr{H}_i$ with positive Hermitian inner product $\langle\cdot,\cdot\rangle_i$:

[DEF] $\mathscr{H}_i \cong \mathbb{C}^{mi}$, $m_i = \dim \mathscr{H}_i \in \mathbb{N}$.

The isomorphism to $\mathbb{C}^{mi}$ is noncanonical. A chosen basis is a local frame and carries no physical meaning by itself.

[DEF|OPEN] Fiber dimension. The integer m_i is part of the kinematic specification. The present theory does not derive its physical value or the observed matter representations. For the minimal unitary-transport core, linked events shall satisfy $m_i=m_j$. Regions of varying dimension require partial isometries, embeddings, or additional defect data and are excluded from v1.0 unless explicitly introduced as an effective extension.

[DEF] Complex structure. The primitive fibers are complex. A real formulation is not active in v1.0. The complex structure supports unitary frames, phases, Hermitian operators, and determinant-line representations.

[DEF|OPEN] Clifford module. A local fiber may carry a selected Clifford representation when constructing D_{rel} or a protected rank-two sector. Clifford structure is not automatically attached to every event as a metaphysically primitive property; its active status is specified in Section 4.3.

[DEF] Composition rule. The global one-record state space is formed by a direct sum. Tensor-product composition is reserved for explicitly declared composite systems or independent subsystems and shall not be inferred merely from the existence of many events.

3.4 Link Transport Variables

[DEF] Primitive transport variable. Every active causal link e=(i,j) carries a unitary linear map

[DEF] $U_{ij}: \mathscr{H}_j \to \mathscr{H}_i$, $U_{ij}{\dagger}U_{ij}=I_{\mathscr{H}j}$, $U_{ij}U_{ij}{\dagger}=I_{\mathscr{H}i}$.

This convention transports a state or record at the target fiber back to the source fiber for comparison. A later section may use the opposite convention only if it is explicitly redefined and all path-ordering formulas are changed consistently.

[THM] Formal inverse. For equal-dimensional fibers, the inverse transport is

[THM] $U_{ji} := U_{ij}^{-1}=U_{ij}{\dagger}$.

The superscript “formal” may be omitted inside a path-holonomy calculation when the orientation is unambiguous. The map is not evidence for a causal edge (j,i).

[DEF] Path transport. For $\gamma=(i_0,\ldots,i_n)$, the canonical ordered transport is

[DEF] $U[\gamma] = \prod_{r=1}^{n} U_{i(r-1)ir}: \mathscr{H}_{in} \to \mathscr{H}_{i0}$.

Concatenation of paths corresponds to composition of their maps. The identity path gives the identity operator.

[DEF] Local-frame covariance. For local frame transformations $g_{i\in U}(\mathscr{H}_i)$,

[DEF] $\psi_i \mapsto g_{i\psi i}$, $U_{ij} \mapsto g_i\, U_{ij}\, g_j^{-1}$.

The largest permitted product of local unitary frame transformations is denoted $\mathscr{G}_{\mathrm{frame}}$. It is a redundancy group. It is not, without further selection, the physical gauge group of nature.

[DEF | OPEN] Dynamical status. The values U_{ij} are primitive configuration variables in Part II. Their action and equations of motion are specified later. The Diamond–Wilson action is the best-developed active transport action, but its coefficient and physical gauge content remain open.

3.5 Substrate Fields

The corpus uses the word "field" for objects with different logical roles. Part II separates configuration fields from derived curvatures, effective responses, and numerical controls.

Symbol	Mathematical role	Ontology status	Evidence	Unresolved point
$S_U[\mathscr{C},r]$	Admissibility functional on histories/configurations	Primitive axiom candidate	[DEF | OPEN]	Its precise role as action, constraint, or measure term is not frozen.
$\Phi_U[\mathscr{C},r]$	Unity phase functional	Amplitude-level proposal	[DEF | OPEN]	No complete history measure or probability law exists.
Φ_{sub}	Hermitian or otherwise explicitly declared operator on $\mathscr{H}$	Provisional primitive configuration field	[DEF | OPEN]	Its field action, normalization, and physical identity are open.
Φ_{upd}	Oriented update/record flux on links	Candidate derived/source field	[DEF | OPEN]	Its dynamics and continuum source map are not derived.
Ω_{DW}	Signed Diamond–Wilson curvature or central curvature component	Derived geometric field	[DEF | NUM]	Defined from oriented holonomy; physical source law remains open.
h or H_{supp}	Scalar or diagonal packet-support response	Effective variable	[CON]	Belongs to the packet model, not the primitive ontology.
p_a, R_{rank}, K	Packet coordinates and observables	Derived/effective observables	[DEF | THM | CON]	Defined only after projection and singular-value normalization.
Step size, seed, tolerance	Numerical controls	Numerical only	[NUM]	Never treated as primitive physical fields.

[DEF | OPEN] Canonical substrate field. The symbol Φ_{sub} is reserved for the operator used in projected relational constructions. In v1.0 it is admitted provisionally as a configuration variable because later active matter sections require it, but no claim is made that it is the unique or final primitive matter field.

[DEF] Hermiticity convention. Whenever Φ_{sub} is used to define a Hermitian projected observable, its domain and Hermiticity shall be stated. If a non-Hermitian field is used, singular-value and eigenvalue claims shall be separated explicitly.

> **NO FIELD-NAME EQUIVALENCE**
>
> Φ_U, Φ_{sub}, and Φ_{upd} are distinct objects. They may not be identified merely because earlier papers used the same Greek letter. Ω_{DW} is a curvature derived from transport, while h is an effective response variable.

3.6 Causal Diamonds

[DEF] Minimal causal diamond. A minimal diamond $\mathscr{D}=(x_-;y_1,y_2;x\_+)$ is an interval with exactly two mutually incomparable interior events and two maximal two-link paths:

[DEF] $x_- \lessdot y_1 \lessdot x\_+, \quad x_- \lessdot y_2 \lessdot x\_+, \quad y_1 \parallel y_2.$

Here $y_{1\|y2}$ means neither $y_{1<y2}$ nor $y_{2<y1}$. The two oriented boundary paths are $\gamma_1=(x_-,y_1,x\_+)$ and $\gamma_2=(x_-,y_2,x\_+)$.

[DEF] Diamond holonomy. The relative path transport is the endpoint endomorphism

[DEF] $U_{\mathscr{D}} = U[\gamma_1]\, U[\gamma_2]^{-1}: \mathscr{H}_{x-} \to \mathscr{H}_{x-}.$

Under a local frame change at the source, $U_{\mathscr{D}}$ transforms by conjugation. Traces and conjugation-invariant class functions are therefore frame invariant.

[DEF] Orientation. The ordered pair (γ_1,γ_2) fixes the orientation of $\mathscr{D}$. Exchanging the paths gives

[THM] $U_{-\mathscr{D}}=U_{\mathscr{D}}^{-1}=U_{\mathscr{D}^\dagger}.$

Small-curvature Lie-algebra coordinates and other signed curvature quantities change sign under this reversal. The real Wilson loss Re Tr$(I-U_{\mathscr{D}})$ is orientation even.

[DEF] Nonminimal diamond. A nonminimal causal diamond is an ordered pair of distinct directed causal paths with common endpoints. Additional conditions—internal disjointness, irreducibility, or allowed intersections—shall be stated whenever a nonminimal diamond enters an action or observable.

[DEF] Wilson observable. The canonical traced loop contribution is

[DEF] $W_{\mathscr{D}} = \mathrm{Re}\,\mathrm{Tr}_R(I-U_{\mathscr{D}}),$

The representation R, trace normalization, orientation convention, and any diamond weight must be declared.

[THM] Derived status. Diamonds, path transports, holonomies, and Wilson observables are derived from the primitive order, link set, local fibers, and transport variables. A diamond is not an additional primitive cell.

3.7 Primitive Versus Emergent Status

Object	Primitive	Derived	Effective	Numerical	Normative note
Event set $\mathscr{C}$	Primitive	—	—	—	Provisional kinematic input; deeper origin open.

Object	Primitive	Derived	Effective	Numerical	Normative note
Causal order $\prec$	Primitive	—	—	—	Dynamics of the order are open.
Causal links $\mathscr{E}$	—	Derived	—	—	Cover relations of $\prec$.
Local Hilbert fibers $\mathscr{H}_i$	Primitive	—	—	—	Finite complex fibers; physical dimension not selected.
Link transports U_{ij}	Primitive variable	—	—	—	Dynamical values governed later.
Relational Unity S_U	Primitive axiom candidate	—	—	—	Role as action/measure remains open.
Substrate field Φ_{sub}	Provisional primitive variable	—	—	—	Field action and physical identity open.
Causal diamonds and $U_{\mathscr{D}}$	—	Derived	—	—	Built from order and transport.
D_{rel}	—	Derived operator	—	—	Defined in Part III; weights unresolved.
Protected projectors Π_a	—	—	Effective/open	Often numerical	Origin not yet derived.
Singular packet p,R,K	—	Derived from M	Effective	Numerically instantiated	Not primitive matter data.
Determinant lines L_a	—	Derived from effective sectors	Effective geometry	—	Existence exact after sectors are given.
Ω_{DW}	—	Derived curvature	Effective source role	Numerically measured	Source law not microscopic.
h,H_{supp}	—	—	Effective	Numerically evolved	Packet-response variable.
Seeds, step sizes, tolerances	—	—	—	Numerical	No physical status.

PART II ONTOLOGY FREEZE

The minimal primitive configuration for the active working theory is $(\mathscr{C},\prec,\{\mathscr{H}_i\},\{U_{ij}\},\Phi_{sub})$, together with the unresolved Unity functional or measure data required by the foundational proposal. Links, paths, diamonds, holonomies, operators, protected sectors, packets, and determinant lines are not additional primitives unless a future major version states otherwise.

4. Global State Space and Kinematics

This section assembles the local fibers into the state space on which relational operators act, fixes the norms used throughout the program, classifies the Clifford and exterior structures, and defines admissible configurations before any action is varied.

4.1 Global Relational State Space

[DEF] Finite substrate. For a finite event set, the global one-record Hilbert space is the orthogonal direct sum

[DEF] $\mathscr{H} = \oplus_{i\in\mathscr{E}} \mathscr{H}_i$.

A state $\psi\in\mathscr{H}$ is a family $\psi=(\psi_i)$ with $\psi_{i\in\mathscr{H}_i}$. Orthogonality of distinct event fibers is a kinematic bookkeeping convention, not a statement that events are dynamically independent.

[DEF] Countable substrate. For a countable locally finite event set, the canonical completion is the ℓ^2 direct sum

[DEF] $\mathscr{H} = \{\psi=(\psi_i) : \Sigma_i \|\psi_i\|_{i^2} < \infty\}$.

[DEF] Global frame transformation. A local-frame transformation is represented globally by the block-diagonal unitary

[DEF] $G = \oplus_i g_i, \quad \psi \mapsto G\psi$.

[DEF] Block operators. An operator A on $\mathscr{H}$ has blocks $A_{ij}:\mathscr{H}_j\to\mathscr{H}_i$. Under local frames,

[DEF] $A_{ij} \mapsto g_i A_{ij} g_j^{-1}, \quad A \mapsto GAG^{-1}$.

[DEF] Direct sum versus tensor product. The direct sum represents a field or record distributed over event fibers. A tensor product $\mathscr{H}_{A\otimes\mathscr{H}B}$ is introduced only for explicitly declared composite subsystems, multipartite operational settings, or additional field species. The specification shall not identify $\oplus_{i\mathscr{H}_i}$ with $\otimes_{i\mathscr{H}_i}$.

4.2 Inner Products and Norms

[DEF] Global inner product. For $\psi,\varphi\in\mathscr{H}$,

[DEF] $\langle\psi,\varphi\rangle_{\mathscr{H}} = \Sigma_i \langle\psi_i,\varphi_i\rangle_i, \quad \|\psi\|_2 = \sqrt{\langle\psi,\psi\rangle_{\mathscr{H}}}$.

Norm	Definition	Domain	Invariance	Approved use
Hilbert norm	$\|\psi\|_2 = \sqrt{\langle\psi,\psi\rangle}$	States in $\mathscr{H}$	Unitary invariant	State normalization and convergence.
Operator norm	$\|A\|_{op} = \sup_{\|\psi\|_2=1} \|A\psi\|_2$	Bounded operators	Unitary invariant	Perturbation and stability control.
Frobenius / Hilbert-Schmidt norm	$\|A\|_F = \sqrt{\mathrm{Tr}(A^\dagger A)}$	Finite-rank or Hilbert-Schmidt operators	Unitary bi-invariant	Operator amplitude and Pauli normalization.

Norm	Definition	Domain	Invariance	Approved use
Trace norm	$\|\|A\|\|_1 = \mathrm{Tr}\sqrt{(A^\dagger A)}$	Trace-class operators	Unitary bi-invariant	Singular-value sum and matrix distance.
Exterior-power norm	$\|\|v_1\wedge\cdots\wedge v_k\|\|^2 = \det[\langle v_a,v_b\rangle]$	$\Lambda^k\mathscr{H}$	Induced-unitary invariant	Volumes and determinant-line normalization.

[EXT] **Mathematical status.** These norm definitions are standard imported mathematics. Their use is exact. A claim that a particular norm supplies a physical energy, response, probability, or coupling is a separate physical identification and shall carry its own [DEF], [CON], [NUM], or [OPEN] status.

NORM-SELECTION RULE

A numerical or physical result shall name the norm used. Norm-dependent closure, leakage, gap, and stability claims are noncompliant if they rely on an unnamed or retrospectively selected norm.

4.3 Clifford Structure

[EXT|DEF] **Clifford representation.** When the active operator requires a three-generator Euclidean Clifford representation, the canonical generators satisfy

[EXT|DEF] $\sigma_a \sigma_b + \sigma_b \sigma_a = 2\delta_{ab} I, \quad a,b\in\{1,2,3\}.$

The Pauli matrices provide the standard two-dimensional complex representation. Their Frobenius normalization is

[THM|EXT] $\|\sigma_a\|_F = \sqrt{\mathrm{Tr}(\sigma_a^\dagger \sigma_a)} = \sqrt{2}.$

[EXT|OPEN] **Status of Cl(3).** The algebraic structure is imported and exact. The specification does not presently derive why the physical substrate selects this representation, why it produces three observed generations, or why its Frobenius norm is the physical flavor amplitude. Those are separate open or constitutive arrows.

[DEF] **Bivectors.** For any complex vector space V, the exterior-square space Λ^2V is the antisymmetric quotient of $V\otimes V$. It shall not be conflated with a selected Clifford bivector representation unless an explicit isomorphism and metric are stated.

[THM] **Rank-two determinant line.** If E is a two-dimensional complex inner-product space, then Λ^2E is one-dimensional and carries the determinant representation of U(E). This exact theorem is used later to define determinant lines after protected rank-two sectors have been supplied.

[DEF|OPEN] **Protected rank-two sectors.** The sectors $\mathscr{E}_a$ and their projectors Π_a are not primitive Clifford data. They are effective or open selections from the larger relational state space. Their existence in a numerical or projected construction does not solve the generation problem.

Structure	Mathematical status	Evidence	Physical boundary
Pauli/Clifford relations	Imported exact algebra	[EXT | THM]	May be used in operator representations.
Frobenius norm √2	Exact matrix norm	[THM | EXT]	Does not physically select Koide equipartition.
Λ^2V construction	Canonical functor	[DEF | THM]	Independent of the physical interpretation.
Protected rank-two sectors	Selected subspaces	[DEF | OPEN]	Not a primitive consequence of Cl(3).
Three physical generations	Observed matter interpretation	[OPEN]	Not derived by the representation alone.

4.4 Relational Configuration Space

[DEF] Fixed-substrate configuration space. For a fixed admissible $(\mathscr{C},\prec)$ and fixed fiber dimensions, the unreduced configuration space is schematically

[DEF] $\hat{C}_{\text{fixed}} = (\prod_{(i,j)\in\mathscr{E}} U(\mathscr{H}_j,\mathscr{H}_i)) \times \mathfrak{F}_{\text{sub}} \times \mathfrak{F}_{\text{add}}$,

where $\mathfrak{F}_{\text{sub}}$ contains the allowed substrate-field configurations and $\mathfrak{F}_{\text{add}}$ contains any other explicitly declared primitive fields. The exact field domain and regularity conditions shall be stated in the action section.

[DEF] Physical quotient. Configurations related by local frame transformations represent the same kinematic configuration:

[DEF] $\mathfrak{c}_{\text{fixed}} = \hat{C}_{\text{fixed}} / \mathscr{G}_{\text{frame}}$.

[OPEN] Dynamical-causal extension. If causal structures are summed over or dynamically changed, the extended space would be a disjoint union over admissible order-isomorphism classes,

[OPEN] $\mathfrak{c}_{\text{dyn}} = \bigsqcup_{[(\mathscr{C},\prec)]} \mathfrak{c}_{\text{fixed}}(\mathscr{C},\prec)$,

possibly followed by a measure, amplitude, or transition law. The current corpus does not freeze this measure or identify whether the ontology is sequential-growth, block-relational, or a sum over finite orders.

[DEF] Configuration, state, and history. A configuration is an instantaneous or structural assignment of primitive variables; a state is a vector or density object on the declared state space; a history is an ordered or globally weighted sequence/family of configurations. These words shall not be interchanged without a defined time or ordering parameter.

[OPEN] Path integral or history sum. No complete IRMT path measure is presently defined. S_U, Φ_U, and any history-amplitude rule of the form $\mathscr{A}_{\text{hist}} \propto \exp(i\,\Phi_U)$ remain foundational proposals until their domains, composition, gauge quotient, convergence, and probability map are specified.

4.5 Admissibility Conditions

A configuration belongs to the active kinematic domain only if it satisfies the following minimum conditions. Additional sector-specific conditions may strengthen this list but may not silently weaken it.

ID	Condition	Normative requirement
A1	Causal consistency	$\prec$ is an irreflexive transitive locally finite relation.
A2	Finite link valence	Every event has finite in-degree and out-degree in the active computational and local-action domain, unless a convergence theorem permits otherwise.
A3	Fiber compatibility	Every active unitary link connects equal-dimensional complex Hilbert fibers.
A4	Unitary transport	$U_{ij\dagger}=U_{ij}^{-1}$; nonunitary maps require a separately declared extension.
A5	Operator domains	Every unbounded or infinite-dimensional operator has a specified dense domain, adjoint, and closure property.
A6	Hermiticity declarations	An operator called observable or Hamiltonian is Hermitian/self-adjoint on its stated domain; non-Hermitian uses are labelled.
A7	Gauge/frame covariance	All equations are covariant under $\mathcal{G}_{\mathrm{frame}}$ and physical observables descend to the quotient.
A8	Relational locality	A term called local depends only on a declared finite neighborhood, path, diamond, interval, or bounded causal support.
A9	Boundary data	Finite regions state initial, final, spatial, causal, or open-boundary conditions and their transformation properties.
A10	Numerical disclosure	Every truncation, regulator, seed, step size, tolerance, and projection used to realize the configuration is reported as numerical metadata.

EXCLUDED FROM THE MINIMAL CORE

Variable-dimensional unitary links, physical observables depending on event labels, nonunitary primitive transport, an unqualified tensor product over all events, a dynamic causal order without a normalized law, and undefined unbounded operators are not admitted by v1.0.

5. Symmetries and Redundancies

This section distinguishes exact redundancies of the discrete description from physical symmetries, effective packet symmetries, continuum targets, and unproved emergence claims. A symmetry may constrain a form without selecting a unique coefficient or dynamics.

5.1 Relabelling Invariance

[DEF] **Order-preserving relabelling.** For a bijection $\pi:\mathscr{C}\to\mathscr{C}$ preserving causal order,

[DEF] $x_i \mapsto x_{\pi(i)}, \quad x_i \prec x_j \Leftrightarrow x_{\pi(i)} \prec x_{\pi(j)}.$

All incidence data, fibers, fields, paths, and transports are pushed forward with the relabelling. Physical observables shall be invariant under this action.

[THM] **Invariant constructions.** Cardinalities of intervals, spectra of covariantly transformed operators, conjugacy classes of closed holonomies, traced Wilson observables, and any function defined solely from the order-isomorphism class are relabelling invariant.

[DEF] **Automorphisms versus relabellings.** A relabelling changes only the description. An automorphism is a nontrivial relabelling that preserves a given configuration. Automorphism groups may characterize physical degeneracy or symmetry, but labels themselves never do.

5.2 Local Frame Covariance

[DEF] **Local frame group.** The maximal kinematic frame group is

[DEF] $\mathscr{G}_{\mathrm{frame}} = \prod_{i\in\mathscr{C}} U(\mathscr{H}_i),$

or the product of explicitly declared subgroups preserving additional primitive structures. It acts independently at each event.

[DEF] **Field transformations.** The canonical transformations are

[DEF] $\psi_i \mapsto g_i\psi_i, \quad U_{ij} \mapsto g_iU_{ij}g_j^{-1}, \quad A_{ij} \mapsto g_iA_{ij}g_j^{-1}.$

For a global operator A, this is $A\mapsto GAG^{-1}$. A projector transforms as $\Pi\mapsto G\Pi G^{-1}$. A path transport transforms only at its endpoints.

[THM] **Closed holonomy.** For a closed or relative path based at x_i,

[THM] $U_{\mathrm{loop}} \mapsto g_i\, U_{\mathrm{loop}}\, g_i^{-1}.$

Hence $\mathrm{Tr}_R(U_{\mathrm{loop}})$, $\mathrm{Re}\,\mathrm{Tr}_R(I-U_{\mathrm{loop}})$, eigenvalues, determinant, and conjugacy-class functions are frame invariant when the representation and trace are fixed.

5.3 Gauge Symmetry Versus Basis Redundancy

MANDATORY DISTINCTION

Local frame covariance is the statement that descriptions in different fiber bases are equivalent. A physical gauge symmetry additionally requires a selected subgroup, dynamical connection, matter representations, charges, gauge-invariant observables, and quantum consistency. The first does not derive the second.

Layer	What transforms	Group status	Meaning	Evidence
Local frame redundancy	Choice of basis in each $\mathscr{H}_i$	$\mathscr{G}_{\mathrm{frame}\subseteq\prod U}(m_i)$	Kinematic equivalence	[DEF]
Discrete transport gauge covariance	Transformation of U_{ij} and loop holonomy	Chosen compact subgroup/representation	Kinematic plus action invariance	[DEF]

MANDATORY DISTINCTION

Local frame covariance is the statement that descriptions in different fiber bases are equivalent. A physical gauge symmetry additionally requires a selected subgroup, dynamical connection, matter representations, charges, gauge-invariant observables, and quantum consistency. The first does not derive the second.

Layer	What transforms	Group status	Meaning	Evidence
Physical gauge symmetry	Actual interaction group and charges	Not yet selected	Physical redundancy and interaction structure	[OPEN]
Standard Model gauge content	SU(3)×SU(2)×U(1), chiral reps, hypercharge	Not derived	Observed physical sector	[OPEN]
Continuum gauge field	A_μ and $F_{\mu\nu}$	Conditional smooth limit	Imported/effective continuum description	[EXT | OPEN]

[OPEN] **Physical group selection.** No statement in Part II selects the Standard Model group, matter representations, chirality, hypercharge, or anomaly cancellation. Generic U(m) covariance is permission for a family of gauge descriptions, not evidence that nature chooses one member.

5.4 Causal Orientation Reversal

[DEF] **Path reversal.** The formal reverse γ^{-1} reverses the order of factors and replaces every link transport by its inverse:

[THM] $U[\gamma^{-1}] = U[\gamma]^{-1}$.

[DEF] **Diamond reversal.** For $-\mathscr{D}=(\gamma_2,\gamma_1)$,

[THM] $U_{-\mathscr{D}}=U_{\mathscr{D}}^{-1}$.

An orientation-even Wilson loss is unchanged, while a signed Lie-algebra curvature coordinate changes sign in the small-curvature branch:

[THM | DEF] $W_{-\mathscr{D}} = W_{\mathscr{D}}, \quad \Omega_{DW}(-\mathscr{D}) = -\Omega_{DW}(\mathscr{D})$.

[DEF | CON] **Current parity.** A physically oriented current constructed from signed curvature shall transform as $J_\Omega(-\mathscr{D})=-J_\Omega(\mathscr{D})$. The specific law $J_\Omega=\Omega_{DW}\, H_{supp}$ remains constitutive, even though its orientation parity is consistent.

[DEF] **Not time reversal.** Causal orientation reversal is an operation on an oriented comparison cell. It is not identified with the antiunitary physical time-reversal operator T, does not reverse the causal order globally, and does not assert the existence of a reverse causal process.

5.5 Discrete Symmetries

Symmetry	Present status	Evidence	Boundary
Event relabelling	Exact redundancy	[DEF]	Applies to all primitive configurations.
Diamond path exchange	Exact orientation reversal	[DEF | THM]	Inverts holonomy and reverses signed curvature.

Symmetry	Present status	Evidence	Boundary
Subordinate exchange S_2	Effective packet symmetry	[CON|THM]	Used on the one-plus-two manifold; microscopic origin open.
Triplet permutation S_3	Kinematic/effective symmetry of unlabeled components	[DEF|OPEN]	Broken by ordering a dominant component or by unequal dynamics.
Parity P	Not frozen	[OPEN]	Requires a spacetime/Clifford representation and action.
Time reversal T	Not frozen	[OPEN]	Not identical to causal orientation reversal.
Charge conjugation C	Not frozen	[OPEN]	Requires a physical matter and gauge representation.
CPT	Not established	[OPEN]	A continuum quantum-field theorem cannot be imported without its assumptions.

[THM | CON] **Pair-symmetric packet manifold.** If $p_2=p_3$ and the effective flow respects subordinate exchange, the one-plus-two manifold is invariant. The invariance theorem is exact for the declared flow; the physical selection of the symmetry remains constitutive or open.

[DEF] **Ordering is not a symmetry.** The convention $p_{1\geq p2\geq p3}$ selects a coordinate chamber and removes permutation redundancy for reporting. It does not constitute dynamical symmetry breaking by itself.

5.6 Continuous Symmetries

Symmetry	Group / parameter	Meaning	Evidence	Current limit
Local unitary frames	$\Pi_{iU}(\mathscr{H}_i)$	Exact kinematic redundancy	[DEF]	Active in the discrete core.
Global phase	Diagonal U(1) subgroup	Redundancy of state-vector description where applicable	[DEF]	Operational probabilities still require a complete quantum model.
Physical internal gauge group	Unknown subgroup and representation	Physical symmetry	[OPEN]	Not selected by local frames.
Lorentz symmetry	Continuum target	Emergent/approximate spacetime symmetry	[EXT|OPEN]	Requires a controlled causal-set continuum limit.
Diffeomorphism invariance	Continuum target	Emergent geometric redundancy	[EXT|OPEN]	Not identical to event relabelling.
Continuous packet-flow reparametrization	Choice of relaxation parameter	Numerical/effective redundancy only when equations transform consistently	[CON|NUM]	Not fundamental physical time.

[DEF] **Largest permitted frame group.** If only the Hermitian inner product is primitive, the maximal local frame group is $U(m_i)$. If a primitive tensor, grading, real structure, symplectic form, or Clifford representation is also frozen, the permitted frame group is the subgroup preserving that structure. The specification shall list the preserved data before reducing $\mathscr{G}_{\text{frame}}$.

5.7 Broken and Emergent Symmetries

IRMT uses "emergent" only when a symmetry absent or nonmanifest in the microscopic variables is shown to govern a derived regime. Permission, analogy, or imported continuum notation is not emergence.

Symmetry / structure	Microscopic status	Emergent or broken status	Promotion gate
Relabelling invariance	Exact at discrete level	Unbroken redundancy	Primitive definition
Local frame covariance	Exact at kinematic level	Unbroken redundancy	Primitive fiber structure
Physical gauge symmetry	Not selected	Open	Requires group and representation theorem
Subordinate S_2	Assumed/effective and preserved by selected flow	Effective; may be dynamically stable in tests	Requires microscopic selection
Triplet S_3	Available before ordering; broken to S_2 in one-plus-two sector	Effective/representation dependent	Requires physical sector derivation
Lorentz symmetry	Not exact in a finite poset realization	Continuum target	Requires statistical/continuum convergence
Diffeomorphism invariance	Not the same as relabelling	Continuum target	Requires emergent metric/action
Chirality	Representation resource only	Open physical selection	Requires observed chiral matter content
Identity determinant metric	Exact at bare protected-block quadratic order	Not protected under mixed wedges	Requires decoupling/protection theorem

SYMMETRY DOES NOT SELECT COEFFICIENTS

A symmetry can forbid terms, identify invariant subspaces, or constrain a response to a family. It does not select a unique member of that family unless a uniqueness theorem is proved. In particular, determinant-line gauge covariance, pair symmetry, and orientation permit independent common and relative response coefficients; they do not derive the identity response map.

5.8 Part II Compliance Statement

Every later part of the Core Specification shall use the ontology, state-space construction, transformation laws, and status boundaries defined here. A later construction is noncompliant if it:

- treats event labels or local frames as physical observables;

- identifies the Hasse link graph with the full transitive causal order;
- uses unitary transport between unequal-dimensional fibers without defining an extension;
- conflates Φ_U, Φ_{sub}, Φ_{upd}, Ω_{DW}, or h;
- describes generic local U(m) covariance as the derivation of the Standard Model;
- treats a formal path reversal as a reverse causal link or physical time reversal;
- promotes an effective packet symmetry, protected sector, or determinant line to primitive status without a versioned ontology change; or
- claims an emergent continuum symmetry without a controlled limiting map.

PART II ENDPOINT

The working primitive data are now explicit, but their dynamics are not. Part III must define the active relational operators and display the complete action architecture, including every absent interaction. Nothing in Part II alone derives quantum probabilities, physical gauge content, gravity, generations, packet stabilization, or charged-lepton masses.

Source-Control Crosswalk

Record	Title	Part II control function
Record 1	Claim Ledger	Controls which historical ontology and symmetry claims remain active.
Record 2	Definition and Notation Ledger	Primary source for canonical symbols, domains, transformation laws, and conflicts.
Record 3	Action Ledger	Prevents a kinematic variable from being misrepresented as dynamically derived.
Record 4	Coefficient Ledger	Controls dimensions and distinguishes physical coefficients from conventions and numerical controls.
Record 5	Dependency Graph	Controls primitive-to-derived arrows and weakest-dependency inheritance.
Record 6	Retired and Superseded Claims	Excludes generic gauge, chGUE/BBP, measurement, gravity-closure, and program-closure overclaims.

6. Operational Quantum Layer

QREV-2026-07-03-01 adds a typed operational layer to Part II. This layer does not replace the primitive direct-sum kinematics. It specifies the additional local and bipartite objects needed to state quantum probability claims without silently identifying many event fibers with a tensor product.

OPERATIONAL STATUS The following objects are admitted as controlled operational definitions and premise candidates. They are not yet derived from the microscopic action or history measure. Their derivation gates are recorded in Records 2 and 5.

6.1 Operational regions, settings, and outcomes

[DEF] Operational region. An operational region is $R=(E\_R, \partial E\_R)$, where E_R is a finite causally convex event subset and ∂E_R is the declared read-out subset.

[DEF|OPEN] Setting object. A setting is $x \in X\_R$ together with a local representation map $\rho\_R(x)$. The map may reference only data local to R. Operational availability and free intervention status are not derived by this definition.

[DEF|OPEN] Outcome partition. An outcome family $\mathscr{O}\_R=\{O\_a\}$ is a finite invariant partition of regional read-out configurations. It does not by itself select a preferred basis or measurement update rule.

6.2 Declared composites and local effects

[DEF|OPEN] Declared composite. A tensor product $\mathscr{H}\_A \otimes \mathscr{H}\_B$ may be introduced only for an explicitly declared bipartite operational scenario. It is not inferred from the direct sum $\oplus\_i \mathscr{H}\_i$.

[DEF|OPEN] Full local effect algebra. LQ-POVM denotes the premise that each local operational fiber admits the full effect algebra $Eff(\mathscr{H}\_R)=\{E{:}0 \le E \le I\}$, with every finite decomposition $\Sigma\_i E\_i=I$ operationally available as a POVM. Part II local Hilbert fibers alone do not prove this premise.

[DEF|OPEN] AX1J. Joint effect noncontextuality and separate additivity require a joint weighting $\omega(E,F)$ that depends only on local effects E and F and is additive in either argument over every admissible local POVM decomposition.

6.3 Causal marginals and free settings

[DEF|OPEN] Free-setting semantics. A causal no-influence proof requires settings to function as exogenous interventions, not merely as variables statistically correlated with common-past substrate data. A representative condition is $P(\lambda\_past|x,y)=P(\lambda\_past)$.

[OPEN] Native no-signalling gate. A substrate-native proof must combine a local causal-support law for marginals with free-setting semantics. The projective trace proof in Part IV remains an in-framework theorem, not a replacement for this native gate.

6.4 Rank-one weighting residual axioms

[DEF|OPEN] RA1. Rank-one outcome noncontextuality states that a rank-one outcome weight depends on the ray and the preparation, not on the basis in which the ray is presented.

[DEF|OPEN] RA2. Dimension stability states that appending causally inert orthogonal read-out directions leaves weights on the original outcomes unchanged.

[THM|RA1+RA2] Within pure-state, rank-one projective scenarios, frame covariance, RA1, basis normalization, and RA2 force $v(P\_e;\psi)=|\langle e|\psi\rangle|^2$. The fixed-dimension affine family has $0 \le f_0 \le 1/(d-1)$ absent monotonicity; RA2 forces $f_0=0$. This does not derive arbitrary POVMs, mixed states, updates, preferred basis, or outcome dynamics.

6.5 Part II operational compliance

Object / premise	Status	Noncompliant use
Operational region / setting / outcome	[DEF | OPEN]	Treating the notation as a derived measurement theory.
Declared composite	[DEF | OPEN]	Inferring a universal tensor product from the direct-sum event kinematics.
LQ-POVM	[DEF | OPEN]	Claiming full local POVM availability from finite Hilbert fibers alone.
AX1J	[DEF | OPEN]	Using local noncontextuality to infer joint effect noncontextuality without proof.
Free settings	[DEF | OPEN]	Deriving no-signalling from causal separation while allowing common-past measurement dependence.
Rank-one Born weight	[THM | RA1+RA2]	Calling the full Born rule, POVM rule, or measurement update solved.

PART II 0.3.1 ENDPOINT Part II now contains the primitive kinematic ontology plus the operational quantum vocabulary required by the Q-series. Dynamics, probability generation, full effect availability, state/preparation selection, and multipartite closure remain outside Part II and are governed by Parts III-IV and Record 5.

IRMT CORE SPECIFICATION v1.0

PART III

OPERATORS AND DYNAMICS

Fundamental Operators, Action Architecture, Equations of Motion, and Dynamical Principles

The present theory does not yet possess one complete microscopic action. This Part therefore specifies the active operators exactly, separates native actions from effective flows and imported continuum machinery, and displays every missing interaction as an explicit open term.

Abdulaziz Abdi · Toronto · 3 July 2026

Standalone Working Draft 0.4.1

Document Control

Control field	Value
Document	IRMT Core Specification v1.0 — Part III: Operators and Dynamics
Working version	0.4.1
Specification status	Standalone working draft; not a frozen v1.0.0 release
Controlled sections	6. Fundamental Operators; 7. Complete Microscopic Action; 8. Equations of Motion and Dynamical Principles
Primary source records	Record 2: Definition and Notation Ledger; Record 3: Action Ledger; Record 4: Coefficient Ledger; Record 5: Dependency Graph; Record 6: Retired and Superseded Claims
Precedence	Part I controls evidentiary language. Part II controls primitive objects and kinematic conventions. This Part controls operator, action, and flow status wherever earlier papers conflict.
Permanent identifier	Pending assignment at frozen release

Part III Status Statement

Normative status. Part III defines the active operator hierarchy and the complete present inventory of actions, flows, constraints, and missing couplings. It does not manufacture a unified action where none exists. The symbol S_{IRMT} is reserved for a future action only after every term and independently varied field has been specified.

Contents

Normative Decisions Introduced in Part III

1. One active relational Dirac operator form is fixed at the kinematic level, while its link weights, Clifford factors, and continuum selection remain explicitly open inputs.
2. The canonical protected projector is Π_T. It is an effective or open selection, not a primitive or dynamically derived object.
3. The current native action is the Diamond–Wilson transport action. The packet sector is presently an effective relaxation flow, not a completed Euler–Lagrange theory.
4. The symbols S_{BD}, S_{spec}, S_{YM}, and S_{EH} denote imported or conditional continuum machinery and shall not be included silently in a native IRMT action.
5. The packet-to-determinant interaction generating $J_\Omega=\Omega_{DW}\, H_{supp}$ is absent from the present action and remains constitutive.

6. Physical evolution, causal growth, relaxation flow, numerical iteration, path exposure, cosmological time, and renormalization scale are distinct parameters and shall not be identified without a proved map.
7. The current theory is a structured stack of native, effective, imported, numerical, and open sectors—not one microscopically unified dynamics.

8. Conditional operational quantum theorems are admitted as exact inside their declared interface, but they do not add a native action term or close the microscopic probability, preparation, or update problem.

6. Fundamental Operators

This section fixes the operators that can be written on the Part II state space. It distinguishes exact constructions from physical-selection rules. An operator may be mathematically well defined even when the theory does not yet derive why that operator, projector, representation, or normalization is physically selected.

6.0 Operator Hierarchy and Naming Rule

[DEF] Every operator shall be assigned to one of four layers before it is used in a theorem or numerical experiment.

Layer	Examples	Permitted claim
Kinematic	Link maps U_{ij}, path transport, D_{rel} once its blocks are specified	The object is well defined on the declared state space.
Representation-derived	Exterior-square operator, determinant-line action, projectors induced by a fixed decomposition	The construction follows exactly after the representation/decomposition is chosen.
Effective	Π_T, $M=\Pi_{T\Phi}$_subΠ_T, packet variables, H_{supp}, boundary potential	Conditional statements inside the effective model.
Numerical	Finite matrices, extracted projectors, feedback variants, tolerances and ensembles	Evidence only for the implemented model and controls.

> **Naming rule.** A symbol shall not be reused for a primitive operator, an effective projection, and a numerical matrix. The canonical notation in this Part supersedes conflicting uses in Papers I–XVI.

6.1 Relational Dirac Operator

[DEF] Global domain. The active relational Dirac operator is a densely defined block operator on the direct-sum Hilbert space $\mathscr{H}$ of Part II. For every active cover link e=(i,j), define a link block

[DEF] $B_{ij} = w_{ij}\,\Gamma_{ij}\,U_{ij}: \mathscr{H}_j \to \mathscr{H}_i$.

[DEF|OPEN] Here w_{ij} is a real nonnegative link weight with the inverse-length dimension required by the chosen discretization, Γ_{ij} is a declared Clifford/link factor, and U_{ij} is the primitive unitary transport. If no nontrivial Clifford factor is used, $\Gamma_{ij}=I$ shall be stated explicitly.

[DEF] Hermitian block convention. The canonical active operator has off-diagonal blocks

[DEF] $(D_{rel})_{ij} = B_{ij}, \quad (D_{rel})_{ji} = B_{ij}^\dagger, \quad (D_{rel})_{ii} = V_i$.

[DEF|OPEN] where V_i is a declared Hermitian on-site block, normally zero unless a mass, potential, boundary, or regularization term is explicitly introduced. All non-link off-diagonal blocks vanish. On finite substrates this gives $D_{rel}=D_{rel}^\dagger$. On countable substrates, self-adjointness requires a specified common dense domain and the usual closability/domain conditions.

[THM] Local-frame covariance. With $G=\oplus_i g_i$, the blocks transform by conjugation and therefore

[THM] $D_{rel} \mapsto G\,D_{rel}\,G^{-1}$.

[DEF|OPEN] Grading. A $\mathbb{Z}_2$ grading Γ_* is present only when each relevant fiber has a compatible grading and every link block is odd:

[DEF|OPEN] $\Gamma_*^\dagger = \Gamma_*, \quad \Gamma_*^2=I, \quad \{\Gamma_*,D_{rel}\}=0$.

[OPEN] The existence of such a grading does not derive observed chirality, hypercharge, or anomaly cancellation. Those are physical representation-selection problems.

[EXT|OPEN] Continuum interpretation. D_{rel} is an active discrete kinematic operator. A statement that it converges to the Lorentzian continuum Dirac operator is conditional until one frozen weighting, refinement map, domain, norm, and error bound are supplied.

> **Retired spectral premise.** No native chGUE, Marchenko–Pastur, or BBP universality is attached to D_{rel}. Those mechanisms are historical controls only under Record 6.

6.2 Protected Projectors

[DEF] Orthogonal projector. Every protected projector Π is required to satisfy

[DEF] $\Pi^2=\Pi, \quad \Pi^\dagger=\Pi$.

[THM|EXT] Spectral projector. If I is a declared Borel interval and D_{rel} is self-adjoint, the exact mathematical spectral projector is $\Pi_I=\chi_I(D_{rel})$. Its physical status depends entirely on how I is selected.

Canonical symbol	Definition / role	Present status
Π_T	Rank-three projector onto the protected triplet used by the projected packet construction.	[DEF|OPEN] Effective selection; not yet generated by the core action.
Π_a, a=1,2,3	Projectors onto three protected rank-two sectors E_a used by exterior-square flavor geometry.	[DEF|OPEN] Exact after sectors are chosen; physical selection remains open.

Canonical symbol	Definition / role	Present status
$\Pi_{\mathscr{L}}$	Projector onto $\mathscr{L}=L_1\oplus L_2\oplus L_3$ inside the exterior-square space.	[THM] Representation-derived after Π_a are fixed.
Π_{mix}	Projector onto the complementary mixed-wedge sector.	[THM] Representation-derived after the decomposition is fixed.
$\Pi_D=J_3/3$	Projector onto the common/democratic line spanned by (1,1,1).	[THM] Exact representation projector; not the dominant singular component.
$\Pi_S=I_3-\Pi_D$	Projector onto the two-dimensional traceless/relative plane.	[THM] Exact representation projector.
$\Pi_\parallel$, $\Pi_\perp$	Dominant packet coordinate and subordinate pair projectors in a chosen ordered packet frame.	[DEF|CON] Effective packet-frame objects; distinct from Π_D and Π_S.

[DEF] Selection rule. A projector may be called dynamically generated only if it arises reproducibly from a declared action or transition law without using the target masses, Koide value, or desired phase to choose the spectral window, rank, or basis.

[DEF|NUM] Closure observable. Any numerical use of Π_T shall report a gauge-invariant leakage measure, for example

[DEF|NUM] $\varepsilon_{close} = ||(I-\Pi_T)\ \Phi_{sub}\ \Pi_T|| \ / \ ||\Phi_{sub}\ \Pi_T||$,

[NUM] together with the norm, tolerance, ensemble, and sensitivity analysis. The tolerance is a numerical control, not a physical constant.

6.3 Projected Relational Operator

[DEF] Protected space. Let $T=\mathrm{ran}\ \Pi_T$. The active projected relational operator is

[DEF] $M = \Pi_T\ \Phi_{sub}\ \Pi_T : T \to T$.

[DEF] Equivalently, in an orthonormal protected basis $\{\psi_a\}$,

[DEF] $M_{ab} = \langle\psi_a|\ \Phi_{sub}\ |\psi_b\rangle$.

[THM] Hermiticity. If Φ_{sub} is Hermitian and Π_T is orthogonal, then $M=M^\dagger$. If Φ_{sub} is not Hermitian, singular values remain defined but eigenvalue and energy interpretations shall not be used without a separate normal or Hermitian construction.

[THM] Covariance. A unitary change of protected basis gives $M\mapsto VMV^\dagger$. Eigenvalues, singular values, traces, determinants, and unitarily invariant norms are basis invariant. Individual matrix entries are not observables.

[DEF|OPEN] Physical status. The compression is exact after Π_T and Φ_{sub} are specified. The present theory does not yet derive either input from one microscopic field action. M is therefore an effective projected operator, not a primitive mass matrix.

6.4 Singular Packet Variables

[DEF] Ordered singular values. Let

[DEF] $\sigma_1 \geq \sigma_2 \geq \sigma_3 \geq 0$

[DEF] be the singular values of M. If $\Sigma_a \sigma_a>0$, define the normalized packet

[DEF] $p_a = \sigma_a / \Sigma_b \sigma_b, \quad p_a\geq0, \quad \Sigma_a p_a=1.$

Quantity	Canonical definition	Range / status
R_{rank}	p_1	$1/3\leq R_{rank}\leq1$ for an ordered three-component packet.
K_{pkt}	$\Sigma_a p_a^2$	$1/3\leq K_{pkt}\leq1$; equal to the Koide ratio when p_a are normalized square-root masses.
S_F	$1-K_{pkt}$	$0\leq S_F\leq2/3$; exact Frobenius complement used by the effective support flow.
H_{Shan}	$-\Sigma_a p_a \log p_a$	Optional diagnostic; not the active Frobenius support functional.
p(R)	$(R,(1-R)/2,(1-R)/2)$	Pair-symmetric effective submanifold.
K(R)	$R^2+(1-R)^2/2$	Exact on p(R).
R_K	$(1+\sqrt{2})/3$	Exact interior solution of K(R)=2/3.

[DEF|THM] Signed Koide amplitudes. The symbol s_a is reserved for signed circular amplitudes satisfying $m_a=m_0^2s_a^2$. Principal square roots obey $\sqrt{m_a}=m_0|s_a|$. The all-positive branch permits $p_a=s_a/\Sigma_b s\_b$; outside that branch absolute values are mandatory.

[NUM|OPEN] Rank concentration is numerically supported as the strongest implemented hierarchy diagnostic. Its promotion to a fundamental order parameter requires derivation from the substrate-field action and target-independent projector formation.

6.5 Wilson and Diamond Operators

[DEF] Path transport and diamond holonomy follow the Part II conventions. For an oriented diamond $\mathscr{D}$ with boundary paths γ_1 and γ_2,

[DEF] $U_{\mathscr{D}} = U[\gamma_1]\, U[\gamma_2]^{-1}.$

[DEF] Wilson loss. In a declared unitary representation R of dimension d_R,

[DEF] $W_{\mathscr{D}} = \mathrm{Re}\, \mathrm{Tr}_R(I-U_{\mathscr{D}}).$

[THM] For unitary $U_{\mathscr{D}}$, $W_{\mathscr{D}}\geq0$ and is invariant under local-frame conjugation. It is orientation even.

[DEF|OPEN] Signed Lie-algebra curvature. On a branch where the matrix logarithm is defined, set

[DEF|OPEN] $\Omega_{\mathscr{D}} = -i\, \mathrm{Log}(U_{\mathscr{D}}), \quad \Omega_{-\mathscr{D}}=-\Omega_{\mathscr{D}}.$

[DEF|CON] The signed central Diamond–Wilson curvature is the normalized central trace

[DEF|CON] $\Omega_{DW} = (1/d_R)\, \mathrm{Tr}_R\, \Omega_{\mathscr{D}}.$

[CON] The definition is local and gauge invariant on its branch. Its use as the scalar source multiplying the packet support generator is constitutive and is not implied by the Wilson action.

6.6 Exterior-Square Operator

[THM|EXT] Exterior-square state space. For the global or selected internal space V, the induced operator $\Lambda^2 A$ is defined by

[THM|EXT] $(\Lambda^2 A)(v\wedge w) = Av \wedge Aw.$

[THM] Protected decomposition. Given three protected rank-two sectors E_a, define determinant lines and their sum

[THM] $L_a=\Lambda^2 E_a, \quad \mathscr{L}=L_1\oplus L_2\oplus L_3.$

[DEF] The selected exterior-square space decomposes as

[DEF] $\Lambda^2 V = \mathscr{L} \oplus \mathscr{W}_{\mathrm{mix}} \oplus \mathscr{R}$

[DEF] where $\mathscr{W}_{\mathrm{mix}}$ contains wedges coupling distinct protected sectors and $\mathscr{R}$ denotes any remaining exterior-square complement. The exact decomposition shall be reported for every finite implementation.

[DEF|THM] Induced projected operator. The determinant-line flavor operator is

[DEF|THM] $M_\wedge = \Pi_{\mathscr{L}} (\Lambda^2\Phi_{\mathrm{sub}}) \Pi_{\mathscr{L}} : \mathscr{L}\to\mathscr{L}.$

[DEF] Quadratic block form. A general Hermitian quadratic response on $\mathscr{L}\oplus\mathscr{W}_{\mathrm{mix}}$ has the block matrix

[DEF] $Q = \begin{bmatrix} A & B \\ B^\dagger & C \end{bmatrix}$

[THM] with protected block A, mixed block C, and coupling B. If C is positive and invertible, integrating out the mixed sector gives the exact Schur complement

[THM] $A_{\mathrm{eff}} = A - B\, C^{-1} B^\dagger.$

[THM|NUM] This term is the principal obstruction to treating the bare protected determinant metric as automatically stable.

6.7 Determinant-Line Bundle

[THM] Bundle existence. Each L_a is one dimensional and carries the determinant representation of $U(E_a)$. Their direct sum $\mathscr{L}$ is therefore a canonical three-line representation after the sectors E_a are fixed.

[THM] Line-frame action. If $g_a\in U(E_a)$, then a nonzero line vector $\ell_a\in L_a$ transforms as

[THM] $\ell_a \mapsto \det(g_a)\, \ell_a.$

[DEF] Connection variables. A determinant-line connection may be represented by compact link phases $u_a=e^{i\theta_a}$ or by local Lie-algebra coordinates A_a on a chosen branch. The finite phases θ_a are physical only through gauge-invariant closed holonomies or declared relative/oriented invariants.

[THM] Common and relative projectors. On the line-coordinate space $\mathbb{C}^3$, let $u_D=(1,1,1)/\sqrt{3}$ and

[THM] $\Pi_D=u_D u_D^\dagger=J_3/3, \quad \Pi_S=I_3-\Pi_D.$

[THM | OPEN] A pair-preserving linear current has the general form $\Omega_{DW}(a_{D\Pi}\_D+b_{S\Pi}\_S)$. The desired identity response corresponds to $a_D=b_S$, but the declared symmetries do not select that equality.

[CON] Support generator. The effective packet response is represented by a Hermitian diagonal line operator H_{supp}. The law

[CON] $J_\Omega = \Omega_{DW}\, H_{supp}$

[CON] is retained as the minimal effective closure law. Bundle existence, line representations, and the law sourcing their connection are separate statements.

7. Complete Microscopic Action

This is the central honesty condition of the specification: the current corpus does not contain a complete microscopic action. The purpose of Section 7 is to show exactly what exists, what is effective, what is imported, and what is absent.

7.1 Action Architecture

[DEF] Reserved symbol. The notation S_{IRMT} is reserved for a future scalar functional over all independently varied primitive variables. It shall not be used for the present collection of disconnected sector equations.

[OPEN] $S_{IRMT} = S_{causal} + S_{transport} + S_{field} + S_{packet} + S_{geometry} + S_{interaction}$.

[OPEN] The displayed equation is an architecture requirement, not an assertion that every term presently exists.

Required sector	Present expression	Status in v0.4.1
Causal structure	No frozen action or normalized transition law for changing $\prec$. Fixed-order calculations treat $(\mathscr{C},\prec)$ as background.	[OPEN]
Link transport	Diamond–Wilson action $S_W[U]$.	[DEF] Native active action.
Substrate field	No frozen $S_{field}[\Phi_{sub,U,}\prec]$.	[OPEN]
Packet formation/stabilization	Natural-gradient collapse/support flow in p,h; no one scalar microscopic action.	[CON | THM] Effective flow.
Determinant phase	Effective boundary potential Γ_∂ and constitutive current J_Ω.	[CON | THM]
Geometry/gravity	Benincasa–Dowker, spectral action, Yang–Mills, and Einstein–Hilbert structures are imported conditional routes.	[EXT | OPEN]
Packet–connection interaction	No compact bounded term generating J_Ω by variation.	[OPEN]
Matter–geometry interaction	No jointly varied native action.	[OPEN]

Required sector	Present expression	Status in v0.4.1
Protected–mixed interaction	Present implicitly in the full exterior-square quadratic block; not dynamically protected.	[THM | NUM | OPEN]

Current architecture. The theory presently contains one well-defined native discrete gauge action, several effective flows or potentials, imported continuum actions, and explicit missing interactions. This is a structured action inventory, not a unified action.

7.2 Fundamental Versus Effective Actions

Object	Layer	May be varied as a physical action?	Rule
$S_W[U]$	Native discrete transport	Yes, with fixed causal order, group, representation, and diamond weights.	Its variation produces a link equation only.
$C(p)$, $S_F(p)$	Effective packet functionals	They define natural-gradient directions, not presently a fundamental physical action.	Do not call s physical time.
$\Gamma_\partial(\varphi,h)$	Effective boundary potential	Yes inside the effective flavor model.	Its stationary point is conditional on the determinant phase input.
S_{BD}	Imported causal-set gravity	Only as an explicitly external route.	Do not merge with S_W without a derived coupling.
$\mathrm{Tr}\, f(D^2/\Lambda^2)$	Imported spectral action	Only after D, f, Λ, signature, and convergence are specified.	Generic heat-kernel terms are not IRMT-specific.
S_{YM}, S_{EH}	Continuum targets	Not microscopic IRMT terms unless derived by a controlled limit.	Always carry [EXT | OPEN].
Numerical loss/update	Algorithmic	No.	Iteration parameters and tolerances are not dynamics.

[DEF] Layer non-composition. A native action, effective potential, imported continuum action, and numerical objective may not be added merely because their variables can be written in one vector. A derivation or matching map is required for every cross-layer sum.

7.3 Causal-Structure Action

[DEF] Fixed-order sector. All currently controlled Wilson, projected-operator, packet, and exterior-square calculations condition on an admissible causal order. No variation $\delta S/\delta\prec$ is defined in that sector.

[OPEN] Summed-order sector. A path sum over causal orders would require a measure on labelled or unlabelled locally finite orders, automorphism factors, boundary data, and a real or complex action. None is presently frozen.

[SUP|OPEN] Sequential-growth sector. A stochastic growth interpretation would require normalized transition probabilities satisfying causal consistency and label invariance. The historical density-biased attachment rule is schematic and is not active dynamics.

> **Ontology rule.** Block-emergent, path-summed, and sequential-growth descriptions are mutually distinct formulations. Future work must select one or prove their equivalence before cosmological time or causal evolution is claimed.

7.4 Link-Transport Action

[DEF] For fixed causal order and a declared compact unitary representation R, the active transport action is

[DEF] $S_W[U] = \beta_W \Sigma_{\mathscr{D}\in\mathfrak{D}}\, \omega_{\mathscr{D}}\, \mathrm{Re}\, \mathrm{Tr}_R(I-U_{\mathscr{D}})$.

[DEF|OPEN] The set $\mathfrak{D}$ of included diamonds, nonnegative weights $\omega_{\mathscr{D}}$, representation R, and trace convention are part of the action definition. β_W is a free or matched coupling, not derived by local-frame covariance.

[THM] Frame invariance. Each $U_{\mathscr{D}}$ transforms by conjugation at its base event, so S_W is invariant under the local-frame redundancy. The action also respects event relabelling when the diamond set and weights are relabelled covariantly.

[THM] Boundedness. For unitary $U_{\mathscr{D}}$ and $\omega_{\mathscr{D}}\geq 0$, each loop loss is nonnegative. Therefore $S_W\geq 0$ when $\beta_W\geq 0$.

[DEF|OPEN] The action is generic compact transport dynamics. It neither selects the Standard Model group nor generates packet, matter, or geometry sources without additional terms.

7.5 Substrate-Field Action

[OPEN] No active microscopic action determines Φ_{sub}. The compression $M=\Pi_{T\Phi}\_sub\Pi_T$ therefore begins after a field choice, normalization, and protected projector have been supplied.

[OPEN] A future S_{field} shall, at minimum:

- declare the domain, codomain, Hermiticity or normality, dimensions, and local-frame transformation of Φ_{sub};
- couple to the causal and transport variables through gauge-covariant local or explicitly nonlocal terms;
- be bounded below or possess another stated stability principle;
- generate the protected sectors and packet without using charged-lepton masses, the Koide target, or the desired azimuth to select them;
- state whether Φ_{sub} is classical, operator-valued, stochastic, or integrated in a quantum measure;

- produce a conserved source or stress tensor if it couples to geometry.

[DEF|OPEN] Until those conditions are met, Φ_{sub} is a provisional effective field variable.

7.6 Packet and Stabilization Dynamics

[THM|EXT] Simplex natural gradient. For a differentiable scalar F(p), define

[THM|EXT] $G_{F,i}(p)=p_i[\partial_i F-\Sigma_j p_j \partial_j F]$.

[THM] For the Frobenius concentration $C(p)=\Sigma_i p_i^2$,

[THM] $G_{C,i}=2p_i(p_i-K_{pkt})$.

[CON] The active effective packet flow is

[CON] $dp_i/ds = (1-h)\, G_{C,i}(p), \quad \tau_h\, dh/ds = qR_{rank}-h$.

[THM|CON] The parameter s is relaxation time. The flow preserves $\Sigma_{i}p\_i=1$ and the simplex boundary. It is not presently an Euler–Lagrange equation of a fundamental action.

[THM] Pair-symmetric reduction. On p(R)=(R,(1–R)/2,(1–R)/2),

[THM] $dR/ds = (1-h)\, R(1-R)(3R-1)$.

[THM|CON] In the adiabatic limit h=qR,

[THM|CON] $dR/ds = (1-qR)\, R(1-R)(3R-1)$.

[THM|CON] Interior balance requires $h_*=1$ and $qR_*=1$. The compatibility choice

[THM|CON] $q_K=1/R_K=3(\sqrt{2}-1)$

[CON] places the effective fixed point at the Koide crossing. The identity is exact after the compatibility condition is imposed; q_K is not yet independently generated by microscopic dynamics.

[THM|CON] Packet normalization coefficient. The later coefficient $\beta_{pkt}=q_K/(\xi_6\xi_3)$ is an exact composite inside the adopted response construction but inherits the constitutive status of q_K and the physical sector identification.

7.7 Diamond–Wilson Action and Determinant Reduction

[THM] The determinant-line Wilson sector is obtained by evaluating or descending S_W on the protected line representations. In the bare small-fluctuation protected-block calculation, the normalized determinant metric is

[THM] $G_{W,bare}=I_3, \quad b_{bare}=0$.

[THM] This is the strongest present microscopic positive result for the determinant metric. It holds at bare protected quadratic order. It is not an all-orders protection theorem.

[THM|CON] The finite central U(2) Wilson trace and its dressing function are exact after a representation and angle are specified. The assignment of the packet response to that angle is treated separately under Section 7.9.

7.8 Geometry and Gravity Terms

Term	Canonical expression / role	Status
S_{BD}	Four-dimensional Benincasa–Dowker causal-set curvature action.	[EXT] Imported causal-set action.
S_{BD}^Ξ	Coherence-weighted modification of the BD terms.	[CON | OPEN] No single frozen weighting convention.
S_{spec}	Tr $f(D_{rel}^2/\Lambda^2)$.	[EXT | OPEN] Generic spectral action; active operator convergence not proved.
S_{YM}	$(2g_{YM}^2)^{-1}\int \mathrm{Tr}(F^2)$.	[EXT | OPEN] Conditional continuum target of S_W.
S_{EH}	$(16\pi G_N)^{-1}\int\sqrt{-g}(R-2\Lambda_{cos})+S_m$.	[EXT | OPEN] Continuum target, not native discrete action.
Flux balance	Discrete divergence of Φ_{upd} and continuum conservation targets.	[DEF | OPEN] Constraint/bridge, not an action.

[DEF] No imported term may be combined with S_W or the packet flow without a derivation of shared variables, units, measure, variation, and boundary conditions.

7.9 Interaction Terms

Coupling required	Present status	Action-level consequence
Packet ↔ determinant connection	Absent. $J_\Omega=\Omega_{DW}\,H_{supp}$ is constitutive.	The present mixed Hessian $\delta^2S/(\delta A_{det}\,\delta h)$ is zero.
Matter / Φ_{sub} ↔ causal geometry	Absent as a jointly varied native term.	No native backreaction or derived T_{eff}.
Packet ↔ substrate field	Compression $M=\Pi_{T\Phi}$_subΠ_T is defined, but no field action generates Π_T or packet closure.	Effective observation map only.
Protected determinant lines ↔ mixed wedges	Generically present through block B in the full exterior-square Hessian.	Schur correction $A_{eff}=A-BC^{-1}B^\dagger$.
Common ↔ relative determinant channels	Both allowed by symmetry with independent coefficients $a_{D,b}$_S.	Identity response is not symmetry-selected.
Quantum probability ↔ action	No complete history measure or $P(a,b\mid x,y)$.	No action-derived Born/no-signalling sector.

[DEF | CON] Present scalar-plus-Wilson architecture. At the effective charged-lepton level, the current action inventory may be summarized schematically as

[DEF | CON] $S_{current} = S_{stab}[p,h] + S_W[A_{det}]$,

[THM] where S_{stab} denotes the effective stabilization sector rather than one fully frozen scalar action. Because no mixed term is present,

[THM] $\delta^2 S_{current} / (\delta A_{det}\,\delta h) = 0$.

[OPEN] Candidate design target. A future compact interaction S_{mix} shall satisfy $\delta S_{mix}/\delta A_{det}=J_\Omega$ while remaining gauge invariant, bounded or stable, orientation covariant, and protected against mixed-wedge renormalization. A schematic linear A·J term is not accepted as the completed compact action.

> **Central missing term.** The response-to-connection law is not absent because of notation or a small algebraic omission. It is absent because the current variational architecture contains no packet-dependent determinant source.

7.10 Coefficient Status Table

Coefficient	Term / role	Dimension	Status / source	Free in active model?
β_W	Diamond–Wilson stiffness	Dimensionless in lattice units	[DEF | OPEN] Introduced coupling; not selected by frame covariance.	Yes
$\omega_{\mathscr{D}}$	Diamond weight	Depends on normalization	[DEF] Geometric or analysis choice; must be reported.	Model dependent
w_{ij}	D_{rel} link weight	Inverse length or lattice units	[DEF | OPEN] Operator normalization not uniquely derived.	Yes / selected
q	Support response strength	Dimensionless	[CON] Free before compatibility matching.	Yes
q_K	Koide-compatible q	Dimensionless	[THM | CON] Exact after setting $R^*=R_K$.	No after compatibility lock
τ_h	Support delay	Relaxation-time units	[CON] Effective timescale.	Yes
β_{pkt}	Packet response normalization	Dimensionless in adopted convention	[THM | CON] Composite $q_K/(\xi_6\xi_3)$.	No inside active construction
λ_φ	D_3 phase stiffness	Potential units	[CON] Free positive stiffness.	Yes
$a_{D,b}$_S	Common/relative source weights	Current/curvature units	[OPEN] Symmetry leaves them independent.	Yes / undetermined
ℓ_c	Discreteness scale	Length	[DEF | EXT] Primitive or externally matched.	Externally anchored
Λ_{spec}, f_n	Spectral-action cutoff and moments	Energy / powers	[EXT | OPEN] Imported and unfixed.	Yes
G_N, Λ_{cos}	Continuum gravity constants	L^2 and L^{-2}	[EXT] Experimental/continuum inputs until derived.	External

7.11 Stability, Boundedness, Unitarity, Gauge and Causal Status

Sector	Boundedness / stability	Unitarity	Gauge / frame status	Causal status
Diamond–Wilson	Nonnegative for $\beta_{W,\omega}$_$\mathscr{D}\geq 0$.	Classical action; unitary link variables.	Exactly frame invariant.	Local on declared causal diamonds.

Sector	Boundedness / stability	Unitarity	Gauge / frame status	Causal status
D_{rel} kinematics	Self-adjointness on finite systems; countable-domain conditions open.	No physical time evolution specified.	Covariant by block conjugation.	Link local.
Packet flow	Simplex bounded; interior fixed point locally stable under stated conditions.	Nonunitary relaxation; not quantum evolution.	Singular-value invariant.	No physical causal-time interpretation.
D_3 boundary potential	Bounded below at fixed ρ for $\lambda_\varphi>0$.	Static effective potential.	Gauge invariant through the oriented line invariant.	No native causal propagation.
BD / spectral / EH	Route-dependent; Euclidean gravity has known conformal issues.	No full quantization supplied.	Imported covariance only after assumptions.	Conditional continuum causal interpretation.
Full present theory	No global boundedness theorem because no complete action exists.	No unified unitarity statement.	Sectorwise only.	No complete causal dynamics.

8. Equations of Motion and Dynamical Principles

Equations in the corpus arise from different logical sources. This section prevents a Wilson Euler–Lagrange equation, an effective natural-gradient flow, a stochastic update, a numerical iteration, and a continuum field equation from being described as one type of dynamics.

8.1 Independently Varied, Relaxed, Fixed, and Numerical Objects

Class	Objects in the present specification	Status
Native varied variable	U_{ij} in S_W for fixed causal order and fixed representation.	Physical stationary action variable in the transport sector.
Effective relaxed variables	Packet p, support h, flavor azimuth φ_ℓ.	Constitutive/effective dynamics or potential minimization.
Fixed backgrounds in active packet work	$(\mathscr{C},\prec)$, fiber dimensions, Φ_{sub}, Π_T, sector decomposition, group/representation.	Not varied; conclusions are conditional on them.
Open future varied variables	Causal order, Φ_{sub}, geometry, determinant connection jointly with packet, mixed sectors, matter fields.	Required for S_{IRMT}.
Imported continuum variables	A_μ, $g_{\mu\nu}$, continuum matter fields.	Varied only inside explicitly imported continuum actions.
Numerical controls	Seeds, graph size, step size, tolerances, mode count, MC samples, masks and resolutions.	Never physical dynamical variables.

8.2 Euler–Lagrange Equations and Effective Flow Equations

[THM] Wilson variation. For an infinitesimal Lie-algebra variation $U_e(\varepsilon)=\exp(i\varepsilon X_e)U_e$, stationary transport satisfies

[THM] $dS_W[U(\varepsilon)]/d\varepsilon\,|_{\varepsilon=0} = 0$ for all $X_e \in \mathfrak{g}$.

[THM] Equivalently, the Lie-algebra projection of the oriented weighted staple sum at every varied link vanishes. The exact staple expression depends on the declared path orientation and representation and shall be printed with every implementation.

[THM] Sourced determinant equation. The present determinant Wilson sector gives

[THM] $\delta S_W/\delta A_{det} = 0$,

[OPEN] not $\delta S/\delta A_{det}=\Omega_{DW}\, H_{supp}$. The latter requires an additional interaction.

[CON] Packet equations. The equations

[CON] $dp_i/ds=(1-h)G_{C,i}$, $\tau_h dh/ds=qR-h$

[DEF] are effective relaxation equations. They shall not be introduced with the phrase “Euler–Lagrange equation” unless an explicit scalar action, kinetic structure, and variation are supplied.

[CON] Flavor stationarity. For

[CON] $\Gamma_\partial=-\lambda_\varphi\rho^3 \cos(3\varphi_\ell-2h/3)$,

[THM|CON] stationarity gives

[THM|CON] $\sin(3\varphi_\ell-2h/3)=0$.

[THM|CON] For $\lambda_\varphi>0$ the principal minimum has $3\varphi_\ell-2h/3=0 \bmod 2\pi$. At $h_*=1$, $\varphi_*=2/9$ on the selected principal branch.

[THM] Mixed-sector stationarity. For a positive quadratic mixed block C, variation with respect to c gives

[THM] $c_*=-C^{-1}B^\dagger w$, $S_{eff}[w]=\frac{1}{2}w^\dagger(A-BC^{-1}B^\dagger)w$.

[OPEN] Missing field equations. No current Euler–Lagrange equations exist for changing causal order, generating Φ_{sub}, jointly sourcing geometry, or producing the packet-dependent determinant current.

8.3 Constraint Equations

Constraint	Canonical form	Status / purpose
Packet normalization	$p_a\geq 0$ and Σ_{ap}_a=1	[DEF] Preserved by the natural-gradient flow.
Link unitarity	$U_{ij}^\dagger U_{ij}=I$ and U_{ijU}_ij†=I	[DEF] Configuration-space constraint.
Projector	$\Pi^2=\Pi=\Pi^\dagger$	[DEF] Orthogonal protected-sector constraint.
Hermiticity	$D_{rel}=D_{rel}^\dagger$; $M=M^\dagger$ when $\Phi_{sub}=\Phi_{sub}^\dagger$	[DEF|OPEN] Domain issues on infinite systems.

Constraint	Canonical form	Status / purpose
Causal order	Irreflexive, transitive, locally finite; links are covers	[DEF] Part II admissibility.
Frame quotient	Configurations related by $G=\oplus g_i$ are equivalent	[DEF] Kinematic redundancy.
Triplet closure	ε_{close} below a declared tolerance	[NUM | OPEN] Applicability gate, not a law of nature.
Logarithm branch	Spectrum of $U_{\mathscr{D}}$ avoids the selected branch cut	[DEF] Required for signed $\Omega_{\mathscr{D}}$.
Mixed-block stability	C positive/invertible; Schur complement positive for stability	[THM | OPEN] Protection condition.
Probability law	$P\geq 0$, normalized, compositional, no-signalling	[OPEN] Required future quantum constraint.

8.4 Dynamical Flow Versus Physical Time

Parameter	Meaning	May be called physical time?
t_{phys}	Future causal or Hamiltonian evolution parameter, if derived.	Yes, only after a physical dynamics and observables are supplied.
s	Packet relaxation/optimization parameter.	No.
n or t_{iter}	Numerical update/feedback iteration.	No.
τ_{exp}	Path or exposure parameter used to integrate a connection.	Not automatically; it may be geometric or normalized.
μ or log μ	Renormalization-group scale.	No.
t_{cos}	Emergent cosmological time in a continuum model.	Only after the discrete-to-continuum map is derived.
Monte Carlo index	Independent sample label.	No.

Non-identification rule. An attractor in s, convergence in an iteration count, a Berry path integral, and propagation in physical time are different structures. No equation may transfer stability, causality, or unitarity from one parameter to another without a proved map.

8.5 Initial and Boundary Data

[DEF] Because there is no single complete action, “a solution of IRMT” is not yet a well-defined global object. A sector calculation shall state its data explicitly.

- Causal data: the event set, strict order, boundary events or region, diamond set, and any ensemble measure.

- Fiber data: dimensions, inner products, Clifford representation, grading, and boundary conditions.
- Transport data: compact group, representation, initial or boundary link matrices, weights, $\beta_{W,}$ and varied links.
- Field data: Φ_{sub} domain, Hermiticity, normalization, and whether it is fixed, sampled, or varied.
- Projection data: rule defining Π_T and $\Pi_{a,}$ rank, spectral window if used, closure observable, and tolerance.
- Packet data: p(0), h(0), q, $\tau_{h,}$ solver, and stopping/convergence criteria.
- Flavor data: line-bundle frames, orientation convention, holonomy branch, boundary potential, and branch choice.
- Continuum data: refinement parameter, scaling of weights and units, observables, error norm, and comparison target.

[DEF] Boundary conditions and omitted sectors are part of the model definition and shall not be treated as implementation details.

8.6 Equilibrium, Attractors, Metastability, and Perturbative Stability

[DEF|THM] Wilson equilibrium. A transport configuration is stationary when the link-staple equation vanishes for every varied link. Gauge-equivalent stationary configurations represent the same physical transport state.

[THM|CON] Packet equilibrium. For the pair-symmetric delayed system

[THM|CON] $\dot{R}=(1-h)g(R), \quad \tau_h\dot{h}=qR-h, \quad g(R)=R(1-R)(3R-1),$

[THM] an interior fixed point exists at $R_*=1/q$, $h_*=1$ when $1<q<3$. Its linearization is

[THM] $J_* = [\ 0 \quad -g(R^*)\ ]$
$[\ q/\tau h \quad -1/\tau h\ ]$

[THM] with characteristic polynomial

[THM] $\lambda^2 + \lambda/\tau_h + qg(R_*)/\tau_h = 0.$

[THM|CON] For $\tau_h>0$ and $1<q<3$, $qg(R_*)>0$ and both eigenvalues have negative real part. The interior fixed point is therefore locally asymptotically stable within the effective pair-symmetric model.

[DEF] This theorem does not establish global basin membership, packet formation, protection against off-manifold perturbations, or physical-time stability.

[THM|CON] Flavor minimum. A phase is an equilibrium of Γ_∂ when its first variation vanishes and the second variation is positive. Higher harmonics preserve the principal branch only under the stated sign/alignment conditions.

[THM|NUM|OPEN] Mixed-wedge protection. A bare protected metric is perturbatively stable only if B=0 by a protected symmetry or if $||BC^{-1}B^\dagger||$ is small relative to $||A||$ under a reparameterization-invariant measure. The current packets did not generate the preregistered hierarchy.

[DEF] Metastability. The term shall be used only when an effective potential or stochastic transition law defines a lifetime or escape rate. Long numerical residence near a state is not by itself metastability.

8.7 Quantization Status

Question	Current answer
Are local state spaces complex Hilbert spaces?	Yes [DEF]. This is quantum-compatible kinematics.
Is there a complete path integral over all primitive variables?	No [OPEN].
Is there a Hamiltonian generating physical time evolution?	No [OPEN].
Is S_W quantized?	Not in the core specification. It is presently a classical compact link action with unitary variables.
Are packet flows unitary quantum dynamics?	No. They are effective relaxation equations.
Is the full outcome probability law derived?	No. P(a,b|x,y) remains open.
Is the Born rule or measurement update active?	No. The Paper VI quantitative mechanism is retired.
Are continuum quantum field theories recovered?	Only as imported/conditional targets.
Can IRMT presently be called a complete quantum theory?	No. It is a quantum-motivated relational framework with partial kinematics and effective/numerical sectors.

Part III compliance condition. A future paper may call an equation “fundamental dynamics” only if its variables belong to the primitive configuration space, its coefficient status is declared, its variation or transition law is specified, and every cross-sector coupling used by the conclusion appears in the same action or in a proved reduction from it.

8.8 Operational Probability and Preparation Bridge

[DEF|EXT] Declared operational interface. The Q-series permits a finite-dimensional operational read-out layer containing regional Hilbert spaces, local projectors or effects, a preparation object, and a joint weighting rule. These objects define a valid conditional interface, but none is presently generated by the native action inventory of Section 7.

[THM|DEF-G0] In the declared projective interface, $P(a,b|x,y)=\mathrm{Tr}[(\Pi a(x)\otimes \Pi b(y))\rho]$ is positive and normalized, and completeness of the remote projector family yields no-signalling. The cosine–Bessel correlator follows for the declared phase-entangled state and von Mises phase distribution.

[THM|EXT] Under the premise bundle LQ-POVM + AX1J + operational no-signalling with free-setting semantics, the imported BBBEW theorem places every bipartite correlation in the quantum set without requiring a microscopic tensor-product composite. This is a boundary theorem, not a derivation of the weighting law or the realized state.

[OPEN] Action-to-weighting bridge. No term in the present microscopic action generates the complete local effect algebra, the separately additive joint weighting $\omega(E,F)$, the preparation/state family, the update rule, or the operational probability functional. This missing interaction is the decisive probability-sector action gap.

[OPEN] Record-dynamics selection. The aggregation theorem $\kappa_{eff}=N\kappa_0 A(\kappa_0)(1+o(1))$ is exact only in the independent aggregation ensemble. Serial diffusion instead obeys $E[e^{i\varphi N}]=\chi_\varepsilon(1)^N$. The action must determine which ensemble, or which mixture, the substrate realizes.

Revision History

Version	Date	Status	Controlled change
0.4.0	30 June 2026	Superseded working draft	Initial audited standalone Part.
0.4.1	3 July 2026	Current working draft	Integrated the Q-series operational interface and registered the missing action-to-probability, effect-algebra, preparation, and record-ensemble selection bridges.

[DEF] This revision incorporates the adopted and corrected content of WN-Q1 through WN-Q6. The working notes remain provenance records but are no longer required to interpret the controlled statements added here.

END OF PART III

IRMT CORE SPECIFICATION v1.0

PART IV

OBSERVABLES AND EMERGENCE

Physical Observables, Measurement and Probability, and the Discrete-to-Continuum Map

This Part fixes what IRMT may call a physical observable, separates invariant mathematical quantities from operationally measurable outputs, reopens the measurement and probability sector after the retirement of the original random-matrix mechanism, and establishes the exact conditions required for any discrete-to-continuum emergence claim.

Abdulaziz Abdi · Toronto · 7 July 2026

Standalone Working Draft 0.5.5

Document Control

Field	Controlled entry
Specification family	IRMT Core Specification v1.0
Part	Part IV — Observables and Emergence
Working-draft version	0.5.5
Date	7 July 2026
Author	Abdulaziz Abdi
Dependencies	Front Matter and Part I; Part II — Primitive Structure; Part III — Operators and Dynamics; Records 1–7
Normative scope	Physical-observable definitions, measurement/probability requirements, emergence maps, continuum validation criteria, and present status boundaries

Field	Controlled entry
Excluded scope	Detailed experimental packages, completion roadmap, and final test matrix, which belong to later Parts
Release status	Working draft. Not a frozen v1.0.0 release.

Part IV Status Statement

> **Normative status.** A quantity is not physical merely because it is computable, invariant, or numerically stable. It becomes an operational observable only when its estimator, units, domain, uncertainty, and comparison rule are specified. Likewise, a resemblance between discrete and continuum equations is not an emergence proof.

[DEF] The active corpus presently contains exact gauge-invariant quantities, conditional projected and packet observables, numerically supported signatures, phenomenological data estimators, and several open measurement and continuum maps. This Part preserves each at its strongest justified status.

Contents

Normative Decisions Introduced in Part IV

1. Only quantities invariant under all declared redundancies may be candidates for physical observables; gauge-fixed entries and raw phases are excluded unless reconstructed invariantly.
2. The exact finite spectrum of a frozen relational operator remains meaningful after the failure of native random-matrix universality, but random-matrix labels and spectral outlier interpretations are not active physical conclusions.

3. Projected quantities are conditional observables: their invariance is exact once the projector and parent field are fixed, while their physical meaning inherits the status of the projector-selection and field-selection rules.
4. The packet variables R and K are invariant hierarchy coordinates. The response variables h and Hsupp belong to the effective stabilization model and have no independent operational measurement at present.
5. Determinant holonomies, Wilson traces, and oriented closed invariants are genuine gauge-invariant carriers; the law sourcing their physical values remains constitutive.
6. The original quantitative measurement mechanism is superseded. IRMT currently lacks a complete operational probability map $P(a,b|x,y)$.
7. A continuum claim requires a controlled refinement family, explicit scaling parameter, convergence topology, error measure, invariance preservation, and independent validation.

8. Operational regions, settings, outcomes, and declared composites are now admitted as controlled working definitions for the CP-II-01 scenario class.

9. A valid projective probability law and cosine–Bessel correlator exist conditionally inside a declared Hilbert interface; the interface and preparation are not action-derived.

10. The bipartite quantum-set boundary is conditionally secured by an imported theorem under LQ-POVM, AX1J, operational no-signalling, and free-setting premises; multipartite closure remains open.

11. The pure-state rank-one Born form is conditionally unique under RA1 and RA2, but full effect-algebra and update rules remain open.

9. Physical Observables

An IRMT physical observable shall be invariant under all declared redundancies and shall possess an explicit extraction or comparison procedure. This section states the active observables, their limitations, and their present operational meaning.

9.1 Gauge-Invariant Observables

[DEF] Let X denote a configuration and G the declared redundancy group, including event relabellings and local frame transformations. A scalar observable is a map on the quotient configuration space satisfying

[DEF] $\mathscr{O}[g\cdot X]=\mathscr{O}[X]$ for every $g\in G$.

[DEF] Covariant objects may enter the theory, but only their invariant contractions, conjugacy classes, spectra, traces, determinants, or closed-path reconstructions may be interpreted physically.

Quantity	Invariant content	Current status
Causal-order invariants	Cardinality, interval counts, chains, antichains, cover relations, and diamond counts.	[DEF] Exact combinatorial observables; physical scale requires a continuum map.
Loop holonomy U(C)	Conjugacy class, eigenvalues, characteristic polynomial, traces, and determinant.	[THM] Exact after the path, representation, and orientation are fixed.
Wilson observable	Re TrR(I−U(C)) or an explicitly normalized class function.	[DEF | THM] Native gauge-invariant transport observable.
Spectrum of Drel	Unordered eigenvalue multiset and unitarily invariant spectral functions.	[THM] Exact for the frozen finite operator; physical interpretation remains conditional.
Projected spectrum / singular values	Spectrum or singular values of M=PΦP under a covariant projector.	[THM | CON] Exact invariants conditional on P and Φ.
Packet invariants	R, K, symmetric polynomials, entropy, and closure diagnostics derived from singular values.	[DEF | THM | NUM] Effective hierarchy observables.
Determinant-line holonomy	Closed phases e^{iΘa}, products, ratios, phase differences, and oriented invariants.	[THM | CON] Exact carriers; physical source law is constitutive.
CMB estimators	C(θ), S1/2, pseudo-Cℓ, and locked-kernel likelihood statistics.	[EXT | NUM] Operational public-data observables.
Charged-lepton masses and ratios	Externally measured masses and dimensionless ratios used for post-construction comparison.	[EXT] Comparison data, not internal inputs unless explicitly declared.

Excluded as physical observables. Individual matrix entries of Uij, Drel, Φsub, or M; a chosen eigenvector basis; open-path phases; gauge-fixed Berry connections; finite-step increments; Monte Carlo seeds; closure tolerances; and fitted nuisance parameters are not physical observables by themselves.

9.2 Spectral Observables

[DEF] The failure of native chGUE universality retires a universality-class interpretation; it does not invalidate the exact spectrum of a specified finite relational operator. The following distinction is mandatory.

Spectral object	Meaning after the universality failure	Permitted claim
spec Drel	Exact spectrum of the chosen finite, self-adjoint operator.	“Finite-operator spectrum” or “spectral diagnostic.”
Empirical spectral density	Histogram or measure of eigenvalues under a declared normalization and window.	Numerical ensemble property only.
Heat trace / spectral moments	Tr exp(−tDrel²), Tr f(Drel²/Λ²), and related invariants.	Exact finite invariants; continuum meaning requires convergence.

Spectral object	Meaning after the universality failure	Permitted claim
Spacing ratios	Scale-free local statistics of ordered eigenvalues.	Diagnostic of spectral phase; not proof of a universality class without scaling and controls.
IPR / participation ratio	Localization diagnostic for normalized eigenvectors in the event-fiber decomposition.	Numerical localization statement; not yet physical spatial localization.
Low-mode projector	Projector onto a declared spectral window or eigenspace.	Exact after the rule is frozen; physical protection or generation interpretation remains open.
chGUE, MP, BBP quantities	Valid properties of external control ensembles.	Historical controls only; not native IRMT observables.

[OPEN] A spectral quantity may be promoted to a physical observable only after the active operator is frozen, the relevant continuum or operational map is stated, and stability under graph size, boundary treatment, discretization, and admissible perturbations is demonstrated.

9.3 Projected Observables

[DEF] Let P be a covariantly defined orthogonal projector and Φ a covariant parent field. The projected operator is

[DEF] $M=P\Phi P$.

[THM] Under a frame transformation g, a valid projected construction satisfies $P\mapsto gPg^\dagger$, $\Phi\mapsto g\Phi g^\dagger$, and therefore $M\mapsto gMg^\dagger$. Its spectrum, singular values, traces, determinant, rank, and unitarily invariant norms are gauge invariant.

Projected quantity	Status	Restriction
Matrix entries M_{ab}	Covariant, not invariant.	No physical meaning without a fixed operational frame.
spec M	Invariant.	Physical interpretation inherits the status of P and Φ.
Singular values σ_a	Invariant and non-negative.	Active packet inputs; not automatically particle masses.
Rank and spectral gaps	Invariant diagnostics.	May characterize collapse/protection, not generation multiplicity by themselves.
Projected eigenvectors	Basis dependent within degeneracies.	Only invariant subspaces/projectors are physically meaningful.
P itself	Exact after selection rule.	The present physical protected-projector rule remains open.

> **Projection status.** $M=P\Phi P$ is not primitive. It is a conditional effective observable. Exact statements about M do not establish that nature selects P or Φ.

9.4 Packet Observables

[DEF] Let the ordered singular values of M be $\sigma 1 \geq \sigma 2 \geq \sigma 3 \geq 0$ and define normalized packet coordinates

[DEF] $p_a = \sigma_a / (\sigma_1 + \sigma_2 + \sigma_3), \quad \Sigma_a p_a = 1.$

[DEF] The active packet observables are defined as follows.

Symbol	Definition	Meaning and status
R	R=p1.	[DEF] Rank-concentration coordinate. It measures dominance of the largest singular direction.
K	$K=\Sigma a\ pa^2$. On the pair-symmetric branch, $K=R^2+(1-R)^2/2$.	[THM] Frobenius concentration / Koide packet coordinate. It is not by itself a probability.
h	Auxiliary scalar response satisfying the effective relaxation law $\tau h\ dh/ds=qR-h$.	[CON] Effective support response; not an independently measured quantity.
Hsupp	Hermitian diagonal response operator on the determinant-line space, constructed from the sector support responses.	[CON] Source-coordinate object in $J\Omega=\Omega DW$ Hsupp; its identity normalization is not action-derived.

[DEF|CON] The packet p, R, and K are invariant functions of the singular values. By contrast, h and Hsupp belong to the effective stabilization and holonomy-closure model. Their current empirical role is latent: they are inferred through the behavior of the effective mass construction rather than independently observed.

[THM|CON] At the effective interior fixed point, $h^*=1$ and $qR^*=1$. Setting $q=qK=1/RK$ places that fixed point at the Koide crossing; this is an exact consequence of the adopted flow and a constitutive coefficient choice, not an independent measurement theorem.

9.5 Holonomy Observables

[DEF] For each determinant line La and a closed path C, define the compact holonomy

[DEF] $U_a(C)=\exp(i\Theta_a(C)), \quad \Theta_a \in \mathbb{R} / 2\pi\mathbb{Z}.$

[THM] The phase angle depends on a branch, but the unit complex number, its products, and its ratios are branch independent. A common determinant phase is carried by the product over lines, while relative phases are carried by ratios.

[THM] $U_D=\prod_a U_a, \quad U_{ab}=U_a U_b^{-1}.$

[THM] Wilson traces are class functions of closed holonomies. In the normalized central U(2) representation used by the effective mass construction,

[THM] $\mathrm{Tr}\ U_c(\theta)=2\cos(\theta/2), \quad \det U_c(\theta)=e^{i\theta}.$

[THM|CON] The exact finite-angle Wilson dressing is a physical group-theoretic invariant once the angle is supplied, but the current identification $\theta=qK$ is constitutive.

[DEF | CON] An oriented flavor invariant may be represented by a compact phase combination such as

[DEF | CON] $\chi=\rho^3 \exp[i(3\varphi_\ell-2h/3)], \quad \mathrm{Re}\ \chi=\rho^3 \cos(3\varphi_\ell-2h/3).$

[NUM | SUP] Local Berry curvature and finite ribbon/transgression phases are gauge-invariant when constructed from closed loops or oriented surfaces. Paper XVI establishes them as genuine local carriers but rejects a universal passive packet-to-phase map.

Holonomy quantity	Operational status
Closed Wilson trace	Exact invariant; future continuum interpretation as gauge flux or interference phase requires a physical gauge-sector map.
Determinant phase e^{iΘa}	Exact compact line observable; current charged-lepton interpretation is effective.
Relative phase e^{i(Θa−Θb)}	Exact line-ratio observable; can encode flavor-plane orientation.
Oriented D3 invariant	Effective phase-locking observable within the selected boundary interaction.
Local transgression phase	Numerically validated geometric carrier; not a universal source law.

9.6 Continuum Observables

[DEF] A discrete quantity survives the continuum limit only if a sequence of normalized estimators converges in a declared topology to a finite continuum object. The following are current candidates, not uniformly completed results.

Discrete quantity	Continuum candidate	Required scaling / normalization	Current status
Event count N in a region	Causal spacetime volume V	N/ρ with fixed dimension and sprinkling measure.	[EXT | OPEN] Standard causal-set correspondence; IRMT measure not frozen.
Longest chain / interval height	Proper time τ	Dimension-dependent calibration times ℓc.	[EXT | OPEN] Candidate estimator.
Interval-layer counts	Scalar curvature density / gravitational action	BD-type dimension-dependent coefficients and nonlocality scale.	[EXT] Imported causal-set result; IRMT-specific coupling open.
Diamond Wilson loss	Yang–Mills action density Tr F^2	Small-loop limit, diamond density, βW, trace normalization, and controlled refinement.	[EXT | OPEN] Conditional continuum bridge.
Spectrum / heat trace of Drel	Continuum Dirac spectrum or heat-kernel invariants	Operator normalization and spectral/resolvent convergence.	[OPEN] No controlled theorem for active Drel.
Flux bilinears	Continuum stress-energy tensor	Coarse-graining kernel, units, conservation, and error bounds.	[CON | OPEN] Candidate source map.
Minimal-diamond weighted response	Finite susceptibility coefficients ξ6 and ξ3	k=2, r=1/2, declared Alexandrov construction.	[THM] Exact within the adopted continuum observable.
Map-space temperature correlations	C(θ) and S1/2	Fixed map, mask, estimator, beam/noise treatment, and simulations.	[EXT | NUM] Operational phenomenology.

Continuum prohibition. The existence of a familiar leading term in a formal expansion is not enough. No quantity shall be called a continuum observable unless the discrete estimator, normalization, convergence regime, and error measure are all specified.

9.7 Operational Meaning

[DEF] For each claimed observable, the specification shall answer what could, in principle, be measured or compared with experiment. The present answers are:

Claimed observable	In-principle measurement or comparison	Present limitation
Causal counts and interval statistics	Compare graph estimators across generated causal ensembles or, after a continuum map, with spacetime volume/dimension observables.	No direct physical causal-set data source exists.
Wilson traces / loop holonomies	In a completed gauge sector, compare with interference phases, fluxes, or lattice Wilson loops.	Physical group, representation, and continuum normalization remain open.
Drel spectral diagnostics	Compare finite-size spectra, localization, and scaling across simulations; eventually compare dispersion or spectral density with field data.	No active particle/continuum correspondence.
R and K	Compare effective hierarchy coordinates with normalized charged-lepton square-root mass ratios after the packet-to-mass correspondence is declared.	Projector, field, and scale maps remain conditional.
h and Hsupp	Infer only within the effective stabilization/holonomy model through its mass and phase outputs.	No independent experimental estimator presently exists.
Determinant phases / oriented invariant	Infer the effective azimuth from the charged-lepton ratio pattern or future interference observables.	No independent flavor-holonomy measurement is identified.
Charged-lepton masses and ratios	Direct comparison with measured electron, muon, and tau masses and their uncertainties.	Agreement tests the full conditional chain, not each microscopic arrow separately.
CMB $C(\theta)$, $S_{1/2}$, pseudo-C_ℓ	Compute from public Planck/WMAP maps, masks, beams, and simulations using a locked pipeline.	Kernel parameters are calibrated phenomenological quantities.
Gravity observables	Would include metric, curvature, geodesic, lensing, wave, or coupling observables in a completed continuum theory.	No IRMT-specific gravity observable is currently predicted from the microscopic action.
Quantum correlators	Would be estimated as outcome frequencies for declared settings x and y.	The probability map generating those frequencies is missing.

Operational rule. An invariant with no conceivable estimator may remain a mathematical observable of the model, but it shall not be advertised as an experimentally testable physical observable.

10. Measurement and Probability

IRMT still lacks a microscopic measurement theory, but it now possesses a controlled conditional operational layer. The Q-series defines admissible settings and outcomes, constructs a positive normalized no-signalling projective law inside a declared Hilbert interface, derives the cosine–Bessel correlator there, conditionally fixes the bipartite quantum boundary through an imported theorem, and localizes the pure-state rank-one Born form to named residual axioms. None of these results derives the full operational layer from the native action.

10.1 Current Status of Measurement

[SUP] The original quantitative mechanism in Paper VI remains retired. Revision 0.5.5 replaces it with the Q-series operational route: exact theorems are retained only inside explicitly declared settings, outcome partitions, local effect structures, weighting axioms, and preparation assumptions.

Historical component	Current status
Native chGUE bulk	Retired for the active relational Dirac operator.
Marchenko–Pastur / BBP threshold κ_c	Retired as an IRMT measurement threshold.
Unique rank-three observation projector	Not derived; retired as a theorem.
Projection as the unique restoration of unitarity	Not established; physical evolution and ensemble averaging were conflated.
Born-rule derivation	Retired with the threshold/projection architecture.
Preferred-basis derivation	Open.
Relational-consistency motivation	Retained as a conceptual research direction only.

Current statement. IRMT does not presently solve the measurement problem and predicts no universal collapse threshold, intrinsic superposition lifetime, or unique observational rank.

10.2 Outcome Space

[DEF] An operational region is a causally convex finite region $R=(E_R,\partial E_R)$ with a declared read-out subset. A setting is local structure $\rho_R(x)$ on the read-out space, and an outcome is a cell of a finite frame- and relabelling-invariant record partition. For a bipartite binary Bell test:

[DEF | OPEN] $x\in X,\quad y\in Y,\quad a\in\{-1,+1\},\quad b\in\{-1,+1\}.$

[DEF | OPEN] The definitions above make the CP-II-01 Bell-scenario class well posed. General finite, countable, continuous, sequential, inefficient-detector, and post-selected experiments still require explicit instruments and consistency rules. The theory shall define:

- what constitutes a physical system and a measurement context;

- how settings x and y are represented in the primitive or effective state space;
- which records count as outcomes a and b;
- how repeated trials, preparation procedures, and spacelike separation are represented;
- how coarse-graining, detector inefficiency, and null outcomes are handled;
- how composite and sequential measurements are formed.

[DEF] No outcome shall be identified with a spectral eigenvalue, projector label, or record class by notation alone. The operational identification must be derived or explicitly constitutive.

10.3 Probability Map

[OPEN] At the microscopic level, the central missing object remains a substrate-selected conditional probability map

[OPEN] $P(a,b \mid x,y).$

[THM|DEF-G0] Inside the declared projective operational interface, one exact conditional realization is $P(a,b|x,y)=\mathrm{Tr}[(\Pi a(x)\otimes\Pi b(y))\rho]$. This law is imported/declared rather than generated by the present action. A microscopic derivation may instead use a history functional or instrument structure, but it must specify the measure and exact conditionalization rule, for example

[OPEN] $P(a,b \mid x,y)=\int d\mu(\lambda)\ P(a,b \mid x,y,\lambda),$

[OPEN] without assuming the desired quantum correlator in the conditional probabilities or the measure.

> **Non-circularity requirement.** The cosine correlation, Born weights, no-signalling marginals, or Tsirelson bound may not be inserted into the definition of P and then cited as outputs of the theory.

10.4 Required Probability Properties

[THM|DEF-G0] Positivity and normalization hold identically in the declared projective interface. No-signalling follows from completeness of the remote setting family. A first-principles derivation must reproduce these properties from the substrate and must additionally establish the following composition rules.

[OPEN] $P(a,b \mid x,y) \geq 0.$

[OPEN] $\Sigma_{a,b}\ P(a,b \mid x,y)=1.$

[OPEN] No-signalling requires the local marginals to be independent of the remote setting:

[OPEN] $\Sigma_b P(a,b \mid x,y)=P_A(a \mid x),\quad \text{independent of } y,$

[OPEN] $\Sigma_a P(a,b \mid x,y)=P_B(b \mid y),\quad \text{independent of } x.$

[OPEN] The probability theory shall also define composition and consistency rules.

- Independent composition: the rule for combining independently prepared systems.

- Conditional composition: updating probabilities after a recorded outcome.
- Coarse-graining: summing or integrating fine outcomes must reproduce the coarse probability.
- Sequential composition: the rule for time-ordered instruments or repeated measurements.
- Convex mixing: probabilistic preparation mixtures must remain valid states.
- Exchange and relabelling consistency: equivalent descriptions shall give the same probabilities.
- Normalization under post-selection: any conditional experiment shall state its denominator and domain.

[DEF] Where continuous outcomes are used, sums shall be replaced by integrals with the relevant measure, and positivity/normalization shall hold almost everywhere.

10.5 Correlators

[DEF] For binary outcomes $a,b\in\{-1,+1\}$, the correlator derived from a probability law is

[DEF] $E(x,y)=\Sigma_{a,b}\, ab\, P(a,b \mid x,y)$.

[THM|DEF-G0+CON-Ψ] For the declared phase-entangled record state $|\Psi\varphi\rangle=(|01\rangle-e^{i\varphi}|10\rangle)/\sqrt{2}$ and equatorial projectors, the correlator is computed from P and equals $E\varphi(\alpha,\beta)=-\cos[(\alpha-\beta)-\varphi]$. The cosine is therefore an output inside this interface, while the state family and operational framework remain declared inputs.

[THM|DEF-G0+CON-Ψ] Averaging the declared state over $\varphi\sim\mathrm{vonMises}(0,\kappa)$ gives the finite-coherence expression

[CON] $E_{\mathrm{eff}}(x,y)=-\eta_{\mathrm{coh}}\cos\theta_{xy},\quad \eta_{\mathrm{coh}}=I_1(\kappa)/I_0(\kappa)$,

[THM|DEF-G0+CON-Ψ] The visibility ηcoh is the exact first moment of the von Mises distribution and the cosine follows from the declared state/projector geometry. The full expression is thus a theorem inside the conditional interface, not a theorem selecting that interface or preparation from the substrate.

Statement	Status
Maximum entropy on S1 yields the von Mises distribution.	[THM]
Its first circular moment is I1(κ)/I0(κ).	[THM]
The bipartite correlator has a cosine angular form.	[CON] in the current theory.
The correlator follows from P(a,b|x,y).	[OPEN]
The marginals are no-signalling.	[OPEN]

10.6 Tsirelson Target

[THM|EXT|LQ-POVM+AX1J+NS] For bipartite scenarios, the imported BBBEW theorem supplies the quantum-set boundary if every local POVM is operationally admitted, the joint weight is effect-noncontextual and separately additive, and operational no-signalling holds with free-setting/intervention semantics. No microscopic tensor-product composite is required for this boundary statement.

> **Required theorem.** For every admissible bipartite binary-setting experiment generated by the completed IRMT probability theory, the CHSH expression shall satisfy $|S|\leq 2\sqrt{2}$; the theory shall exclude supraquantum no-signalling correlations and shall identify conditions under which the bound is approached or attained in the coherent limit.

[DEF] With settings x0,x1 for Alice and y0,y1 for Bob, define

[DEF] $S=E(x_0,y_0)+E(x_0,y_1)+E(x_1,y_0)-E(x_1,y_1)$.

[OPEN] The remaining first-principles task is to derive the LQ-POVM/AX1J/no-signalling premise bundle and the realized preparation from the substrate. The BBBEW result is bipartite only; multipartite quantum-boundary selection remains open. Reproducing 2√2 inside the declared interface is not a microscopic closure claim.

10.7 Record Scaling and Born-Weight Localization

[THM|Eagg] For N independent von Mises registrations of one common phase with single-record concentration κ0, the posterior concentration is κeff=κ0RN and RN/N→A(κ0)=I1(κ0)/I0(κ0) almost surely. Hence κeff=Nκ0A(κ0)(1+o(1)). This is an ensemble theorem, not a universal κ=N law.

[THM] For serial increments φN=Σiεi with characteristic function χε(t), E[e^{iφN}]=χε(1)^N and E[cosφN]=Re[χε(1)^N]. The Gaussian law e^{–Ns²/2} is exact only for Gaussian increments, or asymptotic in a separately stated small-increment diffusion limit.

[THM|DEF-G0+CON-Ψ+Eagg] Under standard fluctuation control, the conditional CHSH deficit obeys 2√2−S(N)=√2/[Nκ0A(κ0)]·(1+op(1)); typical sample fluctuations enter at Op(N−3/2). The substrate must still select the aggregation ensemble before this becomes a physical prediction.

[THM|RA1+RA2] For pure states and rank-one projective outcomes, frame covariance localizes the weight to f(|⟨e|ψ⟩|²). Fixed-dimension normalization gives f(x)=(1–df0)x+f0 with 0≤f0≤1/(d–1) unless monotonicity is separately imposed. Dimension stability forces f0=0, so v=|⟨e|ψ⟩|².

[OPEN] The Born-weight result does not yet cover arbitrary effects, POVMs, mixed states, measurement updates, preferred-basis selection, or outcome dynamics. The next gate is a non-circular extension from rank-one weights to the full local effect algebra and joint weighting AX1J required by the bipartite-boundary theorem.

10.8 Negative Controls, Disputed Imports, and Ledger Cross-References

[THM|EXT] Damped-PR negative control. Let PR_eta = eta PR + (1-eta)U, where PR is the Popescu-Rohrlich box and U is the uniform box. Visibility mixing preserves validity and no-signalling, so any proposed R5-010 proof that would also certify PR_eta for eta > 1/sqrt(2) is insufficient to prove the quantum boundary. With eta(kappa)=I1(kappa)/I0(kappa), the diagnostic threshold is eta(kappa*)=1/sqrt(2), kappa*≈2.058215. This is a permanent Record 5 negative control; it does not assert that IRMT produces PR boxes.

[EXT-DISPUTED] MGM quarantine. The Masanes-Galley-Mueller measurement-postulate theorem is recorded only as a disputed external candidate because Kent's published critique and the authors' response leave the operative premise dispute unresolved. It shall not be used as load-bearing support for AX1J, the full Born rule, the POVM-extension gate, measurement update, or measurement-sector closure unless a later versioned literature review explicitly promotes it.

Ledger navigation. The controlling residual quantum identifiers are N1a-i and N1a-ii for rank-one Born premises, the full-effect extension gate for AX1J/LQ-POVM, N1b/N2 for preparation and state selection, N5 for record-ensemble selection, and N6 for the multipartite boundary. Record 5 controls the row-level status.

10.9 Effect Algebra, Mixed States, and Update Rule Localization

[THM | RA1 + RA2-prime + EXT] WN-Q7 moves the full-effect Born form from open to conditional. Naimark dilation represents each effect upstairs by a projector, and RA2-prime transports the projective Born weight downstairs. This is a conditional theorem, not a substrate derivation of RA1, RA2-prime, DEF-G0, or the local effect algebra.

[THM | RA1 + RA2-prime + N3] Mixed-state Born weights are forced as Tr(rho E) when mixed configurations arise as restrictions of pure composites. The N3 composite/purification dependency remains attached.

[THM | DEF-G0 + UR1 + UR3] WN-Q8 rev.1 conditionally forces the ideal projective update to be Lueders: Phi_a(rho)=P_a rho P_a. UR1 and UR3 remain derivability gates.

[THM-classification | DEF-G0 + UR1] General POVM updates are not unique. They factor as Lambda_a(sqrt(E_a) rho sqrt(E_a)) with apparatus-dependent channel Lambda_a. IRMT therefore does not predict a unique POVM post-state without an apparatus model.

The measurement-sector residue is now named rather than amorphous: RA1, RA2-prime, UR1, UR3, N3, N1b, G0/N1 and apparatus models remain open or conditional. No unconditional measurement-sector completion is claimed.

11. Emergence and Continuum Map

An emergence claim is a controlled map between levels of description. It requires more than a formal analogy: the source variables, target variables, scaling regime, preserved structures, convergence topology, and error law must be explicit.

11.1 Discrete-to-Continuum Scaling

[DEF|OPEN] A continuum claim shall be stated for a sequence of finite models indexed by n. Let Cn denote the nth causal-relational structure, Nn its event count in a fixed macroscopic region, and ℓn its microscopic scale. A typical refinement regime is

[DEF|OPEN] $N_n \to \infty, \quad \ell_n \to 0, \quad \rho_n = \ell_n^{-d} \to \infty,$

[DEF|OPEN] while the target physical region and macroscopic observables remain finite.

Required element	Specification requirement
Scaling parameter	Declare εn=ℓn/L, ρn, Nn, nonlocality scale, or another dimensionless refinement parameter.

Required element	Specification requirement
Refinement	Define embeddings, coarse-graining maps, sprinkling law, graph-growth rule, or ensemble relation between successive n.
Graph-size limit	State what is fixed, what diverges, boundary treatment, dimension, and probability measure.
Observable normalization	Specify powers of Nn, ρn, ℓn, representation traces, and volume factors.
Spectral convergence	Choose empirical spectral measure, eigenvalue convergence, resolvent convergence, heat-trace convergence, or another explicit topology.
Error measure	Use an estimator-specific norm or distance: absolute/relative error, operator norm, Wasserstein distance, covariance-weighted residual, or confidence interval.
Universality domain	State which regulator, ensemble, seed, graph family, or microscopic perturbation changes leave the limit unchanged.

[DEF] A valid statement shall have the form

[DEF] $\mathrm{dist}(\mathscr{C}_n[\mathscr{O}_n], \mathscr{O}_{cont}) \leq \varepsilon_n, \quad \varepsilon_n \to 0,$

[DEF] where $\mathscr{C}$n is the declared coarse-graining map and dist is the declared error measure.

11.2 Emergent Geometry

[EXT | OPEN] The proposed continuum geometry must be reconstructed from causal order plus a volume measure or an equivalent relational structure. The following maps are candidates or imported results, not uniformly derived IRMT theorems.

Continuum property	Discrete estimator / map	Present status
Causal order	The partial order itself; in a continuum approximation, chronological precedence.	[DEF | EXT] Kinematic identification.
Volume	N/ρ for a declared region.	[EXT] Standard sprinkling correspondence; ρ remains primitive or matched.
Proper time	Longest-chain or interval-height estimator times a dimension-dependent coefficient.	[EXT | OPEN] Requires calibration and concentration bounds.
Dimension	Myrheim–Meyer, midpoint scaling, spectral dimension, or another declared estimator.	[EXT | NUM] Estimator dependent; no single active IRMT definition frozen.
Metric / conformal geometry	Causal order fixes conformal structure in suitable continuum spacetimes; volume fixes scale.	[EXT] Continuum theorem, conditional on manifoldlike approximation.
Curvature	Benincasa–Dowker interval combinations or a validated spectral/holonomy estimator.	[EXT | OPEN] Imported causal-set route; IRMT-specific convergence open.
Causal volume element	Limit of normalized counting measure.	[EXT | OPEN] Requires the ensemble measure and density map.

Geometry status. IRMT currently assumes or imports the main causal-set reconstruction correspondences. It has not yet derived a unique manifoldlike phase, physical dimension, metric, or curvature map from a complete native action.

11.3 Gravity

[DEF] Three logically different gravity statements shall remain separate.

Layer	What is established	What remains open
Generic spectral action	For suitable Laplace-type continuum operators, heat-kernel expansions contain cosmological, Einstein–Hilbert, gauge, and higher-curvature terms.	Whether the active Drel converges to such an operator; cutoff moments and coefficients; physical matter coupling.
Causal-set gravity	Benincasa–Dowker-type interval actions reproduce continuum curvature in expectation under stated sprinkling and scaling assumptions.	Applicability to the active IRMT causal ensemble, coefficient normalization, fluctuations, and backreaction.
IRMT-specific gravity	A relational update-flux source, causal order, and transport structure are available as ingredients.	One native action yielding geometry, conserved stress-energy, Newton coupling, matter backreaction, and a controlled continuum limit.

[DEF] The phrase “IRMT derives Einstein gravity” is prohibited until the third row is completed. The first two rows establish conditional compatibility with external mathematical frameworks.

11.4 Gauge Fields

[THM] Generic bundle covariance is exact at the discrete kinematic level: local frame transformations, unitary link transports, loop holonomy, and Wilson class functions are well defined.

[EXT|OPEN] A Yang–Mills continuum action may arise from the small-loop expansion of the Diamond–Wilson action under smoothness, isotropy, density, and normalization assumptions.

Question	Current answer
Does IRMT possess discrete gauge covariance?	Yes, generically, for the declared local frame group.
Is the physical gauge group selected?	No. Generic U(m)-type covariance permits many groups.
Are observed matter representations derived?	No.
Are chirality and hypercharges derived?	No.
Is anomaly cancellation proved?	No.
Is the continuum gauge coupling predicted?	No. βW, diamond density, trace convention, and scale remain unresolved or matched.

[DEF] Accordingly, IRMT currently derives generic discrete gauge geometry, not the Standard Model gauge sector.

11.5 Matter Fields

[DEF] The status of matter variables is layered.

Matter structure	Primitive, derived, or effective?	Present interpretation
Local Hilbert fibers H_i	Primitive kinematic data in Part II.	Carrier spaces; not physical particle multiplets by themselves.
Link transports U_{ij}	Primitive configuration variables within the fixed-order kinematics.	Gauge comparison maps.
Substrate field Φ_{sub}	Provisional primitive or model-dependent field input.	Its action, representation, and physical identity remain open.
Relational Dirac operator D_{rel}	Derived operator from causal links, weights, Clifford data, and transports.	Kinematic/spectral organizer; physical continuum fermion map open.
Protected projector P or Π_T	Derived after a selection rule is declared; current physical rule open.	Defines the effective low-dimensional sector.
Projected operator $M=P\Phi P$	Derived conditional observable.	Source of packet singular values and hierarchy.
Packet p, R, K	Derived effective observables.	Hierarchy coordinates, not yet fundamental particle variables.
Determinant lines L_a	Derived representation-theoretic structures after rank-two sectors are fixed.	Canonical phase carriers.
Observed fermion representations	Not derived.	Standard Model chirality, charges, and generations remain open.

[DEF] Matter representations shall not be inferred solely from matrix dimension, Clifford rank, Grassmann notation, spectral outliers, or the number of protected packet components.

11.6 Coupling and Back-Reaction

[OPEN] A complete continuum theory must specify both directions of interaction.

Direction	Required map	Current status
Geometry → matter	Causal order, link structure, volume, and connection enter D_{rel}, Φ_{sub} dynamics, packet formation, and propagation.	Partly defined kinematically; no complete physical evolution.
Matter → gauge connection	Variation of a mixed matter–connection action produces a conserved gauge current.	Open for the determinant current; $J_\Omega=\Omega D_W H_{supp}$ is constitutive.
Matter → geometry	Variation with respect to geometric/causal variables produces a conserved stress-energy or discrete source.	Open; flux-moment maps are conditional.
Geometry → geometry	A gravitational action determines causal/metric dynamics.	Imported candidate actions exist; native action absent.
Gauge field → matter	Connection enters covariant transport and the relational Dirac operator.	Defined kinematically; physical representation and coupling not selected.

[OPEN] In a future unified action, the schematic field equations must arise from joint variation, for example

[OPEN] $\delta S_{IRMT}/\delta\Phi=0,\quad \delta S_{IRMT}/\delta A=J,\quad \delta S_{IRMT}/\delta g$ or $\delta C=0$,

[OPEN] with discrete replacements where no continuum metric exists. The same action must guarantee the relevant conservation identity through its symmetry, not by separately imposing conservation after coarse-graining.

> **Present obstruction.** The current packet stabilization sector and determinant Wilson sector are block diagonal, so their mixed variation vanishes. The desired packet-dependent current is therefore not generated by the present action.

11.7 Continuum Validation Criteria

[DEF] Before any continuum statement is promoted from conditional or imported to derived, all of the following criteria shall be met.

1. Frozen microscopic definition: the causal ensemble, operator, action, representation, weights, boundary conditions, and varied variables are fixed before the limit is examined.
2. Controlled refinement family: a sequence Cn, scaling parameter, and relation between successive resolutions are specified.
3. Invariant estimator: the discrete observable is gauge/relabel invariant or its covariant reconstruction is explicit.
4. Finite normalized limit: the required powers of N, ρ, ℓ, area, volume, or trace normalization are fixed independently of the target.
5. Convergence theorem or strong numerical evidence: a declared topology and error measure show approach to the continuum candidate.
6. Error budget: finite-size, boundary, discretization, stochastic, fitting, and numerical errors are separated.
7. Regulator and ensemble robustness: the result survives admissible changes that should not affect the same continuum physics.
8. Coefficient provenance: every continuum coefficient is classified as derived, imported, matched, constitutive, free, or numerical.
9. Symmetry preservation: continuum covariance, gauge identities, conservation laws, and causal consistency follow from the discrete construction.
10. Matter–geometry consistency: source and backreaction equations come from the same action or probability law.
11. Benchmark recovery: known continuum limits are recovered without target-dependent retuning.
12. Novel prediction: at least one nontrivial output is fixed before comparison with new data.
13. Independent replication: code, data, conventions, and pass criteria permit external reproduction.

> **Promotion rule.** A formal expansion may justify [EXT] compatibility; a convergent tested estimator may justify [NUM]; only a controlled map generated by the active IRMT structures and coefficients may be labelled [THM] emergence.

11.8 Gauge-Selection Survey Addendum

[THM|EXT] WN-G1 rev.1 excludes genericity as a route to the Standard Model gauge subgroup: generic independent U(m) transports almost surely generate U(m), not a proper subgroup. Gauge selection must therefore be structural or dynamical.

[EXT]+[OPEN] Gauge selection is reformulated as invariant-structure selection. The typed gates are GG1, derivation of the 5-dimensional gauge fiber or containing structure; GG2, derivation of a protected 3|2 splitting plus determinant/traceless constraint, extra-U1 frame-redundancy proof, or falsification exposure; GG3, chirality selection; and GG4, the corrected anomaly filter.

[THM | conditions] The anomaly filter is executable only with the non-degenerate condition $Y_Q \neq 0$. The degenerate branch (0,t,-t,0,0) is recorded separately and shall not be erased by the two-branch shorthand.

Mandatory language: stabilizer reformulation, not unification; typed target, not prediction.

11.9 Gravity and Cosmology Negative Controls After WN-GR1

[THM-identity + NUM negative control] Raw local bilinear coarse-graining of a conserved microscopic flux does not inherit continuum conservation. A source of the form $T^{\mu\nu} \sim \langle J^\mu J^\nu \rangle$ has divergence (J · grad)J even when div J = 0, unless a dynamically correct stress completion is supplied. The WN-GR1 test gives a dimensionless discrete-grid diagnostic RMS|div T|/RMS|T| approximately 0.54 for a conserved flux, so flux conservation alone is not a gravity bridge.

[OPEN] Repair fork. A conserved effective stress tensor must either be obtained by joint variation of a discrete-covariant/diffeomorphism-invariant action, or the specific constitutive stress/projection law must be declared and tested on the active ensemble. Kinematic completion language is prohibited unless the completion is versioned as a constitutive law.

[CONJ pointer] The WN-Q4 diffusion regime may be tested against the locked Paper XIV CMB kernel only as a candidate microscopic shape. The required gates are N5 regime selection, derivation of C(theta), out-of-sample functional comparison with the locked kernel, and emergence of temperature dominance.

Revision History

Version	Date	Status	Controlled change
0.5.0	30 June 2026	Superseded working draft	Initial audited standalone Part.
0.5.1	3 July 2026	Current working draft	Integrated the corrected Q-series operational definitions, conditional probability and correlator

Version	Date	Status	Controlled change
			theorems, bipartite boundary theorem, record-scaling dichotomy, and rank-one Born-weight localization.
0.5.2	4 July 2026	Current working draft	Added the damped-PR negative control, MGM [EXT-DISPUTED] quarantine, and explicit ledger cross-references for N1a/N5/N6.
0.5.3	6 July 2026	Current working draft	Integrated WN-Q7, WN-Q8 rev.1 and WN-G1 rev.1 into the measurement/gauge observable and emergence status, with no completion-gate promotion.
0.5.5	7 July 2026	Current working draft	Added WN-GR1 gravity/cosmology negative controls, route fork, and CMB diffusion-pointer caveats.

[DEF] This revision incorporates the adopted and corrected content of WN-Q1 through WN-Q6. The working notes remain provenance records but are no longer required to interpret the controlled statements added here.

[DEF] Part IV therefore defines a rigorous physical interface for the program. Exact invariants are preserved, effective and phenomenological observables remain usable, the measurement sector is honestly reopened, and every continuum claim is converted into an explicit validation problem.

QREV-2026-07-08-01 — Quantum, Depth, and Laboratory Update

This update integrates WN-Q9 rev.1 and WN-L1 into the observables stack. N5 is no longer treated as a loose aggregation-versus-diffusion fork inside the minimal model. It is registered as a two-axis crossover law: causal depth diffuses coherence while record multiplicity aggregates it. The theorem status is [THM | minimal model + CON-noise], not a substrate derivation of the noise law.

The corrected shallow-regime surplus law is the normalized deficit (2sqrt(2)-S)/(2sqrt(2)) approximately equal to L sigma^2 / N, with the absolute deficit larger by the factor 2sqrt(2). The deep regime gives finite but exponentially large recovery budgets, N* approximately (kappa*/2) exp(2L sigma^2).

WN-L1 adds a reusable numerical laboratory for the declared DEF-G0 + CON-Psi + CON-noise stack. The lab verifies normalization, nonnegativity, no-signalling and the frame-corrected cosine law at machine precision on random finite substrates. This is a class-limited verification of N4, not a derivation of actual post-G0 dynamics.

- N4: closed only for the random-substrate class specified by WN-L1; open for full substrate dynamics and composites beyond the declared tensor interface.
- N5: structurally resolved under minimal model + CON-noise; open residue is derivation of the link-noise law and determination of sigma.
- Frame covariance remains load-bearing: fixed lab frames produce spurious failures; transported frames recover the theorem stack.
- Harness rule: no-signalling certification requires maximal and tilted probes plus in-plane and out-of-plane leak tests.

Status rule: all entries in this section retain their stated conditionality strings. No unconditional physical selection, gauge group, dimensionful constant, CMB explanation, or full-sector closure is promoted by QREV-2026-07-08-01.

IRMT CORE SPECIFICATION v1.0

PART V

SECTOR STATUS

Controlled Status of the Quantum, Gauge, Gravity, Matter, Charged-Lepton, and Cosmological Sectors

This Part is the controlled sector ledger of IRMT. It states, without historical inflation or retrospective dilution, what each sector defines, what it proves, what it assumes, what has failed, and what must still be derived before promotion to a first-principles claim.

Abdulaziz Abdi · Toronto · 7 July 2026

Standalone Working Draft 0.6.6

Document Control

Field	Controlled entry
Specification family	IRMT Core Specification v1.0
Part	Part V — Sector Status
Working-draft version	0.6.6
Date	7 July 2026
Author	Abdulaziz Abdi
Controlled sections	12. Quantum-Sector Status; 13. Gauge-Sector Status; 14. Gravity-Sector Status; 15. Matter and Charged-Lepton Status; 16. Cosmological Status
Primary dependencies	Parts I–IV and Records 1–7
Normative role	Sector-level claim boundary and promotion ledger
Release status	Working draft; not the frozen v1.0.0 specification

Interpretation rule A sector is not assigned a single percentage of truth or completion. Its exact mathematics, numerical evidence, constitutive closures, imported bridges, failed routes, and open derivations are recorded separately. The status of a full conclusion is limited by the weakest indispensable dependency.

Part V Status Summary

Sector	Established core	Present limiting dependency	Exact current status
Quantum	Circular maximum-entropy mathematics; a conditional projective probability/no-signalling/correlator stack; a conditional bipartite quantum boundary; rank-one Born-weight localization.	No substrate derivation of the full local effect algebra, AX1J, the operational weighting law, preparation/state selection, measurement update, or multipartite boundary.	Substantial conditional mathematical progress; foundational quantum closure remains open.
Gauge	Local frame covariance, unitary transports, holonomy, and Diamond–Wilson action	No selection of the Standard Model group, representations, or normalization	Generic discrete gauge geometry established; physical gauge content open
Gravity	Causal structures and possible imported spectral or BD embeddings	No controlled IRMT-specific continuum limit with coupled matter back-reaction	Conditional compatibility, not an IRMT derivation
Matter / charged leptons	Projected hierarchy, exact Koide geometry, effective stabilization, determinant-line bundle, exact Wilson functions	Projector/field origin, q_k selection, constitutive current, and mixed-sector protection	Strong effective construction; microscopic closure open
Cosmology	Relational network framework and bounded CMB temperature-coherence target	No substrate derivation of the locked kernel or complete cosmological dynamics	Narrow phenomenological support; broad cosmological closure absent

12. QUANTUM-SECTOR STATUS

Status boundary. The quantum sector now contains an exact circular-statistics core, a complete conditional projective probability/correlator stack, a conditional bipartite quantum-boundary theorem, an aggregation-ensemble scaling theorem, and a conditional rank-one Born-weight theorem. The sector remains foundationally open because the premise bundle and preparation are not generated by the microscopic action.

12.1 Compact Quantum Ledger

Status class	Controlled content	Permitted claim	Excluded inference
Defined [DEF]	Operational regions, settings, invariant outcome partitions, declared composites, local effect structures, RA1, RA2, AX1J, and free-setting semantics are controlled working definitions or residual axioms.	IRMT now defines a well-posed bipartite operational scenario class and the premises required by the conditional theorem stack.	Definitions and axioms do not establish their microscopic selection.
Mathematically valid [THM]	Von Mises maximum entropy and moments; projective positivity/normalization/no-signalling inside DEF-G0; cosine–Bessel derivation for CON-Ψ; aggregation-ensemble κ scaling; rank-one Born uniqueness under RA1+RA2.	These are exact statements within their explicit domains and premise bundles.	They do not derive DEF-G0, CON-Ψ, the full effect algebra, AX1J, free settings, or a multipartite theory.
Assumed / constitutive [CON]	The operational Hilbert interface and phase-entangled state are declared; LQ-POVM, AX1J, free-setting semantics, RA1, and RA2 remain adopted premises unless derived; the substrate record ensemble is unselected.	The conditional probability/correlator model and bipartite boundary may be analysed without overclaiming microscopic origin.	No premise may be relabelled as a substrate theorem merely because downstream mathematics is exact.
Failed / superseded [SUP]	The Paper VI quantitative measurement mechanism: MP/BBP threshold, forced rank-three projector, unique collapse update, universal superposition time, and Born-rule closure.	These routes are retained only as historical negative results.	No active measurement conclusion may depend on them.

Status class	Controlled content	Permitted claim	Excluded inference
Open [OPEN]	Microscopic action-to-weighting map; full POVM/effect extension; joint effect weighting; preparation and update selection; composite realization; aggregation-versus-diffusion selection; multipartite quantum boundary.	These are the localized completion targets after the Q-series integration.	The quantum sector may not be described as solved or first-principles.

12.2 Exact Mathematical Core

[THM] For a normalized probability density on the circle with a fixed first trigonometric moment, Shannon-entropy maximization yields the von Mises family.

[THM] $p(\varphi)=\exp[\kappa\cos(\varphi-\mu)]/[2\pi I_0(\kappa)]$

[THM] Its first circular moment is the exact visibility factor

[THM] $\eta(\kappa)=I_1(\kappa)/I_0(\kappa)$.

[THM] At large coherence concentration,

[THM] $1-\eta(\kappa)=1/(2\kappa)+O(\kappa^{-2})$.

> **Scope of the theorem** The theorem fixes the entropy-maximizing distribution and its moments after the constraint class is specified. It does not establish that the physical substrate possesses only those constraints, that κ equals a record count, or that a bipartite quantum probability law follows.

12.3 Assumed Correlator Versus Derived Probability

[CON] The current effective correlation model can be written schematically as

[CON] $E_{\mathrm{eff}}(x,y)=\eta(\kappa)E_0(x,y)$,

Revision rule. The early inserted-kernel route is superseded. Inside DEF-G0+CON-Ψ, the cosine follows from the declared state/projector geometry and the visibility from von Mises dephasing. This improves the logical pedigree of the formula but does not derive the operational interface or state from the substrate.

12.4 Central Quantum Target

[OPEN/THM-conditional] substrate → {LQ-POVM, AX1J, preparation, weighting} → P(a,b|x,y) → E(x,y); and, for bipartite boundary control, {LQ-POVM, AX1J, NS, free settings} → quantum set [THM|EXT].

Each arrow is independently substantive. The first must construct a positive normalized operational probability law. The second must derive correlators and local marginals from that law. The third must characterize the attainable correlation set and prove the CHSH restriction rather than merely evaluate CHSH for a preselected cosine model.

12.5 Required Theorems

1. Operational extension theorem: extend the adopted CP-II-01 definitions to general finite, continuous, sequential, inefficient-detector, and post-selected scenarios.
2. Weighting theorem: derive the full local effect algebra and the joint effect-noncontextual, separately additive weighting AX1J from the active IRMT action/history structure.
3. Causal no-signalling theorem: derive operational no-signalling together with free-setting/intervention semantics from the substrate.
4. Preparation and composition theorem: select the realized state or POPT functional and define independent, sequential, coarse-grained, and conditional measurements.
5. Interface-selection theorem: derive the declared projective/cosine construction, or an empirically equivalent operational law, without target insertion.
6. Boundary-premise theorem: derive the LQ-POVM+AX1J+NS premise bundle. BBBEW then gives the bipartite quantum boundary as an imported theorem.
7. Multipartite and attainability theorem: characterize the multipartite boundary and identify substrate-selected states/settings that approach $2\sqrt{2}$ in the coherent bipartite limit.

> **Exact present quantum claim** IRMT has an exact circular maximum-entropy construction and a conditional finite-visibility correlation model. It does not yet possess a derived operational probability law, a derived cosine correlator, or a proof of the Tsirelson bound from the substrate.

12.6 Integrated Q-Series Theorem Stack

[THM|DEF-G0] $P(a,b|x,y)=\mathrm{Tr}[(\Pi a(x)\otimes\Pi b(y))\rho]$ is positive, normalized, and no-signalling for the declared projective scenario class.

[THM|DEF-G0+CON-Ψ] The declared phase-entangled state gives $E\varphi(\alpha,\beta)=-\cos[(\alpha-\beta)-\varphi]$, and von Mises dephasing gives $E\kappa(\alpha,\beta)=-[I1(\kappa)/I0(\kappa)]\cos(\alpha-\beta)$.

[THM|EXT|LQ-POVM+AX1J+NS] The BBBEW theorem excludes supraquantum bipartite correlations without requiring a microscopic tensor-product composite. The premise bundle, free-setting semantics, realized state, and multipartite extension remain open.

[THM|Eagg] $\kappa_{eff}=N\kappa_0 A(\kappa_0)(1+o(1))$ in the independent aggregation ensemble. Serial diffusion instead follows the increment characteristic function, so the substrate must select the ensemble.

[THM|RA1+RA2] Pure-state rank-one weights equal $|\langle e|\psi\rangle|^2$. The fixed-dimension affine family has $0\le f_0\le 1/(d-1)$; dimension stability removes f_0. General effects, POVMs, mixed states, updates, and outcome dynamics remain open.

12.7 Quantum-Sector Patch Controls

The compact quantum status in this Part is governed row-by-row by Record 5. The permanent negative control for R5-010 is the damped-PR family PR_eta: any proof that validates PR_eta for eta>1/sqrt(2), or kappa>kappa*≈2.058215 under eta=I1/I0, does not prove the quantum boundary. The disputed MGM theorem is quarantined as [EXT-DISPUTED] and carries no load-bearing status for AX1J, full Born, POVM, update, or measurement-closure gates.

For navigation, the active residual identifiers are N1a-i/N1a-ii for rank-one Born premises, the full-effect extension gate for AX1J and LQ-POVM, N5 for the aggregation-versus-diffusion record ensemble, and N6 for the multipartite boundary. The ledgers remain controlling if this prose summary is abbreviated.

12.8 Measurement-Sector Conditional Stack After WN-Q7/WN-Q8

The effect and mixed-state caveats are reduced to conditional theorems: full effects require RA1 + RA2-prime + Naimark, and mixed configurations additionally require N3 purification/composite realizability. The projective update rule is conditionally Lueders under UR1 + UR3. General POVM update is not unique and is classified as apparatus-channel freedom.

N7 is split into N7a, ideal projective update; N7b, general POVM apparatus-channel classification; and N7c, substrate derivation of UR1/UR3. The sector is structurally finished at the conditional level, but RA1, RA2-prime, UR1, UR3, G0/N1, N3 and N1b remain open or conditional.

13. GAUGE-SECTOR STATUS

Status boundary. The gauge sector must distinguish a kinematic redundancy from physical interaction content. Local frame covariance is already well defined. The observed Standard Model group, chiral representations, hypercharges, anomaly cancellation, and coupling normalization are not selected by that covariance.

13.1 Local Frame Covariance

[DEF|THM] At each event i, a local basis transformation g_i acts on the Hilbert fiber and link transport as

[DEF|THM] $|\psi_i\rangle \to g_i|\psi_i\rangle, \quad U_{ij} \to g_j U_{ij} g_i^{-1}.$

[THM] Path transport, closed holonomy conjugacy classes, traces, determinants, and the Diamond–Wilson action are invariant or covariant under this change of frame. This establishes generic discrete bundle geometry and a local descriptive redundancy.

13.2 Physical Gauge Content

Mandatory distinction The ability to choose local bases and transport them unitarily does not select which transformations are physical gauge interactions, which group acts on nature, or which matter representations occur. A generic U(m) frame structure permits many physical theories.

Target	Current status	What is already available	Required promotion theorem
SU(3)×SU(2)×U(1)	Open	Generic unitary frame covariance can host many subgroup choices.	Derive a unique or minimal physical group from the primitive state space and action.
Matter representations	Open	Local fibers and exterior-square representations can be constructed after choices are made.	Select the observed fermion multiplets and their transformations without inserting them.
Chirality	Open	Gradings and Clifford structures are mathematically available.	Derive the observed left/right asymmetric representation content.
Hypercharge	Open	U(1)-type line charges and determinant phases can be represented.	Derive the exact hypercharge assignments and normalization.
Anomaly cancellation	Open	No complete derived chiral spectrum exists to test.	Show cancellation of all gauge, mixed, and gravitational anomalies for the selected content.
Coupling normalization	Open / matched historically	The Diamond–Wilson action has a coupling βW and a conditional continuum relation to gYM.	Fix trace conventions, diamond density, βW, and running without circular matching to the desired values.

13.3 Valid Gauge Structures

[DEF] • Finite-dimensional complex Hilbert fibers and unitary link transports are coherent kinematic structures.

[THM] • Ordered path products and closed-loop holonomies are exact consequences of composable transports.

[THM] • Traces, determinants, conjugacy classes, and Wilson losses are gauge-invariant observables.

[DEF] • The Diamond–Wilson action is the best-specified active microscopic action in the present corpus.

[EXT] • A Yang–Mills form can arise under a smooth small-loop, isotropic, controlled continuum approximation.

13.4 Conditional Continuum Coupling

[THM|EXT] Under the adopted small-diamond and isotropic averaging conventions, a continuum matching relation of the form

[THM|EXT] $g_{YM}^2 = 12\, \beta_W\, \xi_\diamond$

is algebraically available. Its physical use remains conditional because the gauge group, representation trace, Wilson coefficient, diamond density, and controlled convergence are not independently fixed.

Exact present gauge claim IRMT defines a coherent generic discrete gauge-covariant transport theory. It has not derived the physical Standard Model gauge group, matter representations, chirality, hypercharges, anomaly cancellation, or the observed coupling normalization.

13.5 Gauge-Selection Survey After WN-G1 rev.1

The gauge sector now has a theorem-level negative result: genericity cannot select the Standard Model subgroup from U(m) transports. R5-013 is therefore a no-go guard, not merely a warning.

R5-018 is reformulated into GG1 and GG2: derive the gauge fiber dimension/structure and derive a protected 3|2 splitting together with the determinant/traceless condition, an extra-U1 redundancy proof, or a falsification exposure. R5-020 becomes GG4, the corrected anomaly filter with Y_Q != 0 non-degeneracy. GG3 registers chirality as a critical open gate.

No gauge selection theorem exists. The current gain is cartography plus no-go progress, not physical closure.

14. GRAVITY-SECTOR STATUS

Status boundary. The gravity sector contains valid causal-set structures and legitimate external continuum routes, but it does not yet contain an IRMT-specific derivation of Einstein gravity. Compatibility with known spectral-action or Benincasa–Dowker results must remain separate from derivation by the active IRMT operator and action.

14.1 Structures That Remain Valid

Structure	Status	Controlled statement
Locally finite causal order and intervals	[DEF]	Causal events, order intervals, cover relations, and causal diamonds form the discrete kinematic substrate.
Discrete curvature observables	[DEF|EXT]	Layer counts, interval statistics, holonomies, and causal-set curvature estimators may be defined.

Structure	Status	Controlled statement
Benincasa–Dowker action	[EXT]	A known causal-set action has a continuum Einstein–Hilbert limit under its own hypotheses.
Spectral action	[EXT]	Suitable continuum Laplace/Dirac operators possess heat-kernel expansions containing curvature terms.
IRMT update-flux source candidates	[CON]	Flux moments may be proposed as effective source tensors, but their normalization and uniqueness are not derived.

14.2 What Has Not Been Derived

1. Convergence of the actual frozen IRMT operator Drel to a continuum Lorentzian Dirac operator or Laplace-type operator.
2. A unique Einstein limit selected by IRMT rather than merely permitted by imported continuum theorems.
3. The absolute gravitational normalization, including the derivation of the discreteness scale and any diamond-density coefficient.
4. A unique conserved stress-energy tensor derived by variation of the active matter action.
5. Joint matter–geometry equations in which matter back-reacts on causal/geometric variables and geometry alters matter propagation.
6. Exclusion of alternative continuum limits, additional curvature invariants, nonmetric phases, or regulator-dependent effective equations.
7. A controlled error estimate connecting finite causal structures to the proposed continuum field equations.

14.3 Spectral-Action Route

[EXT] A generic spectral functional

[EXT] $S_{spec}[D]=\mathrm{Tr}\, f(D^2/\Lambda^2)$

can contain a Ricci-scalar term when the operator and continuum hypotheses of the heat-kernel theorem are satisfied. This is an imported mathematical result. It does not demonstrate that the active sparse causal operator has the required spectrum, locality, signature, or convergence.

14.4 Benincasa–Dowker Route

[EXT] The four-dimensional causal-set action may be written schematically as

[EXT] $S_{BD}=(4\hbar/\sqrt{6})\ell_c^{-2}[N-N_0-9N_1+16N_2-8N_3]$.

Its continuum limit is a known causal-set result under declared sprinkling and scaling assumptions. IRMT may use it as an external embedding, but it must still show that its own causal ensemble, matter variables, and couplings satisfy those assumptions.

14.5 Normalization and Back-Reaction

[CON|EXT] Relations such as

[CON|EXT] $G_N=\ell_c^2/(16\pi)$

express a continuum normalization only after the discreteness scale is identified. Setting ℓc equal to a Planck scale imports the observed gravitational scale rather than deriving it. Likewise, a flux-moment tensor becomes physical stress-energy only after it is obtained from the same action that governs the geometry and satisfies the corresponding conservation identity.

14.6 Gravity Promotion Test

Required test	Minimum passing result
Operator convergence	One frozen Drel family converges in a declared norm/resolvent/spectral sense with finite-size error bounds.
Geometric convergence	Dimension, causal volume, metric estimators, and curvature converge consistently on the same refinement family.
Action convergence	The active discrete action converges to a stated continuum action with all coefficients and boundary terms controlled.
Matter source	$T\mu\nu$ follows by variation of a derived matter action and obeys the matching conservation law.
Back-reaction	The coupled discrete equations generate both matter propagation and geometry response.
Uniqueness / alternatives	Competing continuum limits are excluded or their domains and additional coefficients are explicitly retained.

Exact present gravity claim IRMT possesses causal kinematics, candidate discrete curvature/source constructions, and possible imported spectral or Benincasa–Dowker embeddings. It has not yet derived convergence of the actual IRMT operator, a unique Einstein limit, the physical normalization, coupled matter back-reaction, or the exclusion of alternative limits.

14.7 Gravity and Continuum Survey After WN-GR1

The gravity sector remains open. WN-GR1 adds a negative control: microscopic Kirchhoff conservation of a flux does not by itself yield a conserved coarse stress tensor under raw quadratic averaging. Conservation must be earned through a joint action/Noether identity or by a specific tested constitutive map.

The Benincasa-Dowker and spectral-action routes are no longer treated as interchangeable continuum bridges. Spectral selection carries the leading heat-kernel cosmological term and fixed higher-coefficient package; BD selection carries the matter-coupling and order-statistics deformation problem. Equivalence requires matched coefficients on the active ensemble, not analogy.

The difficulty floor is manifoldlikeness. IRMT inherits the causal-set continuum problem before its own matter-coupling problem begins. This is a community-hard external gate, not a housekeeping task.

Scale audit. In the active v1.0 ledger after retired claims are excluded, the visible independent theoretical dimensionful imports are v_EW and ell_c. Any derived dimensionless relation between them would reduce the corpus scale inputs and should be audited jointly in Records 4 and 5.

15. MATTER AND CHARGED-LEPTON STATUS

Status boundary. This is the most developed quantitative sector of the current program. Its mathematics and numerical tests are substantially stronger than the foundational quantum, Standard Model, and gravity claims. Its present endpoint is nevertheless effective rather than microscopic because the protected sector, packet coefficient, response-to-connection law, and mixed-sector protection are not all generated by one action.

15.1 Projected Hierarchy

[DEF|CON] The active projected operator is

[DEF|CON] $M=P\,\Phi\,P$,

[THM] where P is a selected protected projector and Φ is a selected substrate-field candidate. Once these are fixed, the singular values of M, their normalized packet shares, and unitary-invariant hierarchy diagnostics are mathematically well defined.

[DEF] $p_a=\sigma_a/\Sigma_b\sigma_b, \quad R=p_1, \quad K=\Sigma_a p_a^2.$

[NUM] Across the implemented projected-operator experiments, increasing rank concentration R is robustly associated with increasing hierarchy. This is a numerically supported mechanism within the tested projector/field construction, not a theorem about every admissible IRMT substrate.

Component	Status	Boundary
Projected operator M	Defined conditionally	Depends on the still-unselected physical projector P and field Φ.
Singular values and packet normalization	Exact mathematics	Basis invariant after M is specified.
Rank concentration as hierarchy diagnostic	Numerically supported	Strong in tested ensembles; universality remains unproved.
Physical origin of the protected triplet	Open	Must follow from the frozen Drel and field action without target selection.

15.2 Koide Geometry

[DEF|CON] On the normalized pair-symmetric packet

[DEF|CON] $p=(R,(1-R)/2,(1-R)/2)$,

[THM] the quadratic packet invariant is

[THM] $K(R)=R^2+(1-R)^2/2$.

[THM] The equation $K=2/3$ has the physical interior solution

[THM] $R_K=(1+\sqrt{2})/3 \approx 0.8047378541$.

Separately, the positive-amplitude circular mass parametrization with transverse Frobenius amplitude √2 yields the Koide identity exactly on its valid branch. The algebraic identity does not by itself explain why a physical charged-lepton packet lies on that latitude, has the required closure, or selects a particular azimuth.

> **Exact separation** The Koide identity and crossing are exact mathematical results inside the stated geometry. Physical selection of the locus, protected triplet, and azimuth remains a dynamical problem.

15.3 Stabilization

[THM|CON] The effective collapse/support flow has an interior balance condition

[THM|CON] $qR=1, \quad h=1$.

[CON] The active coefficient is presently fixed by compatibility with the Koide crossing:

[CON] $q_K=1/R_K=3(\sqrt{2}-1) \approx 1.2426406871$.

This value is exact after the compatibility condition is imposed. It is not yet an independently generated microscopic coupling. The effective flow is stable within its declared domain, but the location of its physical fixed point inherits the constitutive selection of q_k.

15.4 Packet Scale

[THM] The weighted minimal-diamond continuum construction fixes the proper-time and density exponents

[THM] $k=2, \quad r=1/2$,

[THM] and yields the exact six-bivector coefficient

[THM] $\xi_6=51/(1400\sqrt{\pi}) \approx 0.02055262054$.

[THM|CON] The equal leading triplet decomposition gives

[THM|CON] $\xi_3=\xi_6/2 \approx 0.01027631027$,

where the factor one-half is exact in the stated bivector decomposition, while identifying one triplet with the physical protected flavor packet remains conditional.

Quantity	Mathematical status	Physical status
$k=2$ and $r=1/2$	Exact scaling result in the adopted continuum estimator	Conditional on the physical selection of that estimator
ξ_6	Exact continuum coefficient in the stated four-dimensional construction	Conditional as a coefficient of the physical packet action

Quantity	Mathematical status	Physical status
$\xi_3=\xi_6/2$	Exact sector split once the protected triplet identification is made	Physical triplet identification remains open
$A_{packet}=q_k/\xi_3$	Exact composite	Inherits constitutive q_k and triplet identification
$\beta_{packet}=q_k/(\xi_6\xi_3)$	Exact back-solved composite	Not independently generated by a primitive action
vEW	Externally established Standard Model input	Imported absolute energy scale
$3/(\pi A_{packet})$	Exact algebra in the chosen normalization	The component count and $1/\pi$ response normalization are conditional
Finite Wilson dressing $F^W(q_k)$	Exact compact-group function after its argument is given	The identification of the physical holonomy angle with q_k is constitutive

15.5 Determinant-Line Geometry

[THM] For each protected rank-two sector E_a, the exterior square

[THM] $L_a=\Lambda^2E_a$

is a canonical complex determinant line. Their direct sum defines a three-line flavor bundle, and a parent linear operator induces an exact exterior-square operator on antisymmetric pairs. This construction resolves the singular-frame problem at the representation level and supplies covariant line phases.

[THM] The common determinant charge and relative A_2 root charges satisfy an exact tight-frame identity

[THM] $q_0q_0^T + BB^T = 3I_3$.

[THM] The protected-block single-trace Wilson Hessian gives an exact bare quadratic metric

[THM] $G_{W,bare}=I_3, \qquad b_{bare}=0$.

These are exact representation and bare-action results. They establish that the desired common-plus-relative geometry is available, but not that the full dynamics protects it.

15.6 Constitutive Closure

[CON] The effective charged-lepton construction is closed by the response-to-connection law

[CON] $J_\Omega=\Omega\, H_{supp}$.

Here Ω is the signed determinant Diamond–Wilson curvature and Hsupp is the packet support-response vector. The identity map, unit coefficient, and normalized exposure are not generated by the current block-diagonal action. This equation must therefore remain visibly tagged [CON] in every use.

[THM] The active action-level obstruction is exact:

[THM] $S_{current}=S_{stab}[p,h]+S_W[A_{det}]$,

[THM] $\delta^2S_{current}/(\delta A_{det}\, \delta h)=0$.

No variation of the present action can produce the required mixed source. A future microscopic closure requires a compact, bounded, gauge-invariant mixed interaction with the correct current and normalization.

15.7 Mixed-Sector Obstruction

[THM] At bare protected-block quadratic order the determinant metric is the identity. In the full exterior-square field, however, protected variables w couple to mixed variables c through a block operator

[THM] $S^2=\tfrac{1}{2}(w,c)^\dagger \, [\, A \quad B \,;\, B^\dagger \quad C \,]\, (w,c),$

[THM] and integrating out the mixed block gives the Schur complement

[THM] $G_{eff}=A-BC^{-1}B^\dagger.$

For nonzero coupling B, this generically regenerates an allowed relative-channel correction even when the bare double-trace coefficient vanishes. The M6Q–M6S audit tested whether actual closed packets produce enough decoupling to protect the required response ratio.

Audit result	Status	Consequence
Bare protected metric G=I and bbare=0	Exact [THM]	The desired normalization is selected at bare quadratic order.
Mixed-wedge Schur correction	Exact [THM]	Generic dynamical mixed sectors renormalize the protected metric.
0.1% response-ratio tolerance	Numerical audit criterion	Requires the relative correction to remain below 10^{-3}.
Isotropic protection threshold	Exact within the audit model	$\Delta mix/gmix^2 \gtrsim 421.9$ is required for the chosen tolerance.
Actual static and reparameterization-invariant packet measures	Failed [NUM]	The tested closed packets do not satisfy the required hierarchy.
Finite-step apparent suppression	Numerical artifact	It scales with the integration step and cannot be interpreted as physical protection.

[THM|NUM] The central quantitative protection criterion is

[THM|NUM] $\Delta_{mix}/g_{mix}^2 \gtrsim 421.9 \quad \text{for} \quad |\rho_{eff}/q_K-1|\leq 10^{-3}.$

> **M6Q–M6S conclusion** The current packet and exterior-square ingredients do not protect the constitutive identity response. A new interaction, exact decoupling symmetry, or physically generated invariant gap is required.

15.8 Exact Present Claim

> **Controlled charged-lepton statement** The charged-lepton model is mathematically closed as an effective construction conditional on its constitutive response-to-connection law. It is not yet microscopically closed.

This sentence is the mandatory present-status formulation. It preserves the exact Koide geometry, the numerical rank-collapse evidence, the effective stabilization theorem, the continuum coefficients, the determinant-line geometry, the finite Wilson response, and the quantitative mass agreement, while refusing to promote the missing action-level bridge.

16. COSMOLOGICAL STATUS

Status boundary. The cosmological sector has narrowed substantially. The broad early claims do not constitute a complete alternative cosmology. The active framework is a relational-network research program plus one bounded, calibrated, temperature-dominant CMB large-angle coherence target.

16.1 Network Cosmology

The active framework treats cosmological structure as the coarse-grained organization of a causal-relational network. Its provisional variables include event density, ancestry and connectivity statistics, relational distance, coherence scale, update flux, and continuum metric estimators. The framework seeks to recover homogeneous/isotropic expansion and perturbation observables from a frozen causal dynamics.

Framework element	Status	Required development
Causal network and ancestry statistics	Defined	Choose one physical ensemble or growth law.
Relational distance / scale-factor interpretation	Constitutive	Derive a continuum metric and time variable.
Vacuum update burden	Exploratory / conditional	Derive a vacuum action and absolute normalization.
Background expansion	Open	Derive Friedmann-like equations or a documented alternative.
Perturbations and transfer functions	Open	Predict scalar, tensor, temperature, and polarization observables.
Matter formation	Open	The historical BBP condensation mechanism is retired.

16.2 Failed Routes

Tested route	Result	Active consequence
One-parameter finite-coherence dark-energy running	Rejected by the reported Pantheon+ comparison	No active quantitative dark-energy-running prediction.
Direct generic low-ℓ power suppression	Did not robustly replace ΛCDM or explain the full low-ℓ spectrum	The surviving target is not a universal C_ℓ suppression model.
Universal TT/TE/EE suppression	Rejected by polarization behavior	No universal primordial/polarization kernel may be claimed.
Full-spectrum or full-cosmology replacement claims	Unsupported	IRMT is not presently a replacement for ΛCDM.
BBP cosmological matter formation	Retired after native random-matrix failure	Matter formation must be rebuilt from the revised active theory.

16.3 Surviving Target

[CON|NUM] The surviving phenomenological target is the observed deficit in the large-angle real-space CMB temperature correlation. It is represented by a locked low-multipole coherence kernel of the form

[CON|NUM] $F_\ell = 1 - \alpha_{CMB} \exp[-(\ell - 2)/L_H]$,

[NUM] with the C1-calibrated values

[NUM] $\alpha_{CMB} = 0.5846153846, \quad L_H = 5.7948717949.$

The kernel is not a first-principles prediction. Its scientific value comes from locking the calibration before applying the same form to subsequent map, mask, resolution, pseudo-spectrum, and direct real-space tests.

16.4 Calibration Versus Prediction

Stage	Role	What may be claimed	What may not be claimed
C1 spectrum-level selection	Calibration	The kernel form and two coefficients were selected to represent the target statistic.	C1 is not independent evidence and the coefficients are not substrate constants.
C2 map/mask/resolution sweep	Out-of-calibration robustness test	The locked direction persists across multiple processing choices.	The runs are not fully independent data sets and do not establish a complete cosmology.
C3 direct real-space estimator	Estimator-level out-of-calibration test	The same locked kernel improves the $S_{1/2}$ direction across the tested maps.	The anomaly is not eliminated in every map and finite pair sampling remains a numerical control.
Future external analysis	Potential prediction test	A preregistered locked kernel can be tested by independent code and data.	Refitting α or LH to each new analysis would convert the test back into calibration.

16.5 Open Microscopic Derivation

[OPEN] The essential missing arrow is

[OPEN] causal-relational substrate $\rightarrow$ finite-coherence transfer kernel F_ℓ.

A successful derivation must identify the substrate observable controlling the suppression amplitude, derive the multipole recovery scale, propagate it through a cosmological transfer calculation, explain the temperature-dominant channel structure, and reproduce the kernel without using the observed large-angle statistic to choose its coefficients.

1. Define the microscopic coherence or causal-horizon observable.
2. Derive its evolution under the active network dynamics.
3. Map it to primordial or late-time perturbation variables.
4. Compute temperature and polarization transfer functions.
5. Derive αCMB and LH with uncertainty and regulator control.
6. Lock the result before comparison with the CMB maps.
7. Demonstrate consistency with the remainder of the cosmological data set.

Exact present cosmological claim IRMT does not presently supply a complete alternative cosmology. It has rejected several broad routes and retains a bounded, calibrated, temperature-dominant model of the CMB large-angle correlation deficit that has shown directional robustness in locked subsequent tests. The kernel remains to be derived from the substrate.

16.6 Cosmology After WN-GR1

The cosmology sector remains empirical-target-limited. The Paper XIV locked kernel is not explained by WN-GR1. The note registers a testable pointer from the WN-Q4 diffusion regime to large-angle coherence loss, with explicit retirement conditions if the derived shape C(theta) fails against the locked kernel or if temperature dominance must be assumed.

The block-versus-growth ontology fork is now typed: either retain a fixed-order/block ontology and define cosmological time internally, or adopt a classical sequential-growth-class dynamics and inherit its covariance and parameter constraints. The choice is open, but the option space is no longer amorphous.

Revision History

Version	Date	Status	Controlled change
0.6.0	30 June 2026	Superseded working draft	Initial audited standalone Part.
0.6.1	3 July 2026	Current working draft	Reclassified the quantum sector after WN-Q1–Q6: conditional theorem stack strengthened, early inserted-kernel route superseded, and the

Version	Date	Status	Controlled change
			remaining premise/action/state/effect/multipartite gaps localized.
0.6.2	4 July 2026	Current working draft	Added quantum-sector patch controls for the damped-PR negative control, MGM quarantine, and N1a/N5/N6 ledger navigation.
0.6.3	6 July 2026	Current working draft	Integrated WN-Q7, WN-Q8 rev.1 and WN-G1 rev.1 sector-status updates with N7a/N7b/N7c and GG1-GG4 gates.
0.6.6	7 July 2026	Current working draft	Added WN-GR1 gravity/cosmology sector survey: conservation negative control, route asymmetry, manifoldlikeness floor, scale audit, and CMB diffusion pointer.

[DEF] This revision incorporates the adopted and corrected content of WN-Q1 through WN-Q6. The working notes remain provenance records but are no longer required to interpret the controlled statements added here.

Part V Compliance Condition

A future IRMT manuscript complies with Part V only if its abstract, theorem statements, figures, captions, conclusions, repository metadata, and public summaries use the sector statuses recorded here. A valid exact result from one layer may not be promoted into a stronger sector-level claim by omitting an indispensable open, constitutive, imported, failed, or merely numerical dependency.

Sector	Mandatory current wording
Quantum	Exact circular statistics; conditional projective probability/no-signalling/cosine–Bessel theorems; conditional bipartite quantum boundary and rank-one Born form; full effect weighting, preparation, update, action origin, ensemble selection, and multipartite boundary open.
Gauge	Generic local unitary covariance and Wilson geometry established; Standard Model content open.
Gravity	Conditional imported continuum embeddings available; IRMT-specific coupled Einstein derivation open.
Charged leptons	Mathematically closed effective construction conditional on JΩ=ΩHsupp; microscopic closure open.
Cosmology	Broad replacement claims rejected; bounded calibrated CMB temperature-coherence target survives; microscopic kernel open.

Version-control rule Any promotion of a sector statement requires: the relevant completion gate to be passed; Records 1, 3, 4, 5, and 6 to be updated; the dependency path to be re-audited; and the Core Specification version to be incremented.

QREV-2026-07-08-01 — Plateau Sector Status Update

The plateau pass adds five major governance objects: WN-Q9 rev.1, Record 8 v0.1, WN-P2, WN-C1 and WN-L1. The update raises clarity and executability but does not pass a full completion gate. The program now distinguishes full completion gates from class-limited verification gates.

Quantum/measurement: the conditional measurement stack is structurally coherent within DEF-G0. N4 is verified on the random-substrate class; N5 is structurally resolved inside the minimal depth-record model. RA1, RA2-prime, AX2-prime, UR1, UR3, purification realizability, state selection and G0 derivation remain derivability residues.

Lepton/protection: WN-P2 turns EG-1 into a lookup table. Permutation-type actions do not protect the determinant-line triple; genuinely mixing irreducible actions do within the exact symmetric quadratic class. The actual XVI-11 action must still be identified against the table.

Cosmology: WN-C1 completes the theory side of the G-ii confrontation under angular multiplicative damping. The mechanism forces a quadrupole-dominant hierarchy, high-ell recovery and an intermediate overshoot; this makes the pointer more falsifiable rather than more secure.

- Current midpoint tracker: approximately 37.0% with a working range of 34%-41%.
- Full completion gates passed: 0.
- Class-limited verification gates: N4 random-substrate class verified.
- Loaded maintainer-side confrontations: EG-1 lookup against XVI-11; WN-C1 kernel overshoot against locked XIV kernel and realistic fiducial; VII-01 conservation test.

Status rule: all entries in this section retain their stated conditionality strings. No unconditional physical selection, gauge group, dimensionful constant, CMB explanation, or full-sector closure is promoted by QREV-2026-07-08-01.

QREV-2026-07-08-02 Consolidated Sector Update

QREV-2026-07-08-02 integrates WN-A2, WN-O2a, and WN-LS1 into the sector-status ledger without promoting any full sector to solved status.

The update is deliberately narrow. It strengthens the representation/gauge-content branch of R5-129; closes only the algebraic exterior-parity subgate of O-2 conditionally on the exterior-record branch; and records a ledger-native route for R5-042 using w_ij link-weight variation. It does not derive kinetic chirality, generations, masses, full gravitational backreaction, conservation, or continuum Einstein recovery.

R5-129 status update

The CON-Lambda ansatz from WN-A1 is superseded as the main basis by WN-A2 Theorem R within the stated axiom class: free composition, frame covariance, binary-generated relations, non-obstruction, and finite record space. Under those conditions the exterior algebra is selected as the unique finite unobstructed quadratic covariant record algebra. The Standard-Model one-family structure remains conditional on MAP and the open 3|2 rank gate, and dynamical residues remain intact.

O-2a status update

The exterior record algebra carries an exact native Z2 parity split. Induced exterior transport is even and preserves parity. The anticommutation of D_rel with native parity is a theorem only under the ODD-Gamma condition: Gamma_ij must be odd in exterior degree. ODD-Gamma, no-doubling, and continuum chiral propagation remain open.

R5-042 status update

WN-LS1 selects the already-ledgered Dirac link weight w_ij as a candidate fixed-support geometry-variation variable. This avoids the unledgered soft-theta shortcut. Variation of a candidate spectral-plus-matter action defines a link-weight source equation, but conservation and continuum GR remain open. Relabelling covariance is not by itself a physical conservation law.

Gate	Updated status	Weakest remaining dependency
R5-129	Conditionally structurally mapped; not dynamically closed	MAP promotion, O-6 rank gate, kinetic chirality, generations, masses
O-2a	Exterior parity split [THM]; D_rel	ODD-Gamma origin and no-doubling

	anticommutation [THM | ODD-Gamma]	audit
R5-042	Open; targeted route strengthened by WN-LS1	Nontrivial conservation identity and continuum convergence

This consolidation supersedes the loose targeted-gates addendum as the maintained package context; the working notes remain provenance only.

IRMT CORE SPECIFICATION v1.0

PART VI

CORPUS RECONCILIATION

Paper Status, Terminology Control, and Structural Lifecycle Registry

This Part reconciles the sixteen-paper IRMT corpus with the active Core Specification. It preserves valid mathematics, numerical evidence, and negative results while preventing withdrawn closure claims, overloaded terminology, and superseded mechanisms from remaining active by inertia.

Abdulaziz Abdi · Toronto · 3 July 2026

Standalone Working Draft 0.7.4

Document Control

Field	Controlled entry
Specification family	IRMT Core Specification v1.0
Part	Part VI — Corpus Reconciliation
Working-draft version	0.7.4
Date	3 July 2026
Author	Abdulaziz Abdi
Controlled sections	17. Paper-by-Paper Status Matrix; 18. Terminology Reconciliation; 19. Active, Deprecated, and Retired Structures
Primary dependencies	Parts I–V and Records 1–7
Normative role	Historical reconciliation, citation control, terminology freeze, and lifecycle governance
Release status	Working draft; not the frozen v1.0.0 specification

Precedence rule Where a statement in Papers I–XVI conflicts with this Part or with the status ledgers in Parts I–V, the Core Specification controls the active theory. The historical paper remains citable only with the reconciled status and recommended language recorded here.

Classification Key

Classification	Controlled meaning
Exploratory foundation	Introduces ontology, language, or a research direction without closing the physical derivation.
Partially retained framework	Contains active kinematics or mathematics, but some physical interpretations or closure claims are withdrawn.
Superseded mechanism	Its operative mechanism no longer participates in any active derivation.
Effective model	Mathematically defined and usable conditionally, but not generated by the complete microscopic action.
Bounded empirical test	A locked or specified phenomenological hypothesis tested against data with a deliberately narrow claim.
Numerical audit	A computational investigation that establishes behavior, falsifies routes, or defines constraints in specified ensembles.
Exact no-go result	A mathematical or representation-theoretic result excluding a stated route under explicit assumptions.
Constitutive closure	An explicit law adopted to close an effective model while its microscopic origin remains open.

Corpus-at-a-Glance Matrix

Paper	Primary present classification	Active role
I	Exploratory foundation / partially retained framework	Primitive ontology and circular coherence statistics; later Q-series supplies controlled conditional operational reconstructions and sharper premise boundaries.
II	Partially retained framework	Generic gauge geometry plus the local Hilbert/effect setting used by the conditional quantum reconstruction; physical gauge content remains open.

Paper	Primary present classification	Active role
III	Partially retained operator framework / superseded mechanism	Relational Dirac kinematics survive; native chGUE/BBP generation does not.
IV	Exploratory gravity framework	Candidate matter/source and continuum bridges; no closed gravity derivation.
V	Exploratory cosmological framework	Network cosmology vocabulary; broad quantitative claims withdrawn.
VI	Superseded mechanism	Historical measurement proposal only.
VII	Superseded closure / conditional gravity framework	Explicit gravity gaps remain useful; claimed closure withdrawn.
VIII	Exact conditional geometry / superseded mechanism	Positive-branch Koide identity survives; BBP origin and generation closure do not.
IX	Historical architecture / superseded closure	Program map and correction history; closure table retired.
X	Numerical audit	Falsifies native universality and identifies transport/feedback behavior.
XI	Numerical audit	Establishes reachability of the Koide region, not stabilization or physical selection.
XII	Numerical audit / effective hierarchy model	Rank concentration produces hierarchy; pure collapse overshoots.
XIII	Effective model	Deficit-gated stabilization with compatibility-selected q_K.
XIV	Bounded empirical test	Locked CMB temperature-coherence target and explicit failed routes.
XV	Effective model / constitutive closure	Charged-lepton scale and phase construction conditional on response-to-connection law.
XVI	Exact no-go result / numerical audit	Action-level obstruction, allowed-map classification, mixed-sector no-go and protection tests.

17. PAPER-BY-PAPER STATUS MATRIX

Reconciliation rule. Each subsection controls how one paper may be used in the active corpus. “Strongest surviving result” does not mean the entire paper is endorsed. “Superseded claim” identifies the part that must not be imported into later arguments without explicit historical qualification.

17.I PAPER I — Information Relational Manifestation Theory

Controlled field	Reconciled entry
Original purpose	Introduce Relational Unity, a discrete causal-relational substrate, local record spaces, circular coherence statistics, generic internal symmetry, and possible continuum connections.
Strongest surviving result	The foundational ontology and exact circular maximum-entropy model survive. The corrected Q-series additionally reconstructs the cosine–Bessel law inside a declared operational interface and proves aggregation-ensemble scaling, without making these results substrate-derived.
Superseded or restricted claim	The original claims that Paper I itself derived P(a,b|x,y), no-signalling, the cosine law, the quantum set, κ=N universally, Standard Model content, or Einstein gravity remain withdrawn. Later conditional theorems do not retroactively strengthen the historical paper.
Dependency on other papers	Foundational source for Papers II–IX. Its quantum claims are now interpreted through WN-Q1–Q6 as integrated into Parts IV–V: conditional projective reconstruction, BBBEW boundary premise bundle, corrected record scaling, and rank-one Born localization.
Current classification	Exploratory foundation / partially retained framework.
Recommended citation language	“Paper I introduced the IRMT ontology and an exact circular maximum-entropy coherence model. Later Q-series work gives conditional operational reconstructions and localized quantum premises; Paper I itself did not derive the complete quantum sector.”

Citation boundary Do not cite Paper I as a derivation of the full quantum sector, the Standard Model, or Einstein gravity.

17.II PAPER II — Quantum Correlations and Gauge Structure from a Discrete Relational Substrate

Controlled field	Reconciled entry
Original purpose	Extend the foundational substrate to finite-coherence correlations, local Hilbert fibers, unitary link transport, loop holonomy, a Diamond–Wilson action, and proposed gauge/matter interpretations.
Strongest surviving result	Generic frame covariance, unitary transport, holonomy, and the Diamond–Wilson action survive. Its local finite-dimensional Hilbert fibers also provide part of the premise environment for later conditional operational theorems.
Superseded or restricted claim	Record multiplicity does not derive the Standard Model group or matter content. The later Q-series does not show that all local POVMs, AX1J, free-setting semantics, a preparation, or a probability law follow from Paper II; those are adopted premises or open derivations.
Dependency on other papers	Depends on Paper I for ontology/coherence; supplies gauge structures and local fibers used throughout the corpus. Q-series operational definitions and probability results are later controlled amendments, not original Paper II results.
Current classification	Partially retained framework.
Recommended citation language	“Paper II established generic discrete unitary transport and Wilson-holonomy geometry. Its local fibers can host the later conditional operational layer, while the full effect algebra, probability law, physical gauge group, and matter content remain unresolved.”

> **Citation boundary** Generic covariance may be cited as established kinematics; observed gauge content may not.

17.III PAPER III — Relational Dirac Operator, Spectral Structure, and the Problem of Generations

Controlled field	Reconciled entry
Original purpose	Define a Dirac-type operator on the causal-transport substrate and interpret its spectral organization as a route to matter and generations.
Strongest surviving result	The relational Dirac operator remains an active derived kinematic object, provided one canonical variant, domain, weights, and normalization are stated explicitly.
Superseded or restricted claim	Native chGUE universality, Marchenko–Pastur/BBP detachment, spectral-depth mass formulas, and the original generation mechanism are retired after Paper X.
Dependency on other papers	Depends on Papers I–II for the substrate and link transports. Its failed spectral assumptions invalidate quantitative dependencies in Papers V–IX but motivate the numerical redesign in Paper X.
Current classification	Partially retained operator framework / superseded mechanism.
Recommended citation language	“Paper III defined the relational Dirac-operator program; its native chGUE/BBP generation mechanism was subsequently falsified and retired.”

Citation boundary Always separate the operator construction from the retired ensemble interpretation.

17.IV PAPER IV — The Emergence of Gravitation and the Einstein–Hilbert Action

Controlled field	Reconciled entry
Original purpose	Connect relational update flux, spectral structures, and discrete causal geometry to stress–energy and continuum gravity.
Strongest surviving result	The paper identifies useful candidate source variables and correctly points to generic spectral-action, causal-set, and Lovelock tools as possible continuum bridges.
Superseded or restricted claim	No unique IRMT stress tensor, controlled continuum convergence, Einstein limit, spin–torsion prediction, or dark-matter explanation was derived.
Dependency on other papers	Depends on Papers I–III and external spectral/causal-set gravity mathematics; later constrained by Paper X and the action audit in Papers XV–XVI.
Current classification	Exploratory foundation / conditional gravity framework.

Controlled field	Reconciled entry
Recommended citation language	“Paper IV formulated candidate relational source and gravity bridges; applicability and normalization within IRMT remain conditional.”

Citation boundary Cite imported continuum theorems as imported, not as IRMT-specific derivations.

17.V PAPER V — Relational Cosmology

Controlled field	Reconciled entry
Original purpose	Develop a network-based cosmological narrative for expansion, early-universe coherence, matter formation, and vacuum-maintenance energy.
Strongest surviving result	The relational-network interpretation of cosmological history remains an active conceptual framework and supplies terminology for later bounded tests.
Superseded or restricted claim	BBP cosmological matter formation is retired; inflation replacement, Friedmann derivation, dark-energy prediction, and a complete alternative to ΛCDM were not established.
Dependency on other papers	Depends on Papers I–IV; the BBP route is invalidated by Paper X; the dark-energy implementation is tested and rejected in Paper XIV.
Current classification	Exploratory foundation.
Recommended citation language	“Paper V proposed a relational-network cosmology; its quantitative early-universe, matter-formation, and dark-energy mechanisms remain open or retired.”

Citation boundary Do not cite Paper V as a complete cosmological model or an established alternative to inflation/ΛCDM.

17.VI PAPER VI — The Measurement Problem as Relational Consistency

Controlled field	Reconciled entry
Original purpose	Provide a quantitative collapse threshold, finite-rank projection, preferred basis, Born-rule mechanism, and coherence-limited superposition time.
Strongest surviving result	Only the broad research idea that measurement should be formulated as operational relational consistency remains available for future reconstruction.

Controlled field	Reconciled entry
Superseded or restricted claim	The MP/BBP threshold, rank-three projector, projection necessity, preferred-basis theorem, Born-rule derivation, universal timescale, and continuous-variable extension are retired.
Dependency on other papers	Depends critically on Paper III's superseded native random-matrix architecture. Paper X removes the quantitative premise; Part IV reopens the probability problem from first principles.
Current classification	Superseded mechanism.
Recommended citation language	"Paper VI proposed a quantitative measurement mechanism that was later withdrawn after the spectral architecture failed; measurement remains an open IRMT sector."

Citation boundary No active result may cite Paper VI as establishing collapse, Born probabilities, or a measurement timescale.

17.VII PAPER VII — Closing the Gravitational Sector

Controlled field	Reconciled entry
Original purpose	Close the proposed gravity gaps by specifying a coarse-grained stress tensor, Newton normalization, matter–geometry coupling, and a final Einstein equation.
Strongest surviving result	The paper remains useful as an explicit inventory of the three gravity problems that any complete IRMT theory must solve.
Superseded or restricted claim	The claimed derivations of the stress tensor, Newton constant, spectral-depth matter source, coherence correction, and closed Einstein equation are conditional, imported, or retired.
Dependency on other papers	Depends on Papers I, III, and IV plus imported Benincasa–Dowker machinery. Paper X invalidates the spectral-depth premise; Parts III–V formalize the missing joint action and continuum proof.
Current classification	Superseded closure / partially retained framework.
Recommended citation language	"Paper VII attempted to close three gravitational gaps; the current specification retains the gaps and candidate formulas but withdraws the closure claim."

Citation boundary Do not use the paper title as evidence that gravity is closed.

17.VIII PAPER VIII — A First-Principles Derivation of the Koide Formula

Controlled field	Reconciled entry
Original purpose	Explain the Koide relation using Cl(3)/Pauli Frobenius geometry within the then-active BBP generation picture.
Strongest surviving result	On the positive-amplitude branch, the circular three-component parametrization with transverse amplitude $\sqrt{2}$ yields the exact identity $K=2/3$ independently of azimuth.
Superseded or restricted claim	The native BBP origin, generation solution, unrestricted all-orientations wording, and first-principles physical selection of the Frobenius latitude are withdrawn.
Dependency on other papers	Originally depended on Paper III's spectral architecture; its surviving algebra is now separated from that route and feeds Papers XI–XV.
Current classification	Exact conditional geometry / superseded mechanism.
Recommended citation language	"Paper VIII contains an exact positive-branch Koide identity conditional on physical Frobenius equipartition; its BBP origin and generation claims are retired."

Citation boundary Cite the algebraic theorem and its domain, not the original first-principles title as a present status claim.

17.IX PAPER IX — Closing the Program: Structural Architecture and Open Problems

Controlled field	Reconciled entry
Original purpose	Assemble Papers I–VIII into a purportedly complete architecture and close remaining coupling and phase issues.
Strongest surviving result	The paper is a useful historical map of the intended program, dependencies, proposed tests, and the point at which closure was claimed.
Superseded or restricted claim	Program closure, the complete derivation table, binary-tetrahedral phase selection, RG phase closure, predicted UV coupling, and the unified prediction package are retired or reclassified.
Dependency on other papers	Depends on all prior papers and therefore inherits their later failures. Paper X begins the corrective experimental phase; Papers XV–XVI replace and audit the charged-lepton route.
Current classification	Historical architecture / superseded closure.
Recommended citation language	"Paper IX recorded the original closure architecture; subsequent experiments and audits withdrew that closure and retained it only as program history."

Citation boundary Any quotation of a Paper IX closure statement must be paired with its withdrawal.

17.X PAPER X — From Spectral Universality Failure to Spectral Self-Organization

Controlled field	Reconciled entry
Original purpose	Test the native spectral assumptions, catalogue failed mechanisms, and identify conditions under which spectral organization can emerge computationally.
Strongest surviving result	The paper decisively falsifies native chGUE universality in the tested constructions, distinguishes localized from transport-rich phases, and shows spectral feedback can organize low modes numerically.
Superseded or restricted claim	Spectral feedback is not yet physical time evolution or an action-derived microscopic mechanism; transport richness alone does not solve generations or hierarchy.
Dependency on other papers	Audits Paper III and invalidates dependencies in Papers V–IX. Supplies the revised numerical foundation for Papers XI–XIII.
Current classification	Numerical audit.
Recommended citation language	“Paper X falsified the native chGUE premise in the tested relational operators and identified transport/feedback mechanisms that organize spectra numerically.”

Citation boundary Do not promote an iterative numerical update to fundamental dynamics without a derived action or transition law.

17.XI PAPER XI — The Koide Configuration in IRMT — Reachability

Controlled field	Reconciled entry
Original purpose	Determine whether the Koide configuration is accessible within the revised projected-operator landscape after the failure of BBP universality.
Strongest surviving result	The Koide region is reachable under specified projected-operator constructions and is not excluded by the revised numerical state space.
Superseded or restricted claim	Reachability does not imply stability, uniqueness, natural basin measure, physical selection, or a generation theorem.
Dependency on other papers	Depends on Paper VIII for Koide geometry and Paper X for the revised numerical operator perspective; motivates the rank-collapse mechanism in Paper XII.
Current classification	Numerical audit.

Controlled field	Reconciled entry
Recommended citation language	“Paper XI established reachability of the Koide region in specified revised IRMT constructions; it did not establish dynamical selection or stabilization.”

Citation boundary Use “reachable” only in the tested model and never as a synonym for “predicted.”

17.XII PAPER XII — Rank-One Collapse and the Emergence of Hierarchy

Controlled field	Reconciled entry
Original purpose	Identify a robust dynamical coordinate for hierarchy and test whether rank concentration drives packets toward the Koide region.
Strongest surviving result	Rank concentration is the strongest implemented hierarchy mechanism: increasing R produces a controlled one-plus-two hierarchy and reaches the Koide crossing in tested closed packets.
Superseded or restricted claim	Pure unopposed collapse does not stabilize $K=2/3$; it crosses the target and continues toward rank one.
Dependency on other papers	Depends on Papers X–XI for the revised projected setting and on Paper VIII for the Koide target; supplies the collapse sector used by Paper XIII.
Current classification	Numerical audit / effective model.
Recommended citation language	“Paper XII established rank concentration as an effective hierarchy mechanism and showed that pure collapse overshoots the Koide crossing.”

Citation boundary Do not cite rank collapse alone as the stabilizing law.

17.XIII PAPER XIII — Koide Stabilization from Deficit-Gated Entropy

Controlled field	Reconciled entry
Original purpose	Add a support/braking response to rank collapse and produce a stable effective equilibrium at the Koide rank coordinate.
Strongest surviving result	The natural-gradient and delayed-response equations are mathematically explicit and yield a stable effective fixed point when q is set to q_K.
Superseded or restricted claim	The claim that the law contains no Koide information is too strong: q_K is selected by compatibility with R_K and is not generated by a microscopic action.

Controlled field	Reconciled entry
Dependency on other papers	Depends on Paper XII for the collapse coordinate and Paper VIII for R_K; its stabilized packet and response variables feed Paper XV.
Current classification	Effective model.
Recommended citation language	“Paper XIII constructed a stable effective Koide packet using a deficit-gated response law whose active coefficient q_K is compatibility-selected.”

Citation boundary Use “effective stabilization,” not “microscopic derivation of q_K.”

17.XIV PAPER XIV — Finite Relational Coherence and the CMB Large-Angle Temperature Correlation Deficit

Controlled field	Reconciled entry
Original purpose	Search public cosmological data for a bounded signal of finite relational coherence while requiring failed routes to be reported explicitly.
Strongest surviving result	A locked temperature-coherence kernel gives directional improvement for the large-angle temperature-correlation deficit across spectrum, pseudo-spectrum, and direct map-space tests.
Superseded or restricted claim	Simple dark-energy running, generic low-ℓ power suppression, and universal TT/TE/EE suppression fail; the kernel coefficients are calibrated rather than substrate-derived.
Dependency on other papers	Conceptually motivated by Papers I and V, but empirically self-contained. Its active status depends on locked C1 calibration and subsequent C2/C3 tests, not on broad cosmological closure.
Current classification	Bounded empirical test.
Recommended citation language	“Paper XIV reports a calibrated, locked, temperature-dominant finite-coherence target for the CMB large-angle correlation deficit and documents three failed broader routes.”

Citation boundary Do not describe the result as a replacement for ΛCDM or a first-principles prediction of the full spectrum.

17.XV PAPER XV — Charged-Lepton Masses from Relational Rank Collapse and Determinant-Line Holonomy

Controlled field	Reconciled entry
Original purpose	Combine effective packet stabilization, exact minimal-diamond coefficients, determinant-line geometry, finite U(2) Wilson response, and a D3 phase invariant into charged-lepton mass ratios and scale.
Strongest surviving result	The paper gives a mathematically coherent effective mass construction with exact internal geometry, no direct lepton-mass calibration, and quantitatively accurate ratios and scale.
Superseded or restricted claim	The projector/field origin, q_K selection, packet coefficient, response-to-connection lift, normalized exposure, and uniqueness/protection of the phase source are not microscopically derived.
Dependency on other papers	Depends on Papers XII–XIII for packet dynamics and on the revised Koide geometry of Paper VIII; Paper XVI audits its remaining bridge and protection assumptions.
Current classification	Effective model / constitutive closure.
Recommended citation language	“Paper XV provides a mathematically closed charged-lepton model conditional on the constitutive response-to-connection law $J_\Omega=\Omega H_{supp}$ and associated effective identifications.”

Citation boundary The absence of direct lepton-mass fitting may be stated, but it does not justify the phrase “fully first principles.”

17.XVI PAPER XVI — The Microscopic Origin of Determinant-Line Holonomy

Controlled field	Reconciled entry
Original purpose	Test whether the constitutive determinant-line response law in Paper XV can be generated and protected by the existing microscopic ingredients.
Strongest surviving result	The paper proves the current action is variationally block diagonal, classifies the allowed response maps, derives the bare protected identity metric, identifies the Schur-complement obstruction, and quantifies the missing protection hierarchy.
Superseded or restricted claim	Packet-isospectral motion, passive universal Berry mapping, symmetry-only selection, a single compact phase, inter-line fields as a complete source, native graded cancellation, and automatic packet-gap protection all fail as completion routes.
Dependency on other papers	Depends on Paper XV for the target law and on the full projected/exterior-square packet construction. It supplies the present action-level endpoint of the corpus.
Current classification	Exact no-go result / numerical audit.

Controlled field	Reconciled entry
Recommended citation language	“Paper XVI establishes that the current microscopic action does not derive or protect the Paper XV response law, while preserving exact local bundle geometry and a bare Wilson metric.”

Citation boundary Cite negative results as scoped no-go statements under the tested field content, not as proof that no future completion is possible.

Corpus-wide citation rule A paper may be cited for its strongest surviving result only with the domain, evidentiary layer, and supersession boundary recorded above. Titles containing “first principles,” “closing,” or “complete” do not override the present classification.

18. TERMINOLOGY RECONCILIATION

Terminology freeze. The following definitions supersede incompatible uses across Papers I–XVI. Later documents must either use the controlled meaning or introduce an explicitly qualified new term. Historical quotations may retain old wording only when labelled as historical.

Controlled term	Current meaning	Excluded incompatible meaning
Relational spectrum	The eigenvalue, singular-value, localization, or related spectral data of an explicitly named IRMT operator on an explicitly named configuration. The operator, ensemble, normalization, and boundary conditions must be stated.	It is not synonymous with chGUE, a Marchenko–Pastur bulk, physical particles, or observed masses.
Packet	An ordered, normalized finite vector constructed from singular values or other declared invariant amplitudes of a specified projected operator; in the charged-lepton model $p=(p_1,p_2,p_3)$.	It is not automatically a particle multiplet, a probability distribution over measurement outcomes, or a set of physical generations.
Generation	One of the experimentally observed replicated fermion families. A model index, packet component, detached mode, or determinant line may be called a generation candidate only after a physical representation map is derived.	The term may not be used merely because a construction has three components.
Measurement	An operational process defined by setting spaces, outcome spaces, a normalized probability map, composition/conditioning rules, and a specified relation to experimental records.	It is not generic projection, rank reduction, numerical relaxation, or selection of a convenient basis.

Controlled term	Current meaning	Excluded incompatible meaning
Closure	Completion of all indispensable dependencies at the declared layer. “Effective closure” means a conditional model has no internal missing step after its constitutive laws are declared; “microscopic closure” means those laws follow from the active microscopic theory and are protected.	The unqualified word “closed” may not be used when a constitutive, imported, fitted, open, or failed indispensable arrow remains.
Manifestation	The realization or assignment of an admissible relational configuration as an active physical state or record pattern under specified rules. It is an ontology-level term unless a concrete dynamics is supplied.	It is not a synonym for measurement collapse, continuum emergence, observation, or metaphysical creation.
Support	In the packet sector, the declared functional or response opposing unchecked rank concentration; most specifically the complement $S_F=1-K$ and/or its associated response variable.	It is not generic evidentiary support, environmental decoherence, or a gauge source unless explicitly qualified.
Response	A quantitatively defined map from a source, variation, or state variable to a change in another variable. Every use must name the source, target, coefficient, and dynamical/evidentiary status.	It is not a rhetorical synonym for correlation or influence.
Connection	A specified parallel-transport structure or gauge potential on a named bundle, represented discretely by link transports or continuously by a connection one-form.	It is not a generic relationship between concepts, and an effective connection need not be a fundamental gauge field.
Holonomy	The ordered transport around a closed loop or along a closed parameter cycle. Physical quantities are conjugacy-class data, traces, determinants, eigenphases, or other gauge-invariant functions of that transport.	A gauge-dependent open-path phase is not a physical holonomy.
Microscopic	Written directly in the primitive or declared fundamental variables of the active theory, with a specified action/transition law, coefficients, constraints, and no unresolved constitutive bridge for the claim under discussion.	Discrete, small-scale, algebraic, or simulation-level does not by itself mean microscopic.
First principles	Derived from the frozen primitive structure and active dynamics with all indispensable coefficients and maps fixed by theorem, symmetry, or explicitly declared external constants; no target-dependent matching or constitutive bridge may remain in the claimed chain.	“No direct fit to the target data” and “parameter-free after assumptions” are not sufficient.

18.1 Mandatory Qualification Rules

1. Every spectrum must be qualified by its operator: D_{rel} spectrum, projected-M singular spectrum, exterior-square spectrum, or another explicitly defined object.

2. Every packet must state its construction, normalization, ordering convention, and whether it is an observable, latent variable, or numerical diagnostic.
3. The word generation is reserved for observed families unless the text explicitly says component, line, mode, or generation candidate.
4. The words measurement, probability, and outcome may not be used for deterministic relaxation variables without an operational probability map.
5. Closure must always be qualified by layer: algebraic, numerical, effective, action-level, microscopic, or empirical.
6. Connection and holonomy must identify the bundle, path or cycle, representation, and gauge-invariant observable.
7. Microscopic and first-principles claims must include a dependency statement showing that no constitutive or target-matched indispensable arrow remains.

18.2 Controlled Examples

Uncontrolled wording	Controlled replacement
"The relational spectrum has three generations."	"The specified projected operator has three ordered packet components; their identification with observed generations is open."
"Measurement projects the state."	"The historical Paper VI projection mechanism is retired; the operational probability and outcome dynamics remain open."
"The Koide sector is closed."	"The effective packet model is dynamically closed after $q=q_K$ is imposed; microscopic selection of q_K remains open."
"The response becomes the connection."	"The effective model adopts the constitutive map $J_\Omega=\Omega H_{supp}$ with unit normalization and exposure."
"The holonomy is the phase of a basis vector."	"The physical phase is extracted from a gauge-invariant determinant, trace, eigenphase, or oriented closed-cycle invariant."
"The mass formula is first principles because no masses were fitted."	"The mass outputs are not directly calibrated to the lepton masses, but the construction remains conditional on q_K, v_{EW}, and the constitutive response-to-connection law."

> **Terminology compliance** No term in this Section may retain a second incompatible active meaning. Where a historical paper uses an older meaning, later text must either translate it into the controlled vocabulary or mark it as retired terminology.

19. ACTIVE, DEPRECATED, AND RETIRED STRUCTURES

Lifecycle rule. Lifecycle status is distinct from evidentiary status. A structure can be active while still open or constitutive, and an exact theorem can be retired from the active theory if its physical premise is no longer used. The tables below control whether a structure may participate in v1.0 derivations.

19.1 Active Core

These structures are used directly in the Core Specification and form the controlled kinematic, mathematical, or governance backbone. Their individual evidentiary labels remain those assigned in Parts I–V.

Structure	Active role	Boundary / qualification
Locally finite causal set $(C,\prec)$	Primitive causal-relational kinematics.	The dynamics of the order is still open; current use is primarily fixed-order.
Hasse links and causal diamonds	Derived local combinatorial structures for transport and curvature observables.	Links are cover relations, not independent primitive edges.
Local complex Hilbert fibers H_i	Primitive/provisional internal record spaces.	Their dimension and physical representation content are not yet selected.
Unitary link transports U_{ij}	Primitive/provisional comparison maps and local-frame-covariant transport variables.	Generic frame group is not the Standard Model gauge group.
Path transport and loop holonomy	Exact derived bundle geometry.	Physical observables must be gauge invariant.
Diamond–Wilson action S_W	Best-defined discrete transport action.	β_W, physical group, representation, and continuum normalization remain open.
Canonical relational Dirac operator D_{rel}	Active derived kinematic operator.	One frozen variant, weights, domain, and normalization must accompany every claim.
Named spectral and singular-value observables	Invariant diagnostics of specified operators.	No native random-matrix universality is presumed.
Projectors and compressed operators	Exact operator operations when the projector is specified.	Physical selection of Π_T remains open.
Exterior-square functor and determinant lines	Exact representation and bundle construction.	Physical identification depends on the protected rank-two sectors.
Gauge-invariant Wilson traces, determinants, and eigenphases	Controlled holonomy observables.	Open-path or basis-dependent phases are excluded.
Evidentiary taxonomy and dependency rule	Normative claim-control system for v1.0.	The weakest indispensable dependency limits the full claim.

19.2 Effective but Active

These structures are used conditionally in active phenomenological or matter sectors. Their equations may be exact internally, but their physical origin, coefficients, or coupling to the core theory remain constitutive, imported, calibrated, or open.

Structure	Status in v1.0	Required disclosure
Von Mises coherence model	Active exact circular-statistics model; conditional operational dephasing model.	State separately the exact maximum-entropy theorem, the declared operational interface/state, and the open microscopic origin of κ and the weighting law.
Aggregation-ensemble κ scaling and serial-diffusion counterlaw	Active exact ensemble theorems; substrate ensemble selection open.	Use κeff=Nκ0A(κ0)(1+o(1)) only in Eagg; use E[e^{iφN}]=χε(1)^N in Ediff; never restore universal κ=N wording.
Imported spectral-action and Benincasa–Dowker gravity routes	Active conditional continuum bridges.	Label external theorem, unproved applicability, and missing coupled back-reaction.
Relational network cosmology	Active conceptual framework.	No complete background/perturbation dynamics is claimed.
Projected operator $M=\Pi_T\Phi_{sub}\Pi_T$	Active matter-sector definition.	Projector and substrate-field origin remain open.
Normalized packet p and diagnostics R,K	Active invariant hierarchy coordinates.	They are not measurement probabilities or observed generations.
Natural-gradient collapse/support flow	Active effective dynamics.	The flow parameter is not physical time and the action origin is open.
Compatibility-selected q_K	Active exact coefficient within the effective flow.	State that q_K is fixed by alignment with R_K, not independently derived.
Minimal-diamond coefficients k=2, r=1/2, ξ_6, ξ_3	Active exact continuum coefficients within the adopted observable.	Physical assignment to the packet sector remains conditional.
Packet-scale normalization using v_{EW}	Active effective scale construction.	v_{EW} is external and phase/exposure normalization is constitutive.
Determinant-line flavor bundle and D3 invariant	Active effective flavor geometry.	The bundle mathematics is exact; physical phase-source action is open.
$J_\Omega=\Omega H_{supp}$	Active constitutive closure.	Must always carry [CON] and may not be called action-derived.
Finite U(2) Wilson dressing	Active exact group-theoretic function.	Its physical argument $\theta=q_K$ inherits the constitutive lift.
Locked CMB kernel	Active bounded phenomenological model.	α_{CMB} and L_H are calibrated; C2/C3 are subsequent locked tests.

19.3 Deprecated

Deprecated structures are retained temporarily to interpret older papers, reproduce legacy calculations, or maintain notation compatibility. They must not initiate new derivations and should be removed or translated in the frozen specification.

Deprecated structure	Backward-compatibility function	Required replacement
Unqualified “relational spectrum”	Interprets early spectral language.	Name the operator, ensemble, normalization, and observable.
Unqualified “generation” for three model components	Explains terminology in Papers III, VIII, and early packet drafts.	Use packet component, determinant line, protected sector, or generation candidate.
Universal $\kappa=N$ wording	Reproduces early coherence estimates.	Use $\kappa=c_\kappa N$ only as a conditional scaling model with c_κ open.
Early loop-torsion action S_{loop}	Historical precursor to Wilson curvature cost.	Use the Diamond–Wilson action or state the approximation explicitly.
Multiple unfrozen D_{rel} variants	Allows reproduction of older numerical runs.	Use the canonical operator specification with a variant identifier.
Overloaded symbols α, β, ξ, r, ρ	Permits reading of the original papers.	Use the canonical subscripts defined in Record 2 and Record 4.
“Closure” without a layer qualifier	Preserves historical quotations.	Use effective closure, numerical closure, action closure, or microscopic closure.
Valence-defect matter interpretation	Retains a possible early source proposal for comparison.	Treat as an inactive candidate unless integrated with the active matter action.
Spectral depth as an informal hierarchy diagnostic	May describe legacy plots.	Do not use as physical mass or stress–energy.
Binary-tetrahedral phase notation	Maintains interpretability of Paper IX.	Use the active determinant-line/D3 construction or classify the old route as historical.

Deprecated does not mean supported A deprecated object remains readable, not scientifically endorsed. It may be used to reproduce or explain an older result, but any new claim must be translated into active structures and re-audited.

19.4 Retired

Retired structures do not participate in any active derivation. They may appear only in historical discussion, falsification records, or scoped no-go arguments. A retired route cannot be revived by renaming its variables or quoting an earlier paper.

Retired structure or route	Reason retired	Surviving lesson / replacement
Native chGUE universality of D_{rel}	Falsified in the tested native constructions by Paper X.	Measure the spectral phase of the actual operator; use chGUE only as a control.
Marchenko–Pastur/BBP generation mechanism	Depends on the failed native ensemble and lacks a physical representation map.	Protected projected hierarchy replaces the mechanism, not yet the generation theorem.
BBP cosmological matter formation	Inherits the retired spectral premise.	Matter formation remains open.

Retired structure or route	Reason retired	Surviving lesson / replacement
Paper VI quantitative measurement mechanism	Threshold, rank, projection, Born rule, and timescale all depend on the retired architecture or missing probability law.	Paper VI remains retired. The active replacement is the Q-series conditional operational layer and the open effect/preparation/action program.
Spectral-depth physical mass/source formula	Bulk-edge premise and particle map are not active.	Use the declared projected packet only as an effective matter variable.
Paper VII claim of closed gravity	Coarse-graining, normalization, continuum limit, and back-reaction remain open.	Gravity is conditional/imported until a joint action and convergence theorem exist.
Standard Model emergence from generic U(m)	No unique group or representation selection.	Physical gauge content is an open target.
Paper IX program-closure table	Contradicted by Paper X and subsequent audits.	Use the Core Specification status matrix.
Binary-tetrahedral phase as active selector	No dynamics selects the required element.	Active effective phase uses determinant lines and a D3 invariant.
Paper IX RG phase closure	Calculated shift is insufficient.	Any future RG correction must be quantitatively derived after the microscopic phase is fixed.
Paper IX UV coupling as an IRMT prediction	Coefficient was externally matched.	Treat only as historical matching.
Pure rank collapse as stable Koide solution	It overshoots toward rank one.	Deficit-gated support gives the active effective stabilization.
Simple finite-coherence dark-energy running	Rejected by the Paper XIV likelihood test.	No active quantitative dark-energy prediction.
Generic direct low-ℓ power suppression	Failed as a robust full replacement.	Use the bounded large-angle temperature-correlation target.
Universal TT/TE/EE suppression	Polarization did not support the shared kernel.	No active universal polarization prediction.
Packet-isospectral/null-space phase source	Failed to produce the required determinant phase.	A genuine sourced connection remains necessary.
Passive universal Berry/transgression map	Local curvature exists but the finite packet map is nonuniversal/insufficient.	Retain Berry geometry as a carrier, not the source law.
Symmetry-only identity response selection	Exact classification leaves independent singlet/relative coefficients.	Coefficients must be dynamically selected.
Single compact phase completion	Cannot encode the required irrational ratio without extra unselected structure.	Any compact completion must avoid duplicate free normalization.
Inter-line difference fields as complete source	They miss the common determinant mode exactly.	A common-charge carrier is required.
Tight-frame identity as dynamic selection	Representation availability does not fix action weights.	Derive the kinetic/source coefficients.
Bare identity metric as automatically protected	Mixed wedges regenerate the allowed correction.	Require exact decoupling, cancellation, or a verified gap.
Native chiral/graded cancellation	Tested contributions do not cancel while preserving the required properties.	Any new partner mechanism must be derived and positive/unitary.
Automatic packet-gap protection	Current stabilized packets fail invariant protection thresholds.	A revised action must generate the hierarchy.

19.5 Reactivation Rule

1. A retired route may be discussed historically without reactivation.
2. Reactivation requires a materially new mechanism, not a relabelling or parameter change inside the retired architecture.
3. The new mechanism must identify which decisive failure or no-go assumption has been removed.
4. Pass/fail criteria must be fixed before evaluating the new mechanism against the target result.
5. All affected entries in Records 1–6 and Parts III–VI must be versioned and updated together.
6. No retired claim becomes active until the Core Specification explicitly promotes it in a numbered release.

19.6 Q-Series Adoption and Archival Status

Note	Adopted controlled result	Mandatory qualification	Lifecycle
WN-Q1	Well-posed operational target; visibility negative control; gate ordering.	Gate-shaping results do not by themselves construct the substrate probability law.	Incorporated; archive for provenance.
WN-Q2	Local-measure route excluded under M1–M3; operational scenario definitions.	Amplitude route is unique only under retained setting-independence/locality commitments; quotient criterion is sufficient, not exhaustive.	Incorporated with qualification.
WN-Q3	Positive normalized no-signalling projective law; cosine–Bessel derivation.	Declared Hilbert interface and state, not native action output.	Incorporated conditionally.
WN-Q4	Aggregation posterior theorem and ensemble dichotomy.	General diffusion uses χε(1)^N; deficit remainder is stochastic, not deterministic O(N−2).	Incorporated after correction.
WN-Q5	BBBEW bipartite quantum-boundary theorem.	Requires LQ-POVM + AX1J + operational NS/free settings; not Part II alone; bipartite only.	Incorporated with premise bundle.
WN-Q6	Rank-one Born-weight localization and dimension-stability result.	Correct range 0≤f0≤1/(d−1); pure states/rank-one projectors only.	Incorporated after correction.

[DEF] Once the controlled statements above are incorporated into Parts III–VII and Records 2–7, the individual Q-notes are provenance sources rather than mandatory active context.

19.7 Working-Note Adoption: WN-Q7, WN-Q8 rev.1, and WN-G1 rev.1

WN-Q7 is adopted as a conditional effect-algebra and mixed-state Born extension. WN-Q8 rev.1 supersedes WN-Q8 rev.0 and is adopted as the corrected update-rule localization note. WN-G1 rev.1 supersedes WN-G1 rev.0 for gauge-sector integration because it corrects the anomaly nondegeneracy condition and expands GG2 to handle the extra central U(1).

The adopted notes add theorem capsules, filters, and gates. They do not promote a completion gate, and the superseded claims are quarantined in Record 6.

19.8 Working-Note Adoption: WN-GR1

WN-GR1 is adopted as a gravity/cosmology survey and negative-control note. It upgrades the raw flux-to-stress conservation warning into an explicit identity/numerical negative control, prices the spectral and Benincasa-Dowker gravity routes separately, records the manifoldlikeness difficulty floor, pairs the active dimensionful imports v_EW and ell_c, and registers the WN-Q4 diffusion-to-CMB pointer with retirement conditions.

The note closes no gravity or cosmology gate. It is classified as cartography plus negative-control progress. Language claiming that microscopic flux conservation derives Einstein stress-energy, or that diffusion explains the CMB anomaly, remains prohibited.

Revision History

Version	Date	Status	Controlled change
0.7.0	30 June 2026	Superseded working draft	Initial audited standalone Part.
0.7.1	3 July 2026	Current working draft	Reconciled Papers I–II and formally adopted the corrected Q-series as controlled later work, with explicit premise, correction, citation, and archival boundaries.
0.7.2	6 July 2026	Current working draft	Recorded adoption of WN-Q7, WN-Q8 rev.1 and WN-G1 rev.1, including supersession of WN-Q8 rev.0 and WN-G1 rev.0 claims.
0.7.4	7 July 2026	Current working draft	Added WN-GR1 adoption and archival status.

[DEF] This revision incorporates the adopted and corrected content of WN-Q1 through WN-Q6. The working notes remain provenance records but are no longer required to interpret the controlled statements added here.

19.7 Part VI Compliance Condition

Mandatory compliance Every future IRMT paper shall identify the paper-level status, controlled terminology, and lifecycle class of each inherited structure. It shall not cite an earlier title, theorem label, or closure statement as authority against the reconciled status in this Part.

QREV-2026-07-08-01 — Corpus Reconciliation and Supersession Update

This update adds the plateau-falsifiability pass and records four correction controls. WN-Q9 rev.0 remains superseded by WN-Q9 rev.1 for absolute/normalized deficit language and the deep-regime N* table. WN-C1 is integrated with the conservative table-count correction: the package relies only on the displayed family rows unless additional hidden runs are supplied.

The external-reader guide is reconciled with the Q-series ledgers: the Tsirelson boundary is conditional on the local quantum effect algebra, joint assignment rule and operational no-signalling premises. The substrate-alone wording is excluded.

The numerical lab is reconciled as a verification harness, not a physics derivation. The uploaded v1.0 code is archived; the package adds v1.1 with determinant-normalized SU(2) transports to make the implementation vocabulary exact.

- Excluded wording: IRMT explains the CMB anomaly; the diffusion mechanism predicts the observed low quadrupole; the substrate alone gives Tsirelson; permutation symmetry protects the Koide line triple; lab-verified means physically derived.
- Permitted wording: multiplicative damping forces a testable low-to-intermediate-ell overshoot; EG-1 is a lookup; N5 is resolved in structure under minimal model + CON-noise; N4 is verified on the random-substrate class.

Status rule: all entries in this section retain their stated conditionality strings. No unconditional physical selection, gauge group, dimensionful constant, CMB explanation, or full-sector closure is promoted by QREV-2026-07-08-01.

IRMT CORE SPECIFICATION v1.0

PART VII

FALSIFIABILITY AND GOVERNANCE

Failure Criteria, Reproducibility, Change Control, and Completion Gates

This Part governs how IRMT claims may fail, how computational evidence must be released, how the specification may change, and what must be demonstrated before any sector is declared complete. Its purpose is not to protect the theory from failure, but to make failure precise, public, and scientifically productive.

Abdulaziz Abdi · Toronto · 3 July 2026

Standalone Working Draft 0.8.2

Document Control

Field	Controlled entry
Specification family	IRMT Core Specification v1.0
Part	Part VII — Falsifiability and Governance
Working-draft version	0.8.2
Date	3 July 2026
Author	Abdulaziz Abdi
Normative scope	Failure criteria; numerical preregistration; target isolation; null models; reproducibility; semantic versioning; claim promotion and demotion; open derivation priorities; completion gates.
Authority	This Part governs all future IRMT derivations, numerical papers, repositories, claims of completion, and specification changes.
Status	Working draft. The governance rules become binding for the frozen Core Specification v1.0.0 and should be followed immediately during preparation.
Precedence	Where an earlier paper or experiment used a weaker evidentiary or reproducibility standard, this Part controls the current interpretation and any future re-test.

GOVERNANCE PRINCIPLE A theory is not made rigorous by surviving only favourable tests. IRMT shall count a predeclared failure, a null result, or a demotion of an earlier claim as progress whenever the outcome narrows the admissible theory space.

Normative Verbs

Term	Controlled meaning
shall / must	Mandatory requirement for compliance with the specification.
shall not / must not	Prohibited practice or wording.
should	Strong recommendation; any deviation must be justified in the record.

Term	Controlled meaning
may	Permitted option that does not alter claim status by itself.
passed	Every stated criterion has been satisfied with auditable evidence.
not passed	At least one mandatory criterion remains unmet, failed, or untested.

20. FALSIFIABILITY FRAMEWORK

Every active IRMT claim shall be paired with a failure condition that is more specific than “the fit is poor” or “the derivation is incomplete.” Exact statements require exact counterconditions. Numerical statements require predeclared estimators, tolerances, nulls, sample sizes, and stopping rules. Effective constructions require explicit domains outside which they make no claim.

20.1 Exact Failure Conditions

An exact claim is falsified when a valid counterexample, contradiction, or failed implication is demonstrated within the claim’s own declared domain. Changing the domain, normalization, sign convention, or definition after the counterexample is observed does not preserve the original claim; it creates a revised claim that must be versioned.

Claim class	Exact failure condition	Required response	IRMT example
Algebraic identity	The expression fails for one admissible point in the declared domain, or an omitted absolute value, branch, or degeneracy changes the result.	Restrict, correct, or retire the theorem. Propagate the change to every dependent formula.	Koide identity on the positive-amplitude branch.
Logical implication	The premises hold while the stated conclusion does not, or a hidden premise is required.	Withdraw the implication and expose the missing premise as [CON], [CONJ], or [OPEN].	Local frame covariance does not imply Standard Model gauge content.
Existence claim	No solution exists under the declared equations, constraints, and admissible data.	Retire the existence claim or change the theory through governance.	Existence of a compact field encoding the required response ratio.
Uniqueness claim	Two inequivalent admissible solutions, maps, groups, or actions satisfy the same stated criteria.	Demote “unique” to “one admissible construction” and identify the selection problem.	Symmetry allows independent common and relative current coefficients.
Invariance claim	The claimed observable changes under a transformation classified as redundancy.	Remove it from the observable set or construct an invariant replacement.	Raw gauge-fixed phases or basis-dependent matrix entries.

Claim class	Exact failure condition	Required response	IRMT example
No-go theorem	A construction satisfying all stated assumptions produces the supposedly forbidden outcome.	Withdraw the no-go theorem and re-open the route.	Zero mixed variation of the explicitly block-diagonal current action.
Closure claim	Any indispensable arrow in the declared dependency path is open, constitutive, imported, failed, or untested.	Replace closure language with the status of the weakest indispensable arrow.	Microscopic charged-lepton closure.

Counterexample sufficiency

For universal exact statements, one valid counterexample within the declared domain is sufficient. Repetition is required only to establish that the counterexample is not a transcription, implementation, or arithmetic error. For existential or constructive statements, a failed search is not itself an exact disproof unless the search space is finite and exhaustive or a theorem establishes impossibility.

ANTI-RESCUE RULE After a failure is known, the original claim shall not be preserved by silently changing definitions, excluding the counterexample, introducing a new coefficient, or narrowing the domain. Any such modification is a new versioned claim.

20.2 Numerical Failure Conditions

A numerical claim shall declare its success and failure thresholds before the decisive run. The preregistration may be internal and timestamped during early development, but the public paper must identify the frozen protocol and show that the final threshold was not chosen after inspecting the target result.

Required item	Mandatory content
Primary estimand	The single statistic or ordered set of statistics that decides the main claim.
Success threshold	The minimum effect, accuracy, convergence rate, or protection level required for promotion.
Failure threshold	The result at or beyond which the tested claim is rejected, not merely described as inconclusive.
Indeterminate region	Any interval between success and failure thresholds, with the required next action.
Sample and seed plan	Number of instances, seed generation, exclusions, and whether stopping depends on results.
Uncertainty	Confidence or credible interval, Monte Carlo error, numerical conditioning, and finite-size uncertainty.

Required item	Mandatory content
Multiple testing	All searched observables, models, masks, kernels, or hyperparameters and the correction policy.
Numerical tolerance	Solver, gauge, closure, orthogonality, conservation, and arithmetic tolerances.
Robustness requirement	Minimum range of sizes, seeds, coordinate choices, step sizes, and null models.

Current benchmark thresholds

Claim family	Predeclared numerical rule
Packet stabilization	Declare ε_R and ε_K before running; report convergence to R_K and K=2/3, closure leakage, basin fraction, and step refinement. Passing the effective fixed-point test does not pass microscopic selection.
Mixed-sector protection	For the current audit, $\lvert \rho_{eff}/q_K - 1 \rvert \leq 10^{-3}$ is the response-ratio tolerance. In the isotropic model this requires $\Delta_{mix}/g_{mix}^2 \gtrsim 421.9$. Failure shall be recorded even when raw finite-step measures appear favourable.
Continuum convergence	At least three refinement levels; a frozen error norm; decreasing error compatible with a positive convergence order; stable fitted coefficient under removal of the coarsest level; no target-dependent rescaling.
Spectral organization	A preregistered statistic shall distinguish the active construction from matched Poisson, random-transport, shuffled-link, and dense-ensemble controls at fixed size and complexity.
CMB locked-kernel test	Kernel form and coefficients shall be frozen before the test set. No map, mask, estimator, or multipole choice may be selected because it improves the final percentile. Calibration and test results shall be reported separately.

20.3 Target Isolation

An observed quantity may be used as a final comparison target only if it did not enter an indispensable construction step, coefficient choice, model selection, stopping rule, or exclusion rule. The absence of a direct least-squares fit does not establish target isolation when a compatibility coefficient or architecture was selected to reproduce the same target.

$$Y_{obs} \notin \{S_{action}, \theta_{coeff}, \Pi_{select}, R_{stop}\}$$

Data role	Permitted use	Prohibited use
Derivation set	May contain primitives, symmetries, exact mathematical inputs, declared external constants, and target-blind numerical controls.	Observed target values; residuals to the target; target-ranked model selection.
Calibration set	May set explicitly labelled phenomenological coefficients or kernels.	May not later be described as independent confirmation.
Validation set	May test robustness choices that were fixed before examination.	May not be used repeatedly until a preferred configuration is found.
Test set	Used once under the frozen model and analysis plan.	No refitting, threshold movement, mask selection, or unreported alternative analysis.
Post-hoc exploration	Permitted when labelled exploratory and separated from confirmatory evidence.	Cannot promote the claim until repeated on new data or new ensembles.

Target-isolation audit

1. List every observed quantity known to the analyst before the construction was frozen.
2. Trace every coefficient, projector, branch, phase, kernel, threshold, and exclusion to its source.
3. Identify whether target information entered through compatibility, aesthetic preference, manual inspection, or failed alternatives.
4. Mark each output as prediction, calibration, reconstruction, or post-hoc explanation.
5. Repeat the decisive test on a target or ensemble that was unavailable during model construction whenever possible.

20.4 Null Models and Controls

Every numerical claim shall be tested against controls that preserve the nuisance structure most likely to produce a false positive. A weak null that destroys size, sparsity, degree distribution, symmetry, or estimator bias does not establish a theory-specific effect.

Control	Required construction	Purpose
Exact positive control	A case whose answer is analytically known and should be recovered by the implementation.	Detects coding, normalization, and estimator failure.
Exact negative control	A construction in which the claimed effect is mathematically absent.	Measures false-positive rate and numerical leakage.
Matched null ensemble	Preserves size, sparsity, degree/layer structure, dimensions, and numerical pipeline while randomizing the claimed causal ingredient.	Tests whether the ingredient, rather than nuisance structure, produces the effect.

Control	Required construction	Purpose
Ablation	Removes one interaction, feedback term, projector, orientation, or representation component at a time.	Identifies causal contribution within the implemented model.
Complexity-matched baseline	Uses a comparator with similar parameter count and optimization freedom.	Prevents gains caused only by added flexibility.
Permutation / relabeling control	Randomizes labels or orientations while preserving invariant structure.	Detects coordinate or indexing artifacts.
Independent estimator	Measures the same target using a substantially different numerical procedure.	Detects estimator-specific conclusions.
Adversarial control	Constructed deliberately to mimic the target statistic without the proposed mechanism.	Tests specificity of the interpretation.

20.5 Reparameterization and Coordinate Tests

A physical or representation-invariant observable shall not depend on basis, gauge, event labels, equivalent packet coordinates, numerical step subdivision, path parameterization, or arbitrary normalization conventions. The exact invariance requirement is:

$$O(C) = O(g \cdot C) \quad \text{for every declared redundancy} \quad g \in G_{\mathrm{red}}$$

Redundancy test	Required transformation	Pass condition
Local basis / gauge	Apply independent allowed frame transformations at every event.	Gauge-invariant traces, spectra, determinants, and closed holonomies remain unchanged within tolerance.
Event relabeling	Permute event identifiers while preserving causal incidence and all attached data.	All physical outputs and ensemble statistics remain identical.
Packet coordinate chart	Use singular values, simplex coordinates, log ratios, or another invertible chart.	Physical fixed points, stability classification, and invariant observables agree.
Flow reparameterization	Change step size, integrator, and subdivision while holding the continuous effective law fixed.	Converged trajectories and static observables agree; raw step increments are not promoted.
Path parameterization	Reparameterize the same geometric path or ribbon.	Integrated holonomy/curvature observables agree.

Redundancy test	Required transformation	Pass condition
Normalization convention	Translate between explicitly equivalent trace, generator, or state normalizations.	Dimensionless physical predictions agree after the declared conversion.
Representation basis	Rotate within degenerate subspaces or reorder equivalent protected sectors.	Bundle-level invariant statements agree; basis-dependent vectors do not count as observables.

20.6 Negative Results

Negative results are part of the official theory record. They shall not be removed from repositories, timelines, literature reviews, or specification history merely because a replacement mechanism is later found. The negative result defines which theory space has already been tested and prevents cyclic rediscovery of failed routes.

Negative-result field	Mandatory record
Identity	Stable test ID, date, paper/experiment, code commit, data manifest, and specification version.
Question	The exact mechanism or claim tested, including its declared domain.
Protocol	Frozen estimator, thresholds, seeds, controls, tolerances, and stopping rule.
Outcome	Raw and processed outputs, uncertainty, and whether the result was failed, indeterminate, or unsupported.
Interpretation boundary	What the result excludes and what it does not exclude.
Dependency propagation	Every claim, coefficient, paper, and future priority affected by the outcome.
Replacement status	Whether a replacement exists, is only proposed, or is not yet known.

OFFICIAL-RECORD RULE A failed route may be superseded, but it shall remain findable, reproducible, and linked to the claims it retired. A later positive result does not convert the earlier negative result into an error unless the original implementation itself was defective.

21. REPRODUCIBILITY STANDARD

Every computational IRMT paper or experimental note shall release a reconstruction package sufficient for a competent researcher to reproduce the principal tables, figures, pass/fail decisions, and machine-readable outputs without private instructions. A narrative methods section alone is not sufficient.

Required component	Minimum standard
Source code	Complete executable analysis and generation code, including preprocessing, simulation, plotting, and validation scripts. No omitted “helper” notebook may contain a decisive step.
Machine-readable outputs	Raw outputs, processed tables, summary statistics, failure logs, and metadata in open formats such as CSV, JSON, NPZ/HDF5, FITS, or plain text as appropriate.
Environment information	Operating system, language/runtime versions, packages with exact versions, compiler/BLAS/CUDA information where relevant, and hardware notes for nondeterministic accelerators.
Evidence policy	A statement identifying which files are primary evidence, which are derived products, which are diagnostic only, and how failed runs or exclusions are retained.
Manifest	A machine-readable inventory of every file, role, size, checksum, generating command, and dependency.
Checksums	SHA-256 or stronger checksums for release files and, when practical, for large downloaded inputs.
Repository DOI	A permanent archived release, preferably with a DOI, distinct from a mutable development repository.
Random seeds	Master seed, per-run seeds or deterministic seed-generation rule, random-number generator, and any nondeterministic operations.
Numerical tolerances	Solver, convergence, gauge, closure, orthogonality, conservation, integration, and floating-point tolerances.
Exact/numerical separation	Exact identities and analytic derivations shall be stored and discussed separately from floating-point verification. Numerical agreement is not evidence that an exact proof exists.
Execution instructions	One documented command or ordered command sequence that rebuilds the principal results from the archived package.
License and access	Terms permitting inspection and reproduction, plus a record of any unavoidable restricted input and a public substitute test.

21.1 Canonical Release Layout

Path	Required content
README.md	Scope, frozen claims, quick start, expected outputs, resource requirements, and known limitations.
CITATION.cff	Authors, title, version, DOI, release date, and preferred citation.
manifest.json	File inventory, roles, generating commands, dependencies, and SHA-256 checksums.
environment/	Lock files, package lists, container recipe, and hardware/runtime notes.
src/	Versioned source code and reusable modules.
configs/	Frozen experiment, model, threshold, and analysis configurations.
data/raw/	Original or downloaded inputs, or retrieval scripts and checksums when redistribution is prohibited.
data/processed/	Deterministically generated intermediate datasets.
runs/	Per-run configuration, seed, stdout/stderr, status, and raw result.
results/	Machine-readable primary endpoints and declared pass/fail decisions.
figures/	Generated figures only; every figure must be reproducible from results or raw data.
tests/	Unit, invariant, regression, exact-control, and numerical-tolerance tests.
negative_results/	Failed mechanisms, null outcomes, and excluded configurations with full provenance.

21.2 Manifest and Evidence Policy

The manifest shall distinguish source evidence from derived evidence. For each principal claim, the package shall identify the minimal set of files required to verify it and the command that generated each derived file. Manual edits to numerical outputs or figures are prohibited unless the edit is non-substantive, scripted where possible, and disclosed.

Manifest field	Controlled meaning
file	Relative path in the archive.

Manifest field	Controlled meaning
role	source_input, primary_output, derived_output, diagnostic, figure, code, environment, or documentation.
sha256	Checksum of the archived file.
generated_by	Command, script, notebook, or external source.
depends_on	List of input files and configuration identifiers.
claim_ids	Claims or figures for which the file is evidence.
seed / tolerance	Random seed and decisive numerical tolerances where applicable.
status	successful, failed, excluded_with_reason, or not_run.

21.3 Reproduction Levels

Level	Definition	Status consequence
R0 — Author rerun	Original author reruns the archived release on the original environment.	Required before release; verifies package self-consistency only.
R1 — Clean-environment rerun	A clean machine or container reproduces the primary outputs from the archive.	Required for computational publication.
R2 — Independent implementation	A different researcher or team reconstructs the result from the specification and data, not merely by running the same code.	Required for the Replication Gate.
R3 — Adversarial replication	Independent reviewers vary controls, seeds, sizes, numerical schemes, and plausible alternative implementations.	Required before strong generality or robustness language.

21.4 Computational Claim Record

Record field	Required entry
Claim ID and text	One sentence, with status label and specification dependency.
Primary endpoint	Frozen statistic and exact code path producing it.
Inputs	Data versions, generated ensembles, external constants, and exclusions.

Record field	Required entry
Thresholds	Success, failure, and indeterminate criteria.
Controls	Positive, negative, matched-null, ablation, and alternative-estimator controls.
Robustness	Seeds, graph sizes, resolutions, masks, step sizes, and coordinate/gauge tests.
Output location	Manifested machine-readable result and checksum.
Decision	Passed, failed, indeterminate, or not tested, with no rhetorical override.

RELEASE CONDITION A computational paper shall not be treated as reproducible merely because code exists. The archived release must rebuild its principal evidence under a documented clean environment and preserve the exact configuration that produced the published decision.

22. VERSION CONTROL AND CHANGE GOVERNANCE

The Core Specification uses semantic versioning. Version numbers communicate scientific compatibility, not only editorial maturity. A change that alters the primitive theory, the complete action, the admissible state space, or a central physical prediction shall not be hidden inside a patch or silently applied to older papers.

22.1 Frozen Core

Version class	Permitted change	Required consequence
Major: X.0.0	Changes primitive ontology, causal structure, state space, complete action, physical symmetry content, probability law, or the interpretation of a central observable. Also required when a previously passed foundational gate is reopened.	New theory version; all affected derivations and numerical claims must be revalidated.
Minor: 1.Y.0	Adds a backward-compatible derived theorem, effective sector, observable, test, or clarified coefficient without changing the frozen primitive/action content or existing physical predictions.	New capability; affected records and tests are added.

Version class	Permitted change	Required consequence
Patch: 1.0.Z	Corrects typographical, formatting, citation, metadata, or non-substantive explanatory errors. A numerical correction qualifies only if no scientific decision, coefficient, or prediction changes.	No scientific revalidation beyond document QA.
Pre-release: 0.Y.Z	Working-draft development before the frozen v1.0.0 release.	May change substantially; all changes remain traceable.

The frozen core includes, at minimum: primitive variables; admissible state space; causal and gauge redundancies; complete microscopic action; coefficient status; physical observables; probability map; and the rules connecting discrete variables to continuum claims. Until one complete microscopic action exists, the Core-Specification Gate remains not passed.

22.2 Change Proposal

Change-proposal field	Mandatory content
Proposal ID and version target	Unique identifier, author, date, and requested major/minor/patch version.
Reason	Problem demonstrated, evidence, and why interpretation alone cannot resolve it.
Affected definitions	Every primitive, derived object, coefficient, status label, observable, and term whose meaning changes.
Affected papers and records	Papers I–XVI, Core Specification Parts, and audit-record entries requiring update.
Altered predictions	Quantities, signs, scales, ratios, thresholds, or null results that change or cease to apply.
Dependency propagation	All downstream claims whose status changes under the weakest-link rule.
Tests required	Exact proofs, regression tests, numerical reruns, controls, and independent review.
Migration plan	Deprecated names/equations, replacement mapping, compatibility period, and repository redirects.
Decision and rationale	Accepted, rejected, revised, or deferred; reviewer comments and conflicts recorded.

Change sequence

6. Open the change proposal before modifying the authoritative specification.

7. Run dependency analysis using Records 1–6 and the active specification.
8. Implement the change on a versioned branch or working draft.
9. Execute exact, numerical, regression, and reproducibility tests.
10. Record claim promotions, demotions, deprecations, and newly failed routes.
11. Release the new specification version and immutable evidence package.

22.3 Deprecation Policy

A definition, symbol, coefficient, mechanism, or API-like data structure may be deprecated when a replacement exists but historical papers and repositories still depend on the older form. Deprecation is transitional; retirement means the structure is absent from every active derivation.

Requirement	Policy
Deprecation notice	First version in which deprecated; reason; replacement; affected files/papers; final supported version.
Alias period	Old notation may remain as a labelled alias only when the mapping is one-to-one and no physical ambiguity results.
Migration examples	At least one explicit old-to-new equation, data-field, or terminology conversion.
Warnings	Code and documents should emit or display a deprecation warning where feasible.
Retirement	Removal from active use occurs only in the declared version and is entered in Record 6 or its successor.
Historical preservation	Old files remain archived and checksummed; they are not overwritten by corrected versions.

22.4 Claim-Promotion Rule

A claim may be promoted only when the completion gate recorded for that claim has been met. Better wording, more decimal places, a successful fit, or agreement with an observed value does not promote a conjecture or constitutive law to a theorem.

Promotion	Minimum gate
[OPEN] → [CONJ]	A precise mechanism, variables, equations, and falsifiable completion test are stated.
[CONJ] → [NUM]	A preregistered numerical test passes appropriate controls and robustness checks.
[CON] → [THM]	The constitutive law is derived from the frozen action or an exact uniqueness theorem, with no indispensable target-matched coefficient.

Promotion	Minimum gate
[EXT] → [THM]	The result is re-derived from active IRMT variables rather than merely imported from external mathematics.
[NUM] → [THM]	A proof is supplied. Numerical agreement alone never performs this promotion.
Effective closure → microscopic closure	Every indispensable effective law is generated and protected by one complete untuned microscopic action.
Internal reproduction → replication	An independent implementation reproduces the central result under the frozen protocol.

22.5 Claim-Demotion Rule

A failed exact check, decisive numerical test, or dependency audit shall trigger immediate demotion. Demotion does not wait for a replacement mechanism or the next major paper. The active abstract, conclusion, timeline, website, and repository metadata shall be corrected wherever the outdated claim is presented as current.

Demotion field	Mandatory response
Trigger	Counterexample; failed preregistered threshold; invalidated dependency; unreproducible primary result; hidden target leakage; or material implementation error.
Immediate action	Freeze the affected release, label the claim, and stop downstream promotion or expansion using it.
Propagation	Recompute the status of every dependent claim using the dependency graph.
Correction artifact	Issue an erratum, corrected release, or superseding note with immutable links to the original.
Negative-result entry	Record the failure protocol, result, scope, and replacement status.
Version consequence	Use a major version when the primitive/action theory changes; otherwise use the smallest version that accurately communicates scientific compatibility.

NO SILENT CORRECTION A corrected formula, dataset, or code path shall not overwrite the evidence used by the earlier claim. The original release, correction, and dependency consequences must remain linked and distinguishable.

23. OPEN DERIVATION PROGRAM

The active research program is ordered by dependency rather than by novelty. Work at a later priority may be explored, but it shall not be presented as closing a sector whose earlier gate remains open. Priority E is explicitly conditional on the relevant foundational gates.

Priority	Objective	Required deliverable	Forbidden shortcut
Priority 0	Freeze the complete microscopic specification.	One primitive state space; one complete action; explicit symmetries; coefficient classifications; observables; probability status; continuum maps; and reconciled legacy claims.	Treating the current sector stack as already unified.
Priority A	Derive the microscopic quantum operational layer and preparation.	Derive from the frozen action/history structure: operational settings/outcomes beyond CP-II-01; the full local POVM/effect algebra; joint effect noncontextuality and separate additivity AX1J; free-setting causal no-signalling; the realized state or POPT functional; composition and update rules; record-ensemble selection; and the multipartite boundary. Conditional projective and bipartite-boundary theorems remain valid intermediate results.	Treating the declared Hilbert interface, BBBEW premise bundle, RA1/RA2, or aggregation ensemble as already action-derived.
Priority B1	Select the physical gauge group and matter representations.	Derive SU(3)×SU(2)×U(1), chiral representations, hypercharges, anomaly cancellation, and coupling normalization from the frozen state space/action.	Equating local basis covariance with physical gauge content.

Priority	Objective	Required deliverable	Forbidden shortcut
Priority B2	Derive continuum gravity and the matter–geometry bridge.	Controlled limit of the actual IRMT operator/action; unique leading gravitational equation; normalized source map; back-reaction; conservation; and exclusion/control of alternatives.	Citing generic spectral-action or causal-set theorems as an IRMT-specific derivation.
Priority C1	Derive Koide equipartition and q_K.	An untuned packet action selects the protected triplet, Frobenius equipartition, Koide locus, and q_K without using charged-lepton targets.	Compatibility-setting $q=q_K$ and then calling the value dynamically predicted.
Priority C2	Derive and protect the determinant-line current.	A compact bounded gauge-invariant mixed action yields $J_\Omega=\Omega H_{supp}$, fixes exposure/normalization, and protects the common/relative response against mixed wedges.	Adding an arbitrary source, phase, charge, stiffness, or truncation solely to recover the target.
Priority D	Obtain independent replication and adversarial review.	Independent implementations reproduce central numerical results, negative results, exact checks, and repository packages; adversarial controls are reported.	Counting author reruns or same-code execution as independent replication.
Priority E	Permit expansion to quarks, neutrinos, or new cosmological sectors only after the appropriate completion gates have passed.	A written dependency review identifies the passed gate authorizing the expansion and preserves target isolation.	Using new sectors to distract from or compensate for unresolved foundational arrows.

23.1 Dependency Order

$$\text{Priority } 0 \rightarrow \{A, B1, B2, C1, C2\} \rightarrow D \rightarrow E$$

The braces do not imply that A, B1, B2, C1, and C2 are scientifically independent. They may share variables and must ultimately arise from the same frozen action. They indicate that these derivation programs may proceed in parallel after Priority 0 has fixed the object being tested.

23.2 Priority Record

Field	Required content
Owner / contributors	Named individuals or teams responsible for the derivation and audit.

Field	Required content
Starting specification version	The exact frozen or working-draft version whose variables and action are used.
Completion gate	The criteria from Section 24 and any claim-specific extensions.
Target isolation declaration	Observed quantities known, external inputs used, and prohibited target leakage.
Exact work products	Definitions, lemmas, theorems, proofs, symbolic derivations, and counterexample searches.
Numerical work products	Preregistered tests, controls, manifests, seeds, outputs, and negative results.
Decision	Passed, failed, indeterminate, or deferred; date and evidence package.
Dependency updates	Claims, papers, coefficients, and future priorities promoted or demoted.

EXPANSION RULE Exploratory work on quarks, neutrinos, or additional cosmology may be stored as exploratory research. It shall not enter the active Core Specification or be advertised as an IRMT prediction until the gate on which it depends has passed.

24. COMPLETION GATES

A completion gate is binary at the level of public closure language: passed or not passed. Individual subcriteria may be complete, conditional, failed, or untested, but a sector shall not be called complete while any mandatory item is missing. “Substantially complete,” “nearly solved,” or a percentage score shall not substitute for the gate.

Gate status	Controlled meaning
Passed	Every criterion has auditable evidence; no indispensable [OPEN], [CON], [CONJ], failed, or untested arrow remains.
Not passed — open	At least one required derivation or definition is absent.
Not passed — conditional	The sector works only after an indispensable constitutive or imported bridge.
Not passed — failed	A mandatory test or theorem has failed and no accepted replacement exists.
Not tested	The frozen protocol has not yet been executed.

24.1 Core-Specification Gate

Pass criterion	Current status	Evidence / limitation
All primitive variables are defined.	Partially satisfied	Part II defines provisional primitive kinematics; the final dynamical primitive set remains tied to the missing complete action.
One complete microscopic action is stated.	Not satisfied	Part III explicitly records a sector stack with missing causal, substrate-field, packet–connection, and matter–geometry interactions.
All symmetries and redundancies are explicit.	Partially satisfied	Kinematic redundancies are defined; physical gauge selection and some dynamical symmetries remain open.
All coefficients are classified.	Satisfied for current corpus	Record 4 classifies the known coefficients; new action coefficients remain to be introduced and classified.
All physical observables are defined.	Partially satisfied	Part IV defines current discrete/effective observables; operational quantum and complete continuum observables remain open.
Legacy claims are reconciled.	Satisfied for Papers I–XVI	Part VI and Record 6 control terminology, citation, and lifecycle status.

CURRENT GATE DECISION Core-Specification Gate: NOT PASSED. The decisive missing criterion is one complete microscopic action.

24.2 Quantum Gate

Mandatory criterion	Current status
Outcome and setting spaces are operationally defined.	Passed for CP-II-01 working definitions; general operational extension open.
A complete positive normalized P(a,b|x,y) is derived from the substrate.	Not passed; passed conditionally inside DEF-G0 projective interface.
No-signalling, free-setting semantics, and composition/update rules are proved.	Projective no-signalling passed conditionally; free-setting origin and general composition/update open.

Mandatory criterion	Current status
The correlator E(x,y) is derived rather than assumed.	Passed conditionally for CON-Ψ equatorial projectors; state/interface selection open.
The attainable bipartite and multipartite correlation sets are characterized.	Bipartite boundary conditionally characterized by BBBEW premise bundle; multipartite open.
The Tsirelson restriction follows from substrate-derived premises and supraquantum boxes are excluded.	Conditionally passed for bipartite correlations under LQ-POVM+AX1J+NS/free settings; premise derivation open.

CURRENT GATE DECISION Quantum Gate: NOT PASSED. The exact von Mises statistics survive, but the operational probability chain remains open.

24.2.1 Quantum Subgates Introduced by Revision 0.8.2

Subgate	Passing condition	Current decision
Q-A Operational ontology	General settings, outcomes, instruments, trial semantics, and composites are defined invariantly.	Partial: CP-II-01 only.
Q-B Effect algebra	All local effects/POVMs and their operational equivalences are generated or selected.	Not passed.
Q-C Joint weighting	AX1J follows from the substrate and yields a valid joint weight on local effects.	Not passed.
Q-D Causal settings	No-signalling and free-setting/intervention semantics follow from causal support.	Not passed; conditional model only.
Q-E Preparation	The realized state/POPT functional and its phase/entanglement structure are selected target-independently.	Not passed.
Q-F Born extension	Rank-one pure-state theorem extends to all effects, mixed states, updates, and sequential composition.	Not passed.
Q-G Boundary	Bipartite and multipartite attainable sets are characterized from derived premises.	Bipartite conditional; multipartite not passed.
Q-H Record scaling	The action selects aggregation, diffusion, or a controlled mixture and fixes κ statistics.	Not passed.

ANTI-IMPORT RULE. An external theorem may close a mathematical implication after its premises are established, but it shall not be used to relabel those premises as substrate-derived. In particular, BBBEW supplies the bipartite boundary only after LQ-POVM, AX1J, operational no-signalling, and free-setting semantics are independently justified.

24.3 Gauge Gate

Mandatory criterion	Current status
The physical group SU(3)×SU(2)×U(1) is selected from the frozen theory.	Not passed
Observed chiral matter representations are derived.	Not passed
Hypercharges and charge quantization are derived.	Not passed
Gauge and mixed anomalies cancel for the derived spectrum.	Not passed
Coupling normalization and running are derived or correctly classified as inputs.	Not passed
Generic frame covariance is distinguished from physical gauge symmetry.	Passed as a specification distinction

CURRENT GATE DECISION Gauge Gate: NOT PASSED. Generic unitary transport and Wilson geometry do not select observed gauge content.

24.4 Gravity Gate

Mandatory criterion	Current status
The actual frozen IRMT operator/action has a controlled refinement family.	Not passed
A continuum metric, dimension, curvature, and volume map are derived with error bounds.	Not passed
The leading gravitational equation and normalization are fixed.	Not passed
Matter stress–energy and geometry arise from joint variation.	Not passed
Conservation and two-way back-reaction are demonstrated.	Not passed
Alternative continuum limits are excluded or bounded.	Not passed
Imported spectral-action and Benincasa–Dowker results are correctly classified.	Passed as a status distinction

CURRENT GATE DECISION Gravity Gate: NOT PASSED. Available routes are conditional embeddings, not an IRMT-specific controlled continuum derivation.

24.5 Matter Gate

Mandatory criterion	Current status
The protected matter sector and generation multiplicity arise from the frozen action.	Not passed
Koide/Frobenius equipartition is dynamically selected.	Not passed
q_K is generated without compatibility-setting to the Koide point.	Not passed
The packet scale and exact continuum coefficients are connected by derived physical identifications.	Not passed
The determinant-line current $J_\Omega=\Omega H_{supp}$ follows by variation.	Not passed — constitutive
Compact exposure and phase normalization are fixed.	Not passed
Mixed-sector corrections are exactly cancelled or suppressed below the frozen threshold.	Failed in current packets / open replacement
The effective charged-lepton model remains mathematically coherent under its explicit assumptions.	Passed at effective level only

CURRENT GATE DECISION Matter Gate: NOT PASSED. The charged-lepton construction is effectively closed conditional on a constitutive response-to-connection law, but it is not microscopically closed.

24.6 Replication Gate

Mandatory criterion	Current status
Central numerical packages satisfy the Section 21 release standard.	Partially satisfied / package-dependent
A clean-environment rerun reproduces the primary outputs.	Required for each release; not globally certified
Independent researchers reproduce the packet, CMB, spectral, and M6 results.	Not passed
Independent implementations reproduce key exact/numerical boundaries and negative results.	Not passed
Adversarial controls and discrepant results are published.	Not passed

CURRENT GATE DECISION Replication Gate: NOT PASSED. Internal testing and archived packages do not substitute for independent implementation and adversarial review.

24.7 Gate Summary

Gate	Decision	Decisive reason
Core Specification	NOT PASSED	One complete microscopic action is missing.
Quantum	NOT PASSED	Conditional projective and bipartite-boundary theorems exist, but the effect/weighting/preparation/action premises and multipartite closure remain open.
Gauge	NOT PASSED	Observed group, representations, charges, anomalies, and normalization are not selected.
Gravity	NOT PASSED	No controlled IRMT-specific continuum gravitational limit with back-reaction.
Matter	NOT PASSED	Effective charged-lepton closure remains constitutive and unprotected microscopically.
Replication	NOT PASSED	Independent and adversarial reproductions are outstanding.

Revision History

Version	Date	Status	Controlled change
0.8.0	30 June 2026	Superseded working draft	Initial audited standalone Part.
0.8.2	3 July 2026	Current working draft	Revised the quantum priority and completion gate to recognize the Q-series conditional advances while adding explicit effect-algebra, weighting, causal-setting, preparation, Born-extension, record-scaling, and multipartite

Version	Date	Status	Controlled change
			subgates.

[DEF] This revision incorporates the adopted and corrected content of WN-Q1 through WN-Q6. The working notes remain provenance records but are no longer required to interpret the controlled statements added here.

25. FINAL STATUS STATEMENT

The following declaration is the normative closing statement of the Core Specification working-draft sequence. It shall appear unchanged in the frozen v1.0.0 release unless a versioned change proposal demonstrates that its scientific content has materially changed.

IRMT Core Specification v1.0 defines a relational microscopic framework, its currently proposed dynamics, its effective constructions, and its unresolved derivational bridges. It does not classify mathematical compatibility as physical derivation. Quantum correlations, observed gauge content, continuum gravity, and the complete matter mechanism remain open foundational targets. The purpose of the specification is to make these targets precise, testable, and traceable to one fixed theoretical foundation.

25.1 Binding Consequences

Consequence	Controlled interpretation
Compatibility is not derivation.	A known theorem, symmetry-permitted structure, successful reconstruction, or exact identity cannot be described as a physical derivation unless the active theory selects it.
Effective success is preserved honestly.	The charged-lepton and CMB constructions may be used within their stated effective or phenomenological domains without being mislabelled microscopic.
Failures remain evidence.	Native chGUE, BBP generations, the Paper VI measurement mechanism, failed cosmological routes, and rejected M6 completion routes remain part of the official record.
Expansion follows gates.	New particle or cosmological sectors do not compensate for unfinished quantum, gauge, gravity, or matter derivations.
The specification is falsifiable.	A failed gate, exact counterexample, target leak, unreproducible result, or invalidated dependency changes the official status immediately.

END OF PART VII Part VII completes the standalone working-draft sequence of the IRMT Core Specification. The next document-level task is assembly, cross-reference reconciliation, global notation checking, and release-candidate audit for the complete specification.

QREV-2026-07-08-01 — Record 8 and External Reader Channel

Record 8 v0.1 is added as the Surplus and Falsifiability Register. It collects executable or falsifiable commitments in one place, each with a conditionality string, measurement handle, pass condition and retirement condition. Promotion of any entry from conditional to unconditional requires closing every item in its conditionality string and recording the promotion in Record 7.

The External Reader Package is added as a professional-reader guide. Its posture is attack-oriented: it asks a reviewer to target the axiom base, protection gates, manifoldlikeness/chirality floors and the CMB kernel statistics, rather than to endorse the program.

Record 8 supersedes scattered prose claims of testability. Future test claims must either appear in Record 8 or be explicitly marked as informal and non-governing.

- SR-1: depth-records deficit law.
- SR-2: extra-U(1) exposure.
- SR-3: anomaly branch filter.
- SR-4: CMB kernel shape/overshoot test.
- SR-5: VII-01 conservation test.
- SR-6: protection-candidate gates, WN-P1-dependent with WN-P2 EG-1 lookup.
- SR-7: scale-reduction target.
- SR-8: numerical laboratory as standing execution harness.

Status rule: all entries in this section retain their stated conditionality strings. No unconditional physical selection, gauge group, dimensionful constant, CMB explanation, or full-sector closure is promoted by QREV-2026-07-08-01.

IRMT CORE SPECIFICATION v1.0

APPENDICES A-L

Symbols · Dimensions · Coefficients · Actions · Dependencies · Corpus · Experiments · Governance

Document status	Working Draft 0.9.7
Specification target	IRMT Core Specification v1.0.0
Prepared	7 July 2026
Author	Abdulaziz Abdi
Authority	Records 1-7, Parts I-VII, and the recovered experimental corpus
Repository DOI	Pending assignment
Release status	Not frozen; experimental provenance is substantially reconciled, with explicit preservation gaps

This volume is the controlled appendix layer of the Core Specification. It reproduces the authoritative ledgers in human-readable form, adds sector dependency maps, and now reconciles the best-available experimental corpus: the 43-notebook legacy archive, twenty-six recovered experimental/theoretical records, the preserved M5 result bundles, the M6D-M6S audit bundles, and the cosmology tests. Missing source code, raw inputs, archive identifiers, or one-to-one legacy numbering are recorded explicitly rather than reconstructed by inference.

REGISTRY INTEGRITY An empty DOI, checksum, archive path, title, or experiment outcome is a governance finding. It shall remain marked pending until verified from an immutable archive.

Appendix Register

Appendix	Title	Authoritative source
A	Complete Symbol Table	Record 2 notation ledger
B	Dimensional Analysis	Records 2-4 and action audit
C	Coefficient Status Ledger	Record 4
D	Complete Action Catalogue	Record 3
E	Dependency Graphs	Record 5 visual maps
F	Paper Status Matrix	Part VI / Record 6
G	Experiment Registry	Recovered records 01-26; 43-notebook archive; M5/M6 bundles
H	Superseded and Retired Claims	Record 6
I	Imported Mathematical and Physical Results	Core specification audit
J	Open Problems	Parts IV-VII and completion gates
K	Repository and DOI Registry	Recovered corpus inventory, checksums, Zenodo records, and working repository
L	Revision History	Pre-release history, archive-reconciliation changes, and post-v1.0 schema

Appendix A - Complete Symbol Table

This table reproduces every canonical entry in Record 2. Type, domain, codomain/range, units, transformation law, evidence status, lifecycle, and definition remain distinct fields; a blank entry is not inferred.

ID	Symbol	Name	Type	Domain	Codomain / range	Units	Sector	Transformation	Evidence	Lifecycle	Definition
R2-001	mathcalC	Causal event set	Locally finite partially ordered set	-	Set of events	Cardinality	Core ontology	Invariant under event relabelling	[DEF]	Active core	mathcalC=x_i, with causal order prec
R2-002	x_i	Relational event	Element of a poset	mathcalC	Event	Dimensionless label	Core ontology	$x_{imapsto}$ x_{pi}(i) under relabelling	[DEF]	Active core	$x_{iinmathcalC}$
R2-003	prec	Causal precedence	Binary relation	mathcalCtimesmathcalC	mathrmtrue,mathrmfalse	Dimensionless	Core ontology	Order-preserving under relabelling	[DEF]	Active core	x_{iprec} x_j means x_i causally precedes x_j
R2-004	mathcalE	Causal-link set	Directed edge set	Event pairs	Set of links	Cardinality	Core ontology	Relabels covariantly with events	[DEF]	Active core	mathcalE=(i,j):x_{iprec} x_{jtext} and no intermediate event
R2-005	B_{ij}	Causal connectivity matrix	Matrix	mathbbC^|mathcalC|	mathbbC^|mathcalC|	Dimensionless	Core kinematics	Bmapsto P_{pi} B P_{pi}^-1	[DEF]	Active but convention unresolved	B_{ij}=1 when an admissible causal relation/link is present, otherwise 0 (exact convention must be frozen).
R2-006	Z_{ij}	Causal-order matrix	Matrix	mathbbC^|mathcalC|	mathbbC^|mathcalC|	Dimensionless	Core kinematics	Zmapsto P_{pi} ZP_{pi}^-1	[DEF]	Reserved canonical addition	Z_{ij}=1 iff x_{iprec} x_j; proposed canonical notation distinct from B.
R2-007	N	Event count	Positive integer	-	mathbbN	Count	Discrete substrate	Invariant	[DEF]	Active core	N=|mathcalC| or the number of sprinkled events in a tested interval; context must be stated.
R2-008	$N_{mathcal}$ C	Number of causal events	Positive integer	-	mathbbN	Count	Discrete substrate	Invariant	[DEF]	Canonical replacement	$N_{mathcal}$ C=|mathcal C|
R2-009	N_{rm} rec	Record count	Positive integer	-	mathbbN	Count	Quantum/ coherence	Invariant	[DEF]	Canonical replacement	Number of unity-compatible records contributing to a coherence region.
R2-010	$N_{diamond}$	Diamond count	Positive integer	-	mathbbN	Count	Causal diamonds	Invariant	[DEF]	Active effective/numerical	Number of minimal causal diamonds in a specified region or ensemble.
R2-011	d	Continuum/spacetime dimension	Integer	-	mathbb N	Dimensionless	Geometry	Invariant	[DEF]+[OPEN]	Active with unresolved origin	dinmathbb N; dimension used in volume laws, Clifford structure, and continuum limits.
R2-012	rho_{rm} spr	Sprinkling density	Positive scalar	Continuum region	mathbb R_>0	L^-d	Causal set	Scalar	[EXT]+[DEF]	Active numerical/continuum bridge	Poisson sprinkling density in a continuum region.
R2-013	V_d(tau)	Alexandrov-interval volume	Scalar function	mathbb R_{ge0}	mathbb R_{ge0}	L^d	Causal geometry	Lorentz scalar	[EXT]	Active imported bridge	d-dimensional causal interval volume as a function of proper time tau.
R2-014	tau	Proper-time separation	Nonnegative scalar	Causally related event pairs	mathbb R_{ge0}	Time/length	Causal geometry	Lorentz scalar in continuum embedding	[DEF]+[EXT]	Active	Timelike separation between interval endpoints or diamond duration.
R2-015	ell_{rm} c	Causal discreteness length	Positive scalar	-	mathbb R_>0	Length	Causal geometry	Scalar	[DEF]+[OPEN]	Active but not independently fixed	Fundamental or effective discreteness scale relating event density to continuum volume.
R2-016	I(x,y)	Causal interval	Subposet	mathcal Ctimesmathcal C	Subset of mathcal C	Count/volume	Causal geometry	Relabelling covariant	[DEF]	Active; endpoint convention unresolved	I(x,y)=z:xprec zprec y or inclusive variant, which must be specified.
R2-017	mathcal D	Causal diamond	Finite subposet / loop cell	Causal complex	Diamond object	Combinatorial	Causal diamonds	Orientation reversal changes signed quantities	[DEF]	Active	A pair of distinct causal paths with common endpoints; minimality and orientation must be stated.
R2-018	operatornameSt(e)	Link staple	Set-valued map	einmathcal E	$2^{mathcal}$ D	Count	Gauge/causal	Covariant under relabelling	[DEF]	Active but mainly historical gauge construction	Collection of irreducible link-diamonds containing link e.
R2-019	Delta v_e	Connectivity deviation	Integer or scalar	Links or nodes	mathbb R	Dimensionless	Matter/gauge	Invariant	[DEF]+[CONJ]	Historical/ conditional	Deviation of a link/node valence from a reference causal connectivity.

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R2-020	mathcal H_i	Local record Hilbert space	Finite-dimensional complex Hilbert space	$x_{iinmathcal}$ C	Hilbert space	Dimension = m_i	Core kinematics	mathcal H_{ito} $g_{imathcal}$ H_i	[DEF]	Active core	Internal state space attached to event x_i.
R2-021	m_i	Local internal dimension	Positive integer	Events	mathbb N	Count	Core kinematics	Invariant under local frames	[DEF]	Active/open selection	m_i=dimmathcal H_i
R2-022	mathcal H	Global relational Hilbert space	Hilbert direct sum	-	Global Hilbert space	Dimension = sum of m_i	Core kinematics	mathcal Hto Gmathcal H	[DEF]	Active but must be frozen	mathcal H=$bigoplus_{imathcal}$ H_i, unless a different completed space is specified.
R2-023	psi_i	Local record state	Vector	mathcal H_i	Vector	Convention-dependent	Core kinematics	$psi_{imapsto}$ g_{ipsii}	[DEF]	Active core	$psi_{iinmathcal}$ H_i
R2-024	psi_n	Relational Dirac eigenmode	Normalized vector	mathcal H	mathcal H	Normalized	Matter/spectral	Gauge/frame covariant; spectral projectors invariant	[DEF]	Active kinematics	D_{rm} $relpsi_n$=$lambda_{npsin}$
R2-025	langlecdot,cdotrangle	Hilbert inner product	Sesquilinear form	mathcal Htimesmathcal H	mathbb C	State dependent	Core kinematics	Invariant under unitary frame changes	[DEF]	Active core	Positive Hermitian inner product on each record space and the global direct sum.
R2-026	|cdot|$_2$	Hilbert / Euclidean norm	Norm	mathcal H	mathbb R_{ge0}	Same units as vector	Core kinematics	Unitary invariant	[DEF]	Active	|psi|$_2$=sqrtlanglepsi,psirangle
R2-027	|cdot|$_F$	Frobenius norm	Matrix norm	Finite-dimensional operators	mathbb R_{ge0}	Same units as operator	Operator geometry	Unitary bi-invariant	[EXT]	Active	|A|$_F$=sqrtoperatornameTr(A^{dagger} A)
R2-028	|cdot|$_{rm}$ op	Operator norm	Norm	Bounded operators	mathbb R_{ge0}	Same units as operator	Operator geometry	Unitary invariant	[EXT]	Canonical addition	Largest singular value.
R2-029	|cdot|$_1$	Trace norm	Norm	Trace-class finite operators	mathbb R_{ge0}	Same units as operator	Operator geometry	Unitary invariant	[EXT]	Canonical addition	Sum of singular values.
R2-030	S_U[mathcal C,r]	Relational Unity functional	Real-valued functional	Configurations	mathbb R	Action-like / dimensionless unless specified	Foundations/ quantum	Invariant under admissible relabellings and local frames	[DEF]	Active axiom; dynamics unresolved	Global admissibility or cost assigned to a causal configuration and record assignment.
R2-031	Phi_U[mathcal C,r]	Unity phase	Real phase functional	Configurations	mathbb R/2pimathbb Z	Dimensionless phase	Foundations/ quantum	Gauge invariant if physical	[DEF]+[OPEN]	Active proposal	mathcal A[mathcal C,r]propto $e^{iPhi}$$_U$[mathcal C,r]
R2-032	mathcal A[mathcal C,r]	Manifestation amplitude	Complex functional	Configurations	mathbb C	Amplitude	Foundations/ quantum	Must be gauge/relabel invariant after physical quotient	[DEF]+[OPEN]	Conceptual; no complete path measure	Complex weight assigned to a relational history.
R2-033	varphi	Internal relational orientation	Circular variable	-	S^1	Angle	Quantum/ coherence	varphimapstovarphi+$varphi_0$ under global frame rotation	[DEF]	Active effective/statistical	varphiin S^1
R2-034	mu_{varphi}	Mean orientation	Circular parameter	-	S^1	Angle	Quantum/ coherence	Shifts under global frame rotation	[DEF]	Active statistical	Mean direction of the von Mises distribution.
R2-035	kappa	Coherence concentration	Nonnegative scalar	Coherence region	mathbb R_{ge0}	Dimensionless	Quantum/ coherence	Scalar	[DEF]	Active but microscopic scaling open	Concentration parameter of the unity-conditioned von Mises distribution.
R2-036	p_{kappa}(varphi)	Von Mises coherence distribution	Probability density	S^1	mathbb R_{ge0}	Inverse angle / normalized	Quantum/ coherence	Covariant under common angle shifts	[THM]+[EXT]	Active conditional statistical result	p_{kappa}(varphi)=$e^{kappacos}$(varphi-mu_{varphi})/(2pi I_0(kappa))
R2-037	Z_{kappa}	Von Mises partition function	Positive scalar	mathbb R_{ge0}	mathbb R_>0	Dimensionless	Quantum/ coherence	Invariant	[THM]+[EXT]	Active	Z_{kappa}=2pi I_0(kappa)
R2-038	I_n(kappa)	Modified Bessel function	Special function	mathbb R_{ge0}	mathbb R_{ge0}	Dimensionless	Quantum/ coherence	Invariant	[EXT]	Active imported mathematics	Modified Bessel function of the first kind.
R2-039	mathcal R_{rm} coh	Mean resultant length	Scalar order parameter	Probability measures on S1	[0,1]	Dimensionless	Quantum/ coherence	Rotation invariant	[THM]+[EXT]	Canonical replacement	mathcal R_{rm} coh=|langle $e^{ivarphirangle}$|=I_1(kappa)/I_0(kappa)
R2-040	eta(kappa)	Visibility factor	Scalar function	mathbb R_{ge0}	[0,1)	Dimensionless	Quantum/ coherence	Invariant	[THM]+[CON]	Active conditional	eta(kappa)=I_1(kappa)/I_0(kappa)
R2-041	P(a,bmid x,y)	Bipartite outcome law	Conditional probability	Outcome and setting spaces	[0,1]	Dimensionless	Quantum	Physical probabilities invariant under gauge redundancy	[OPEN]	Missing foundational object	Probability of outcomes a,b for settings x,y.
R2-042	E_{rm} corr(x,y)	Bipartite correlator	Scalar function	Setting pairs	[-1,1]	Dimensionless	Quantum	Invariant	[OPEN]	Target; cosine law not derived	E_{rm} corr(x,y)=sum_a,bab,P(a,b|x,y)
R2-043	S_{rm} CHSH	CHSH combination	Scalar observable	Four setting pairs	[-4,4]	Dimensionless	Quantum	Invariant	[EXT]+[OPEN]	Active target	Standard four-setting CHSH linear combination of correlators.

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R2-044	varepsilon$_{rm}$ coh	Finite-coherence deficit	Nonnegative scalar	Coherence parameter	mathbb R$_{ge0}$	Dimensionless	Quantum/ coherence	Invariant	[CON]	Active conditional	varepsilon$_{rm}$ coh=1-eta(kappa) or the explicitly declared Bell-visibility deficit.
R2-045	mathcal W$_{AB}$	Unity Wedge	Causal subregion	Pairs of measurement events	Subposet	Volume/count	Quantum/causal	Relabel invariant	[DEF]	Active	mathcal W$_{AB}$=J^-(A)cap J^-(B) or its discrete counterpart.
R2-046	U$_{ij}$	Link transport	Unitary linear map	mathcal H$_{j}$	mathcal H$_{i}$	Dimensionless	Gauge/transport	U$_{ijmapsto}$ g$_{iUijgj}$^-1	[DEF]	Active core kinematics	U$_{ij}$:mathcal H$_{jtomathcal}$ H$_{i}$
R2-047	g$_{i}$	Local frame transformation	Group element	mathcal H$_{i}$	mathcal H$_{i}$	Dimensionless	Gauge/transport	Acts locally on states and transports	[DEF]	Active; physical group selection open	g$_{iin}$ G$_{isubseteq}$ U(m$_{i}$)
R2-048	G$_{rm}$ frame	Permitted local frame group	Lie group	-	Group	Dimensionless	Gauge/transport	Defines gauge redundancy	[DEF]+[OPEN]	Must be frozen	Largest group preserving the local inner product and declared primitive structures.
R2-049	U[gamma]	Path transport	Ordered product	Directed causal path	Linear map between endpoint spaces	Dimensionless	Gauge/transport	U[gamma]mapsto g$_{rm}$ startU[gamma]g$_{rm}$ end^-1	[DEF]	Active	U[gamma]=U$_{i0i1cdots}$ U$_{in}$-1i$_{n}$
R2-050	U$_{diamond}$	Diamond path-pair holonomy	Group element	Diamond	Endpoint endomorphism	Dimensionless	Gauge/diamonds	U$_{diamondmapsto}$ g,U$_{diamond}$ g^-1	[DEF]	Active	Relative transport around the two paths of a causal diamond.
R2-051	W$_{diamond}$	Diamond Wilson observable	Gauge-invariant scalar	Diamond holonomy	mathbb R	Dimensionless	Gauge/diamonds	Conjugation invariant	[DEF]	Active; formula must be frozen	W$_{diamond}$=operatornameReTr(mathbf 1-U$_{diamond}$) or the exact declared trace functional.
R2-052	S$_{W}$	Diamond-Wilson action	Real functional	Link transports / diamonds	mathbb R	Action	Gauge/diamonds	Gauge and relabelling invariant	[DEF]+[CON]	Active effective; unsourced in XVI	S$_{W}$=sum$_{diamondwdiamond}$ W$_{diamond}$
R2-053	A$_{mu}$	Continuum gauge potential	Lie-algebra-valued one-form	Continuum tangent bundle	mathfrak g	L^-1	Gauge continuum	A$_{mumapsto}$ gA$_{mu}$ g^-1-(partial$_{mu}$ g)g^-1	[EXT]+[OPEN]	Conditional continuum object	Continuum connection obtained conditionally from link transports.
R2-054	F$_{munu}$	Continuum gauge curvature	Lie-algebra-valued two-form	Continuum spacetime	mathfrak g	L^-2	Gauge continuum	F$_{munumapsto}$ gF$_{munug}$^-1	[EXT]+[OPEN]	Conditional imported continuum limit	F$_{munu}$=partial$_{mu}$ A$_{nu}$-partial$_{nu}$ A$_{mu}$+[A$_{mu}$,A$_{nu}$]
R2-055	g$_{rm}$ YM	Gauge coupling	Positive scalar	-	mathbb R_>0	Dimension depends on spacetime dimension	Gauge continuum	Invariant	[OPEN]	Not selected by present core	Continuum Yang-Mills coupling appearing after trace normalization and scaling.
R2-056	beta$_{W}$	Inverse Wilson coupling	Positive scalar	-	mathbb R_>0	Action-dependent	Gauge/diamonds	Invariant	[DEF]+[OPEN]	Not canonically fixed	Coefficient multiplying the discrete Wilson action.
R2-057	D$_{rm}$ rel	Relational Dirac operator	Linear operator	mathcal H	mathcal H	L^-1 or chosen lattice units	Matter/spectral	D$_{rm}$ relmapsto G D$_{rm}$ relG^-1	[DEF]	Active kinematic framework	Discrete Dirac-type operator on the global relational state space, built from causal links, weights, Clifford elements, and transport.
R2-058	w$_{ij}$	Dirac link weight	Scalar coefficient	Links	mathbb R or mathbb C	L^-1	Matter/spectral	Scalar under local frames	[DEF]+[OPEN]	Active but not uniquely selected	Geometric/causal weight multiplying link transport in D$_{rel}$.
R2-059	gamma^{mu}	Clifford generator	Matrix generator	Spinor module	Endomorphisms	Dimensionless	Matter/Clifford	Transforms in the spin representation	[EXT]+[DEF]	Active imported algebra	gamma^{mu},gamma^{nu}=2g^{munu}
R2-060	Gamma$_{ij}$	Spin/record transport matrix	Linear map	mathcal H$_{j}$	mathcal H$_{i}$	Dimensionless	Matter/spectral	Gamma$_{ijmapsto}$ g$_{iGammaijgj}$^-1	[DEF]	Active but overlaps U_ij	Transport factor appearing in the relational Dirac operator or gravity flux construction.
R2-061	lambda$_{n}$	Dirac eigenvalue	Scalar spectral value	Spectrum of D$_{rel}$	mathbb R or mathbb C	L^-1	Matter/spectral	Gauge invariant as a multiset	[DEF]	Active observable with interpretation limits	D$_{rm}$ relpsi$_{n}$=lambda$_{npsin}$
R2-062	mathrmIPR(psi)	Inverse participation ratio	Scalar functional	Normalized eigenvectors	[1/N,1]	Dimensionless	Spectral diagnostics	Basis dependent unless event basis is physical	[EXT]+[NUM]	Active numerical diagnostic	mathrmIPR(psi)=sum$_{i}$|psi$_{i}$|^{4} for a normalized discrete mode (precise block convention required).
R2-063	r$_{rm}$ gap	Adjacent-gap ratio	Scalar statistic	Ordered eigenvalues	[0,1]	Dimensionless	Spectral diagnostics	Spectral invariant	[EXT]+[NUM]	Active numerical diagnostic	Standard unfolded-free ratio of consecutive level spacings.
R2-064	P$_{rm}$ obs	Observational projector	Orthogonal projector	mathcal H	mathcal H	Dimensionless	Measurement/ spectral	P$_{rm}$ obsmapsto GP$_{rm}$ obsG^-1	[SUP]	Retired pending reconstruction	Projector onto an observational subspace in the superseded measurement architecture.
R2-065	Pi	Canonical projector symbol	Orthogonal projector	mathcal H	mathcal H	Dimensionless	Core operators	Pimapsto GPi G^-1	[DEF]	Canonical replacement	Pi^{2}=Pi=Pi^{dagger}

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R2-066	Pi$_{a}$	Protected-sector projector	Rank-two orthogonal projector	mathcal H	mathcal H	Dimensionless	Matter/packet	Pi$_{amapsto}$ GPi$_{aG}$^-1	[DEF]+[OPEN]	Active effective; origin must be classified	Pi$_{a}$:mathcal Htomathcal E$_{a}$,quad operatornamerankPi$_{a}$=2
R2-067	mathcal E$_{a}$	Protected rank-two sector	Two-dimensional subspace	-	Subspace of H	Dimension 2	Matter/packet	mathcal E$_{amapsto}$ Gmathcal E$_{a}$	[DEF]+[OPEN]	Active effective	mathcal E$_{a}$=operatornameimPi$_{asubsetmathcal}$ H
R2-068	mathrmchGUE	Chiral Gaussian unitary ensemble	Random-matrix ensemble	Matrix ensemble	Probability ensemble	Dimensionless	Historical spectral mechanism	Unitary invariant	[SUP]	Retired/falsified for native operator	Previously assumed universality class for D$_{rel}$.
R2-069	lambda$_{rm}$ MP^{pm}	Marchenko-Pastur edges	Scalar bounds	Aspect ratio	mathbb R	Dimensionless after normalization	Historical spectral mechanism	Invariant	[SUP]+[EXT]	Retired as native IRMT threshold	Spectral edges of a sample-covariance ensemble used in the superseded architecture.
R2-070	theta$_{rm}$ BBP	BBP spike strength	Scalar parameter	-	mathbb R	Operator units	Historical spectral mechanism	Invariant	[SUP]+[EXT]	Retired as native generation mechanism	Low-rank perturbation strength in the former generation mechanism.
R2-071	Phi^{rm} upd$_{ij}$	Informational update flux	Link-valued quantity	Links	Internal vector or scalar as specified	Model dependent	Gravity	Covariant under local frames and odd under link reversal if oriented	[DEF]+[OPEN]	Conditional/ historical gravity bridge	Synchronization/update required across causal link (i,j).
R2-072	rho$_{rm}$ rec	Record/update density	Scalar density	Causal regions	mathbb R$_{ge0}$	Energy/volume or update/causal-volume after normalization	Gravity	Scalar	[DEF]+[OPEN]	Conditional	Rate or density of relational updates needed to sustain a localized mode in a causal region.
R2-073	operatornamediv$_{mat hcal}$ C	Discrete causal divergence	Linear operator	Link fluxes	Node scalars/vectors	Flux per causal cell	Gravity	Relabel covariant	[DEF]+[EXT]	Conditional	Outgoing minus incoming oriented flux on the Hasse diagram.
R2-074	J$^{mu}{}_{rm}$ upd	Coarse-grained update current	Continuum vector field	Continuum spacetime	Tangent vectors	Energy density/flux	Gravity	Vector	[OPEN]	Conditional continuum object	Continuum current obtained from relational update flux under a declared coarse-graining map.
R2-075	T$_{munu}{}^{rm}$ eff	Effective stress-energy tensor	Symmetric rank-two tensor	Continuum spacetime	Symmetric tensors	Energy density	Gravity	Covariant tensor	[OPEN]+[EXT]	Conditional	Coarse-grained tensor constructed from update flux and mode momentum.
R2-076	G$_{munu}$	Einstein tensor	Symmetric divergence-free tensor	Continuum spacetime	Rank-two tensors	L^-2	Gravity	Covariant	[EXT]	Imported target	G$_{munu}$=R$_{munu}$-tfrac12Rg$_{munu}$
R2-077	R$_{rm}$ sc	Scalar curvature	Scalar field	Continuum spacetime	mathbb R	L^-2	Gravity	Diffeomorphism scalar	[EXT]+[OPEN]	Conditional emergent object	Ricci scalar of an emergent continuum geometry.
R2-078	g$_{munu}$	Emergent metric	Nondegenerate symmetric tensor	Continuum tangent bundle	Symmetric 2-tensors	Dimensionless in geometric units	Gravity	Diffeomorphism covariant	[OPEN]+[EXT]	Not derived from actual frozen IRMT operator	Continuum metric in a manifold-like limit.
R2-079	G$_{N}$	Newton gravitational constant	Positive scalar	-	mathbb R_>0	L^{d}-2/M or standard units	Gravity	Invariant	[OPEN]	Not securely derived	Continuum coupling between curvature and stress-energy.
R2-080	S$_{rm}$ BD	Benincasa-Dowker action	Discrete action	Causal sets	mathbb R	Action	Gravity/causal set	Relabelling invariant	[EXT]	Imported external construction	Established causal-set curvature action used in conditional gravitational embeddings.
R2-081	S$_{rm}$ EH	Einstein-Hilbert action	Continuum action	Continuum metrics	mathbb R	Action	Gravity	Diffeomorphism invariant	[EXT]	Imported target	S$_{rm}$ EHproptoint d^{dxsqrt}-g,(R$_{rm}$ sc-2Lambda)
R2-082	Lambda$_{rm}$ cos	Cosmological constant	Scalar	-	mathbb R	L^-2	Gravity/ cosmology	Invariant	[EXT]+[OPEN]	Not derived	Constant vacuum curvature term in the continuum action/equations.
R2-083	mathscr C$_{rm}$ cg	Coarse-graining map	Map between discrete and continuum observables	Discrete configurations	Continuum tensors	Normalization dependent	Gravity	Covariant if valid	[OPEN]	Must be reconstructed/c ontrolled	mathscr C$_{rm}$ cg:textdiscrete flux datato T$_{munu}{}^{rm}$ eff
R2-084	a(t)	Cosmological scale factor	Positive function	Cosmic time or ordering parameter	mathbb R_>0	Dimensionless	Cosmology	Scalar under spatial symmetries	[CON]+[OPEN]	Active conceptual framework	Coarse-grained relational separation scale in the cosmological model.
R2-085	H$_{rm}$ cos(t)	Hubble rate	Scalar function	Cosmic time	mathbb R	T^-1	Cosmology	Scalar	[EXT]+[CON]	Conditional	H$_{rm}$ cos=dot a/a

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R2-086	d_{rm} rel(x_i,x_j)	Relational separation	Distance-like scalar	Event pairs on antichain	mathbb R_{ge0}	Dimensionless or length after calibration	Cosmology	Permutation invariant	[CON]+[OPEN]	Conceptual	Coarse-grained separation of events on a cosmological antichain from connectivity statistics.
R2-087	Omega$_m$	Matter density parameter	Dimensionless scalar	-	[0,1]	Dimensionless	Cosmology	Invariant	[EXT]	External	Standard cosmological matter density fraction used as external/input parameter.
R2-088	w(z)	Dark-energy equation-of-state function	Scalar function	Redshift	mathbb R	Dimensionless	Cosmology	Scalar	[EXT]+[NUM]	Tested route; simple IRMT running failed	Ratio of effective pressure to density as a function of redshift.
R2-089	C_{ell}^{XY}	CMB angular power spectrum	Sequence of scalars	ellinmathbb N	mathbb R_{ge0}	Temperature-squared or channel units	CMB	Rotationally invariant	[EXT]	External observable	Angular power spectrum for channels X,Y in T,E.
R2-090	F_{ell}	Locked finite-coherence kernel	Multiplicative sequence	ellge2	mathbb R	Dimensionless	CMB	Rotationally invariant	[CON]+[NUM]	Active bounded phenomenology ; not microscopic	F_{ell}=1-alpha$_{rm}$ CMBexp[-(ell-2)/L_H] (or exact frozen convention).
R2-091	alpha$_{rm}$ CMB	CMB kernel amplitude	Dimensionless scalar	-	mathbb R	Dimensionless	CMB	Invariant	[NUM]+[CON]	Calibrated in C1	Amplitude of the locked low-ell finite-coherence kernel.
R2-092	L_H	CMB coherence multipole scale	Positive scalar	-	mathbb R_>0	Multipole	CMB	Invariant	[NUM]+[CON]	Calibrated in C1	E-folding scale of the locked kernel in multipole space.
R2-093	C(theta)	CMB angular correlation function	Scalar function	thetain[0,pi]	mathbb R	Temperature-squared	CMB	Rotationally invariant	[EXT]	External observable	Real-space temperature two-point correlation at angular separation theta.
R2-094	S_1/2	Large-angle CMB statistic	Nonnegative scalar	CMB map or spectrum	mathbb R_{ge0}	Temperature^4	CMB	Rotationally invariant in full sky; estimator-dependent under masks	[EXT]+[NUM]	Active bounded empirical target	S_1/2=int_-1^1/2[C(theta)]^2,d(costheta)
R2-095	f_{rm} sky	Observed sky fraction	Scalar	Map/mask	[0,1]	Dimensionless	CMB	Invariant under map rotations only for symmetric masks	[EXT]+[NUM]	Active analysis variable	Fraction of sky retained after masking.
R2-096	N_{rm} MC	Monte Carlo realization count	Positive integer	-	mathbb N	Count	Numerics/CMB	Invariant	[NUM]	Active numerical metadata	Number of simulated realizations in an ensemble.
R2-097	m_a^(ell)	Charged-lepton mass	Positive scalar	Flavor index	mathbb R_>0	Mass/energy	Charged leptons	Observable scalar	[EXT]	External comparison datum	aine,mu,tau
R2-098	x_a	Square-root mass coordinate	Positive scalar	Flavor index	mathbb R_>0	M^1/2	Koide geometry	Permutes under flavor relabelling	[DEF]	Active effective geometry	x_a=sqrtm_a^(ell)
R2-099	mathbf x	Square-root mass vector	Vector in R3	-	mathbb R^3	M^1/2	Koide geometry	Transforms under flavor permutations	[DEF]	Active effective	mathbf x=(x_1,x_2,x_3)
R2-100	mathbf u	Democratic unit vector	Unit vector	-	mathbb R^3	Dimensionless	Koide geometry	Invariant under S3 permutations	[DEF]+[THM]	Active	mathbf u=(1,1,1)/sqrt3
R2-101	mathbf $x_{parallel}$	Democratic component	Vector projection	mathbb R^3	operatornamespanmathbf u	M^1/2	Koide geometry	Permutation singlet	[DEF]	Active	mathbf $x_{parallel}$=(mathbf xcdotmathbf u)mathbf u
R2-102	mathbf x_{perp}	Transverse flavor component	Vector projection	mathbb R^3	mathbf u^{perp}	M^1/2	Koide geometry	Transforms in the two-dimensional S3 representation	[DEF]	Active	mathbf x_{perp}=mathbf x-mathbf $x_{parallel}$
R2-103	K	Koide hierarchy ratio	Dimensionless scalar	Positive triplets	[1/3,1]	Dimensionless	Koide geometry	Permutation invariant	[DEF]+[EXT]	Active	K=fracsum$_a$ m_a(sum$_{asqrtma}$)^2=frac|mathbf x|^2(mathbf 1cdotmathbf x)^2
R2-104	phi$_{ell}$	Koide flavor azimuth	Angle	Koide circle	S^1	Angle	Koide geometry	Transforms under D3/S3 actions	[DEF]+[CON]	Active effective; microscopic selection conditional	Azimuth of the square-root mass vector on the Koide circle.
R2-105	r_K^{rm} amp	Koide transverse-to-democratic amplitude ratio	Nonnegative scalar	Positive triplets	mathbb R_{ge0}	Dimensionless	Koide geometry	Permutation invariant	[DEF]+[THM]	Needs convention reconciliation	r_K^{rm} amp=|mathbf x_{perp}|/|mathbf $x_{parallel}$|; equals 1 at squared-norm equipartition under the geometric decomposition, while older circular parametrizations may use a different r.
R2-106	Phi$_{rm}$ sub	Substrate field/operator	Linear operator	mathcal H	mathcal H	Operator/energy units	Projected matter	Phi$_{rm}$ submapsto GPhi$_{rm}$ subG^-1	[DEF]+[OPEN]	Active effective; microscopic dynamics incomplete	Substrate-native field projected into protected sectors to form mass-like operators.

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R2-107	M	Projected relational operator	Finite operator/matrix	Protected subspace	Protected subspace	Same units as Phi_{sub}	Projected matter	Mmapsto V M V^{dagger} within the protected basis	[DEF]+[NUM]	Active effective	M=$PiPhi_{rm}$ subPi,quad M_{ab}=$langlepsi_a$| Phi_{rm} sub|$psi_{brangle}$
R2-108	$sigma_a$	Singular values of projected operator	Ordered nonnegative scalars	Projected operator	mathbb R_{ge0}^3	Same units as M	Projected matter	Unitary invariant	[DEF]+[NUM]	Active	$sigma_{1gesigma2gesigma3ge0}$ are singular values of M or M_{wedge}.
R2-109	p_a	Normalized singular-amplitude shares	Probability-simplex coordinates	Nonzero singular triplets	[0,1],sum p_a=1	Dimensionless	Projected matter	Permutation covariant	[DEF]	Active	p_a=$sigma_a$/$sum_{bsigmab}$
R2-110	R_{rm} rank	Rank concentration	Dimensionless scalar	Nonzero projected operators	[1/3,1]	Dimensionless	Projected matter	Unitary invariant after ordering	[DEF]+[NUM]	Active strongest numerical mechanism	R_{rm} rank=$sigma_1$/($sigma_1$+$sigma_2$+$sigma_3$) =p_1
R2-111	R_K	Koide rank crossing	Dimensionless scalar	-	(1/3,1)	Dimensionless	Projected matter	Invariant	[THM]	Active exact within closed trajectory	R_K=(1+sqrt2)/3 on the pair-symmetric trajectory.
R2-112	q	Effective entropy-brake strength	Positive scalar	Packet state	mathbb R_>0	Dimensionless	Packet dynamics	Scalar	[CON]	Active effective	Coefficient multiplying the support-maintenance response in the reduced stabilization flow.
R2-113	q_K	Koide fixed-point coefficient	Positive scalar	-	mathbb R_>0	Dimensionless	Packet dynamics	Invariant	[CON]+[THM]	Active constitutive/matched coefficient	q_K=1/R_K=3(sqrt2-1)
R2-114	h	Subordinate support response	Scalar state variable	Packet trajectory	mathbb R	Dimensionless	Packet dynamics	Scalar under residual pair exchange	[CON]+[NUM]	Active effective	Effective response maintaining subordinate packet support; h_*=1 at the normalized equilibrium.
R2-115	H_{rm} supp	Support generator/operator	Hermitian operator or response vector	Flavor/determinant space	Hermitian endomorphism or coordinate vector	Dimensionless after normalization	Packet/holonomy	Transforms covariantly under line-bundle gauge transformations	[CON]	Active constitutive object	Representation of the stabilized support responses on the determinant-line bundle.
R2-116	S_{rm} coll	Rank-collapse functional	Scalar functional	Projected operators / simplex	mathbb R	Action/flow units	Packet dynamics	Invariant under declared packet symmetries	[CON]+[NUM]	Active effective; not a frozen fundamental action	Effective functional whose gradient increases rank concentration.
R2-117	S_{rm} ent	Deficit-gated entropy/support functional	Scalar functional	Packet simplex	mathbb R	Action/flow units	Packet dynamics	Permutation or pair-exchange invariant as declared	[CON]+[NUM]	Active effective	Effective support-maintenance functional activated by subordinate-support deficit.
R2-118	t_{rm} flow	Relaxation-flow parameter	Real parameter	-	mathbb R	Algorithmic time	Packet dynamics	Reparameterizes under changes of flow speed	[DEF]	Active; must not be called physical time without derivation	Parameter along optimization/relaxation flow; not automatically physical time.
R2-119	k_{tau}	Proper-time weight exponent	Real exponent	-	mathbb R	Dimensionless	Minimal-diamond response	Invariant	[THM]+[CON]	Active within adopted continuum observable	Exponent k in the weighted causal-diamond proper-time factor; selected as k_{tau}=2 by asymptotic scaling within the construction.
R2-120	r_{rm} ren	Renormalization power	Real exponent	-	mathbb R	Dimensionless	Minimal-diamond response	Invariant	[THM]+[CON]	Active within construction	Power r in the event-density or sample-size renormalization; selected as r_{rm} ren=1/2 within the continuum scaling construction.
R2-121	K_{rm} tr(N;k_{tau},r_{rm} ren)	Renormalized diamond trace estimator	Scalar estimator	Causal-set samples	mathbb R	Dimensionless after renormalization	Minimal-diamond response	Gauge invariant if built from traced holonomies	[DEF]+[NUM]	Active	Finite-density weighted trace observable approaching the continuum coefficient xi6.
R2-122	xi_6	Six-bivector continuum coefficient	Positive scalar	-	mathbb R_>0	Dimensionless in adopted normalization	Minimal-diamond response	Invariant	[THM]	Active exact within adopted continuum construction	xi_6=51/(1400sqrtpi)
R2-123	xi_3	Protected-triplet susceptibility	Positive scalar	-	mathbb R_>0	Dimensionless	Minimal-diamond response	Invariant	[THM]+[CON]	Active within sector decomposition	xi_3=xi_6/2
R2-124	$beta_{rm}$ pkt	Packet normalization coefficient	Positive scalar	-	mathbb R_>0	Normalization dependent	Charged-lepton scale	Invariant	[CON]	Active effective/externally anchored	Coefficient relating continuum diamond response to the finite packet amplitude.
R2-125	A_{rm} pkt	Dimensionless packet amplitude	Positive scalar	-	mathbb R_>0	Dimensionless	Charged-lepton scale	Invariant	[CON]	Active effective	A_{rm} pkt=$beta_{rm}$ pktxi_6

ID	Symbol	Name	Type	Domain	Codomain / range	Units	Sector	Transformation	Evidence	Lifecycle	Definition
R2-126	alpha$_{D}$	Diamond normalization coefficient	Positive scalar	-	mathbb R_>0	Dimensionless	Charged-lepton scale	Invariant	[THM]+[CON]	Active within construction	alpha$_{D}$=3/(pi A$_{rm}$ pkt) in the adopted construction.
R2-127	E$_{rm}$ pkt	Packet energy scale	Positive scalar	-	mathbb R_>0	Energy	Charged-lepton scale	Invariant	[CON]	Active effective; electroweak input external	Predicted common charged-lepton packet energy before flavor splitting and corrections.
R2-128	v$_{rm}$ EW	Electroweak scale	External scalar	-	mathbb R_>0	Energy	Charged-lepton scale	Invariant	[EXT]	External input	Standard Model electroweak scale used as an input to the packet-energy construction.
R2-129	Lambda^{2mathcal} H	Exterior-square state space	Hilbert/exterior-power space	-	Exterior-square space	Dimension choose(dim H,2)	Exterior-square geometry	Induced representation of G$_{frame}$	[EXT]+[DEF]	Active	Second exterior power of the global relational state space.
R2-130	Lambda$^{2Phi}{}_{rm}$ sub	Induced exterior-square operator	Linear operator	Lambda^{2mathcal} H	Lambda^{2mathcal} H	Quadratic in Phi eigen/singular scales	Exterior-square geometry	Lambda^{2}(GPhi G^-1)=(Lambda^{2G})(Lambda^{2Phi})(Lambda^{2G})^-1	[THM]+[DEF]	Active	Lambda$^{2Phi}{}_{rm}$ sub:Lambda^{2mathcal} HtoLambda^{2mathcal} H
R2-131	L$_{a}$	Determinant line	One-dimensional complex vector space	Protected rank-two sector	Complex line	Dimension 1	Exterior-square geometry	L$_{amapsto}$(det g$_{a}$)L$_{a}$	[THM]+[DEF]	Active exact geometry	L$_{a}$=Lambda^{2mathcal} E$_{a}$
R2-132	mathcal F	Determinant-line flavor bundle	Direct-sum vector bundle	Parameter/configuration space	Rank-three complex bundle	Rank 3	Exterior-square geometry	Permuted by S3/D3 and acted on by line phases	[THM]+[DEF]	Active exact construction	mathcal F=L$_{1oplus}$ L$_{2oplus}$ L$_{3}$
R2-133	Pi$_{mathcal}$ F	Flavor-bundle projector	Orthogonal projector	Lambda^{2mathcal} H	mathcal F	Dimensionless	Exterior-square geometry	Covariant	[DEF]	Active	Projector from Lambda2 H onto the three determinant lines.
R2-134	M$_{wedge}$	Exterior-square projected flavor operator	3x3 operator	mathcal F	mathcal F	Quadratic field units	Exterior-square geometry	M$_{wedgemapsto}$ V M$_{wedge}$ V^{dagger}	[DEF]+[THM]	Active effective geometry	M$_{wedge}$=Pi$_{mathcal}$ F(Lambda$^{2Phi}{}_{rm}$ sub)Pi$_{mathcal}$ F
R2-135	Omega$_{a}{}^{rm}$ basis	Normalized determinant-line basis state	Unit vector	-	L$_{a}$	Dimensionless	Exterior-square geometry	Omega$_{a}{}^{rm}$ basismapsto e$^{ichi}{}_{aOmegaa}{}^{rm}$ basis	[DEF]	Canonical clarification	Normalized generator of the one-dimensional line L$_{a}$.
R2-136	omega$_{a}$	Determinant-line connection	U(1) connection one-form	Parameter space	imathbb R	Inverse parameter	Holonomy	omega$_{amapstoomegaa}$+dchi$_{a}$	[THM]+[CON]	Geometrically available; physical source conditional	Connection induced on L$_{a}$ by variation/transport of the protected sector.
R2-137	Theta$_{a}$	Finite determinant-line phase	Angle/holonomy coordinate	Closed paths	S^{1}	Angle	Holonomy	Gauge invariant modulo 2pi for closed paths	[THM]+[CON]	Active effective	operatornameHol(L$_{a}$)=e$^{iTheta}{}_{a}$
R2-138	Omega$_{rm}$ DW	Signed central Diamond-Wilson curvature	Real curvature coordinate	Diamond/packet deformation space	mathbb R	Dimensionless or area-normalized curvature	Holonomy/ microscopic audit	Gauge invariant; odd under causal orientation reversal	[NUM]+[DEF]	Active positive local geometry; universal map fails	Orientation-sensitive central curvature variable extracted from Diamond-Wilson transport.
R2-139	J$_{Omega}$	Determinant-line current	Hermitian line-bundle source	Determinant-line response space	Hermitian endomorphisms of F	Model dependent	Holonomy/ microscopic audit	Gauge covariant and orientation sensitive	[OPEN]+[CON]	Constitutive endpoint	Current/source entering determinant-line connection dynamics.
R2-140	J$_{Omega}$=Omega$_{rm}$ DWH$_{rm}$ supp	Response-to-connection law	Constitutive operator equation	Packet and curvature variables	Line-bundle current	Model dependent	Holonomy/ microscopic audit	Gauge covariant; odd in orientation	[CON]	Active constitutive, not microscopic theorem	Identifies signed central curvature with additive determinant-line support coordinates.
R2-141	Pi$_{D}$	Common/determinant-channel projector	Projector	Three-line response space	Same space	Dimensionless	Representation audit	Invariant under permutations	[DEF]+[THM]	Active audit notation	Projector onto the common determinant/singlet channel of the three-line response space.
R2-142	Pi$_{S}$	Relative/subordinate-channel projector	Projector	Three-line response space	Same space	Dimensionless	Representation audit	Covariant under permutation/root representation	[DEF]+[THM]	Active audit notation	Projector onto the relative two-dimensional line-splitting channel.
R2-143	a$_{D}$,b$_{S}$	Allowed constitutive coefficients	Real scalars	-	mathbb R^{2}	Normalization dependent	Representation audit	Invariant	[OPEN]+[THM]	Expose non-uniqueness	Coefficients in J$_{Omega}$=Omega$_{rm}$ DW(a$_{DPiD}$+b$_{SPiS}$)
R2-144	mathcal W$_{rm}$ mix	Mixed-wedge sector	Subspace	Lambda^{2mathcal} H	Subspace	Dimension model dependent	Exterior-square geometry	Transforms in mixed exterior-square representations	[DEF]+[THM]	Active obstruction	Exterior-square components not contained in the three protected determinant lines.
R2-145	Delta G$_{rm}$ mix	Mixed-sector metric correction	Symmetric bilinear correction	Line response space	Symmetric matrices	Coupling squared / normalized	Representation audit	Permutation covariant	[THM]+[NUM]	Active no-go result	Correction to the determinant-line response metric generated by coupling to mixed wedges.
R2-146	epsilon$_{rm}$ mix	Mixed-wedge coupling	Real scalar	-	mathbb R	Model dependent	Representation audit	Invariant	[DEF]+[OPEN]	Active audit control	Finite coupling between determinant-line and mixed exterior-square sectors.

ID	Symbol	Name	Type	Domain	Codomain / range	Units	Sector	Transformation	Evidence	Lifecycle	Definition
R2-147	Delta$_{rm}$ gap	Protection/decoupling gap	Nonnegative scalar	Coupled sector operator	mathbb R_{ge0}	Operator/energy units	Representation audit	Invariant	[OPEN]+[NUM]	Required hierarchy not generated by tested packets	Spectral or dynamical separation required to suppress mixed-sector corrections.
R2-148	S_3	Three-object permutation group	Finite group	Three labels	Group actions	Dimensionless	Flavor symmetry	Permutes components	[EXT]+[DEF]	Active	Permutation symmetry acting on triplet components/sectors.
R2-149	D_3	Dihedral flavor symmetry	Finite group	Flavor plane	Group actions	Dimensionless	Flavor symmetry	Orthogonal action on transverse plane	[EXT]+[CON]	Active effective	Cyclic permutations and reflections acting on the Koide flavor plane.
R2-150	delta$_c$	Phase-locking coefficient/exponent	Dimensionless scalar	-	mathbb R	Dimensionless	Flavor phase	Invariant	[CON]+[THM]	Active within effective invariant	delta$_c$=2/3 in the selected minimal oriented invariant (exact role must be frozen).
R2-151	mathcal I_{D3}	Oriented D3 invariant	Scalar functional	Determinant-line phases	mathbb R or S^1	Dimensionless	Flavor phase	D3 invariant or pseudoscalar under orientation as declared	[CON]	Active effective	Lowest oriented permutation/reflection-covariant invariant used to select the flavor azimuth.
R2-152	phi_*	Stationary flavor azimuth	Angle	Flavor circle	S^1	Angle	Flavor phase	Transforms under discrete flavor symmetries	[THM]+[CON]	Active conditional	Stationary point of the selected oriented invariant on the Koide circle.
R2-153	kappa$_c$	Critical coherence threshold	Positive scalar	-	mathbb R_>0	Dimensionless	Measurement	Invariant	[SUP]	Retired pending new derivation	Threshold claimed from Marchenko-Pastur/BBP structure in Paper VI.
R2-154	kappa$_{rm}$ dyn	Dynamical coherence parameter	Scalar	System state	mathbb R_{ge0}	Dimensionless	Measurement	Scalar	[SUP]	Retired pending reconstruction	Time-/state-dependent coherence compared with kappa$_c$ in the former measurement model.
R2-155	Delta$_U$	Unitarity defect	Nonnegative scalar/operator norm	Evolution map	mathbb R_{ge0}	Dimensionless	Measurement	Gauge invariant if norm based	[SUP]+[OPEN]	Concept may be reused but theorem is retired	Proposed measure of norm/transport failure under uncontrolled phase dispersion.
R2-156	tau$_{rm}$ sup	Maximum superposition time	Positive scalar	System parameters	mathbb R_>0	Time	Measurement	Scalar	[SUP]	Retired	Former predicted upper time for maintaining superposition.
R2-157	s	Random seed	Integer metadata	-	mathbb Z	Dimensionless	Numerics	Not physical	[NUM]	Active metadata	Pseudo-random generator seed for an experimental run.
R2-158	s_a^{rm} amp	Signed Koide/packet amplitude	Real scalar	Flavor index	mathbb R	Square-root mass units or dimensionless after scaling	Koide/packet	Permutes with flavor	[DEF]	Historical/ effective; root convention must be explicit	Signed amplitude whose square gives a nonnegative mass-like component in Paper VIII notation.
R2-159	rho$_{rm}$ corr	Sample correlation coefficient	Scalar statistic	Paired samples	[-1,1]	Dimensionless	Numerics	Invariant under affine rescaling for Pearson except sign	[EXT]+[NUM]	Active diagnostic	Pearson/Spearman correlation used to compare diagnostics in an ensemble.
R2-160	Delta K	Koide deviation	Scalar residual	Triplets	mathbb R	Dimensionless	Numerics/packet	Invariant	[DEF]+[NUM]	Active numerical diagnostic	Delta K=K-2/3 or |Delta K| as explicitly stated.
R2-161	epsilon$_{rm}$ tol	Numerical tolerance	Positive scalar	-	mathbb R_>0	Units of tested quantity	Numerics	Not physical	[NUM]	Active metadata	Declared threshold for convergence, equality, or pass/fail tests.
R2-162	mathbb E_{rm} ens	Ensemble expectation	Expectation operator	Random variables	mathbb R or mathbb C	Same units as variable	Numerics/ statistics	Invariant	[EXT]+[NUM]	Canonical addition	Average over a declared random causal-set/transport/seed ensemble.
R2-163	operatornamemed$_{rm}$ ens	Ensemble median	Statistic	Random samples	mathbb R	Same units as variable	Numerics/ statistics	Invariant under monotone transformations	[EXT]+[NUM]	Active numerical statistic	Median over a declared ensemble.

Appendix B - Dimensional Analysis

Dimensional entries are preserved exactly as recorded. “Dimensionless in lattice units,” “action dependent,” or “model dependent” is not silently promoted to a physical SI or natural-unit dimension. The Core Specification has not yet frozen a single universal unit convention for all sectors.

B.1 Fields, operators, observables, and geometric objects

ID	Symbol	Name	Type	Recorded dimension / units	Dimension status	Defining relation	Audit note
R2-001	mathcalC	Causal event set	Locally finite partially ordered set	Cardinality	Declared dimensional quantity	mathcalC=x_i, with causal order prec	
R2-002	x_i	Relational event	Element of a poset	Dimensionless label	Dimensionless or counting unit	$x_{iinmathcalC}$	
R2-003	prec	Causal precedence	Binary relation	Dimensionless	Dimensionless or counting unit	x_{iprec} x_j means x_i causally precedes x_j	
R2-004	mathcalE	Causal-link set	Directed edge set	Cardinality	Declared dimensional quantity	mathcalE=(i,j):x_{iprec} x_{jtext} and no intermediate event	
R2-005	B_{ij}	Causal connectivity matrix	Matrix	Dimensionless	Dimensionless or counting unit	B_{ij}=1 when an admissible causal relation/link is present, otherwise 0 (exact convention must be frozen).	
R2-006	Z_{ij}	Causal-order matrix	Matrix	Dimensionless	Dimensionless or counting unit	Z_{ij}=1 iff x_{iprec} x_j; proposed canonical notation distinct from B.	
R2-007	N	Event count	Positive integer	Count	Dimensionless or counting unit	N=$\vert$mathcalC$\vert$ or the number of sprinkled events in a tested interval; context must be stated.	
R2-008	$N_{mathcal}$ C	Number of causal events	Positive integer	Count	Dimensionless or counting unit	$N_{mathcal}$ C=$\vert$mathcal C$\vert$	
R2-009	N_{rm} rec	Record count	Positive integer	Count	Dimensionless or counting unit	Number of unity-compatible records contributing to a coherence region.	
R2-010	$N_{diamond}$	Diamond count	Positive integer	Count	Dimensionless or counting unit	Number of minimal causal diamonds in a specified region or ensemble.	
R2-011	d	Continuum/spacetime dimension	Integer	Dimensionless	Dimensionless or counting unit	dinmathbb N; dimension used in volume laws, Clifford structure, and continuum limits.	
R2-012	rho_{rm} spr	Sprinkling density	Positive scalar	L^-d	Declared dimensional quantity	Poisson sprinkling density in a continuum region.	
R2-013	V_d(tau)	Alexandrov-interval volume	Scalar function	L^d	Declared dimensional quantity	d-dimensional causal interval volume as a function of proper time tau.	
R2-014	tau	Proper-time separation	Nonnegative scalar	Time/length	Declared dimensional quantity	Timelike separation between interval endpoints or diamond duration.	
R2-015	ell_{rm} c	Causal discreteness length	Positive scalar	Length	Declared dimensional quantity	Fundamental or effective discreteness scale relating event density to continuum volume.	
R2-016	I(x,y)	Causal interval	Subposet	Count/volume	Declared dimensional quantity	I(x,y)=z:xprec zprec y or inclusive variant, which must be specified.	
R2-017	mathcal D	Causal diamond	Finite subposet / loop cell	Combinatorial	Declared dimensional quantity	A pair of distinct causal paths with common endpoints; minimality and orientation must be stated.	
R2-018	operatornameSt(e)	Link staple	Set-valued map	Count	Dimensionless or counting unit	Collection of irreducible link-diamonds containing link e.	
R2-019	Delta v_e	Connectivity deviation	Integer or scalar	Dimensionless	Dimensionless or counting unit	Deviation of a link/node valence from a reference causal connectivity.	
R2-020	mathcal H_i	Local record Hilbert space	Finite-dimensional complex Hilbert space	Dimension = m_i	Declared dimensional quantity	Internal state space attached to event x_i.	
R2-021	m_i	Local internal dimension	Positive integer	Count	Dimensionless or counting unit	m_i=dimmathcal H_i	

ID	Symbol	Name	Type	Recorded dimension / units	Dimension status	Defining relation	Audit note
R2-022	mathcal H	Global relational Hilbert space	Hilbert direct sum	Dimension = sum of m$_i$	Declared dimensional quantity	mathcal H=bigoplus$_{\text{imathcal}}$ H$_i$, unless a different completed space is specified.	
R2-023	psi$_i$	Local record state	Vector	Convention-dependent	Convention / model dependent	psi$_{\text{iinmathcal}}$ H$_i$	
R2-024	psi$_n$	Relational Dirac eigenmode	Normalized vector	Normalized	Declared dimensional quantity	D$_{\text{rm}}$ relpsi$_n$=lambda$_{\text{npsin}}$	
R2-025	langlecdot,cdotrangle	Hilbert inner product	Sesquilinear form	State dependent	Declared dimensional quantity	Positive Hermitian inner product on each record space and the global direct sum.	
R2-026	|cdot|$_2$	Hilbert / Euclidean norm	Norm	Same units as vector	Declared dimensional quantity	|psi|$_2$=sqrtlanglepsi,psirangle	
R2-027	|cdot|$_F$	Frobenius norm	Matrix norm	Same units as operator	Declared dimensional quantity	|A|$_F$=sqrtoperatornameTr(A$^{\text{dagger}}$ A)	
R2-028	|cdot|$_{\text{rm}}$ op	Operator norm	Norm	Same units as operator	Declared dimensional quantity	Largest singular value.	
R2-029	|cdot|$_1$	Trace norm	Norm	Same units as operator	Declared dimensional quantity	Sum of singular values.	
R2-030	S$_U$[mathcal C,r]	Relational Unity functional	Real-valued functional	Action-like / dimensionless unless specified	Dimensionless or counting unit	Global admissibility or cost assigned to a causal configuration and record assignment.	
R2-031	Phi$_U$[mathcal C,r]	Unity phase	Real phase functional	Dimensionless phase	Dimensionless or counting unit	mathcal A[mathcal C,r]propto e$^{\text{iPhi}}$$_U$[mathcal C,r]	
R2-032	mathcal A[mathcal C,r]	Manifestation amplitude	Complex functional	Amplitude	Declared dimensional quantity	Complex weight assigned to a relational history.	
R2-033	varphi	Internal relational orientation	Circular variable	Angle	Dimensionless or counting unit	varphiin S^1	
R2-034	mu$_{\text{varphi}}$	Mean orientation	Circular parameter	Angle	Dimensionless or counting unit	Mean direction of the von Mises distribution.	
R2-035	kappa	Coherence concentration	Nonnegative scalar	Dimensionless	Dimensionless or counting unit	Concentration parameter of the unity-conditioned von Mises distribution.	
R2-036	p$_{\text{kappa}}$(varphi)	Von Mises coherence distribution	Probability density	Inverse angle / normalized	Declared dimensional quantity	p$_{\text{kappa}}$(varphi)=e$^{\text{kappacos}}$(varphi-mu$_{\text{varphi}}$)/(2pi I$_0$(kappa))	
R2-037	Z$_{\text{kappa}}$	Von Mises partition function	Positive scalar	Dimensionless	Dimensionless or counting unit	Z$_{\text{kappa}}$=2pi I$_0$(kappa)	
R2-038	I$_0$(kappa)	Modified Bessel function	Special function	Dimensionless	Dimensionless or counting unit	Modified Bessel function of the first kind.	
R2-039	mathcal R$_{\text{rm}}$ coh	Mean resultant length	Scalar order parameter	Dimensionless	Dimensionless or counting unit	mathcal R$_{\text{rm}}$ coh=|langle e$^{\text{ivarphirangle}}$|=I$_1$(kappa)/I$_0$(kappa)	
R2-040	eta(kappa)	Visibility factor	Scalar function	Dimensionless	Dimensionless or counting unit	eta(kappa)=I$_1$(kappa)/I$_0$(kappa)	
R2-041	P(a,bmid x,y)	Bipartite outcome law	Conditional probability	Dimensionless	Dimensionless or counting unit	Probability of outcomes a,b for settings x,y.	
R2-042	E$_{\text{rm}}$ corr(x,y)	Bipartite correlator	Scalar function	Dimensionless	Dimensionless or counting unit	E$_{\text{rm}}$ corr(x,y)=sum$_a$,bab,P(a,b|x,y)	
R2-043	S$_{\text{rm}}$ CHSH	CHSH combination	Scalar observable	Dimensionless	Dimensionless or counting unit	Standard four-setting CHSH linear combination of correlators.	
R2-044	varepsilon$_{\text{rm}}$ coh	Finite-coherence deficit	Nonnegative scalar	Dimensionless	Dimensionless or counting unit	varepsilon$_{\text{rm}}$ coh=1-eta(kappa) or the explicitly declared Bell-visibility deficit.	
R2-045	mathcal W$_{AB}$	Unity Wedge	Causal subregion	Volume/count	Declared dimensional quantity	mathcal W$_{AB}$=J^-(A)cap J^-(B) or its discrete counterpart.	
R2-046	U$_{ij}$	Link transport	Unitary linear map	Dimensionless	Dimensionless or counting unit	U$_{ij}$:mathcal H$_{\text{jtomathcal}}$ H$_i$	
R2-047	g$_i$	Local frame transformation	Group element	Dimensionless	Dimensionless or counting unit	g$_{\text{iin}}$ G$_{\text{isubseteq}}$ U(m$_i$)	

ID	Symbol	Name	Type	Recorded dimension / units	Dimension status	Defining relation	Audit note
R2-048	G_{rm} frame	Permitted local frame group	Lie group	Dimensionless	Dimensionless or counting unit	Largest group preserving the local inner product and declared primitive structures.	
R2-049	U[gamma]	Path transport	Ordered product	Dimensionless	Dimensionless or counting unit	U[gamma]=$U_{i0i1cdots}$ U_{in}-1i_{n}	
R2-050	$U_{diamond}$	Diamond path-pair holonomy	Group element	Dimensionless	Dimensionless or counting unit	Relative transport around the two paths of a causal diamond.	
R2-051	$W_{diamond}$	Diamond Wilson observable	Gauge-invariant scalar	Dimensionless	Dimensionless or counting unit	$W_{diamond}$=operatornameReTr(mathbf 1-$U_{diamond}$) or the exact declared trace functional.	
R2-052	S_{W}	Diamond-Wilson action	Real functional	Action	Declared dimensional quantity	S_{W}=$sum_{diamondwdiamond}$ $W_{diamond}$	
R2-053	A_{mu}	Continuum gauge potential	Lie-algebra-valued one-form	L^-1	Declared dimensional quantity	Continuum connection obtained conditionally from link transports.	
R2-054	F_{munu}	Continuum gauge curvature	Lie-algebra-valued two-form	L^-2	Declared dimensional quantity	F_{munu}=$partial_{mu}$ A_{nu}-$partial_{nu}$ A_{mu}+[A_{mu},A_{nu}]	
R2-055	g_{rm} YM	Gauge coupling	Positive scalar	Dimension depends on spacetime dimension	Declared dimensional quantity	Continuum Yang-Mills coupling appearing after trace normalization and scaling.	
R2-056	$beta_{W}$	Inverse Wilson coupling	Positive scalar	Action-dependent	Declared dimensional quantity	Coefficient multiplying the discrete Wilson action.	
R2-057	D_{rm} rel	Relational Dirac operator	Linear operator	L^-1 or chosen lattice units	Convention / model dependent	Discrete Dirac-type operator on the global relational state space, built from causal links, weights, Clifford elements, and transport.	
R2-058	w_{ij}	Dirac link weight	Scalar coefficient	L^-1	Declared dimensional quantity	Geometric/causal weight multiplying link transport in D_{rel}.	
R2-059	$gamma^{mu}$	Clifford generator	Matrix generator	Dimensionless	Dimensionless or counting unit	$gamma^{mu}$,$gamma^{nu}$=2g^{munu}	
R2-060	$Gamma_{ij}$	Spin/record transport matrix	Linear map	Dimensionless	Dimensionless or counting unit	Transport factor appearing in the relational Dirac operator or gravity flux construction.	
R2-061	$lambda_{n}$	Dirac eigenvalue	Scalar spectral value	L^-1	Declared dimensional quantity	D_{rm} $relpsi_{n}$=$lambda_{npsin}$	
R2-062	mathrmIPR(psi)	Inverse participation ratio	Scalar functional	Dimensionless	Dimensionless or counting unit	mathrmIPR(psi)=sum_{i}|psi_{i}|^{4} for a normalized discrete mode (precise block convention required).	
R2-063	r_{rm} gap	Adjacent-gap ratio	Scalar statistic	Dimensionless	Dimensionless or counting unit	Standard unfolded-free ratio of consecutive level spacings.	
R2-064	P_{rm} obs	Observational projector	Orthogonal projector	Dimensionless	Dimensionless or counting unit	Projector onto an observational subspace in the superseded measurement architecture.	
R2-065	Pi	Canonical projector symbol	Orthogonal projector	Dimensionless	Dimensionless or counting unit	Pi^{2}=Pi=Pi^{dagger}	
R2-066	Pi_{a}	Protected-sector projector	Rank-two orthogonal projector	Dimensionless	Dimensionless or counting unit	Pi_{a}:mathcal Htomathcal E_{a},quad operatornamerankPi_{a}=2	
R2-067	mathcal E_{a}	Protected rank-two sector	Two-dimensional subspace	Dimension 2	Declared dimensional quantity	mathcal E_{a}=operatornameim$Pi_{asubsetmathcal}$ H	
R2-068	mathrmchGUE	Chiral Gaussian unitary ensemble	Random-matrix ensemble	Dimensionless	Dimensionless or counting unit	Previously assumed universality class for D_{rel}.	
R2-069	$lambda_{rm}$ MP^{pm}	Marchenko-Pastur edges	Scalar bounds	Dimensionless after normalization	Dimensionless or counting unit	Spectral edges of a sample-covariance ensemble used in the superseded architecture.	
R2-070	$theta_{rm}$ BBP	BBP spike strength	Scalar parameter	Operator units	Convention / model dependent	Low-rank perturbation strength in the former generation mechanism.	
R2-071	Phi^{rm} upd_{ij}	Informational update flux	Link-valued quantity	Model dependent	Convention / model dependent	Synchronization/update required across causal link (i,j).	
R2-072	rho_{rm} rec	Record/update density	Scalar density	Energy/volume or update/causal-volume after normalization	Declared dimensional quantity	Rate or density of relational updates needed to sustain a localized mode in a causal region.	

ID	Symbol	Name	Type	Recorded dimension / units	Dimension status	Defining relation	Audit note
R2-073	operatornamediv$_{mathcal}$ C	Discrete causal divergence	Linear operator	Flux per causal cell	Declared dimensional quantity	Outgoing minus incoming oriented flux on the Hasse diagram.	
R2-074	J$^{mu}_{rm}$ upd	Coarse-grained update current	Continuum vector field	Energy density/flux	Declared dimensional quantity	Continuum current obtained from relational update flux under a declared coarse-graining map.	
R2-075	T$_{munu}^{rm}$ eff	Effective stress-energy tensor	Symmetric rank-two tensor	Energy density	Declared dimensional quantity	Coarse-grained tensor constructed from update flux and mode momentum.	
R2-076	G$_{munu}$	Einstein tensor	Symmetric divergence-free tensor	L^-2	Declared dimensional quantity	G$_{munu}$=R$_{munu}$-tfrac12Rg$_{munu}$	
R2-077	R$_{rm}$ sc	Scalar curvature	Scalar field	L^-2	Declared dimensional quantity	Ricci scalar of an emergent continuum geometry.	
R2-078	g$_{munu}$	Emergent metric	Nondegenerate symmetric tensor	Dimensionless in geometric units	Dimensionless or counting unit	Continuum metric in a manifold-like limit.	
R2-079	G$_{N}$	Newton gravitational constant	Positive scalar	L^{d}-2/M or standard units	Declared dimensional quantity	Continuum coupling between curvature and stress-energy.	
R2-080	S$_{rm}$ BD	Benincasa-Dowker action	Discrete action	Action	Declared dimensional quantity	Established causal-set curvature action used in conditional gravitational embeddings.	
R2-081	S$_{rm}$ EH	Einstein-Hilbert action	Continuum action	Action	Declared dimensional quantity	S$_{rm}$ EHproptoint d^{dxsqrt}-g,(R$_{rm}$ sc-2Lambda)	
R2-082	Lambda$_{rm}$ cos	Cosmological constant	Scalar	L^-2	Declared dimensional quantity	Constant vacuum curvature term in the continuum action/equations.	
R2-083	mathscr C$_{rm}$ cg	Coarse-graining map	Map between discrete and continuum observables	Normalization dependent	Declared dimensional quantity	mathscr C$_{rm}$ cg:textdiscrete flux datato T$_{munu}^{rm}$ eff	
R2-084	a(t)	Cosmological scale factor	Positive function	Dimensionless	Dimensionless or counting unit	Coarse-grained relational separation scale in the cosmological model.	
R2-085	H$_{rm}$ cos(t)	Hubble rate	Scalar function	T^-1	Declared dimensional quantity	H$_{rm}$ cos=dot a/a	
R2-086	d$_{rm}$ rel(x$_{i}$,x$_{j}$)	Relational separation	Distance-like scalar	Dimensionless or length after calibration	Dimensionless or counting unit	Coarse-grained separation of events on a cosmological antichain from connectivity statistics.	
R2-087	Omega$_{m}$	Matter density parameter	Dimensionless scalar	Dimensionless	Dimensionless or counting unit	Standard cosmological matter density fraction used as external/input parameter.	
R2-088	w(z)	Dark-energy equation-of-state function	Scalar function	Dimensionless	Dimensionless or counting unit	Ratio of effective pressure to density as a function of redshift.	
R2-089	C$_{ell}^{XY}$	CMB angular power spectrum	Sequence of scalars	Temperature-squared or channel units	Declared dimensional quantity	Angular power spectrum for channels X,Y in T,E.	
R2-090	F$_{ell}$	Locked finite-coherence kernel	Multiplicative sequence	Dimensionless	Dimensionless or counting unit	F$_{ell}$=1-alpha$_{rm}$ CMBexp[-(ell-2)/L$_{H}$] (or exact frozen convention).	
R2-091	alpha$_{rm}$ CMB	CMB kernel amplitude	Dimensionless scalar	Dimensionless	Dimensionless or counting unit	Amplitude of the locked low-ell finite-coherence kernel.	
R2-092	L$_{H}$	CMB coherence multipole scale	Positive scalar	Multipole	Declared dimensional quantity	E-folding scale of the locked kernel in multipole space.	
R2-093	C(theta)	CMB angular correlation function	Scalar function	Temperature-squared	Declared dimensional quantity	Real-space temperature two-point correlation at angular separation theta.	
R2-094	S$_{1}$/2	Large-angle CMB statistic	Nonnegative scalar	Temperature^{4}	Declared dimensional quantity	S$_{1}$/2=int_-1^{1}/2[C(theta)]^{2},d(costheta)	
R2-095	f$_{rm}$ sky	Observed sky fraction	Scalar	Dimensionless	Dimensionless or counting unit	Fraction of sky retained after masking.	
R2-096	N$_{rm}$ MC	Monte Carlo realization count	Positive integer	Count	Dimensionless or counting unit	Number of simulated realizations in an ensemble.	
R2-097	m$_{a}$^(ell)	Charged-lepton mass	Positive scalar	Mass/energy	Declared dimensional quantity	aine,mu,tau	

ID	Symbol	Name	Type	Recorded dimension / units	Dimension status	Defining relation	Audit note
R2-098	x_a	Square-root mass coordinate	Positive scalar	$M^1/2$	Declared dimensional quantity	x_a=sqrtm$_a$^(ell)	
R2-099	mathbf x	Square-root mass vector	Vector in R3	$M^1/2$	Declared dimensional quantity	mathbf x=(x_1,x_2,x_3)	
R2-100	mathbf u	Democratic unit vector	Unit vector	Dimensionless	Dimensionless or counting unit	mathbf u=(1,1,1)/sqrt3	
R2-101	mathbf $x_{parallel}$	Democratic component	Vector projection	$M^1/2$	Declared dimensional quantity	mathbf $x_{parallel}$=(mathbf xcdotmathbf u)mathbf u	
R2-102	mathbf x_{perp}	Transverse flavor component	Vector projection	$M^1/2$	Declared dimensional quantity	mathbf x_{perp}=mathbf x-mathbf $x_{parallel}$	
R2-103	K	Koide hierarchy ratio	Dimensionless scalar	Dimensionless	Dimensionless or counting unit	K=fracsum$_a$ m_a(sum$_{asqrtma}$)^2=frac|mathbf x|^2(mathbf 1cdotmathbf x)^2	
R2-104	phi$_{ell}$	Koide flavor azimuth	Angle	Angle	Dimensionless or counting unit	Azimuth of the square-root mass vector on the Koide circle.	
R2-105	r_K^{rm} amp	Koide transverse-to-democratic amplitude ratio	Nonnegative scalar	Dimensionless	Dimensionless or counting unit	r_K^{rm} amp=|mathbf x_{perp}|/|mathbf $x_{parallel}$|; equals 1 at squared-norm equipartition under the geometric decomposition, while older circular parametrizations may use a different r.	
R2-106	Phi$_{rm}$ sub	Substrate field/operator	Linear operator	Operator/energy units	Declared dimensional quantity	Substrate-native field projected into protected sectors to form mass-like operators.	
R2-107	M	Projected relational operator	Finite operator/matrix	Same units as Phi$_{sub}$	Declared dimensional quantity	M=PiPhi$_{rm}$ subPi,quad M_{ab}=langlepsi$_a$|Phi$_{rm}$ sub|psi$_{brangle}$	
R2-108	sigma$_a$	Singular values of projected operator	Ordered nonnegative scalars	Same units as M	Declared dimensional quantity	sigma$_{1gesigma2gesigma3ge0}$ are singular values of M or M_{wedge}.	
R2-109	p_a	Normalized singular-amplitude shares	Probability-simplex coordinates	Dimensionless	Dimensionless or counting unit	p_a=sigma$_a$/sum$_{bsigmab}$	
R2-110	R_{rm} rank	Rank concentration	Dimensionless scalar	Dimensionless	Dimensionless or counting unit	R_{rm} rank=sigma$_1$/(sigma$_1$+sigma$_2$+sigma$_3$)=p_1	
R2-111	R_K	Koide rank crossing	Dimensionless scalar	Dimensionless	Dimensionless or counting unit	R_K=(1+sqrt2)/3 on the pair-symmetric trajectory.	
R2-112	q	Effective entropy-brake strength	Positive scalar	Dimensionless	Dimensionless or counting unit	Coefficient multiplying the support-maintenance response in the reduced stabilization flow.	
R2-113	q_K	Koide fixed-point coefficient	Positive scalar	Dimensionless	Dimensionless or counting unit	q_K=1/R_K=3(sqrt2-1)	
R2-114	h	Subordinate support response	Scalar state variable	Dimensionless	Dimensionless or counting unit	Effective response maintaining subordinate packet support; h_*=1 at the normalized equilibrium.	
R2-115	H_{rm} supp	Support generator/operator	Hermitian operator or response vector	Dimensionless after normalization	Dimensionless or counting unit	Representation of the stabilized support responses on the determinant-line bundle.	
R2-116	S_{rm} coll	Rank-collapse functional	Scalar functional	Action/flow units	Declared dimensional quantity	Effective functional whose gradient increases rank concentration.	
R2-117	S_{rm} ent	Deficit-gated entropy/support functional	Scalar functional	Action/flow units	Declared dimensional quantity	Effective support-maintenance functional activated by subordinate-support deficit.	
R2-118	t_{rm} flow	Relaxation-flow parameter	Real parameter	Algorithmic time	Declared dimensional quantity	Parameter along optimization/relaxation flow; not automatically physical time.	
R2-119	k_{tau}	Proper-time weight exponent	Real exponent	Dimensionless	Dimensionless or counting unit	Exponent k in the weighted causal-diamond proper-time factor; selected as k_{tau}=2 by asymptotic scaling within the construction.	
R2-120	r_{rm} ren	Renormalization power	Real exponent	Dimensionless	Dimensionless or counting unit	Power r in the event-density or sample-size renormalization; selected as r_{rm} ren=1/2 within the continuum scaling construction.	
R2-121	K_{rm} tr(N;k_{tau},r_{rm} ren)	Renormalized diamond trace estimator	Scalar estimator	Dimensionless after renormalization	Dimensionless or counting unit	Finite-density weighted trace observable approaching the continuum coefficient xi6.	
R2-122	xi$_6$	Six-bivector continuum coefficient	Positive scalar	Dimensionless in adopted normalization	Dimensionless or counting unit	xi$_6$=51/(1400sqrtpi)	

ID	Symbol	Name	Type	Recorded dimension / units	Dimension status	Defining relation	Audit note
R2-123	xi_3	Protected-triplet susceptibility	Positive scalar	Dimensionless	Dimensionless or counting unit	$\mathrm{xi}_3=\mathrm{xi}_6/2$	
R2-124	$\mathrm{beta}_{\mathrm{rm}}$ pkt	Packet normalization coefficient	Positive scalar	Normalization dependent	Declared dimensional quantity	Coefficient relating continuum diamond response to the finite packet amplitude.	
R2-125	A_{rm} pkt	Dimensionless packet amplitude	Positive scalar	Dimensionless	Dimensionless or counting unit	A_{rm} pkt=$\mathrm{beta}_{\mathrm{rm}}$ pktxi_6	
R2-126	$\mathrm{alpha}_{\mathrm{D}}$	Diamond normalization coefficient	Positive scalar	Dimensionless	Dimensionless or counting unit	$\mathrm{alpha}_{\mathrm{D}}$=3/(pi A_{rm} pkt) in the adopted construction.	
R2-127	E_{rm} pkt	Packet energy scale	Positive scalar	Energy	Declared dimensional quantity	Predicted common charged-lepton packet energy before flavor splitting and corrections.	
R2-128	v_{rm} EW	Electroweak scale	External scalar	Energy	Declared dimensional quantity	Standard Model electroweak scale used as an input to the packet-energy construction.	
R2-129	$\mathrm{Lambda}^{\mathrm{2mathcal}}$ H	Exterior-square state space	Hilbert/exterior-power space	Dimension choose(dim H,2)	Declared dimensional quantity	Second exterior power of the global relational state space.	
R2-130	$\mathrm{Lambda}^{\mathrm{2Phi}}{}_{\mathrm{rm}}$ sub	Induced exterior-square operator	Linear operator	Quadratic in Phi eigen/singular scales	Declared dimensional quantity	$\mathrm{Lambda}^{\mathrm{2Phi}}{}_{\mathrm{rm}}$ sub:$\mathrm{Lambda}^{\mathrm{2mathcal}}$ $\mathrm{HtoLambda}^{\mathrm{2mathcal}}$ H	
R2-131	L_{a}	Determinant line	One-dimensional complex vector space	Dimension 1	Declared dimensional quantity	$\mathrm{L}_{\mathrm{a}}=\mathrm{Lambda}^{\mathrm{2mathcal}}$ E_{a}	
R2-132	mathcal F	Determinant-line flavor bundle	Direct-sum vector bundle	Rank 3	Declared dimensional quantity	mathcal F=$\mathrm{L}_{\mathrm{1oplus}}$ $\mathrm{L}_{\mathrm{2oplus}}$ L_3	
R2-133	$\mathrm{Pi}_{\mathrm{mathcal}}$ F	Flavor-bundle projector	Orthogonal projector	Dimensionless	Dimensionless or counting unit	Projector from Lambda2 H onto the three determinant lines.	
R2-134	$\mathrm{M}_{\mathrm{wedge}}$	Exterior-square projected flavor operator	3x3 operator	Quadratic field units	Declared dimensional quantity	$\mathrm{M}_{\mathrm{wedge}}=\mathrm{Pi}_{\mathrm{mathcal}}$ F($\mathrm{Lambda}^{\mathrm{2Phi}}{}_{\mathrm{rm}}$ sub)$\mathrm{Pi}_{\mathrm{mathcal}}$ F	
R2-135	$\mathrm{Omega}_{\mathrm{a}}{}^{\mathrm{rm}}$ basis	Normalized determinant-line basis state	Unit vector	Dimensionless	Dimensionless or counting unit	Normalized generator of the one-dimensional line L_{a}.	
R2-136	$\mathrm{omega}_{\mathrm{a}}$	Determinant-line connection	U(1) connection one-form	Inverse parameter	Declared dimensional quantity	Connection induced on L_{a} by variation/transport of the protected sector.	
R2-137	$\mathrm{Theta}_{\mathrm{a}}$	Finite determinant-line phase	Angle/holonomy coordinate	Angle	Dimensionless or counting unit	operatornameHol(L_{a})=$\mathrm{e}^{\mathrm{iTheta}}{}_{\mathrm{a}}$	
R2-138	$\mathrm{Omega}_{\mathrm{rm}}$ DW	Signed central Diamond-Wilson curvature	Real curvature coordinate	Dimensionless or area-normalized curvature	Dimensionless or counting unit	Orientation-sensitive central curvature variable extracted from Diamond-Wilson transport.	
R2-139	$\mathrm{J}_{\mathrm{Omega}}$	Determinant-line current	Hermitian line-bundle source	Model dependent	Convention / model dependent	Current/source entering determinant-line connection dynamics.	
R2-140	$\mathrm{J}_{\mathrm{Omega}}=\mathrm{Omega}_{\mathrm{rm}}$ $\mathrm{DWH}_{\mathrm{rm}}$ supp	Response-to-connection law	Constitutive operator equation	Model dependent	Convention / model dependent	Identifies signed central curvature with additive determinant-line support coordinates.	
R2-141	Pi_{D}	Common/determinant-channel projector	Projector	Dimensionless	Dimensionless or counting unit	Projector onto the common determinant/singlet channel of the three-line response space.	
R2-142	Pi_{S}	Relative/subordinate-channel projector	Projector	Dimensionless	Dimensionless or counting unit	Projector onto the relative two-dimensional line-splitting channel.	
R2-143	$\mathrm{a}_{\mathrm{D}},\mathrm{b}_{\mathrm{S}}$	Allowed constitutive coefficients	Real scalars	Normalization dependent	Declared dimensional quantity	Coefficients in $\mathrm{J}_{\mathrm{Omega}}=\mathrm{Omega}_{\mathrm{rm}}$ DW($\mathrm{a}_{\mathrm{DPiD}}+\mathrm{b}_{\mathrm{SPiS}}$)	
R2-144	mathcal W_{rm} mix	Mixed-wedge sector	Subspace	Dimension model dependent	Convention / model dependent	Exterior-square components not contained in the three protected determinant lines.	
R2-145	Delta G_{rm} mix	Mixed-sector metric correction	Symmetric bilinear correction	Coupling squared / normalized	Declared dimensional quantity	Correction to the determinant-line response metric generated by coupling to mixed wedges.	
R2-146	$\mathrm{epsilon}_{\mathrm{rm}}$ mix	Mixed-wedge coupling	Real scalar	Model dependent	Convention / model dependent	Finite coupling between determinant-line and mixed exterior-square sectors.	
R2-147	$\mathrm{Delta}_{\mathrm{rm}}$ gap	Protection/decoupling gap	Nonnegative scalar	Operator/energy units	Declared dimensional quantity	Spectral or dynamical separation required to suppress mixed-sector corrections.	
R2-148	S_3	Three-object permutation group	Finite group	Dimensionless	Dimensionless or counting unit	Permutation symmetry acting on triplet components/sectors.	

ID	Symbol	Name	Type	Recorded dimension / units	Dimension status	Defining relation	Audit note
R2-149	D_3	Dihedral flavor symmetry	Finite group	Dimensionless	Dimensionless or counting unit	Cyclic permutations and reflections acting on the Koide flavor plane.	
R2-150	delta_c	Phase-locking coefficient/exponent	Dimensionless scalar	Dimensionless	Dimensionless or counting unit	delta_c=2/3 in the selected minimal oriented invariant (exact role must be frozen).	
R2-151	mathcal I_{D3}	Oriented D3 invariant	Scalar functional	Dimensionless	Dimensionless or counting unit	Lowest oriented permutation/reflection-covariant invariant used to select the flavor azimuth.	
R2-152	phi_*	Stationary flavor azimuth	Angle	Angle	Dimensionless or counting unit	Stationary point of the selected oriented invariant on the Koide circle.	
R2-153	kappa_c	Critical coherence threshold	Positive scalar	Dimensionless	Dimensionless or counting unit	Threshold claimed from Marchenko-Pastur/BBP structure in Paper VI.	
R2-154	kappa_{rm} dyn	Dynamical coherence parameter	Scalar	Dimensionless	Dimensionless or counting unit	Time-/state-dependent coherence compared with kappa_c in the former measurement model.	
R2-155	Delta_U	Unitarity defect	Nonnegative scalar/operator norm	Dimensionless	Dimensionless or counting unit	Proposed measure of norm/transport failure under uncontrolled phase dispersion.	
R2-156	tau_{rm} sup	Maximum superposition time	Positive scalar	Time	Declared dimensional quantity	Former predicted upper time for maintaining superposition.	
R2-157	s	Random seed	Integer metadata	Dimensionless	Dimensionless or counting unit	Pseudo-random generator seed for an experimental run.	
R2-158	s_a^{rm} amp	Signed Koide/packet amplitude	Real scalar	Square-root mass units or dimensionless after scaling	Dimensionless or counting unit	Signed amplitude whose square gives a nonnegative mass-like component in Paper VIII notation.	
R2-159	rho_{rm} corr	Sample correlation coefficient	Scalar statistic	Dimensionless	Dimensionless or counting unit	Pearson/Spearman correlation used to compare diagnostics in an ensemble.	
R2-160	Delta K	Koide deviation	Scalar residual	Dimensionless	Dimensionless or counting unit	Delta K=K-2/3 or |Delta K| as explicitly stated.	
R2-161	epsilon_{rm} tol	Numerical tolerance	Positive scalar	Units of tested quantity	Declared dimensional quantity	Declared threshold for convergence, equality, or pass/fail tests.	
R2-162	mathbb E_{rm} ens	Ensemble expectation	Expectation operator	Same units as variable	Declared dimensional quantity	Average over a declared random causal-set/transport/seed ensemble.	
R2-163	$\text{operatornamemed}_{rm}$ ens	Ensemble median	Statistic	Same units as variable	Declared dimensional quantity	Median over a declared ensemble.	

B.2 Action and flow dimensional audit

ID	Action / rule	Type	Expression	Coefficients	Coefficient status	Regime	Time meaning	Stability / boundedness	Audit note
R3-001	Relational Unity admissibility functional	Global admissibility functional	$S_U[\mathscr{C},r]$ weights globally coherent causal histories; exact functional is not frozen.	Unity weights / normalization	Unspecified	History-level	Structural weighting, not fundamental temporal evolution	Unknown	Paper I, Unity as Global Admissibility on Histories.
R3-002	Unity-weighted history measure	Measure deformation	$d\mu_U[\mathscr{C},r] \propto \exp(-S_U[\mathscr{C},r])\, d\mu_0[\mathscr{C},r]$ (schematic measure-level reading).	Overall normalization	Unspecified	History/ statistical	Ensemble weighting	Requires real bounded-below S_U; not shown	Paper I, From Measure Weighting to Amplitude Structure.
R3-003	Unity phase / manifestation-amplitude rule	Complex amplitude rule	$\mathscr{A}[\mathscr{C},r] \propto \exp(i\Phi_U[\mathscr{C},r])$; physical predictions require a declared sum over histories/orientations.	Amplitude normalization and Φ_U	Open	History-level	Amplitude composition, not established physical evolution	Norm/normalization not formulated	Paper I, Unity as Physical Constraint on Manifestation Amplitudes.
R3-004	Von Mises maximum-entropy functional	Constrained entropy extremization	Extremize $-\int p \ln p\, d\varphi$ subject to $\int p=1$ and a fixed circular first moment; Lagrange multipliers α,κ yield $p \propto e^{\kappa\cos}(\varphi-\mu)$.	α, κ	Fixed by imposed constraints	Continuum/ statistical	Equilibrium variational principle	Entropy is concave under standard assumptions	Papers I-II.
R3-005	Relational Dirichlet energy	Quadratic graph energy	$E_D[\psi]=\langle\psi,\Delta\_\mathscr{C}\psi\rangle=1/2\ \Sigma_x{\sim}y w_{xy}\lvert\psi(x)-\psi(y)\rvert^2$.	Graph weights w_{xy}	Chosen/geometric	Discrete	Relaxational interpretation only	Nonnegative for symmetric w_xy≥0	Paper I, Variational Principle of Relational Unity.
R3-006	Loop-torsion functional	Discrete curvature cost	$S_{loop}=\Sigma\_\square\ \Theta\_\square^2$.	Overall stiffness κ_g	Chosen	Discrete	Stationary action	Nonnegative	Paper I, Relational torsion functional.
R3-007	Continuum Maxwell action	Continuum field action	$S_{Maxwell}=-1/4\int d^4x\sqrt{-g}\ F_{\mu\nu F}{}^{\mu\nu}$.	Continuum normalization / coupling	Imported or chosen	Continuum	Physical spacetime action	Standard Hamiltonian positivity after signature treatment	Paper I, Maxwell Dynamics.
R3-008	Diamond-Wilson action	Discrete Wilson action	$S_W[U]=\beta_W\ \Sigma\_\diamond\in\mathscr{P}\ \mathrm{Re\ Tr}(I-U\_\diamond)$, $U\_\diamond=U_{p1Up2}\dagger$.	β_W; representation trace normalization	Free/matched; not derived	Discrete	Stationary action	Nonnegative for standard compact convention	Paper II; audited in Paper XVI.
R3-009	Continuum Yang-Mills action	Conditional continuum limit	$S_{YM}=(1/2g_{YM}^2)\int d^4x\ \mathrm{Tr}(F_{\mu\nu F}{}^{\mu\nu})$; paper normalization gives schematic $g_{YM}^2=12\beta_{W\xi}$.	g_{YM}, β_W, diamond density ξ	Conditional / convention dependent	Continuum	Physical spacetime action	Standard after signature handling	Paper II, Continuum Limit of Diamond Holonomies.
R3-010	Connectivity-defect source rule	Sourced variation and scaling law	$\delta S_W/\delta U_e=\beta_W\Sigma\_\diamond\in St(e)\mathrm{Im}(U\_\diamond)$; valence defect $\Delta\nu$ yields $D\star F=J$ with $J^\nu{\sim}-\Delta\nu\langle F\rangle a^2$.	β_W, a^2, combinatorial factor	Scaling coefficient open	Discrete to continuum	Stationary action plus ensemble averaging	Inherited from S_W	Paper II, Ensemble-Averaged Field Equations.
R3-011	Density-biased causal attachment rule	Stochastic update rule	$P(x \prec y \mid \rho_{rec})=P_0(x \prec y)[1+\lambda_{RG}\ F(\rho_{rec}(x),\rho_{rec}(y))]$.	λ_{RG} and functional F	Free/programmatic	Discrete stochastic	Growth/update parameter; conflicts with block-universe wording	Probability positivity requires extra constraints	Paper I, Density-Biased Causal Attachment.
R3-012	Spectral action route	Spectral functional	$S_{spec}[D_{rel}]=\mathrm{Tr}\ f(D_{rel}^2/\Lambda^2)$, with heat-kernel expansion in a continuum regime.	Moments of f, Λ, operator normalization	Imported/free until fixed	Discrete spectral to continuum	Euclidean/stationary functional	Depends on f	Paper I gravity program.
R3-013	Coherence-weighted causal action	Discrete effective action	$S_{eff}{\sim}\hbar\Sigma_i{\prec}jW(i,j)[1-\Xi(i,j)]$ (schematic paper form).	$\hbar$, W normalization, Ξ normalization	Mostly unspecified	Discrete	Stationary variational principle	Unknown	Paper IV, Coherence-Weighted Action.
R3-014	Four-dimensional Benincasa-Dowker action	Imported discrete action	$S_{BD}=(4\hbar/\sqrt{6})\ell_c$^-2$[N-N_0-9N_1+16N_2-8N_3]$ in the paper's notation.	Fixed BD numerical coefficients and ℓ_c	Imported normalization	Discrete	Stationary or sum-over-orders	Not a general boundedness theorem	Paper IV, Appendix B.
R3-015	Coherence-weighted BD action	Modified discrete action	S_{BD}^Ξ uses coherence-weighted chain/link terms, written schematically as $\Sigma W\Xi$ or $\Sigma W(1-\Xi)$.	Weight normalization and ℓ_c	Constitutive; sign/placement ambiguous	Discrete	Stationary variational principle	Unknown	Paper IV, Geometric Closure and Appendix B.
R3-016	Discrete flux-balance law	Constraint / coarse-graining bridge	$\mathrm{div}\_\mathscr{C}\Phi_{upd}(i)=\Sigma_i{\prec}j\Phi_{ij}-\Sigma_k{\prec}i\Phi_{ki}$; target $\nabla_{\mu J}{}^{\mu}=0$ and $\nabla_{\mu T}{}^{\mu\nu}=0$.	Coarse-graining normalization	Open	Discrete to continuum	Balance law, not a time evolution	Not an energy	Papers IV and VII.
R3-017	Flux-momentum stress-tensor map	Coarse-graining constitutive map	$T_{eff}{}^{\mu\nu}$=normalized local average of symmetrized flux-momentum bilinears.	Diamond-density and ℓ_c normalization	Conditional	Discrete to continuum	Stationary coarse-graining	Not applicable	Paper VII, Lemma A and Appendix A.
R3-018	Effective gravitational-coupling rule	Coefficient identification	G_N is identified from ℓ_c and BD normalization; G_{eff} receives a coherence-deficit correction.	ℓ_c, diamond density, coherence correction	Conditional / not independently fixed	Continuum	No time role	Not applicable	Paper VII, Lemma B.
R3-019	Einstein-Hilbert action and field equation	Continuum target action	$S_{EH}=(16\pi G_N)$^-1$\int\sqrt{-g}(R-2\Lambda)d^4x+S_m$; $\delta S/\delta g$ gives $G_{\mu\nu}+\Lambda g_{\mu\nu}=8\pi G_{NT\mu\nu}$.	G_N, Λ	Imported/external target	Continuum	Physical spacetime action	Standard GR issues apply	Papers IV and VII.

ID	Action / rule	Type	Expression	Coefficients	Coefficient status	Regime	Time meaning	Stability / boundedness	Audit note
R3-020	Causal-network growth rule	Conceptual stochastic evolution	Events/links grow and connectivity dilutes; $a(t)$ is identified with coarse-grained relational separation.	Growth/attachment law unspecified	Open	Discrete	Claimed cosmic evolution; conflicts with Paper I block ontology	Unknown	Paper V.
R3-021	Vacuum maintenance burden	Effective energy-density rule	ρ_{vac}^{IRMT} is a baseline relational update cost per coarse-grained volume; no unique microscopic formula.	Baseline update cost	Free/constitutive	Continuum effective	Cosmic-time interpretation	Unknown	Paper V.
R3-022	Finite-coherence dark-energy-running model	Phenomenological likelihood model	One-parameter finite-coherence modification of $H(z)$ or $\rho_{DE}(z)$ tested against Pantheon+.	Running amplitude	Fitted	Continuum phenomenology	Redshift evolution	Standard likelihood model	Paper XIV, Negative Result I.
R3-023	Direct low-ℓ power-suppression model	Phenomenological transfer rule	$C_\ell^{TT} \to F_{\ell C \ell}^{TT}$ with fitted low-ℓ suppression.	Amplitude and scale	Fitted	Harmonic-space	No physical time	Not applicable	Paper XIV, Negative Result II.
R3-024	Universal TT/TE/EE suppression rule	Multi-channel phenomenological kernel	$C_\ell^{XY} \to F_{\ell C \ell}^{XY}$ for TT, TE, and EE with a shared kernel.	Shared amplitude and scale	Fitted	Harmonic-space	No physical time	Not applicable	Paper XIV, Negative Result III.
R3-025	Locked temperature finite-coherence kernel	Phenomenological response kernel	$F_\ell=1-\alpha_{CMB} \exp[-(\ell-2)/L_H]$, calibrated in C1 and locked for C2/C3.	α_{CMB},L_H	Calibrated, then fixed	Harmonic and real-space phenomenology	No physical time	Finite kernel for locked values	Paper XIV.
R3-026	Free relational unitary transport rule	Discrete evolution rule	$\psi_n+1=U_{n\psi n}$ with U_n unitary along causal links.		Kinematic	Discrete	Claimed physical evolution	Norm preserving	Paper VI.
R3-027	Random-phase accumulation law	Stochastic update	$\varphi_n+1=\varphi_n+\delta\varphi_n$; phase variance grows as an assumed random walk.	Increment variance	Assumed	Discrete stochastic	Step index treated as evolution	Unwrapped variance grows	Paper VI, Projection Necessity and App. C.
R3-028	Projection / collapse update	Discontinuous state update	$\psi \to \Pi_{obs\psi}/\|\Pi_{obs\psi}\|$ when κ crosses a claimed threshold.	κ_c and projector rank	Superseded	Discrete event	Claimed measurement time	Normalized after projection	Paper VI, Theorem C.
R3-029	Coherence-weighted Born rule	Probability rule	$P_n \propto \int d\varphi\ p_\kappa(\varphi)\|\langle n\|\psi(\varphi)\rangle\|^2$; claimed large-$\kappa$ limit is $\|\langle n\|\psi\rangle\|^2$.	κ	Conditional/ superseded	Statistical	Outcome probability, not evolution	Requires explicit normalization	Paper VI.
R3-030	Relational Dirac operator	Operator construction	D_{rel} is a weighted oriented causal-link operator with Clifford/tetrad and transport factors; one active formula must be frozen.	Link-weight normalizations	Partly chosen/imported	Discrete	No specified physical time	Depends on weights	Paper III, revised after Paper X.
R3-031	chGUE-BBP perturbation model	Random-matrix deformation	$D=D_0+\theta_{BBPVlow}$-rank with D_0 assumed chGUE.	Spike and ensemble variance	Assumed/imported	Discrete ensemble	No physical time	Standard random-matrix model	Falsified in Paper X.
R3-032	Transport-richness spectral-phase construction	Parameterized operator sweep	Increase internal transport dimension/noncommutativity, rebuild D_{rel}, and measure localization statistics.	Transport dimension and strength	Numerical controls	Discrete numerical	Parameter sweep, not physical time	Unitary transport projection used	Paper X.
R3-033	Spectral feedback update	Iterative numerical update	$U_e^t+1=\mathscr{P}[\alpha U_e^{local}+\beta U_e^{neighbor}+\gamma Q_e(\psi_n{}^t{}_{low})]$ (representative form).	α,β,γ, mode count, step count	Numerical controls	Discrete iterative	Optimization iteration	No global Lyapunov theorem	Paper X, Spectral Feedback.
R3-034	Static/local candidate objective family	Numerical energies and update families	Node encoding, ancestry, path memory, frustration, constraint-satisfaction, and low-rank objectives.	Many numerical hyperparameters	Numerical controls	Discrete numerical	Optimization iterations	Model dependent	Paper X.
R3-035	Projection map M=ΠΦΠ	Operator definition	$M_{ab}=\langle\psi_a\|\Phi_{sub}\|\psi_b\rangle$, equivalently $M=\Pi_{T\Phi sub}\Pi_T$.	Field normalization	Open/constitutive	Discrete operator	No time role	Not an energy	Papers XII and XV.
R3-036	Normalized collapse-support flow	Normalized vector-field flow	$dp/ds=\mathrm{unit}(G_{collapse})+q_{KRrank}\ \mathrm{unit}(G_{entropy})$ (paper/experiment sign convention).	q_K and step size	Compatibility selected; artificial unit normalization	Continuous/ numerical	Relaxation parameter s	Simplex bounded	Papers XII-XIII.
R3-037	Simplex natural-gradient rule	Geometric flow operator	$G_F,i(p)=p_i[\partial_{iF}-\Sigma_{jpj}\partial_{jF}]$.	Flow-time normalization	Conventional	Continuous relaxation	Relaxation/ optimization time s	Depends on F; state space compact	Paper XV §3.2.
R3-038	Frobenius collapse functional	Scalar functional	$C(p)=K(p)=\Sigma_{ipi}{}^2$; $G_C,i=2p_i(p_i-K)$.	Overall flow-time factor	Conventional	Continuous relaxation	Relaxation time s	1/3≤C≤1	Paper XV §3.3.
R3-039	Frobenius-complement support functional	Scalar functional	$S_F(p)=1-K(p)$; $G_{SF}=-G_C$.	No independent shape coefficient	Exact complement; role constitutive	Continuous relaxation	Relaxation time s	0≤S_F≤2/3	Paper XV §3.4.
R3-040	Combined packet flow	First-order flow	$dp_i/ds=(1-h)G_C,i(p)$.	Flow-time scale	Constitutive	Continuous relaxation	Relaxation/ optimization time	K bounded on simplex	Paper XV §3.4.
R3-041	Support-response relaxation law	Auxiliary dynamical equation	$\tau_h\ dh/ds=qR_{rank}-h$.	τ_h and q	τ_h free; q compatibility selected	Continuous relaxation	Relaxation time s	Stable linear relaxation for τ_h>0	Paper XV §3.5.

ID	Action / rule	Type	Expression	Coefficients	Coefficient status	Regime	Time meaning	Stability / boundedness	Audit note
R3-042	Adiabatic deficit-gated flow	Reduced flow	$\tau_h \to 0$ gives $dp_i/ds=(1-qR_{rank})G_C,i(p)$.	q	Constitutive / compatibility selected	Continuous relaxation	Relaxation time	Simplex bounded	Papers XIII and XV.
R3-043	Pair-symmetric reduced flow	One-dimensional flow	$dR/ds=(1-qR)R(1-R)(3R-1)$.	q and flow-time scale	q constitutive	Continuous relaxation	Relaxation time	Bounded on $1/3\leq R\leq 1$	Paper XV §3.6.
R3-044	q_K compatibility condition	Coefficient selection rule	$q_K=1/R_K=3(\sqrt{2}-1)$, chosen so $R^*=R_K$.	q_K	Compatibility selected, not microscopic	Algebraic within effective model	No time role	Not applicable	Papers XIII and XV.
R3-045	Triplet-closure constraint	Constraint / applicability condition	Require leakage $\Vert(I-\Pi_T)\Phi_{sub}\Pi_T\Vert/\Vert\Phi_{sub}\Pi_T\Vert$ below a declared threshold; exact metric/threshold not frozen.	Closure threshold or penalty	Open/numerical	Discrete operator	Boundary condition	Not an action	Papers XIII and XV.
R3-046	Weighted minimal-diamond response estimator	Observable / response sum	$\mathscr{O}_k,r=N\_\mathscr{C}\text{^}-r\Sigma\_\Diamond\tau\_\Diamond^k\mathscr{W}\_\Diamond$ (schematic); continuum scaling selects $k=2,r=1/2$.	k_τ,r_{ren} and normalization	$k=2,r=1/2$ exact within construction	Discrete estimator	No time role	Not an action	Paper XV §4.
R3-047	Six-bivector / triplet susceptibility rule	Continuum coefficient identification	$\xi_6=51/(1400\sqrt{\pi})$, $\xi_3=\xi_6/2$; these enter the adopted packet normalization.	ξ_6,ξ_3,β_{pkt}	ξ exact in construction; β_pkt constitutive/external	Continuum response	No time role	Not an action	Paper XV §§4-5.
R3-048	Exterior-square induced operator	Representation construction	$M\_\wedge=\Pi\_\mathscr{F}(\Lambda^2\Phi_{sub})\Pi\_\mathscr{F}$ on $\mathscr{F}=L_1\oplus L_2\oplus L_3$.	None in induced representation	Fixed once inputs are fixed	Discrete operator	No time role	Not an action	Paper XV §6.
R3-049	Finite U(2) Wilson packet-energy rule	Finite-holonomy effective energy	E_{pkt} is obtained from the exact fundamental Wilson trace of a central U(2) holonomy and the electroweak scale.	$\beta_{pkt},\xi_6,\xi_3,\alpha_D,v_{EW}$	Exact identities plus external scale and constitutive lift	Finite group response	No time role	Positive on selected branch	Paper XV §7.
R3-050	Lowest oriented D_3 boundary interaction	Effective boundary potential	$\Gamma\_\partial=-\lambda\mathrm{Re}\chi=-\lambda\rho^3\cos(3\varphi_\ell-2h/3)$.	λ	Free stiffness; stationary point independent for $\lambda>0$	Effective boundary	Static minimization	Bounded below at fixed ρ for $\lambda>0$	Paper XV §8.
R3-051	Higher-harmonic boundary action	Effective analytic potential family	$\Gamma\_\partial=-\Sigma_n\geq 1\lambda_{nRe}(\chi^n)=-\Sigma_{n\lambda n\rho}{}^{3ncos}(n\Delta)$, $\Delta=3\varphi_\ell-2h/3$.	λ_n	Free; stability for nonnegative sequence	Effective boundary	Static minimization	Depends on coefficient series	Paper XV §8.10-8.11.
R3-052	Scalar stabilization sector	Effective scalar action/flow sector	$S_{stab}[p,h]$ denotes the packet sector producing the p,h equations; it has no A_{det} dependence.	q,τ_h,flow normalization	Constitutive/ effective	Reduced effective	Relaxation time	Packet functionals bounded on simplex; one scalar action not fully frozen	Paper XVI §5.1.
R3-053	Determinant-line Wilson sector	Reduced gauge action	$S_W[A_{det}]$ is the Diamond-Wilson action reduced to determinant-line connections and has no p,h dependence.	β_W and trace normalization	Partly fixed / partly open	Discrete/reduced	Stationary action	Nonnegative for standard branch	Paper XVI §5.1.
R3-054	Present total charged-lepton action	Sum of disconnected sectors	$S_{current}=S_{stab}[p,h]+S_W[A_{det}]$.	All sector coefficients	Mixed	Effective	Combines relaxation and stationary variables without one time principle	No global theorem	Paper XVI §5.1-5.2.
R3-055	Unsourced determinant Wilson equation	Euler-Lagrange equation	$\delta S_W/\delta A_{det}=0$; stationary phases are loop/center dependent rather than packet dependent.	Wilson coefficients	Inherited	Reduced gauge equation	Stationary equation	Depends on Wilson potential	Paper XVI §5.4 and M6K.
R3-056	Missing mixed packet-connection term	Absent interaction	No $S_{mix}[p,h,A_{det}]$ is present, so $\delta^2 S_{current}/(\delta A_{det}\delta h)=0$.	Unknown	Absent	Discrete/reduced	Must reconcile physical and relaxation variables	Unknown	Paper XVI §5.1-5.3.
R3-057	Candidate mixed source action	Candidate interaction	$S_{mix},cand\sim-\Sigma$ or $\int\mathrm{Tr}(A_{detJ\Omega})$, $J_\Omega=\Omega_{DWHsupp}$, or a compact loop equivalent.	Overall normalization and channel map	Not derived	Discrete/reduced	Would be physical interaction	Naive linear A·J form may be unbounded	Paper XVI, required microscopic current.
R3-058	General symmetry-allowed current family	Response classification	$J_\Omega=\Omega_{DW}(a_D\Pi_D+b_S\Pi_S)$; a general pair-preserving linear map has four coefficients.	a_D,b_S or four coefficients	Free / undetermined	Reduced response law	No time role	Not an action	Paper XVI and M6L.
R3-059	Single compact packet-phase completion	Candidate compact field action	Introduce one compact θ with subgroup $\exp(i\theta H_{supp})$ and periodic kinetic/potential terms.	Stiffness, charge, period	New free parameters	Reduced compact field	Auxiliary/physical phase evolution	Periodic potential can be bounded	Paper XVI §6; M6M.
R3-060	Two-compact-phase completion	Candidate field extension	Independent dominant and subordinate compact phases with separate kinetic/stiffness and charge terms.	Two stiffnesses, charges, windings, exposures	New free coefficients	Reduced compact field	Auxiliary/physical phase dynamics	Can be bounded with periodic potentials	Paper XVI §6.4-6.5.
R3-061	Charged inter-line field action	Candidate gauge-matter action	S_X contains kinetic/potential terms for X_{ab} and covariant couplings; $\chi_X=\mathrm{Im}(X_{12}X_{23}X_{31})$.	Masses, stiffnesses, charges, potentials	Undetermined	Reduced gauge-matter	Physical field dynamics if adopted	Depends on potential	Paper XVI; M6N.
R3-062	Exterior-square common-plus-root structure	Representation coupling identity	$q_0=(1,1,1)$, and $q_0q_0^T+BB^T=3I_3$.	Relative common/root dynamical weights	Charges fixed; weights not fixed	Finite-dimensional	No time role	Not an action	Paper XVI §7; M6O.

ID	Action / rule	Type	Expression	Coefficients	Coefficient status	Regime	Time meaning	Stability / boundedness	Audit note
R3-063	Bare protected-block single-trace Wilson descent	Quadratic action metric	Protected rank-two Wilson traces yield $G_W=I_3$ and $b_{bare}=0$ after half-angle normalization.	Overall Wilson stiffness	Relative metric fixed at bare quadratic order	Reduced quadratic action	Small-fluctuation stationary theory	Positive quadratic form	Paper XVI; M6P.
R3-064	Protected-mixed quadratic action	Coupled block action	S^(2)=1/2(w,c)†[[A,B],[B†,C]](w,c), w∈determinant lines, c∈mixed wedges.	Blocks A,B,C	Partly derived / partly model dependent	Quadratic reduced	Stationary/ integrating-out analysis	Requires positive/stable A,C	Paper XVI §8; M6Q.
R3-065	Schur-complement effective action	Integrated-out effective action	S_{eff}^(2)[w]=1/2 w†(A-BC^-1B†)w.	Mixed coupling and gap	Derived once block action is accepted	Quadratic effective	Stationary low-energy reduction	Stable if Schur complement positive	Paper XVI §8; M6Q.
R3-066	Chiral-pairing and graded-trace cancellation candidates	Candidate cancellation mechanisms	Modify partner/graded contributions to cancel BC^-1B† while preserving the bare determinant metric.	Relative signs, masses, phases, partner couplings	Not fixed; engineered cancellation needs new structure	Quadratic/ effective	Stationary correction analysis	Indefinite engineered signs threaten stability	Paper XVI §9; M6R.
R3-067	Spectral-gap decoupling condition	Protection criterion	Require ‖BC^-1B†‖≪‖A‖, or an equivalent reparameterization-invariant mixed-sector gap.	Gap threshold and coupling norm	Preregistered numerical criterion	Quadratic/ numerical	No time role	Supports stability if satisfied	Paper XVI §10; M6S.
R3-068	Determinant response-to-connection law	Effective constitutive law	$J_\Omega=\Omega_{DWHsupp}$; unit oriented exposure is then integrated to determinant phases/holonomy.	Common normalization/exposure	Constitutive	Reduced effective	Finite transport, not relaxation time	Not an action	Paper XV limitation and Paper XVI conclusion.
R3-069	Unified microscopic action template	Open architecture	$S_{IRMT}=S_{causal}+S_{transport}+S_{field}+S_{packet}+S_{Wilson}+S_{geometry}+S_{interaction}$, with absent terms shown explicitly.	All coefficients in Record 4	Open	Discrete fundamental plus controlled limits	Must distinguish physical time, stochastic growth, relaxation, and RG	Must be proved bounded/stable in its domain	Core Specification plan.

B.3 Coefficient dimensions and normalization dependencies

ID	Symbol	Name	Units	Value / formula	Appears in	Class	Fixed by	Dependencies	Present status
R4-001	α_{ME}	Entropy normalization multiplier	Dimensionless	α_{ME} is fixed by $\int p(\varphi)d\varphi=1$; equivalently $\exp(\alpha_{ME}-1)=1/Z(\kappa)$.	Von Mises variational functional	Fixed by mathematical normalization	Probability normalization	κ_{coh} and $Z(\kappa)$	Active mathematical coefficient
R4-002	κ_{coh}	Von Mises coherence concentration	Dimensionless	$p(\varphi)=\exp[\kappa_{coh}\cos(\varphi-\mu)]/[2\pi I_0(\kappa_{coh})]$.	Coherence distribution and visibility $\eta=I_1/I_0$	Constitutive	Fixed by the imposed first circular moment, but not by a frozen microscopic action	Mean resultant $\mathscr{R}_{coh}$	Active statistical parameter; microscopic law open
R4-003	c_κ	Coherence-to-record scaling coefficient	Dimensionless	$\kappa_{coh}=c_\kappa N_{rec}$; the paper sets $c_\kappa=1$.	$\kappa=N_{rec}$ and $\varepsilon\approx1/(2N_{rec})$	Constitutive	Chosen by the identification of inverse phase variance with record count	Poisson fluctuation model; independent-record assumption	Active conditional scaling hypothesis
R4-004	Z_κ	Von Mises partition function	Dimensionless	$Z_\kappa=2\pi I_0(\kappa_{coh})$.	$p_\kappa(\varphi)$	Fixed by mathematical normalization	Integration over S^1	κ_{coh}	Active exact function
R4-005	η_{coh}	Coherence visibility factor	Dimensionless	$\eta_{coh}(\kappa)=I_1(\kappa)/I_0(\kappa)$.	E_{corr} and finite-coherence deficit	Fixed by mathematical normalization	Circular moment identity	κ_{coh}	Active exact function within the assumed distribution
R4-006	c_ε	Large-coherence deficit coefficient	Dimensionless	$1-\eta_{coh}(\kappa)=c_\varepsilon/\kappa+O(\kappa^{-2})$, with $c_\varepsilon=1/2$; after $\kappa=N$, $\varepsilon\approx1/(2N)$.	Quantum visibility deficit and Paper VII gravity correction	Fixed by mathematical normalization	Asymptotic expansion of I_1/I_0	κ_{coh}; conditional $c_\kappa=1$	Exact asymptotic coefficient; physical $\varepsilon(N)$ conditional
R4-007	c_{cos}	Cosine-correlator amplitude	Dimensionless	$E_{corr}(x,y)=c_{cos}\,\eta_{coh}\cos\theta$; the papers set $c_{cos}=1$.	CHSH correlator	Constitutive	Inserted/inherited cosine law rather than derived $P(a,b\mid x,y)$	Missing joint probability law	Foundationally open
R4-008	S_T	Tsirelson target	Dimensionless	$S_T=2\sqrt{2}$.	CHSH sector	Imported from experiment	Established quantum theory / experiment, not IRMT	Derived future $P(a,b\mid x,y)$	External target, not an IRMT coefficient
R4-009	ρ_{spr}	Poisson sprinkling density	L^{-d}	$\rho_{spr}=\ell_c^{-d}$; Paper I specializes to $\rho=\ell_P^{-4}$.	$N\approx\rho V_d$ and continuum maps	Constitutive	Primitive density or identification with a discreteness scale	d and ℓ_c	Primitive/open normalization
R4-010	λ_U	Relational Unity strength	Action dependent	S_U may carry an overall coefficient λ_U; no canonical value is frozen.	S_U or Φ_U	Free	Not specified in the corpus	Complete history measure	Undefined coefficient
R4-011	β_W	Diamond-Wilson coupling	Dimensionless in lattice units	$S_W=\beta_W\sum_\diamond \mathrm{Re}\,\mathrm{Tr}(I-U_\diamond)$.	Discrete Wilson action	Free	Introduced as a coupling parameter	Gauge group, representation, trace convention	Active but not derived
R4-012	$\xi_\diamond$	Combinatorial irreducible-diamond density	Dimensionless	$N_\diamond=\xi_\diamond\,\rho_{spr}V$.	g_{YM}, stress-tensor normalization, claimed G_N bridge	Numerical control parameter	Requires causal-set combinatorial computation	Dimension d, sprinkling process, minimal-diamond definition	Uncomputed or historically estimated
R4-013	c_Σ	Isotropic bivector-average coefficient	a^4	$\langle\Sigma^{\mu\nu}\Sigma^{\alpha\beta}\rangle=(a^4/24)(g^{\mu\alpha}g^{\nu\beta}-g^{\mu\beta}g^{\nu\alpha})$.	Continuum matching of S_W	Fixed by mathematical normalization	Four-dimensional isotropic bivector average	Dimension and loop convention	Exact within adopted isotropic continuum model
R4-014	g_{YM}^2	Continuum gauge coupling	Dimensionless in $d=4$	$g_{YM}^2=12\,\beta_W\,\xi_\diamond$.	$S_{YM}=(2g_{YM}^2)^{-1}\int \mathrm{Tr}F^2$	Composite derived	Algebraic matching of the adopted Wilson expansion	β_W, $\xi_\diamond$, representation trace normalization	Conditional continuum relation
R4-015	$T(R)$	Representation trace index	Dimensionless	$\mathrm{Tr}_R(T_aT_b)=T(R)\delta_{ab}$.	Gauge kinetic normalization and determinant-line descent	Derived from symmetry	Chosen representation	Gauge group and representation R	Exact after representation choice
R4-016	κ_g	Quadratic loop-torsion stiffness	Action dependent	$S_{loop}=\kappa_g\sum_\square\Theta_\square^2$.	Early $U(1)$ curvature cost	Free	Introduced phenomenologically	Relation to β_W not frozen	Deprecated precursor
R4-017	λ_{RG}	Record-geometry attachment coupling	Inverse units of F	$P(x<y\mid\rho_{rec})=P_0[1+\lambda_{RG}F(\rho_{rec}(x),\rho_{rec}(y))]$.	Causal-structure update rule	Free	No derivation or calibration	Choice of F and positivity constraints	Programmatic / inactive
R4-018	a_c	Causal lattice/discreteness length in Wilson expansion	Length	$\Sigma^{\mu\nu}=O(a_c^2)$; loop area terms scale as a_c^4.	Continuum expansion	Constitutive	Primitive discreteness choice	ρ_{spr} and ℓ_c	Open primitive scale
R4-019	β_{UV}	Historical UV-matched gauge coefficient	Dimensionless	$\beta_{UV}=g_{bare}^2/[12\,\xi_{density}]\approx1.04\times10^4$.	Historical gauge coupling model	Chosen by matching	Matched to approximate Planck-scale gauge coupling	$g_{bare}^2\approx0.5$ and $\xi_{density}\approx2.3\times10^{-3}$	Historical / superseded as a closure claim
R4-020	$\xi_{density}$	Historical local diamond density estimate	Dimensionless	$\xi_{density}\approx2.3\times10^{-3}$.	β_{UV} and $g_{IRMT}(E)$	Numerical control parameter	Historical estimate attributed to earlier work	Causal ensemble and local record count	Historical and not independently established
R4-021	g_{bare}^2	Planck-scale bare gauge coupling	Dimensionless	$g_{bare}^2\approx0.5$.	β_{UV} determination	Imported from experiment	Approximate GUT/QFT running input	E_{GUT} and α_{GUT}	Historical external input
R4-022	α_{GUT}	Unification fine-structure estimate	Dimensionless	$\alpha_{GUT}\approx1/25$.	g_{bare}^2 estimate	Imported from experiment	Approximate GUT model input	Chosen unification scenario	Historical
R4-023	E_{GUT}	Grand-unification scale	GeV	$E_{GUT}\approx2\times10^{16}$ GeV.	RG boundary matching	Imported from experiment	Approximate model-dependent GUT scale	Chosen BSM running	Historical

ID	Symbol	Name	Units	Value / formula	Appears in	Class	Fixed by	Dependencies	Present status
R4-024	n_E	Quartic energy-scaling exponent	Dimensionless exponent	$g_{IRMT}^2(E)\propto(E/E_{Pl})^{n_E}$, $n_E=4$.	Historical running law	Derived from dynamics	Dimensional causal-diamond counting	Assumed τ∼ℏ/E and four-dimensional record count	Historical / unsupported as physical running
R4-025	w_{ij}	Relational Dirac link weights	L^-1 or lattice units	D_{rel} contains w_{ij} times Clifford/transport factors.	Relational Dirac operator	Free	Benincasa-Dowker-inspired choice, not uniquely selected	Causal layers, orientation, ℓ_c	Active but not frozen
R4-026	σ_{RMT}^2	chGUE variance	Operator^2	Matrix-entry variance setting the chGUE bulk scale.	chGUE spectral model	Numerical control parameter	Ensemble convention	Matrix size and normalization	Retired
R4-027	c_{MP}	Marchenko-Pastur aspect ratio	Dimensionless	$c_{MP}=p/n$ or the paper's matrix-dimension ratio.	MP spectral edge and κ_c	Numerical control parameter	Chosen ensemble dimensions	Superseded random-matrix architecture	Retired
R4-028	θ_{BBP}	BBP perturbation strength	Operator units	$D=D_0+\theta_{BBP}\,V$.	BBP detachment	Free	Chosen perturbation	chGUE bulk and rank	Retired
R4-029	r_F	Pauli Frobenius amplitude	Dimensionless	$r_F=\lVert\sigma_a\rVert_F=\sqrt{2}$.	Original Koide identity	Fixed by mathematical normalization	Pauli Frobenius norm; physical identification additionally assumed	Cl(3) representation and BBP amplitude interpretation	Exact norm, conditional physical identification
R4-030	κ_c	Measurement threshold	Dimensionless	κ_c is identified from a Marchenko-Pastur/BBP edge.	Collapse update	Derived from dynamics	Superseded spectral architecture	c_MP and chGUE assumptions	Retired
R4-031	r_{obs}	Observational projector rank	Count	rank $\Pi_{obs}=3$.	Measurement projector	Derived from symmetry	Claimed from d=3 Poisson/Clifford geometry	Superseded measurement architecture	Retired quantitative claim
R4-032	σ_φ^2	Random phase-increment variance	Angle^2 per step	$\mathrm{Var}(\delta\varphi_n)=\sigma_\varphi^2$.	Phase-dispersion update	Free	Assumed increment distribution	Numerical step and environment model	Retired
R4-033	α_{fb}	Spectral-feedback local weight	Dimensionless	$U_e^t+1=\mathscr{P}[\alpha_{fb}\,U_e^{local}+\beta_{fb}\,U_e^{neighbor}+\gamma_{fb}\,Q_e(\text{low modes})]$.	Spectral-feedback update	Numerical control parameter	Chosen experimental hyperparameter	β_fb, γ_fb, projection 𝒫	Experimental only
R4-034	β_{fb}	Spectral-feedback neighbor weight	Dimensionless	Neighbor-averaging coefficient in the feedback update.	Spectral-feedback update	Numerical control parameter	Chosen experimental hyperparameter	α_fb, γ_fb	Experimental only
R4-035	γ_{fb}	Spectral-feedback eigenmode weight	Dimensionless	Coefficient multiplying the low-eigenmode contribution Q_e.	Spectral-feedback update	Numerical control parameter	Chosen experimental hyperparameter	α_fb, β_fb, n_low	Experimental only
R4-036	n_{low}	Number of low modes in feedback	Count	Q_e uses n_{low} selected low-lying eigenmodes.	Spectral-feedback update	Numerical control parameter	Chosen experimental design	Graph size and spectral window	Experimental
R4-037	Δt_{fb}	Feedback iteration step	Iteration units	Numerical update magnitude before projection.	Spectral-feedback dynamics	Numerical control parameter	Chosen for numerical stability	Update normalization	Purely numerical
R4-038	c_{BD}	Benincasa-Dowker layer coefficients	Dimensionless vector	$S_{BD}\propto N-N_0-9N_1+16N_2-8N_3$.	Discrete curvature action	Fixed by mathematical normalization	Imported causal-set theorem	d=4 and BD conventions	External/imported
R4-039	c_{BD},0	BD overall prefactor	Action × L^2 / ℏ	$S_{BD}=(4\hbar/\sqrt{6})\ell_c$^-2[...].	Discrete gravity action	Fixed by mathematical normalization	Imported BD normalization	d=4 and action convention	External/imported
R4-040	η_T	Stress-tensor coarse-graining normalization	Length / density dependent	Paper VII fixes η_T using ℓ_c and ξ_◇; exact fraction requires typesetting verification.	T_eff coarse-graining map	Constitutive	Dimensional analysis plus analogy with kinetic theory	ℓ_c, ξ_◇, flux units	Conditional normalization
R4-041	c_G	Einstein-Hilbert coupling convention	Dimensionless multiplier of ℓ_c^2	$G_N=\ell_c^2/(16\pi)$ in Paper VII's normalization.	Claimed gravitational coupling	Fixed by mathematical normalization	Matching to the imported Einstein-Hilbert convention	BD normalization and identification of ℓ_c	Conditional, not a unique IRMT derivation
R4-042	ℓ_c	Fundamental discreteness scale	Length	$G_N=c_G\,\ell_c^2$; Paper VII then sets $\ell_c=\ell_P$ for comparison.	ρ_spr, S_BD, G_N	Chosen by matching	Identified with the Planck length	Observed G_N	Primitive scale externally anchored
R4-043	c_G,coh	Coherence correction coefficient in G_eff	Dimensionless	$G_{eff}=G_N/(1-\varepsilon_{coh})\approx G_N(1+c_G{,}coh\,\varepsilon_{coh})$, c_G,coh=1.	Effective gravitational coupling	Constitutive	Chosen coherence weighting of S_BD	ε_coh and weighted-action prescription	Conditional bridge
R4-044	Λ_{cos}	Cosmological constant / vacuum maintenance term	L^-2	$G_{\mu\nu}+\Lambda_{cos}\,g_{\mu\nu}=8\pi G_{eff}\,T_{\mu\nu}$; Λ_{cos} is interpreted as vacuum maintenance flux.	Gravity and late-time acceleration	Free	No microscopic calculation	Vacuum update-flux model	Open external/effective parameter
R4-045	λ_{mg}	Matter-geometry coupling normalization	Model dependent	T_{eff} or ρ_{matter} is identified with a function of λ_n and ψ_n with an implicit unit coefficient.	Matter source strength	Constitutive	Analogy and dimensional normalization	D_rel normalization and coarse-graining	Conditional
R4-046	Ω_m,0	Matter-density prior	Dimensionless	Gaussian prior centered at $\Omega_m\approx0.315$ with width ≈0.02.	Supernova likelihood	Imported from experiment	Standard cosmological prior	Selected data analysis	External analysis input
R4-047	α_{DE}	Dark-energy-running amplitude	Dimensionless	One-parameter running amplitude; fit collapses to $\alpha_{DE}=0$.	Modified H(z) / ρ_DE(z)	Chosen by matching	Likelihood fit to Pantheon+	Selected running ansatz	Rejected route
R4-048	α_{CMB}	Locked CMB finite-coherence amplitude	Dimensionless	$F_\ell=1-\alpha_{CMB}\exp[-(\ell-2)/L_H]$, $\alpha_{CMB}=0.5846153846$.	CMB temperature kernel	Chosen by matching	C1 calibration to the target statistic	C1 grid and selected kernel form	Active calibrated phenomenological coefficient

ID	Symbol	Name	Units	Value / formula	Appears in	Class	Fixed by	Dependencies	Present status
R4-049	L_H	Locked CMB recovery length	Multipole units	L_H=5.7948717949 (reported approximately as 5.8).	CMB temperature kernel	Chosen by matching	C1 calibration	Kernel form and C1 target	Active calibrated phenomenological coefficient
R4-050	K_*	Koide geometric value	Dimensionless	K_*=2/3.	Koide locus	Fixed by mathematical normalization	Algebraic geometry of the chosen triplet parametrization	Physical selection of the locus remains separate	Active exact geometric value
R4-051	R_K	Koide rank concentration	Dimensionless	$R_K=(1+\sqrt{2})/3$.	$K(R)=R^2+(1-R)^2/2$	Fixed by mathematical normalization	Algebraic solution of K(R)=2/3	Closed pair-symmetric trajectory	Active exact coordinate
R4-052	q_K	Koide stabilization coefficient	Dimensionless	$q_K=1/R_K=3(\sqrt{2}-1)$.	h=qR and fixed point qR=1	Chosen by matching	Compatibility of the packet fixed point with the Koide locus	R_K and the adopted flow law	Active effective coefficient, not microscopic
R4-053	q	General support/collapse strength	Dimensionless	h_{eq}=qR; q is free before setting $q=q_K$.	Packet stabilization flow	Free	Effective model parameter	Packet action not derived	Free in the general effective flow
R4-054	h_*	Equilibrium support response	Dimensionless	h_*=qR_*=1.	Support response and phase invariant	Derived from dynamics	Algebraic consequence of the adopted h=qR and R*=1/q flow	Effective flow law	Exact within effective dynamics
R4-055	τ_h	Support-response delay	Flow-time units	τ_h dh/ds=qR-h.	Auxiliary response dynamics	Free	Introduced effective timescale	Flow parametrization	Active effective parameter
R4-056	n_{gate}	Deficit-gate exponent	Dimensionless exponent	Brake factor is linear in the deficit/rank response; $n_{gate}=1$.	Packet flow	Constitutive	Selected as the minimal gate	Alternative nonlinear gates	Active effective choice
R4-057	k_τ	Proper-time weight exponent	Dimensionless exponent	$k_\tau=2$.	Weighted minimal-diamond sum	Fixed by mathematical normalization	Asymptotic continuum scaling	Alexandrov geometry and adopted observable	Active exact within construction
R4-058	r_{ren}	Density renormalization power	Dimensionless exponent	$r_{ren}=1/2$.	N^{-r} weighted response	Fixed by mathematical normalization	Asymptotic scaling	Chosen observable and near-null shell	Active exact within construction
R4-059	ξ_6	Six-bivector response coefficient	Dimensionless in adopted normalization	$\xi_6=51/[1400\sqrt{\pi}]$.	Full bivector collapse response	Fixed by mathematical normalization	Exact Alexandrov volume, occupancy, internal moment, and null-ray integral	d=4 and adopted minimal-diamond observable	Active exact within construction
R4-060	c_{EM}	Electric-magnetic triplet split	Dimensionless	$\xi_3=c_{EM}\,\xi_6$, $c_{EM}=1/2$.	Protected triplet susceptibility	Derived from symmetry	Hodge/electric-magnetic sector equipartition	d=4 and null-bivector leading response	Active exact within construction
R4-061	ξ_3	Protected-triplet susceptibility	Dimensionless	$\xi_3=\xi_6/2=51/[2800\sqrt{\pi}]$.	Packet support response	Composite derived	ξ_6 and c_EM=1/2	ξ_6, sector decomposition	Active exact within construction
R4-062	A_{pkt}	Full packet collapse amplitude	Dimensionless	$A_{pkt}=\beta_{pkt}\,\xi_6=q_K/\xi_3$.	Packet energy and stabilization strength	Composite derived	Algebraic combination after adopting q_K and triplet identification	q_K, ξ_3, ξ_6	Active conditional composite
R4-063	β_{pkt}	Microscopic packet action coefficient	Dimensionless in adopted action normalization	$\beta_{pkt}=q_K/(\xi_6\xi_3)=A_{pkt}/\xi_6$.	Packet collapse field	Composite derived	Solved from the constitutive requirement $q=\beta\xi_6\xi_3$=q_K	q_K, ξ_6, ξ_3	Active conditional coefficient
R4-064	α_{quad}	Quadratic packet-energy coefficient	Dimensionless	$\alpha_{quad}=3/(\pi A_{pkt})$.	E_quad=α_quad v_EW	Composite derived	Algebraic normalization of the adopted packet/Wilson construction	A_pkt, three sectors, 1/π phase normalization	Active conditional composite
R4-065	v_{EW}	Electroweak symmetry-breaking scale	GeV	v_{EW}=246.21965 GeV.	E_quad and E_packet	Imported from experiment	Established electroweak input	Standard Model convention/scheme	External input
R4-066	c_{flavor}	Protected flavor-component count	Count	$E_{quad}=[3/(\pi A_{pkt})]v_{EW}$.	Packet energy	Derived from symmetry	Adopted three-sector architecture	Protected rank-two sector count	Active conditional structural integer
R4-067	c_{phase}	Wilson phase-normalization factor	Dimensionless	$E_{quad}=3v_{EW}/(\pi A_{pkt})$.	Packet energy	Constitutive	Adopted closed-Wilson phase normalization	Response-to-connection identification and exposure convention	Active conditional normalization
R4-068	c_U	Normalized central U(2) generator coefficient	Dimensionless	$U_c(\theta)=\exp(i\theta\, I_2/2)$.	Fundamental U(2) Wilson trace and determinant	Fixed by mathematical normalization	Fundamental representation convention	Chosen U(2) representation	Exact after representation choice
R4-069	c_W,quad	Quadratic Wilson coefficient	Dimensionless	$W_2(\theta)=\theta^2/4$.	Quadratic packet energy	Fixed by mathematical normalization	Taylor expansion of 2-2cos(θ/2)	c_U=1/2	Exact
R4-070	c_W,4	Leading finite-angle correction coefficient	Dimensionless	$F_W(\theta)=1-\theta^2/48+O(\theta^4)$.	Finite-holonomy correction	Fixed by mathematical normalization	Taylor expansion	Central U(2) trace	Exact
R4-071	$F_W(q_K)$	Exact Wilson dressing at Koide response	Dimensionless	$F_W(q_K)=16\sin^2(q_K/4)/q_K^2$.	E_packet=E_quad F_W(q_K)	Composite derived	Wilson trace plus constitutive θ=q_K	q_K and response-connection law	Conditional exact composite
R4-072	δ_c	Subordinate determinant-phase coefficient	Dimensionless	Relative phase $\Delta=3\varphi_\ell-\delta_c h$ with $\delta_c=2/3$.	Γ_∂=-λρ³cos(3φ_ℓ-2h/3)	Derived from symmetry	Determinant-line trace/exponent in the selected minimal invariant	Chosen exterior-square representation and constitutive phase lift	Exact within the effective invariant

ID	Symbol	Name	Units	Value / formula	Appears in	Class	Fixed by	Dependencies	Present status
R4-073	λ_φ	D_3 phase-locking stiffness	Energy/action units	$\Gamma\_\partial=-\lambda_\varphi\,\rho^3\cos(3\varphi_\ell-2h/3)$, $\lambda_\varphi>0$.	Flavor-phase potential	Free	No microscopic value derived	Boundary interaction scale	Free but stationary location independent for positive λ_φ
R4-074	λ_n	Higher-harmonic phase coefficients	Action units	$\Gamma\_\partial=-\Sigma_n\geq1\lambda_n\,\rho^{3n\cos}(n\Delta)$.	Phase robustness analysis	Free	Unspecified effective coefficients	UV completion / additional fields	Optional effective family
R4-075	φ_*	Principal flavor azimuth	Radians	φ_*=2h_*/9=2/9 rad.	Koide-circle mass ratios	Composite derived	Stationarity of the effective D_3 potential and h_*=1	δ_c, h_*, principal branch	Conditional effective prediction
R4-076	Δs_{exp}	Packet-flow step size	Flow-time units	Finite step used in packet trajectories.	Packet experiments	Numerical control parameter	Chosen for integration	Flow solver and tolerance	Purely numerical
R4-077	ε_{close}	Triplet-closure tolerance	Dimensionless	Leakage/closure observable must lie below a declared ε_{close}; exact universal value is not yet frozen.	Packet-selection gate	Numerical control parameter	Preregistered acceptance choice	Chosen closure norm	Active audit control, not a physical constant
R4-078	q_0	Common determinant charge	Charge units	$q_0=(1,1,1)$; each determinant line carries unit common charge.	Determinant-line gauge action	Derived from symmetry	Exterior-square determinant representation	Protected rank-two sectors	Active exact representation coefficient
R4-079	q_{root}	Relative root charges	Charge units	Root vectors are differences e_a-e_b with entries 0,±1.	Relative flavor-plane currents	Derived from symmetry	A_2 root system of line differences	Three determinant lines	Active exact representation coefficients
R4-080	c_{frame}	Center-root tight-frame coefficient	Dimensionless	$q_0q_0^T+BB^T=3I_3$.	Invariant determinant-line metric	Fixed by mathematical normalization	Exact representation identity	q_0 and A_2 roots	Active exact
R4-081	a_{bare}	Bare single-trace determinant metric coefficient	Normalized quadratic units	$G_W=a_{bare}\,I_3+b_{bare}\,J_3$ with $a_{bare}=1$.	Bare determinant-line action	Fixed by mathematical normalization	Protected-block Wilson Hessian and half-angle normalization	Chosen trace normalization	Active exact bare coefficient
R4-082	b_{bare}	Bare double-trace coefficient	Normalized quadratic units	$b_{bare}=0$.	Bare determinant-line action	Fixed by mathematical normalization	Single-trace protected-block Wilson action	Protected truncation	Active exact bare result
R4-083	a_D	Common-channel current coefficient	Current/curvature units	$J_\Omega=\Omega_{DW}(a_D\Pi_D+b_S\Pi_S)$.	Determinant-line source	Free	Not fixed by the stated symmetries	Future mixed action	Undetermined
R4-084	b_S	Relative-channel current coefficient	Current/curvature units	$J_\Omega=\Omega_{DW}(a_D\Pi_D+b_S\Pi_S)$.	Determinant-line source	Free	Not fixed by the stated symmetries	Future mixed action	Undetermined
R4-085	c_{lift}	Additive identity-lift coefficient	Exposure/connection units	$J_\Omega=c_{lift}\,\Omega_{DW}\,H_{supp}$; the effective model sets $c_{lift}=1$.	Determinant current and finite phase	Constitutive	Exact additivity selects the identity map only after normalization is assumed	Unit exposure and bare identity metric	Active constitutive coefficient
R4-086	T_{exp}	Normalized packet exposure	Exposure parameter	$\Theta=\int\Omega_{DW}\,H_{supp}\,d\tau$; effective construction uses normalized exposure $T_{exp}=1$.	Finite determinant-line phase	Constitutive	Adopted normalization; compactness does not fix it	Response-connection law	Active constitutive normalization
R4-087	g_{mix}	Protected-mixed wedge coupling	Model dependent	$G_{eff}=I_3-g_{mix}^2\,B\dagger M_C$^-1B.	Mixed-wedge renormalization	Derived from dynamics	Extracted from the full operator/packet but not fixed universally	Exterior-square field and packet	Physical coupling measure exists, but hierarchy is insufficient
R4-088	Δ_{mix}	Mixed-sector spectral gap	Operator units	$\eta_{mix}=2g_{mix}^2/\Delta_{mix}$; protection requires large Δ_{mix}/g_{mix}^2.	Mixed-wedge decoupling	Derived from dynamics	Measured from actual packets	Full exterior-square spectrum	Active measured quantity; requirement fails
R4-089	ε_{ratio}	Response-ratio protection tolerance	Dimensionless	$\lvert\rho_{eff}/q_K-1\rvert\leq10^{-3}$.	Mixed-wedge pass/fail test	Numerical control parameter	Preregistered scientific tolerance	Desired charged-lepton response accuracy	Audit criterion, not a physical constant
R4-090	H_{req}	Required decoupling hierarchy	Dimensionless ratio	$\Delta_{mix}/g_{mix}^2\gtrsim421.9$ for $\varepsilon_{ratio}=10^{-3}$.	M6Q/M6S protection test	Composite derived	Algebraic consequence of the isotropic model and fixed tolerance	ε_ratio and correction formula	Active exact requirement within the model
R4-091	ε_{gauge}	Gauge-invariance numerical tolerance	Dimensionless	Gauge error $\leq10^{-10}$.	M6I-M6J validation	Numerical control parameter	Machine-precision audit choice	Floating-point implementation	Numerical tolerance
R4-092	n_{area}	Berry-rectangle area-law exponent	Dimensionless exponent	$\lvert\Theta\rvert\propto\varepsilon^n{}_{area}$, expected $n_{area}=2$.	Infinitesimal Berry rectangles	Fixed by mathematical normalization	Two-dimensional infinitesimal area law	Smooth local curvature	Active local geometric result
R4-093	n_{area},min	Lower accepted local scaling exponent	Dimensionless	$1.7\leq d\log\lvert\Theta\rvert/d\log\varepsilon\leq2.3$.	Local curvature fit acceptance	Numerical control parameter	Preregistered spread band	Finite-step fitting	Audit tolerance
R4-094	n_{area},max	Upper accepted local scaling exponent	Dimensionless	$1.7\leq d\log\lvert\Theta\rvert/d\log\varepsilon\leq2.3$.	Local curvature fit acceptance	Numerical control parameter	Preregistered spread band	Finite-step fitting	Audit tolerance
R4-095	k_‖	Dominant compact-phase stiffness	Action units	General action permits independent k_‖ and k_⊥.	Candidate compact phase dynamics	Free	New field-extension coefficient	Two-phase completion	Not adopted
R4-096	k_⊥	Subordinate compact-phase stiffness	Action units	Independent of k_‖ in the general action.	Candidate compact phase dynamics	Free	New field-extension coefficient	Two-phase completion	Not adopted

ID	Symbol	Name	Units	Value / formula	Appears in	Class	Fixed by	Dependencies	Present status
R4-097	ϑ_{ch}	Selected chiral cancellation phase	Radians	A quarter-phase/odd propagator can be chosen to force cancellation.	Candidate graded/chiral protection	Chosen by matching	Selected to cancel a target correction	Enlarged partner structure	Rejected as native mechanism
R4-098	N_{MC},C3	C3 Monte Carlo count	Count	N_{MC},C3=3000 simulations per ensemble.	C3 percentile estimation	Numerical control parameter	Computational design	Available resources and percentile precision	Primary reported high-stat control
R4-099	N_{pair},C3	C3 random pixel-pair count	Count	N_{pair},C3=500000.	Direct C(θ) estimator	Numerical control parameter	Computational design	Map resolution and binning	Primary high-stat control
R4-100	N_{bin},θ	Angular-bin count	Count	N_{bin},θ=60.	Direct angular correlation estimator	Numerical control parameter	Analysis design	θ range and pair count	Numerical control
R4-101	$NSIDE_{C2}$	HEALPix resolutions	HEALPix resolution	NSIDE∈32,64.	Map degradation and pseudo-C_ℓ	Numerical control parameter	Analysis design	Map and mask pipeline	Robustness controls
R4-102	t_{mask}	Planck degraded-mask thresholds	Dimensionless	t_{mask}∈0.80,0.90,0.95.	Masked map processing	Numerical control parameter	Analysis design	Planck masks	Robustness controls
R4-103	N_{step},pkt	Packet-flow iteration count	Iterations	Representative reporting at steps 0,300,600,1000.	Stabilization convergence	Numerical control parameter	Simulation design	Step size and solver	Numerical diagnostic
R4-104	u_{fail}	Under-collapsed residual fraction	Fraction	Approximately 18% remain under-collapsed at the reported intermediate/final audit stage.	Basin-membership result	Numerical control parameter	Observed ensemble result, not a coefficient	Packet ensemble and closure criteria	Numerical outcome

Appendix C - Coefficient Status Ledger

The primary classification reports the source of the value, not its numerical precision. Composite exact values inherit every unresolved assumption in their dependencies.

bol	Name	Sector	Value / formula	Decimal	Units	Primary classification	Evidence	Fixed by	Dependencies	Present status	Promotion gate
	Entropy normalization multiplier	Quantum coherence	α_{ME} is fixed by $\int p(\varphi)d\varphi=1$; equivalently $\exp(\alpha_{ME}-1)=1/Z(\kappa)$.		Dimensionless	**Fixed by mathematical normalization**	[THM]+[EXT]	Probability normalization	κ_{coh} and $Z(\kappa)$	Active mathematical coefficient	No promotion needed; keep the physical origin of the constraint separate.
	Von Mises coherence concentration	Quantum coherence	$p(\varphi)=\exp[\kappa_{coh}\cos(\varphi-\mu)]/[2\pi I_0(\kappa_{coh})]$.		Dimensionless	**Constitutive**	[DEF]+[THM]	Fixed by the imposed first circular moment, but not by a frozen microscopic action	Mean resultant $\mathscr{R}_{coh}$	Active statistical parameter; microscopic law open	Derive κ_{coh} from the frozen history/action measure rather than identify it with record count by assertion.
	Coherence-to-record scaling coefficient	Quantum coherence	$\kappa_{coh}=c_\kappa N_{rec}$; the paper sets $c_\kappa=1$.	1	Dimensionless	**Constitutive**	[CONJ]+[OPEN]	Chosen by the identification of inverse phase variance with record count	Poisson fluctuation model; independent-record assumption	Active conditional scaling hypothesis	Derive c_κ from the microscopic measure and show universality across admissible substrates.
	Von Mises partition function	Quantum coherence	$Z_\kappa=2\pi I_0(\kappa_{coh})$.		Dimensionless	**Fixed by mathematical normalization**	[THM]+[EXT]	Integration over S^1	κ_{coh}	Active exact function	No promotion needed.
	Coherence visibility factor	Quantum coherence	$\eta_{coh}(\kappa)=I_1(\kappa)/I_0(\kappa)$.		Dimensionless	**Fixed by mathematical normalization**	[THM]+[EXT]	Circular moment identity	κ_{coh}	Active exact function within the assumed distribution	Retain exact status only for the visibility moment.
	Large-coherence deficit coefficient	Quantum coherence	$1-\eta_{coh}(\kappa)=c_\varepsilon/\kappa+O(\kappa^{-2})$, with $c_\varepsilon=1/2$; after $\kappa=N$, $\varepsilon\approx1/(2N)$.	0.5	Dimensionless	**Fixed by mathematical normalization**	[THM]+[EXT]	Asymptotic expansion of I_1/I_0	κ_{coh}; conditional $c_\kappa=1$	Exact asymptotic coefficient; physical $\varepsilon(N)$ conditional	Keep c_ε exact but mark $\varepsilon=1/(2N)$ conditional.
	Cosine-correlator amplitude	Quantum foundations	$E_{corr}(x,y)=c_{cos}\,\eta_{coh}\cos\theta$; the papers set $c_{cos}=1$.	1	Dimensionless	**Constitutive**	[OPEN]	Inserted/inherited cosine law rather than derived $P(a,b\mid x,y)$	Missing joint probability law	Foundationally open	Derive c_{cos} and the cosine dependence from a positive normalized no-signalling probabil
	Tsirelson target	Quantum foundations	$S_T=2\sqrt{2}$.	2.82842712474619	Dimensionless	**Imported from experiment**	[EXT]	Established quantum theory / experiment, not IRMT	Derived future $P(a,b\mid x,y)$	External target, not an IRMT coefficient	Prove the IRMT probability set excludes supraquantum correlatio and reaches this bound in the state limit.
	Poisson sprinkling density	Causal substrate	$\rho_{spr}=\ell_c$^-d; Paper I specializes to $\rho=\ell_P$^-4.		L^-d	**Constitutive**	[DEF]+[OPEN]	Primitive density or identification with a discreteness scale	d and ℓ_c	Primitive/open normalization	State whether ρ_{spr} is primitive, summed over, or fixed by matchin
	Relational Unity strength	Foundations	S_U may carry an overall coefficient λ_U; no canonical value is frozen.		Action dependent	**Free**	[OPEN]	Not specified in the corpus	Complete history measure	Undefined coefficient	Freeze the unity functional and determine whether λ_U is redunda quantized, or physical.
	Diamond-Wilson coupling	Gauge transport	$S_W=\beta_W\,\Sigma\_\diamond\,\mathrm{ReTr}(I-U\_\diamond)$.		Dimensionless in lattice units	**Free**	[DEF]+[OPEN]	Introduced as a coupling parameter	Gauge group, representation, trace convention	Active but not derived	Derive or match β_W only after th physical gauge group and trace normalization are fixed.
	Combinatorial irreducible-diamond density	Gauge / gravity	$N\_\diamond=\xi\_\diamond\,\rho_{spr}\,V$.		Dimensionless	**Numerical control parameter**	[NUM]+[OPEN]	Requires causal-set combinatorial computation	Dimension d, sprinkling process, minimal-diamond definition	Uncomputed or historically estimated	Compute $\xi_\diamond$ with a frozen causal ensemble and uncertainty budget.
	Isotropic bivector-average coefficient	Gauge continuum	$\langle\Sigma^{\mu\nu}\Sigma^{\alpha\beta}\rangle=(a^4/24)(g^{\mu\alpha g\nu\beta}-g^{\mu\beta g\nu\alpha})$.	0.0416666666666667	a^4	**Fixed by mathematical normalization**	[THM]+[EXT]	Four-dimensional isotropic bivector average	Dimension and loop convention	Exact within adopted isotropic continuum model	Verify the coefficient under the act causal-diamond distribution.
	Continuum gauge coupling	Gauge continuum	$g_{YM}^2=12\,\beta_W\,\xi\_\diamond$.		Dimensionless in d=4	**Composite derived**	[THM]+[OPEN]	Algebraic matching of the adopted Wilson expansion	β_W, $\xi_\diamond$, representation trace normalization	Conditional continuum relation	Demonstrate controlled converger and independently fix β_W and ξ
	Representation trace index	Gauge representation	$\mathrm{Tr}_R(T_{aTb})=T(R)\delta_{ab}$.		Dimensionless	**Derived from symmetry**	[EXT]+[THM]	Chosen representation	Gauge group and representation R	Exact after representation choice	Derive the physical representation content before claiming physical normalization.
	Quadratic loop-torsion stiffness	Gauge precursor	$S_{loop}=\kappa_g\,\Sigma\_\square\Theta\_\square^2$.		Action dependent	**Free**	[CON]	Introduced phenomenologically	Relation to β_W not frozen	Deprecated precursor	Identify κ_g as the small-angle limi β_W or retire it.
	Record-geometry attachment coupling	Geometry	$P(x\prec y\mid\rho_{rec})=P_0[1+\lambda_{RG}\,F(\rho_{rec}(x),\rho_{rec}(y))]$.		Inverse units of F	**Free**	[CONJ]+[OPEN]	No derivation or calibration	Choice of F and positivity constraints	Programmatic / inactive	Derive from a normalized causal action or transition probability.
	Causal lattice/discreteness length in Wilson expansion	Gauge / causal set	$\Sigma^{\mu\nu}=O(a_c^2)$; loop area terms scale as a_c^4.		Length	**Constitutive**	[DEF]+[OPEN]	Primitive discreteness choice	ρ_{spr} and ℓ_c	Open primitive scale	Unify a_c with ℓ_c and state wheth it is derived or externally matched
	Historical UV-matched gauge coefficient	Gauge running	$\beta_{UV}=g_{bare}^2/[12\,\xi_{density}]\approx1.04\times10^4$.	10400	Dimensionless	**Chosen by matching**	[SUP]+[EXT]	Matched to approximate Planck-scale gauge coupling	$g_{bare}^2\approx0.5$ and $\xi_{density}\approx2.3\times10^{-3}$	Historical / superseded as a closure claim	Rename β_{UV} and retain only as a historical matched proposal.

bol	Name	Sector	Value / formula	Decimal	Units	Primary classification	Evidence	Fixed by	Dependencies	Present status	Promotion gate
	Historical local diamond density estimate	Gauge running	$\xi_{density}\approx 2.3\times 10^{-3}$.	0.0023	Dimensionless	**Numerical control parameter**	[SUP]+[NUM]	Historical estimate attributed to earlier work	Causal ensemble and local record count	Historical and not independently established	Recompute from the frozen causal ensemble or remove from active formulas.
	Planck-scale bare gauge coupling	Gauge running	$g_{bare}^2\approx 0.5$.	0.5	Dimensionless	**Imported from experiment**	[SUP]+[EXT]	Approximate GUT/QFT running input	E_GUT and α_GUT	Historical external input	Use an up-to-date, group-specific R analysis if the route is revived.
	Unification fine-structure estimate	Gauge running	$\alpha_{GUT}\approx 1/25$.	0.04	Dimensionless	**Imported from experiment**	[SUP]+[EXT]	Approximate GUT model input	Chosen unification scenario	Historical	Specify the model and RG scheme before reuse.
	Grand-unification scale	Gauge running	$E_{GUT}\approx 2\times 10^{16}$ GeV.	2e16	GeV	**Imported from experiment**	[SUP]+[EXT]	Approximate model-dependent GUT scale	Chosen BSM running	Historical	Specify a concrete unification mod
	Quartic energy-scaling exponent	Gauge running	$g_{IRMT}^2(E)\propto(E/E_{Pl})^{n}{}_{E}$, $n_E=4$.	4	Dimensionless exponent	**Derived from dynamics**	[SUP]+[CONJ]	Dimensional causal-diamond counting	Assumed τ∼ℏ/E and four-dimensional record count	Historical / unsupported as physical running	Derive from the frozen causal proc and reconcile with continuum RG.
	Relational Dirac link weights	Dirac kinematics	D_{rel} contains w_{ij} times Clifford/transport factors.		L^-1 or lattice units	**Free**	[DEF]+[OPEN]	Benincasa-Dowker-inspired choice, not uniquely selected	Causal layers, orientation, ℓ_c	Active but not frozen	Freeze one operator and derive or justify all link weights.
	chGUE variance	Historical spectral model	Matrix-entry variance setting the chGUE bulk scale.		Operator^2	**Numerical control parameter**	[SUP]	Ensemble convention	Matrix size and normalization	Retired	Keep only in retired-model appendices.
	Marchenko-Pastur aspect ratio	Historical measurement/spectral	$c_{MP}=p/n$ or the paper's matrix-dimension ratio.		Dimensionless	**Numerical control parameter**	[SUP]+[EXT]	Chosen ensemble dimensions	Superseded random-matrix architecture	Retired	Retain only for reconstruction of tl failed argument.
	BBP perturbation strength	Historical generations	$D=D_0+\theta_{BBP}$ V.		Operator units	**Free**	[SUP]	Chosen perturbation	chGUE bulk and rank	Retired	Exclude from active generation claims.
	Pauli Frobenius amplitude	Koide historical geometry	$r_F=\lVert\sigma_a\rVert_F=\sqrt{2}$.	1.4142135623731	Dimensionless	**Fixed by mathematical normalization**	[THM]+[CON]	Pauli Frobenius norm; physical identification additionally assumed	Cl(3) representation and BBP amplitude interpretation	Exact norm, conditional physical identification	Derive why the mass/packet amplitude equals this norm.
	Measurement threshold	Measurement	κ_c is identified from a Marchenko-Pastur/BBP edge.		Dimensionless	**Derived from dynamics**	[SUP]	Superseded spectral architecture	c_MP and chGUE assumptions	Retired	No promotion; reconstruct measurement from the revised theory.
	Observational projector rank	Measurement	rank $\Pi_{obs}=3$.	3	Count	**Derived from symmetry**	[SUP]	Claimed from d=3 Poisson/Clifford geometry	Superseded measurement architecture	Retired quantitative claim	Re-derive from the new state space and probability theory.
	Random phase-increment variance	Measurement	$\mathrm{Var}(\delta\varphi_n)=\sigma_\varphi^2$.		Angle^2 per step	**Free**	[SUP]	Assumed increment distribution	Numerical step and environment model	Retired	Keep only for historical reproducti
	Spectral-feedback local weight	Spectral self-organization	$U_e{}^t+1=\mathscr{P}[\alpha_{fb}\,U_e{}^{local}+\beta_{fb}\,U_e{}^{neighbor}+\gamma_{fb}\,Q_e$(low modes)].		Dimensionless	**Numerical control parameter**	[NUM]	Chosen experimental hyperparameter	β_fb, γ_fb, projection 𝒫	Experimental only	Derive from a variational action or demonstrate parameter-insensitive universality.
	Spectral-feedback neighbor weight	Spectral self-organization	Neighbor-averaging coefficient in the feedback update.		Dimensionless	**Numerical control parameter**	[NUM]	Chosen experimental hyperparameter	α_fb, γ_fb	Experimental only	Same gate as α_fb.
	Spectral-feedback eigenmode weight	Spectral self-organization	Coefficient multiplying the low-eigenmode contribution Q_e.		Dimensionless	**Numerical control parameter**	[NUM]	Chosen experimental hyperparameter	α_fb, β_fb, n_low	Experimental only	Find a dynamical action selecting or show robust behavior across a preregistered range.
	Number of low modes in feedback	Spectral self-organization	Q_e uses n_{low} selected low-lying eigenmodes.		Count	**Numerical control parameter**	[NUM]	Chosen experimental design	Graph size and spectral window	Experimental	Demonstrate scale-invariant select or derive a spectral cutoff.
	Feedback iteration step	Spectral self-organization	Numerical update magnitude before projection.		Iteration units	**Numerical control parameter**	[NUM]	Chosen for numerical stability	Update normalization	Purely numerical	Pass step-size and subdivision aud before any physical interpretation
	Benincasa-Dowker layer coefficients	Gravity	$S_{BD}\propto N-N_0-9N_1+16N_2-8N_3$.		Dimensionless vector	**Fixed by mathematical normalization**	[EXT]	Imported causal-set theorem	d=4 and BD conventions	External/imported	Verify applicability to the actual IR ensemble.
	BD overall prefactor	Gravity	$S_{BD}=(4\hbar/\sqrt{6})\ell_c$^-2[...].	1.63299316185545	Action × L^2 / ħ	**Fixed by mathematical normalization**	[EXT]	Imported BD normalization	d=4 and action convention	External/imported	Control the continuum limit under the frozen IRMT causal ensemble.
	Stress-tensor coarse-graining normalization	Gravity	Paper VII fixes η_T using ℓ_c and ξ_◇; exact fraction requires typesetting verification.		Length / density dependent	**Constitutive**	[CON]+[OPEN]	Dimensional analysis plus analogy with kinetic theory	ℓ_c, ξ_◇, flux units	Conditional normalization	Re-derive from a controlled discre to-continuum measure and verify exact printed formula.
	Einstein-Hilbert coupling convention	Gravity	$G_N=\ell_c^2/(16\pi)$ in Paper VII's normalization.	0.0198943678864869	Dimensionless multiplier of ℓ_c^2	**Fixed by mathematical normalization**	[EXT]+[CON]	Matching to the imported Einstein-Hilbert convention	BD normalization and identification of ℓ_c	Conditional, not a unique IRMT derivation	Prove convergence of the actual IR operator/action and independently ℓ_c.
	Fundamental discreteness scale	Gravity / causal set	$G_N=c_G\,\ell_c^2$; Paper VII then sets $\ell_c=\ell_P$ for comparison.		Length	**Chosen by matching**	[DEF]+[EXT]	Identified with the Planck length	Observed G_N	Primitive scale externally anchored	Either derive ℓ_c from the theory o state it as the sole external gravitational input.
	Coherence correction coefficient in G_eff	Gravity	$G_{eff}=G_N/(1-\varepsilon_{coh})\approx G_N(1+c_{G,coh}\,\varepsilon_{coh})$, $c_{G,coh}=1$.	1	Dimensionless	**Constitutive**	[CON]+[OPEN]	Chosen coherence weighting of S_BD	ε_coh and weighted-action prescription	Conditional bridge	Derive the weighted gravitational action from one microscopic theor

bol	Name	Sector	Value / formula	Decimal	Units	Primary classification	Evidence	Fixed by	Dependencies	Present status	Promotion gate
	Cosmological constant / vacuum maintenance term	Gravity / cosmology	$G_{\mu\nu}+\Lambda_{cos}\, g_{\mu\nu}=8\pi G_{eff}\, T_{\mu\nu}$; Λ_{cos} is interpreted as vacuum maintenance flux.		L^-2	**Free**	[EXT]+[CONJ]	No microscopic calculation	Vacuum update-flux model	Open external/effective parameter	Derive the vacuum term or clearly import the observed cosmological constant.
	Matter-geometry coupling normalization	Gravity	T_{eff} or ρ_{matter} is identified with a function of λ_n and ψ_n with an implicit unit coefficient.		Model dependent	**Constitutive**	[CON]+[OPEN]	Analogy and dimensional normalization	D_rel normalization and coarse-graining	Conditional	Derive by variation of a unified matter-geometry action.
	Matter-density prior	Cosmology	Gaussian prior centered at $\Omega_m\approx0.315$ with width ≈0.02.	0.315	Dimensionless	**Imported from experiment**	[EXT]+[NUM]	Standard cosmological prior	Selected data analysis	External analysis input	No promotion; report exact source and prior width.
	Dark-energy-running amplitude	Cosmology	One-parameter running amplitude; fit collapses to $\alpha_{DE}=0$.	0	Dimensionless	**Chosen by matching**	[NUM]	Likelihood fit to Pantheon+	Selected running ansatz	Rejected route	Retain as a negative result only.
	Locked CMB finite-coherence amplitude	CMB	$F_\ell=1-\alpha_{CMB}\exp[-(\ell-2)/L_H]$, $\alpha_{CMB}=0.5846153846$.	0.5846153846	Dimensionless	**Chosen by matching**	[NUM]+[CON]	C1 calibration to the target statistic	C1 grid and selected kernel form	Active calibrated phenomenological coefficient	Derive α_CMB from the substrate; until then report it as calibration.
	Locked CMB recovery length	CMB	$L_H=5.7948717949$ (reported approximately as 5.8).	5.7948717949	Multipole units	**Chosen by matching**	[NUM]+[CON]	C1 calibration	Kernel form and C1 target	Active calibrated phenomenological coefficient	Derive from a microscopic horizon/coherence scale.
	Koide geometric value	Koide geometry	$K_*=2/3$.	0.666666666666667	Dimensionless	**Fixed by mathematical normalization**	[THM]+[EXT]	Algebraic geometry of the chosen triplet parametrization	Physical selection of the locus remains separate	Active exact geometric value	Derive why the physical packet occupies this locus.
	Koide rank concentration	Packet geometry	$R_K=(1+\sqrt{2})/3$.	0.804737854124365	Dimensionless	**Fixed by mathematical normalization**	[THM]	Algebraic solution of K(R)=2/3	Closed pair-symmetric trajectory	Active exact coordinate	No promotion needed; retain the closure assumptions.
	Koide stabilization coefficient	Packet dynamics	$q_K=1/R_K=3(\sqrt{2}-1)$.	1.24264068711929	Dimensionless	**Chosen by matching**	[THM]+[CON]	Compatibility of the packet fixed point with the Koide locus	R_K and the adopted flow law	Active effective coefficient, not microscopic	Construct an untuned packet actio whose stable solution yields q_K.
	General support/collapse strength	Packet dynamics	$h_{eq}=qR$; q is free before setting $q=q_K$.		Dimensionless	**Free**	[CON]	Effective model parameter	Packet action not derived	Free in the general effective flow	Derive q from microscopic susceptibilities without using the Koide target.
	Equilibrium support response	Packet dynamics	$h_*=qR_*=1$.	1	Dimensionless	**Derived from dynamics**	[THM]+[CON]	Algebraic consequence of the adopted h=qR and R*=1/q flow	Effective flow law	Exact within effective dynamics	Keep h_*=1 as a response amplituc separately derive its connection interpretation.
	Support-response delay	Packet dynamics	$\tau_h\, dh/ds=qR-h$.		Flow-time units	**Free**	[CON]	Introduced effective timescale	Flow parametrization	Active effective parameter	Derive a kinetic term or show predictions are insensitive across a physical range.
	Deficit-gate exponent	Packet dynamics	Brake factor is linear in the deficit/rank response; $n_{gate}=1$.	1	Dimensionless exponent	**Constitutive**	[CON]	Selected as the minimal gate	Alternative nonlinear gates	Active effective choice	Derive the gate from the microscop packet action or test universality against other exponents.
	Proper-time weight exponent	Diamond response	$k_\tau=2$.	2	Dimensionless exponent	**Fixed by mathematical normalization**	[THM]+[NUM]	Asymptotic continuum scaling	Alexandrov geometry and adopted observable	Active exact within construction	Replicate analytic and high-density limits independently.
	Density renormalization power	Diamond response	$r_{ren}=1/2$.	0.5	Dimensionless exponent	**Fixed by mathematical normalization**	[THM]+[NUM]	Asymptotic scaling	Chosen observable and near-null shell	Active exact within construction	Independent replication and alternative-discretization test.
	Six-bivector response coefficient	Diamond response	$\xi_6=51/[1400\sqrt{\pi}]$.	0.0205526205435	Dimensionless in adopted normalization	**Fixed by mathematical normalization**	[THM]+[NUM]	Exact Alexandrov volume, occupancy, internal moment, and null-ray integral	d=4 and adopted minimal-diamond observable	Active exact within construction	Independent analytic and computational replication.
	Electric-magnetic triplet split	Diamond response	$\xi_3=c_{EM}\,\xi_6$, $c_{EM}=1/2$.	0.5	Dimensionless	**Derived from symmetry**	[THM]+[NUM]	Hodge/electric-magnetic sector equipartition	d=4 and null-bivector leading response	Active exact within construction	Verify beyond leading continuum order and across admissible sector
	Protected-triplet susceptibility	Diamond response	$\xi_3=\xi_6/2=51/[2800\sqrt{\pi}]$.	0.0102763102718	Dimensionless	**Composite derived**	[THM]+[NUM]	ξ_6 and c_EM=1/2	ξ_6, sector decomposition	Active exact within construction	Show the physical protected packe exactly the sector carrying this susceptibility.
	Full packet collapse amplitude	Charged-lepton scale	$A_{pkt}=\beta_{pkt}\,\xi_6=q_K/\xi_3$.	120.922846260668	Dimensionless	**Composite derived**	[THM]+[CON]	Algebraic combination after adopting q_K and triplet identification	q_K, ξ_3, ξ_6	Active conditional composite	Derive q_K and the packet susceptibility from one action.
	Microscopic packet action coefficient	Charged-lepton scale	$\beta_{pkt}=q_K/(\xi_6\xi_3)=A_{pkt}/\xi_6$.	5883.57314360877	Dimensionless in adopted action normalization	**Composite derived**	[CON]+[THM]	Solved from the constitutive requirement $q=\beta\xi_6\xi_3=q_K$	q_K, ξ_6, ξ_3	Active conditional coefficient	Generate β_pkt from the unified packet action without imposing q_
	Quadratic packet-energy coefficient	Charged-lepton scale	$\alpha_{quad}=3/(\pi A_{pkt})$.	0.00789701605677452	Dimensionless	**Composite derived**	[THM]+[CON]	Algebraic normalization of the adopted packet/Wilson construction	A_pkt, three sectors, 1/π phase normalization	Active conditional composite	Derive the factor 1/π and packet normalization from the microscop action.
	Electroweak symmetry-breaking scale	Charged-lepton scale	$v_{EW}=246.21965$ GeV.	246.21965	GeV	**Imported from experiment**	[EXT]	Established electroweak input	Standard Model convention/scheme	External input	No promotion; specify scheme and uncertainty.
	Protected flavor-component count	Charged-lepton scale	$E_{quad}=[3/(\pi A_{pkt})]v_{EW}$.	3	Count	**Derived from symmetry**	[THM]+[DEF]	Adopted three-sector architecture	Protected rank-two sector count	Active conditional structural integer	Derive sector multiplicity from the frozen state space/action.

bol	Name	Sector	Value / formula	Decimal	Units	Primary classification	Evidence	Fixed by	Dependencies	Present status	Promotion gate
	Wilson phase-normalization factor	Charged-lepton scale	$E_{quad}=3v_{EW}/(\pi A_{pkt})$.	0.318309886183791	Dimensionless	Constitutive	[CON]	Adopted closed-Wilson phase normalization	Response-to-connection identification and exposure convention	Active conditional normalization	Derive the phase/exposure normalization from a compact microscopic action.
	Normalized central U(2) generator coefficient	Holonomy / scale	$U_c(\theta)=\exp(i\theta\, I_2/2)$.	0.5	Dimensionless	Fixed by mathematical normalization	[THM]+[DEF]	Fundamental representation convention	Chosen U(2) representation	Exact after representation choice	Derive why this representation is physically selected.
	Quadratic Wilson coefficient	Holonomy / scale	$W_2(\theta)=\theta^2/4$.	0.25	Dimensionless	Fixed by mathematical normalization	[THM]	Taylor expansion of 2-2cos(θ/2)	c_U=1/2	Exact	No promotion needed.
	Leading finite-angle correction coefficient	Holonomy / scale	$F_W(\theta)=1-\theta^2/48+O(\theta^4)$.	0.0208333333333333	Dimensionless	Fixed by mathematical normalization	[THM]	Taylor expansion	Central U(2) trace	Exact	No promotion needed.
	Exact Wilson dressing at Koide response	Charged-lepton scale	$F_W(q_K)=16\sin^2(q_K/4)/q_K^2$.	0.968241205779502	Dimensionless	Composite derived	[THM]+[CON]	Wilson trace plus constitutive $\theta=q_K$	q_K and response-connection law	Conditional exact composite	Derive $\theta=q_K$ from the microscopic connection dynamics.
	Subordinate determinant-phase coefficient	Flavor phase	Relative phase $\Delta=3\varphi_\ell-\delta_c\, h$ with $\delta_c=2/3$.	0.666666666666667	Dimensionless	Derived from symmetry	[THM]+[CON]	Determinant-line trace/exponent in the selected minimal invariant	Chosen exterior-square representation and constitutive phase lift	Exact within the effective invariant	Derive the determinant phase from the microscopic connection and establish uniqueness against competing invariants.
	D_3 phase-locking stiffness	Flavor phase	$\Gamma_\partial=-\lambda_\varphi\, \rho^3\cos(3\varphi_\ell-2h/3)$, $\lambda_\varphi>0$.		Energy/action units	Free	[CON]	No microscopic value derived	Boundary interaction scale	Free but stationary location independent for positive λ_φ	Derive from the microscopic action show all observables are stiffness independent.
	Higher-harmonic phase coefficients	Flavor phase	$\Gamma_\partial=-\Sigma_n\geq 1\lambda_n\, \rho^{3n\cos}(n\Delta)$.		Action units	Free	[CON]	Unspecified effective coefficients	UV completion / additional fields	Optional effective family	Derive suppression/alignment of a competing invariants.
	Principal flavor azimuth	Flavor phase	$\varphi_*=2h_*/9=2/9$ rad.	0.222222222222222	Radians	Composite derived	[THM]+[CON]	Stationarity of the effective D_3 potential and $h_*=1$	δ_c, h_*, principal branch	Conditional effective prediction	Derive the boundary term and response-connection law from the microscopic theory.
	Packet-flow step size	Packet numerics	Finite step used in packet trajectories.		Flow-time units	Numerical control parameter	[NUM]	Chosen for integration	Flow solver and tolerance	Purely numerical	Pass step refinement and reparameterization/subdivision audits.
	Triplet-closure tolerance	Packet numerics	Leakage/closure observable must lie below a declared ε_{close}; exact universal value is not yet frozen.		Dimensionless	Numerical control parameter	[NUM]+[OPEN]	Preregistered acceptance choice	Chosen closure norm	Active audit control, not a physical constant	Freeze one coordinate-invariant closure measure and perform sensitivity analysis.
	Common determinant charge	Exterior-square representation	$q_0=(1,1,1)$; each determinant line carries unit common charge.	1	Charge units	Derived from symmetry	[THM]	Exterior-square determinant representation	Protected rank-two sectors	Active exact representation coefficient	No promotion needed; retain representation assumptions.
	Relative root charges	Exterior-square representation	Root vectors are differences e_a-e_b with entries $0,\pm1$.		Charge units	Derived from symmetry	[THM]	A_2 root system of line differences	Three determinant lines	Active exact representation coefficients	No promotion needed.
	Center-root tight-frame coefficient	Exterior-square representation	$q_0q_0^T+BB^T=3I_3$.	3	Dimensionless	Fixed by mathematical normalization	[THM]	Exact representation identity	q_0 and A_2 roots	Active exact	Derive equality of the dynamical weights, not only the charge identi
	Bare single-trace determinant metric coefficient	Holonomy audit	$G_W=a_{bare}\, I_3+b_{bare}\, J_3$ with $a_{bare}=1$.	1	Normalized quadratic units	Fixed by mathematical normalization	[THM]	Protected-block Wilson Hessian and half-angle normalization	Chosen trace normalization	Active exact bare coefficient	Derive a consistent truncation or protection theorem.
	Bare double-trace coefficient	Holonomy audit	$b_{bare}=0$.	0	Normalized quadratic units	Fixed by mathematical normalization	[THM]	Single-trace protected-block Wilson action	Protected truncation	Active exact bare result	Protect b=0 under the full exterior square dynamics.
	Common-channel current coefficient	Holonomy audit	$J_\Omega=\Omega_{DW}(a_D\Pi_D+b_S\Pi_S)$.		Current/curvature units	Free	[THM]+[OPEN]	Not fixed by the stated symmetries	Future mixed action	Undetermined	Derive from variation of one normalized action.
	Relative-channel current coefficient	Holonomy audit	$J_\Omega=\Omega_{DW}(a_D\Pi_D+b_S\Pi_S)$.		Current/curvature units	Free	[THM]+[OPEN]	Not fixed by the stated symmetries	Future mixed action	Undetermined	Derive jointly with a_D and prove required ratio.
	Additive identity-lift coefficient	Holonomy closure	$J_\Omega=c_{lift}\, \Omega_{DW}\, H_{supp}$; the effective model sets $c_{lift}=1$.	1	Exposure/connection units	Constitutive	[CON]	Exact additivity selects the identity map only after normalization is assumed	Unit exposure and bare identity metric	Active constitutive coefficient	Derive c_lift=1 from a compact bounded mixed action and protect under mixed wedges.
	Normalized packet exposure	Holonomy closure	$\Theta=\int\Omega_{DW}\, H_{supp}\, d\tau$; effective construction uses normalized exposure $T_{exp}=1$.	1	Exposure parameter	Constitutive	[CON]+[OPEN]	Adopted normalization; compactness does not fix it	Response-connection law	Active constitutive normalization	Derive the physical exposure from causal path length, topological winding, or field dynamics.
	Protected-mixed wedge coupling	Holonomy audit	$G_{eff}=I_3-g_{mix}^2\, B^\dagger M_C$^-1B.		Model dependent	Derived from dynamics	[THM]+[NUM]+[OPEN]	Extracted from the full operator/packet but not fixed universally	Exterior-square field and packet	Physical coupling measure exists, but hierarchy is insufficient	Derive the coupling distribution ar protection mechanism from the unified action.
	Mixed-sector spectral gap	Holonomy audit	$\eta_{mix}=2g_{mix}^2/\Delta_{mix}$; protection requires large Δ_{mix}/g_{mix}^2.		Operator units	Derived from dynamics	[NUM]+[OPEN]	Measured from actual packets	Full exterior-square spectrum	Active measured quantity; requirement fails	Generate a sufficiently large invar gap in closed packets.
	Response-ratio protection tolerance	Holonomy audit	$\lvert\rho_{eff}/q_K-1\rvert\leq 10^{-3}$.	0.001	Dimensionless	Numerical control parameter	[NUM]	Preregistered scientific tolerance	Desired charged-lepton response accuracy	Audit criterion, not a physical constant	Publish sensitivity to alternative preregistered tolerances.

bol	Name	Sector	Value / formula	Decimal	Units	Primary classification	Evidence	Fixed by	Dependencies	Present status	Promotion gate
	Required decoupling hierarchy	Holonomy audit	$\Delta_{mix}/g_{mix}{}^2 \gtrsim 421.9$ for $\varepsilon_{ratio}=10^{-3}$.	421.9	Dimensionless ratio	Composite derived	[THM]+[NUM]	Algebraic consequence of the isotropic model and fixed tolerance	ε_ratio and correction formula	Active exact requirement within the model	Show the result persists for genera positive mixed-sector kernels and physical coupling measures.
	Gauge-invariance numerical tolerance	Holonomy audit	Gauge error $\leq 10^{-10}$.	1e-10	Dimensionless	**Numerical control parameter**	[NUM]	Machine-precision audit choice	Floating-point implementation	Numerical tolerance	Report precision dependence and condition numbers.
	Berry-rectangle area-law exponent	Holonomy audit	$\lvert\Theta\rvert \propto \varepsilon^{n}{}_{area}$, expected $n_{area}=2$.	2	Dimensionless exponent	Fixed by mathematical normalization	[THM]+[NUM]	Two-dimensional infinitesimal area law	Smooth local curvature	Active local geometric result	Replicate across scales and packet families.
	Lower accepted local scaling exponent	Holonomy audit	$1.7 \leq d\log\lvert\Theta\rvert/d\log\varepsilon \leq 2.3$.	1.7	Dimensionless	**Numerical control parameter**	[NUM]	Preregistered spread band	Finite-step fitting	Audit tolerance	Report sensitivity to the band.
	Upper accepted local scaling exponent	Holonomy audit	$1.7 \leq d\log\lvert\Theta\rvert/d\log\varepsilon \leq 2.3$.	2.3	Dimensionless	**Numerical control parameter**	[NUM]	Preregistered spread band	Finite-step fitting	Audit tolerance	Report sensitivity to the band.
	Dominant compact-phase stiffness	Holonomy candidate	General action permits independent k_‖ and k_⊥.		Action units	Free	[OPEN]	New field-extension coefficient	Two-phase completion	Not adopted	Find a symmetry/action tying k_‖=k_⊥ if the route is revived.
	Subordinate compact-phase stiffness	Holonomy candidate	Independent of k_‖ in the general action.		Action units	Free	[OPEN]	New field-extension coefficient	Two-phase completion	Not adopted	Same gate as k_‖.
	Selected chiral cancellation phase	Holonomy candidate	A quarter-phase/odd propagator can be chosen to force cancellation.	1.5707963267949	Radians	Chosen by matching	[NUM]+[OPEN]	Selected to cancel a target correction	Enlarged partner structure	Rejected as native mechanism	Derive the phase from a symmetry and preserve positivity/unitarity.
	C3 Monte Carlo count	CMB numerics	$N_{MC},C3=3000$ simulations per ensemble.	3000	Count	**Numerical control parameter**	[NUM]	Computational design	Available resources and percentile precision	Primary reported high-stat control	Increase and report convergence bands.
	C3 random pixel-pair count	CMB numerics	$N_{pair},C3=500000$.	500000	Count	**Numerical control parameter**	[NUM]	Computational design	Map resolution and binning	Primary high-stat control	Perform deterministic or much lar pair-count checks.
	Angular-bin count	CMB numerics	$N_{bin},\theta=60$.	60	Count	**Numerical control parameter**	[NUM]	Analysis design	θ range and pair count	Numerical control	Test binning stability.
	HEALPix resolutions	CMB numerics	$NSIDE \in 32,64$.	32; 64	HEALPix resolution	**Numerical control parameter**	[NUM]	Analysis design	Map and mask pipeline	Robustness controls	Extend direct C3 sweep to both resolutions.
	Planck degraded-mask thresholds	CMB numerics	$t_{mask} \in 0.80,0.90,0.95$.	0.80; 0.90; 0.95	Dimensionless	**Numerical control parameter**	[NUM]	Analysis design	Planck masks	Robustness controls	Use improved masked-sky covaria treatment.
	Packet-flow iteration count	Packet numerics	Representative reporting at steps 0,300,600,1000.	0; 300; 600; 1000	Iterations	**Numerical control parameter**	[NUM]	Simulation design	Step size and solver	Numerical diagnostic	Report convergence in flow-time a under step refinement.
	Under-collapsed residual fraction	Packet numerics	Approximately 18% remain under-collapsed at the reported intermediate/final audit stage.	0.18	Fraction	**Numerical control parameter**	[NUM]	Observed ensemble result, not a coefficient	Packet ensemble and closure criteria	Numerical outcome	Replicate and model its dependenc on closure diagnostics.

Appendix D - Complete Action Catalogue

This catalogue contains actions, variational functionals, relaxation flows, iterative updates, constraints, phenomenological kernels, and historical action proposals. Object type and theory layer prevent these from being treated as equivalent forms of fundamental dynamics.

Papers	Action / rule	Sector	Type	Expression	Varied / updated	Fixed background	Symmetry	Coefficients	Layer	Evidence	Lifecycle	Coupling status	Disposition
I	Relational Unity admissibility functional	Foundations	Global admissibility functional	$S_U[\mathscr{C},r]$ weights globally coherent causal histories; exact functional is not frozen.	Unclear: histories may be summed/weighted rather than varied	Causal set $\mathscr{C}$ and record assignment r	Intended event-relabelling and local-frame invariance	Unity weights / normalization	Proposed fundamental	[DEF]+[OPEN]	Active axiom, incomplete	No explicit derivation linking it to Wilson, gravity, packet, or holonomy sectors.	Retain only as an explicit primitive until variables, measure, and normalizatio are frozen.
I	Unity-weighted history measure	Foundations	Measure deformation	$d\mu_U[\mathscr{C},r] \propto \exp(-S_U[\mathscr{C},r])\, d\mu_0[\mathscr{C},r]$ (schematic measure-level reading).	Histories in an ensemble/sum	Reference measure $d\mu_0$	Same intended invariances as S_U	Overall normalization	Interpretive fundamental candidate	[DEF]+[CONJ]	Interpretive alternative	Paper I also uses a complex-amplitude interpretation; equivalence is asserted rather than derived.	Do not treat measure and amplitude formulations as equivalent until a precise map is supplied.
I	Unity phase / manifestation-amplitude rule	Quantum foundations	Complex amplitude rule	$\mathscr{A}[\mathscr{C},r] \propto \exp(i\Phi_U[\mathscr{C},r])$; physical predictions require a declared sum over histories/orientations.	History amplitudes / internal orientation	Causal and record data	Global phase redundancy; intended frame invariance	Amplitude normalization and Φ_U	Proposed fundamental	[DEF]+[OPEN]	Active proposal	No complete path measure, composition rule, or joint probability P(a,b∣x,y).	Keep as an amplitude ansat not a complete microscopic quantum action.
I-II	Von Mises maximum-entropy functional	Quantum statistics	Constrained entropy extremization	Extremize $-\int p \ln p\, d\varphi$ subject to $\int p=1$ and a fixed circular first moment; Lagrange multipliers α,κ yield $p\propto e^{\kappa\cos}(\varphi-\mu)$.	Probability density $p(\varphi)$	Normalization and fixed circular mean/resultant	Rotation covariance on S^1	α, κ	Effective statistical	[THM]+[EXT]	Active conditional result	Physical origin and completeness of the constraints remain open.	Retain as exact mathemati conditional on the selected moments.
I	Relational Dirichlet energy	Spectral/ coherence	Quadratic graph energy	$E_D[\psi]=\langle\psi,\Delta\_\mathscr{C}\psi\rangle=1/2\ \Sigma_x\sim y w_{xy}\lvert\psi(x)-\psi(y)\rvert^2$.	State/phase field ψ if minimized	Wedge graph and weights w_{xy}	Vertex relabelling; global U(1)	Graph weights w_{xy}	Kinematic/ effective	[EXT]+[DEF]	Active kinematic functional	Not derived from S_U or connected to later packet stabilization.	Retain as graph energy, not full quantum dynamics.
I	Loop-torsion functional	Gauge	Discrete curvature cost	$S_{loop}=\Sigma\_\square\ \Theta\_\square^2$.	Loop/link phases or gauge potential	Fixed causal plaquettes	U(1) loop-gauge invariance	Overall stiffness κ_g	Historical effective precursor	[DEF]+[CON]	Historical precursor	Overlaps the later Diamond-Wilson action but is not formally identified with it.	Treat as the quadratic smal angle precursor of S_W, no a separate fundamental action.
I	Continuum Maxwell action	Gauge	Continuum field action	$S_{Maxwell}=-1/4\int d^4x\sqrt{-g}\ F_{\mu\nu F}{}^{\mu\nu}$.	Gauge potential A_μ	Emergent metric $g_{\mu\nu}$	U(1) gauge and diffeomorphism covariance	Continuum normalization / coupling	Imported conditional limit	[EXT]+[OPEN]	Conditional target	Controlled convergence from the relational ensemble is missing.	Present as an external continuum target.
II	Diamond-Wilson action	Gauge / causal diamonds	Discrete Wilson action	$S_W[U]=\beta_W\ \Sigma\_\Diamond\in\mathscr{P}$ Re Tr$(I-U_\Diamond)$, $U\_\Diamond=U_{p1Up2}\dagger$.	Link transports U_e	Causal graph and irreducible diamonds $\mathscr{P}$	Local frame/gauge covariance; relabelling	β_W; representation trace normalization	Active effective transport action	[DEF]+[EXT]	Active central action	No packet-support h or determinant-current source appears.	Retain as the best-defined discrete IRMT action; freez group, representation, real-part convention, and β_W.
II	Continuum Yang-Mills action	Gauge	Conditional continuum limit	$S_{YM}=(1/2g_{YM}^2)\int d^4x\ \mathrm{Tr}(F_{\mu\nu F}{}^{\mu\nu})$; paper normalization gives schematic $g_{YM}^2=12\beta_{W\xi}$.	Continuum connection A_μ	Manifold limit and isotropic diamond ensemble	Gauge and diffeomorphism invariance	g_{YM}, β_W, diamond density ξ	Imported conditional limit	[EXT]+[OPEN]	Conditional	Does not select the Standard Model gauge group or matter representations.	Retain only as a bridge conditional on convergenc
II	Connectivity-defect source rule	Gauge / matter	Sourced variation and scaling law	$\delta S_W/\delta U_e=\beta_W\Sigma\_\Diamond\in St(e)Im(U\_\Diamond)$; valence defect $\Delta\nu$ yields $D\star F=J$ with $J^\nu\sim-\Delta\nu\langle F\rangle a^2$.	Link transport U_e	Staple, Poisson valence ν, defect $\Delta\nu$	Gauge covariance and discrete Bianchi identity	β_W, a^2, combinatorial factor	Effective/source conjecture	[CONJ]+[EXT]	Historical conditional	Not reconciled with the later Dirac-mode matter definition.	Retain as a candidate historical source mechanism.
I	Density-biased causal attachment rule	Geometry	Stochastic update rule	$P(x\prec y\mid\rho_{rec})=P_0(x\prec y)[1+\lambda_{RG}F(\rho_{rec}(x),\rho_{rec}(y))]$.	Causal links / attachment probabilities	Record densities and baseline P_0	Relabelling; F intended symmetric	λ_{RG} and functional F	Proposed fundamental geometry dynamics	[CONJ]+[OPEN]	Programmatic	Exact F and normalization absent; ontology conflicts with fixed-manifold language.	Formalize as the causal dynamics or exclude from active core.
I	Spectral action route	Gravity	Spectral functional	$S_{spec}[D_{rel}]=\mathrm{Tr}\ f(D_{rel}^2/\Lambda^2)$, with heat-kernel expansion in a continuum regime.	D_{rel} or underlying geometric variables, depending formulation	Cutoff Λ, function f, assumed convergence	Unitary basis invariance; continuum diffeomorphism covariance after limit	Moments of f, Λ, operator normalization	Conditional effective	[EXT]+[OPEN]	Conditional bridge	Generic spectral-action machinery is not IRMT-specific and is disconnected from the later BD route.	Classify as imported option bridge unless one operator and scaling are frozen.
IV	Coherence-weighted causal action	Gravity	Discrete effective action	$S_{eff}\sim\hbar\Sigma_i\prec jW(i,j)[1-\Xi(i,j)]$ (schematic paper form).	Emergent geometry / causal weights, if varied	Causal set and coherence factor Ξ	Relabelling; intended diffeomorphism covariance in limit	$\hbar$, W normalization, Ξ normalization	Effective	[CON]+[OPEN]	Conditional	No frozen discrete variation with respect to causal order.	Retain only as a schematic proposal.

Papers	Action / rule	Sector	Type	Expression	Varied / updated	Fixed background	Symmetry	Coefficients	Layer	Evidence	Lifecycle	Coupling status	Disposition
IV	Four-dimensional Benincasa-Dowker action	Gravity / causal set	Imported discrete action	$S_{BD}=(4\hbar/\sqrt{6})\ell_c^{-2}[N-N_0-9N_1+16N_2-8N_3]$ in the paper's notation.	Causal order in the relevant causal-set formulation	d=4, layer counts N_k, ℓ_c	Relabelling invariant	Fixed BD numerical coefficients and ℓ_c	Imported	[EXT]	Active imported bridge	Record degrees of freedom do not uniquely derive this action.	Cite explicitly as external causal-set machinery.
IV	Coherence-weighted BD action	Gravity	Modified discrete action	S_{BD}^{Ξ} uses coherence-weighted chain/link terms, written schematically as $\Sigma W\Xi$ or $\Sigma W(1-\Xi)$.	Causal structure and/or coherence variables, not consistently stated	d=4 BD construction	Relabelling and intended frame invariance	Weight normalization and ℓ_c	Effective	[CON]+[OPEN]	Not frozen	The corpus uses more than one schematic weighting convention.	Freeze one expression or retire it from active v1.0.
IV / VII	Discrete flux-balance law	Gravity	Constraint / coarse-graining bridge	$\mathrm{div}\_\mathscr{C}\Phi_{upd}(i)=\Sigma_{i\prec j}\Phi_{ij}-\Sigma_{k\prec i}\Phi_{ki}$; target $\nabla_\mu J^\mu=0$ and $\nabla_\mu T^{\mu\nu}=0$.	No action variation stated; fluxes obey balance	Fixed Hasse graph and stationary averaging cell	Relabelling and link-orientation covariance	Coarse-graining normalization	Conditional effective	[DEF]+[OPEN]	Conditional	A bridge/constraint, not an action.	List separately and require controlled convergence theorem.
VII	Flux-momentum stress-tensor map	Gravity	Coarse-graining constitutive map	$T_{eff}^{\mu\nu}$=normalized local average of symmetrized flux-momentum bilinears.	None independently	Discrete fluxes, momenta, local Unity Wedge	Symmetric tensor; intended continuum covariance	Diamond-density and ℓ_c normalization	Effective	[CON]+[OPEN]	Reclassified conditional	Kinetic-theory analogy does not prove uniqueness from the IRMT action.	Retain as a proposed map with explicit assumptions.
VII	Effective gravitational-coupling rule	Gravity	Coefficient identification	G_N is identified from ℓ_c and BD normalization; G_{eff} receives a coherence-deficit correction.		Imported BD action and Papers I-II deficit	Scalar	ℓ_c, diamond density, coherence correction	Effective	[CON]+[OPEN]	Reclassified conditional	Depends on an unverified quantum deficit and dimension-specific imported action.	Move detailed constants to Record 4; mark normalization open.
IV / VII	Einstein-Hilbert action and field equation	Gravity	Continuum target action	$S_{EH}=(16\pi G_N)^{-1}\int\sqrt{-g}(R-2\Lambda)d^4x+S_m$; $\delta S/\delta g$ gives $G_{\mu\nu}+\Lambda g_{\mu\nu}=8\pi G_N T_{\mu\nu}$.	Metric $g_{\mu\nu}$ and matter fields	Four-dimensional continuum and boundary conditions	Diffeomorphism invariance	G_N, Λ	Imported conditional limit	[EXT]+[OPEN]	Target, not derived	Lovelock uniqueness does not establish convergence from the actual IRMT operator.	Use only as the gravity completion target.
V	Causal-network growth rule	Cosmology	Conceptual stochastic evolution	Events/links grow and connectivity dilutes; a(t) is identified with coarse-grained relational separation.	Causal graph if growth is literal	Existing causal order and connectivity statistics	Relabelling; isotropy after coarse-graining	Growth/attachment law unspecified	Conceptual	[CONJ]+[OPEN]	Conceptual	No explicit stochastic kernel or action.	Choose a block ontology or specify genuine sequential growth.
V	Vacuum maintenance burden	Cosmology	Effective energy-density rule	ρ_{vac}^{IRMT} is a baseline relational update cost per coarse-grained volume; no unique microscopic formula.	None stated	Vacuum causal region and maintenance flux	Cosmological homogeneity/isotropy	Baseline update cost	Conceptual phenomenology	[CONJ]	Conceptual	Not linked to a microscopic Hamiltonian or the later CMB kernel.	Keep as qualitative interpretation only.
XIV	Finite-coherence dark-energy-running model	Cosmology	Phenomenological likelihood model	One-parameter finite-coherence modification of H(z) or $\rho_{DE}(z)$ tested against Pantheon+.	Fit parameters	Pantheon+ data and Ω_m prior	FLRW	Running amplitude	Numerical effective	[NUM]	Rejected route	No evidence of improvement over ΛCDM in the reported test.	Retain in negative-results registry.
XIV	Direct low-ℓ power-suppression model	CMB	Phenomenological transfer rule	$C_\ell^{TT}\to F_\ell C_\ell^{TT}$ with fitted low-ℓ suppression.	Kernel parameters	Reference ΛCDM spectrum	Rotational invariance	Amplitude and scale	Numerical effective	[NUM]	Rejected as general replacement	Did not robustly outperform ΛCDM.	Retain as failed phenomenology.
XIV	Universal TT/TE/EE suppression rule	CMB	Multi-channel phenomenological kernel	$C_\ell^{XY}\to F_\ell C_\ell^{XY}$ for TT, TE, and EE with a shared kernel.	Kernel parameters	ΛCDM channel spectra	Rotational invariance	Shared amplitude and scale	Numerical effective	[NUM]	Rejected route	Polarization did not support universal suppression.	Retain as a narrowing negative result.
XIV	Locked temperature finite-coherence kernel	CMB	Phenomenological response kernel	$F_\ell=1-\alpha_{CMB}\exp[-(\ell-2)/L_H]$, calibrated in C1 and locked for C2/C3.	α_{CMB},L_H only during calibration	ΛCDM TT spectra/maps	Rotational invariance	α_{CMB},L_H	Active effective	[CON]+[NUM]	Active bounded target	Not derived from S_U, network cosmology, or a microscopic coherence action.	Retain as explicitly phenomenological.
VI	Free relational unitary transport rule	Measurement	Discrete evolution rule	$\psi_{n+1}=U_n\psi_n$ with U_n unitary along causal links.	State ψ	Link transports and causal path	Local-frame covariance		Historical measurement model	[DEF]	Kinematic rule retained	Does not imply collapse or threshold.	Retain only as transport kinematics.
VI	Random-phase accumulation law	Measurement	Stochastic update	$\varphi_{n+1}=\varphi_n+\delta\varphi_n$; phase variance grows as an assumed random walk.	Phase distribution	Independent increment statistics	Circular shift invariance	Increment variance	Historical	[SUP]	Retired quantitative mechanism	Dependent on superseded MP/BBP threshold and a disputed phase-to-nonunitarity inference.	Move to retired-mechanism register.
VI	Projection / collapse update	Measurement	Discontinuous state update	$\psi\to\Pi_{obs}\psi/\|\Pi_{obs}\psi\|$ when κ crosses a claimed threshold.	State ψ	Observational projector and κ_c	Only covariant if Π_{obs} is physically selected	κ_c and projector rank	Historical	[SUP]	Retired pending reconstruction	Threshold/rank relied on falsified spectral architecture.	Exclude from active v1.0 dynamics.
VI	Coherence-weighted Born rule	Measurement	Probability rule	$P_n\propto\int d\varphi\, p_\kappa(\varphi)\|\langle n\|\psi(\varphi)\rangle\|^2$; claimed large-κ limit is $\|\langle n\|\psi\rangle\|^2$.	Outcome probabilities	Von Mises distribution and selected basis	Phase rotation covariance	κ	Historical	[SUP]+[OPEN]	Retired quantitative derivation	Does not repair the missing complete joint probability law.	Reconstruct only after the quantum gate.
III	Relational Dirac operator	Matter kinematics	Operator construction	D_{rel} is a weighted oriented causal-link operator with Clifford/tetrad and transport factors; one active formula must be frozen.	Not an action; eigenproblem $D_{rel}\psi=\lambda\psi$	Causal graph, link weights, transport, Clifford module	Local-frame covariance; intended Hermiticity/grading	Link-weight normalizations	Active kinematic	[DEF]+[OPEN]	Active kinematic	No native action for Φ_sub or one unified fermionic sector.	Freeze a single active D_rel and distinguish all numerical variants.

Papers	Action / rule	Sector	Type	Expression	Varied / updated	Fixed background	Symmetry	Coefficients	Layer	Evidence	Lifecycle	Coupling status	Disposition
III / VI /	chGUE-BBP perturbation model	Historical generations	Random-matrix deformation	$D=D_0+\theta_{BBPVlow}$-rank with D_0 assumed chGUE.	Matrix/operator or spike strength	Assumed chGUE ensemble	Random-matrix ensemble symmetries	Spike and ensemble variance	Historical effective	[SUP]	Retired/falsified	Native D_rel exhibits localized/Poisson statistics, invalidating the premise.	Keep only as falsified history.
X	Transport-richness spectral-phase construction	Spectral experiments	Parameterized operator sweep	Increase internal transport dimension/noncommutativity, rebuild D_{rel}, and measure localization statistics.	Transport matrices / dimensions	Fixed causal graphs and controls	Local-frame covariance	Transport dimension and strength	Experimental	[NUM]	Active empirical constraint	Shows controllable spectral phase but no action selecting transport richness.	Retain as numerical evidence.
X	Spectral feedback update	Spectral self-organization	Iterative numerical update	$U_e^t+1=\mathscr{P}[\alpha U_e^{local}+\beta U_e^{neighbor}+\gamma Q_e(\psi_n{}^t{}_{low})]$ (representative form).	Link transports U_e	Current low eigenmodes and causal neighbors	Projection $\mathscr{P}$ enforces unitarity/normalization; covariance intended	α,β,γ, mode count, step count	Experimental effective	[NUM]+[CONJ]	Active numerical mechanism	No variational functional or microscopic coefficient derivation.	Keep as experimentally supported mechanism, not core dynamics.
X	Static/local candidate objective family	Spectral experiments	Numerical energies and update families	Node encoding, ancestry, path memory, frustration, constraint-satisfaction, and low-rank objectives.	Model-specific variables	Fixed graph/control ensembles	Model dependent	Many numerical hyperparameters	Experimental	[NUM]	Rejected family	No tested family generated robust structure beyond controls.	Maintain as a negative-results catalogue.
XII-XV	Projection map M=ΠΦΠ	Charged-lepton packet	Operator definition	$M_{ab}=\langle\psi_a\|\Phi_{sub}\|\psi_b\rangle$, equivalently $M=\Pi_{T\Phi sub}\Pi_T$.	None in the construction	Protected triplet Π_T and selected Φ_{sub}	Basis covariance within protected sector	Field normalization	Active effective	[DEF]+[NUM]	Active effective	Physical identity and action of Φ_sub are not derived.	Retain with explicit effective status.
XII-XIII	Normalized collapse-support flow	Packet stabilization	Normalized vector-field flow	$dp/ds=\mathrm{unit}(G_{collapse})+q_{KRrank}\ \mathrm{unit}(G_{entropy})$ (paper/experiment sign convention).	Normalized singular shares p	Chosen vector fields	Simplex tangent; pair symmetry in reduction	q_K and step size	Superseded effective	[CON]+[NUM]	Superseded by unnormalized flow	Unit normalization erased physical force magnitudes.	Retain historically only.
XV	Simplex natural-gradient rule	Packet dynamics	Geometric flow operator	$G_F,i(p)=p_i[\partial_{iF}-\Sigma_{jpj}\partial_{jF}]$.	Packet shares p_i	Scalar functional F on the simplex	Permutation covariance and simplex tangency	Flow-time normalization	Effective mathematical	[THM]+[EXT]	Active mathematical tool	Does not establish microscopic substrate generation.	Retain as declared effective geometry.
XV	Frobenius collapse functional	Packet dynamics	Scalar functional	$C(p)=K(p)=\Sigma_{ipi}{}^2$; $G_C,i=2p_i(p_i-K)$.	Packet shares p_i	Probability simplex	S_3 permutation	Overall flow-time factor	Active effective	[THM]+[CON]	Active effective	A hierarchy diagnostic is promoted to a driver; microscopic origin open.	Retain as effective packet action/energy with [CON].
XV	Frobenius-complement support functional	Packet dynamics	Scalar functional	$S_F(p)=1-K(p)$; $G_{SF}=-G_C$.	Packet shares p_i	Probability simplex	S_3 permutation	No independent shape coefficient	Active effective	[THM]+[CON]	Active effective	Exact opposition is proved, but no microscopic action selects it.	Retain with constitutive label.
XV	Combined packet flow	Packet dynamics	First-order flow	$dp_i/ds=(1-h)G_C,i(p)$.	Packet shares p_i	Support response h	Permutation covariance and simplex preservation	Flow-time scale	Active effective	[CON]+[THM]	Active effective	Not derived from S_U, S_W, or a Hamiltonian.	Keep as an effective equation, not fundamental EOM.
XV	Support-response relaxation law	Packet dynamics	Auxiliary dynamical equation	$\tau_h\ dh/ds=qR_{rank}-h$.	Support response h	Current R_{rank}	Residual pair symmetry	τ_h and q	Active effective	[CON]	Active effective	Introduces a response variable without a microscopic kinetic term.	Retain, but require future packet action.
XV	Adiabatic deficit-gated flow	Packet dynamics	Reduced flow	$\tau_h\to0$ gives $dp_i/ds=(1-qR_{rank})G_C,i(p)$.	Packet shares p_i	Adiabatic h=qR	Permutation covariance	q	Active effective	[CON]+[THM]	Active effective	Koide appears only after q is set to q_K.	State explicitly that q_K is not generated from one microscopic action.
XV	Pair-symmetric reduced flow	Packet dynamics	One-dimensional flow	$dR/ds=(1-qR)R(1-R)(3R-1)$.	R_{rank}	$p=(R,(1-R)/2,(1-R)/2)$	Subordinate S_2 exchange	q and flow-time scale	Active effective	[THM]+[CON]	Active reduced model	Exact only on a closed pair-symmetric submanifold.	Retain as an analytic reduction.
XIII / XV	q_K compatibility condition	Packet dynamics	Coefficient selection rule	$q_K=1/R_K=3(\sqrt{2}-1)$, chosen so $R^*=R_K$.		Exact geometric R_K	Pair/permutation invariant	q_K	Active effective	[THM]+[CON]	Active constitutive coefficient	Earlier papers used stronger derivational language.	Label compatibility selection explicitly.
XIII-XV	Triplet-closure constraint	Packet dynamics	Constraint / applicability condition	Require leakage $\|\|(I-\Pi_T)\Phi_{sub}\Pi_T\|\|/\|\|\Phi_{sub}\Pi_T\|\|$ below a declared threshold; exact metric/threshold not frozen.	None unless implemented as penalty	Projected field and protected sector	Frame covariance	Closure threshold or penalty	Active effective	[NUM]+[OPEN]	Active condition	Invoked to explain basin membership but not quantitatively frozen.	Define a closure observable and, if fundamental, add its penalty to the action.
XV	Weighted minimal-diamond response estimator	Diamond response	Observable / response sum	$\mathscr{O}_k,r=N\_\mathscr{C}\text{^-}r\Sigma\_\diamond\tau\_\diamond^k\mathscr{W}\_\diamond$ (schematic); continuum scaling selects k=2,r=1/2.	None; evaluated on samples	Minimal diamonds, proper times, Wilson/bivector factor	Relabelling; gauge invariant if traced	k_τ,r_{ren} and normalization	Analytic/ numerical effective	[THM]+[NUM]	Active analytic construction	Normalizes response but does not create the full dynamics.	Retain as an observable, not a fundamental action.
XV	Six-bivector / triplet susceptibility rule	Diamond response	Continuum coefficient identification	$\xi_6=51/(1400\sqrt{\pi})$, $\xi_3=\xi_6/2$; these enter the adopted packet normalization.		Continuum diamond ensemble and sector split	Bivector rotational/Hodge structure	ξ_6,ξ_3,β_{pkt}	Active effective	[THM]+[CON]	Active conditional	Exact coefficients do not prove their charged-lepton physical identification.	Separate mathematical coefficient derivation from physical use.

Papers	Action / rule	Sector	Type	Expression	Varied / updated	Fixed background	Symmetry	Coefficients	Layer	Evidence	Lifecycle	Coupling status	Disposition
XV	Exterior-square induced operator	Flavor geometry	Representation construction	$M\_\wedge=\Pi\_\mathscr{F}(\Lambda^2\Phi_{sub})\Pi\_\mathscr{F}$ on $\mathscr{F}=L_1\oplus L_2\oplus L_3$.		Protected rank-two sectors and Φ_{sub}	Exterior-square covariance and determinant-line frames	None in induced representation	Active effective geometry	[THM]+[DEF]	Active exact construction	Physical sector selection and Φ_sub remain open.	Retain as exact representation geometry.
XV	Finite U(2) Wilson packet-energy rule	Charged-lepton scale	Finite-holonomy effective energy	E_{pkt} is obtained from the exact fundamental Wilson trace of a central U(2) holonomy and the electroweak scale.	No independent variation stated in mass formula	Packet response, U(2) embedding, v_{EW}	U(2) conjugation; determinant distinguishes central phase	$\beta_{pkt},\xi_6,\xi_3,\alpha_D,v_{EW}$	Active effective	[THM]+[CON]+[EXT]	Active conditional	Depends on the unproved response-to-connection identification.	Retain as conditional effective energy formula.
XV	Lowest oriented D_3 boundary interaction	Flavor phase	Effective boundary potential	$\Gamma\_\partial=-\lambda\mathrm{Re}\chi=-\lambda\rho^3\cos(3\varphi_\ell-2h/3)$.	Flavor azimuth φ_ℓ	Transverse radius ρ and support response h	Cyclic invariant; reflection conjugates χ; orientation sensitive	λ	Active effective	[CON]+[THM]	Active effective	Determinant phase entering χ remains constitutive.	Retain as an effective interaction, not microscopic theorem.
XV	Higher-harmonic boundary action	Flavor phase	Effective analytic potential family	$\Gamma\_\partial=-\Sigma_n\geq1\lambda_{nRe}(\chi^n)=-\Sigma_{n\lambda n\rho}{}^{3ncos}(n\Delta)$, $\Delta=3\varphi_\ell-2h/3$.	Flavor azimuth φ_ℓ	ρ,h and χ	Same D_3 covariance	λ_n	Optional effective	[THM]+[CON]	Robustness class	Independent competing invariants could shift the phase.	Keep as optional effective robustness analysis.
XVI	Scalar stabilization sector	Holonomy audit	Effective scalar action/flow sector	$S_{stab}[p,h]$ denotes the packet sector producing the p,h equations; it has no A_{det} dependence.	p,h in the effective sector	Projected packet geometry	Pair symmetry and spectral/frame invariance	q,τ_h,flow normalization	Active effective	[CON]	Active effective	Variationally separate from determinant connection.	Freeze an explicit S_stab or call it a flow sector.
XVI	Determinant-line Wilson sector	Holonomy audit	Reduced gauge action	$S_W[A_{det}]$ is the Diamond-Wilson action reduced to determinant-line connections and has no p,h dependence.	A_{det} or line holonomies	Causal diamonds and representation	Independent determinant-line U(1) gauges; orientation	β_W and trace normalization	Active effective	[DEF]+[EXT]	Active	Variationally separate from packet stabilization.	Retain and make the separation explicit.
XVI	Present total charged-lepton action	Holonomy audit	Sum of disconnected sectors	$S_{current}=S_{stab}[p,h]+S_W[A_{det}]$.	p,h,A_{det} independently	Protected packet and causal graph	Product of packet and determinant-gauge symmetries	All sector coefficients	Current architecture	[THM]+[CON]	Active endpoint	Exact mixed variation δ²S_current/(δA_detδ h)=0.	Use as the central honest statement of v1.0 action architecture.
XVI	Unsourced determinant Wilson equation	Holonomy audit	Euler-Lagrange equation	$\delta S_W/\delta A_{det}=0$; stationary phases are loop/center dependent rather than packet dependent.	A_{det}	Packet variables held independent	Determinant-line gauge covariance	Wilson coefficients	Active result	[THM]+[NUM]	Active no-go	Does not imply Θ_a=Ω_DWh_a.	Retain as exact obstruction.
XVI	Missing mixed packet-connection term	Holonomy audit	Absent interaction	No $S_{mix}[p,h,A_{det}]$ is present, so $\delta^2S_{current}/(\delta A_{det}\delta h)=0$.	Would need A_{det} and h jointly	Current field content	Must preserve line gauges, pair symmetry, and orientation	Unknown	Open fundamental interaction	[OPEN]	Absent	Exact action-level gap isolated by Paper XVI.	Display as an explicit zero/absent term in the specification.
XVI	Candidate mixed source action	Holonomy audit	Candidate interaction	S_{mix},cand~-Σ or $\int\mathrm{Tr}(A_{detJ\Omega})$, $J_\Omega=\Omega_{DWHsupp}$, or a compact loop equivalent.	A_{det} and possibly packet response fields	Ω_{DW},H_{supp},oriented exposure	Gauge invariance, pair symmetry, orientation oddness	Overall normalization and channel map	Open candidate	[OPEN]+[CONJ]	Not in current theory	A compact bounded gauge-invariant completion is missing.	Use only as a design target.
XVI	General symmetry-allowed current family	Holonomy audit	Response classification	$J_\Omega=\Omega_{DW}(a_D\Pi_D+b_S\Pi_S)$; a general pair-preserving linear map has four coefficients.	No action variation established	Packet response and central curvature	Independent line gauges, subordinate exchange, orientation	a_D,b_S or four coefficients	Classification result	[THM]+[OPEN]	Active no-go classification	Both ΩH and ΩTr(H)I satisfy the stated symmetries.	Retain as proof that symmetry is not constitutive selection.
XVI	Single compact packet-phase completion	Holonomy audit	Candidate compact field action	Introduce one compact θ with subgroup $\exp(i\theta H_{supp})$ and periodic kinetic/potential terms.	Compact phase θ	H_{supp} and packet response	U(1) compactness and gauge covariance	Stiffness, charge, period	Rejected candidate	[THM]+[OPEN]	Rejected in tested form	Irrational q_K prevents exact compact closure of the one-parameter trajectory.	Record as failed completion route.
XVI	Two-compact-phase completion	Holonomy audit	Candidate field extension	Independent dominant and subordinate compact phases with separate kinetic/stiffness and charge terms.	Two compact phases	Packet and determinant lines	U(1)×U(1) and pair symmetry	Two stiffnesses, charges, windings, exposures	Underdetermined candidate	[OPEN]	Not adopted	Solves closure only by adding undetermined structure.	Exclude from minimal v1.0 absent a selection theorem.
XVI	Charged inter-line field action	Holonomy audit	Candidate gauge-matter action	S_X contains kinetic/potential terms for X_{ab} and covariant couplings; $\chi_X=\mathrm{Im}(X_{12}X_{23}X_{31})$.	Inter-line fields X_{ab} and line connections	Difference charges e_a-e_b	$U(1)^3$ determinant gauges, pair exchange, orientation	Masses, stiffnesses, charges, potentials	Partial positive / insufficient	[THM]+[OPEN]	Not adopted	Difference charges sum to zero; common determinant U(1) remains invisible.	Retain as representation no-go, not active completion.
XVI	Exterior-square common-plus-root structure	Holonomy audit	Representation coupling identity	$q_0=(1,1,1)$, and $q_0q_0{}^T+BB^T=3I_3$.		Exterior-square representation	Permutation/root-system covariance	Relative common/root dynamical weights	Active exact structure	[THM]	Active partial success	Representation does not force equal common/relative dynamical weights.	Retain as exact input to future action.
XVI	Bare protected-block single-trace Wilson descent	Holonomy audit	Quadratic action metric	Protected rank-two Wilson traces yield $G_W=I_3$ and $b_{bare}=0$ after half-angle normalization.	Small determinant-line connection fluctuations	Protected block traces	Independent line gauges and permutation	Overall Wilson stiffness	Active exact partial result	[THM]	Active strongest microscopic result	Bare result is vulnerable to mixed-wedge renormalization.	Retain as exact bare-action theorem with protection caveat.
XVI	Protected-mixed quadratic action	Holonomy audit	Coupled block action	$S\^(2)=1/2(w,c)\dagger[[A,B],[B\dagger,C]](w,c)$, $w\in$determinant lines, $c\in$mixed wedges.	Protected variables w and mixed variables c	Exterior-square decomposition	Gauge and representation covariance	Blocks A,B,C	Active audit model	[THM]+[CON]	Active obstruction model	Nonzero B couples determinant and mixed sectors.	Retain as the minimal correct protection-audit action.
XVI	Schur-complement effective action	Holonomy audit	Integrated-out effective action	$S_{eff}\^(2)[w]=1/2\ w\dagger(A-BC\^-1B\dagger)w$.	Protected variables w	Stable/invertible mixed block C	Inherited gauge and permutation covariance	Mixed coupling and gap	Active no-go result	[THM]	Active exact obstruction	Bare b=0 is not protected for finite mixed coupling.	Retain as central protection theorem.
XVI	Chiral-pairing and graded-trace cancellation candidates	Holonomy audit	Candidate cancellation mechanisms	Modify partner/graded contributions to cancel $BC\^-1B\dagger$ while preserving the bare determinant metric.	Partner/graded sectors if introduced	Existing chirality and exterior algebra	Chiral/graded and gauge symmetries	Relative signs, masses, phases, partner couplings	Rejected native candidates	[THM]+[NUM]	Rejected with current fields	Native chiral partners add; natural supertraces do not cancel.	Record as tested negative mechanisms.

Papers	Action / rule	Sector	Type	Expression	Varied / updated	Fixed background	Symmetry	Coefficients	Layer	Evidence	Lifecycle	Coupling status	Disposition
T XVI	Spectral-gap decoupling condition	Holonomy audit	Protection criterion	Require $\|BC^{-1}B^\dagger\| \ll \|A\|$, or an equivalent reparameterization-invariant mixed-sector gap.		Actual closed-packet mixed spectrum	Basis/reparameterization invariant	Gap threshold and coupling norm	Open protection condition	[NUM]+[OPEN]	Failed in tested packets	Actual packets did not generate the required hierarchy.	Retain as the completion gate for dynamical protection.
T XV-XVI	Determinant response-to-connection law	Charged-lepton holonomy	Effective constitutive law	$J_\Omega=\Omega_{DWHsupp}$; unit oriented exposure is then integrated to determinant phases/holonomy.	Not derived by current variation	Stabilized packet and signed central curvature	Gauge covariance, pair symmetry, orientation oddness, additivity assumed	Common normalization/exposure	Active endpoint	[CON]	Active constitutive	Not generated by current scalar/Wilson actions or tested microscopic mechanisms.	Mark [CON] every time; do not call the mass model microscopically closed.
ification	Unified microscopic action template	Whole program	Open architecture	$S_{IRMT}=S_{causal}+S_{transport}+S_{field}+S_{packet}+S_{Wilson}+S_{geometry}+S_{interaction}$, with absent terms shown explicitly.	All declared primitive fields	One frozen state space, measure, and symmetry set	Relabelling, local frames, gauge, causal orientation, discrete symmetries	All coefficients in Record 4	Required future fundamental	[OPEN]	Not yet present	Current corpus is a stack of partially disconnected sectors.	Use Record 3 as the inventory from which the minimal unified action is designed.

Appendix E - Dependency Graphs

Edge color encodes the source of warrant: green derived, blue defined, gray imported, teal numerically supported, amber constitutive, red failed, and purple open. A downstream node does not inherit a stronger status than its weakest indispensable incoming arrow.

Edge status	Controlled meaning
Derived	Exact consequence within stated assumptions
Defined	Introduced object or rule
Imported	External theorem/framework
Numerically supported	Supported in specified computation/data
Constitutive	Adopted effective closure
Failed	Tested route rejected or dependency invalidated
Open	Required but not demonstrated

E.1 Quantum dependency map

Quantum dependency map

E.2 Gauge dependency map

Gauge dependency map

E.3 Gravity dependency map

Gravity dependency map

E.4 Matter and charged-lepton dependency map

Matter and charged-lepton dependency map

E.5 Cosmology dependency map

Cosmology dependency map

Appendix F - Paper Status Matrix

The matrix records the strongest result that survives from each paper and the exact wording boundary now imposed by the Core Specification.

Paper	Original purpose	Strongest surviving result	Superseded / restricted claim	Dependencies	Current classification	Recommended citation language
I	Introduce Relational Unity, a discrete causal-relational substrate, local record spaces, circular coherence statistics, generic internal symmetry, and possible continuum connections.	The foundational ontology and kinematic vocabulary remain programmatically useful; maximum entropy on the circle and the associated von Mises moments are mathematically valid once their constraint class is specified.			Exploratory foundation / partially retained framework.	“Paper I introduced the IRMT ontology and an exact circular maximum-entropy coherence model; its quantum, gauge-content, and gravity closure claims remain open.”
II	Extend the foundational substrate to finite-coherence correlations, local Hilbert fibers, unitary link transport, loop holonomy, a Diamond-Wilson action, and proposed gauge/matter interpretations.	Generic local frame covariance, covariant link transport, path and loop holonomy, and the discrete Diamond-Wilson action form a coherent active gauge framework.			Partially retained framework.	“Paper II established generic discrete unitary transport and Wilson-holonomy geometry, while physical gauge-group and matter-content selection remain unresolved.”
III	Define a Dirac-type operator on the causal-transport substrate and interpret its spectral organization as a route to matter and generations.	The relational Dirac operator remains an active derived kinematic object, provided one canonical variant, domain, weights, and normalization are stated explicitly.			Partially retained operator framework / superseded mechanism.	“Paper III defined the relational Dirac-operator program; its native chGUE/BBP generation mechanism was subsequently falsified and retired.”
IV	Connect relational update flux, spectral structures, and discrete causal geometry to stress-energy and continuum gravity.	The paper identifies useful candidate source variables and correctly points to generic spectral-action, causal-set, and Lovelock tools as possible continuum bridges.			Exploratory foundation / conditional gravity framework.	“Paper IV formulated candidate relational source and gravity bridges; applicability and normalization within IRMT remain conditional.”
V	Develop a network-based cosmological narrative for expansion, early-universe coherence, matter formation, and vacuum-maintenance energy.	The relational-network interpretation of cosmological history remains an active conceptual framework and supplies terminology for later bounded tests.			Exploratory foundation.	“Paper V proposed a relational-network cosmology; its quantitative early-universe, matter-formation, and dark-energy mechanisms remain open or retired.”
VI	Provide a quantitative collapse threshold, finite-rank projection, preferred basis, Born-rule mechanism, and coherence-limited superposition time.	Only the broad research idea that measurement should be formulated as operational relational consistency remains available for future reconstruction.			Superseded mechanism.	“Paper VI proposed a quantitative measurement mechanism that was later withdrawn after the spectral architecture failed; measurement remains an open IRMT sector.”
VII	Close the proposed gravity gaps by specifying a coarse-grained stress tensor, Newton normalization, matter-geometry coupling, and a final Einstein equation.	The paper remains useful as an explicit inventory of the three gravity problems that any complete IRMT theory must solve.			Superseded closure / partially retained framework.	“Paper VII attempted to close three gravitational gaps; the current specification retains the gaps and candidate formulas but withdraws the closure claim.”
VIII	Explain the Koide relation using Cl(3)/Pauli Frobenius geometry within the then-active BBP generation picture.	On the positive-amplitude branch, the circular three-component parametrization with transverse amplitude $\sqrt{2}$ yields the exact identity $K=2/3$ independently of azimuth.			Exact conditional geometry / superseded mechanism.	“Paper VIII contains an exact positive-branch Koide identity conditional on physical Frobenius equipartition; its BBP origin and generation claims are retired.”
IX	Assemble Papers I-VIII into a purportedly complete architecture and close remaining coupling and phase issues.	The paper is a useful historical map of the intended program, dependencies, proposed tests, and the point at which closure was claimed.			Historical architecture / superseded closure.	“Paper IX recorded the original closure architecture; subsequent experiments and audits withdrew that closure and retained it only as program history.”
X	Test the native spectral assumptions, catalogue failed mechanisms, and identify conditions under which spectral organization can emerge computationally.	The paper decisively falsifies native chGUE universality in the tested constructions, distinguishes localized from transport-rich phases, and shows spectral feedback can organize low modes numerically.			Numerical audit.	“Paper X falsified the native chGUE premise in the tested relational operators and identified transport/feedback mechanisms that organize spectra numerically.”
XI	Determine whether the Koide configuration is accessible within the revised projected-operator landscape after the failure of BBP universality.	The Koide region is reachable under specified projected-operator constructions and is not excluded by the revised numerical state space.			Numerical audit.	“Paper XI established reachability of the Koide region in specified revised IRMT constructions; it did not establish dynamical selection or stabilization.”
XII	Identify a robust dynamical coordinate for hierarchy and test whether rank concentration drives packets toward the Koide region.	Rank concentration is the strongest implemented hierarchy mechanism: increasing R produces a controlled one-plus-two hierarchy and reaches the Koide crossing in tested closed packets.			Numerical audit / effective model.	“Paper XII established rank concentration as an effective hierarchy mechanism and showed that pure collapse overshoots the Koide crossing.”

Paper	Original purpose	Strongest surviving result	Superseded / restricted claim	Dependencies	Current classification	Recommended citation language
XIII	Add a support/braking response to rank collapse and produce a stable effective equilibrium at the Koide rank coordinate.	The natural-gradient and delayed-response equations are mathematically explicit and yield a stable effective fixed point when q is set to qK.			Effective model.	“Paper XIII constructed a stable effective Koide packet using a deficit-gated response law whose active coefficient qK is compatibility-selected.”
XIV	Search public cosmological data for a bounded signal of finite relational coherence while requiring failed routes to be reported explicitly.	A locked temperature-coherence kernel gives directional improvement for the large-angle temperature-correlation deficit across spectrum, pseudo-spectrum, and direct map-space tests.			Bounded empirical test.	“Paper XIV reports a calibrated, locked, temperature-dominant finite-coherence target for the CMB large-angle correlation deficit and documents three failed broader routes.”
XV	Combine effective packet stabilization, exact minimal-diamond coefficients, determinant-line geometry, finite U(2) Wilson response, and a D3 phase invariant into charged-lepton mass ratios and scale.	The paper gives a mathematically coherent effective mass construction with exact internal geometry, no direct lepton-mass calibration, and quantitatively accurate ratios and scale.			Effective model / constitutive closure.	“Paper XV provides a mathematically closed charged-lepton model conditional on the constitutive response-to-connection law JΩ=ΩHsupp and associated effective identifications.”
XVI	Test whether the constitutive determinant-line response law in Paper XV can be generated and protected by the existing microscopic ingredients.	The paper proves the current action is variationally block diagonal, classifies the allowed response maps, derives the bare protected identity metric, identifies the Schur-complement obstruction, and quantifies the missing protection hierarchy.			Exact no-go result / numerical audit.	“Paper XVI establishes that the current microscopic action does not derive or protect the Paper XV response law, while preserving exact local bundle geometry and a bare Wilson metric.”

Appendix G - Experiment Registry

RECOVERED-CORPUS STATUS The best-available historical experimental record is now substantially complete: 43 valid notebooks, 26 formal experimental/theoretical records, preserved M5A-M5J result bundles, M6D-M6S bundles, and C1-C3. Known gaps remain for the original M5A-M5J executable source, the non-synthetic M5H raw-link input, standalone M5K-M5X packages, and standalone M6A-M6C developmental packages. These absences are registry findings, not grounds to infer or recreate evidence.

The registry now separates scientific outcome, documentary provenance, and reproducibility level. The recovered files are sufficient to reconstruct the scientific development and present status of IRMT, but not every historical run satisfies the frozen specification's highest reproducibility level. Several early experiment identifiers were reused in different branches; therefore the recovered file name and formal record title control provenance until a canonical renumbering is frozen.

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
REC-H01	Numerical Verification of the chGUE Universality Assumption	Does the native relational Dirac operator exhibit chGUE statistics?	No. Tested constructions were Poisson/Anderson-localized; the native chGUE and BBP-generation premise was falsified.	Decisive negative numerical record	01-IRMT_Experimental_Record_-_chGUE_Test_April_2026(4).docx	Recovered formal record + notebook archive
REC-H02	From Anderson Localization to Algebra-Driven Delocalization	Can rich internal transport overcome localization?	Yes. Full transport richness produced a GOE-like delocalized phase, but no generation structure.	Positive phase-control result	02 - From Anderson Localization to Algebra-Driven Delocalization in Relational Dirac Operators(4).docx	Recovered formal record + notebook archive
REC-H03	From Algebraic Delocalization to Universality	Is delocalization octonion-specific, and is there a threshold?	A threshold near three to four independent directions was found; matched non-octonionic matrix classes behaved similarly.	Positive threshold/control audit	03 - From Algebraic Delocalization to Universality(4).docx	Recovered formal record + notebook archive
REC-H04	From Spectral Failure to Phase-Controlled Structure	What controls the spectral phase after native chGUE failure?	Transport richness controls localization/delocalization; strong symmetry can lock degeneracies, while simple breaking does not yield generations.	Partially retained experimental framework	04 - From Spectral Failure to Phase-Controlled Structure(4).docx	Recovered synthesis record

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
REC-H05	Limits of Node-Based Ancestry and the Search for History-Driven Structure	Can ancestry parity or finite cyclic node labels generate robust low-spectrum structure?	Small signals failed larger and rule-varied controls; node-based ancestry was insufficient.	Negative numerical result	05 - Ancestry-Conditioned Transport and the First Evidence of History-Driven Structure(4).docx	Recovered formal record + notebook archive
REC-H06	Limits of Compositional Node-History	Can recursively accumulated compositional node history generate stable organization?	No robust advantage over matched controls; node-compressed histories were closed as a mechanism class.	Negative numerical result	06 - Limits of Compositional Node-History and the Necessity of Path-Dependent Structure(4).docx	Recovered formal record + notebook archive
REC-H07	Failure of Node-Level Structure and Emergence of Relational Constraints	Do matrix path memory, associator frustration, or structured low-rank node quantities work?	They modulated spectra but did not produce robust causal organization beyond controls; attention shifted to interaction-level constraints.	Elimination audit	07 - The Failure of Node-Level Structure and the Emergence of Relational Constraints (4).docx	Recovered formal record + notebook archive
REC-H08	From Construction to Constraint	Can encoding, path summaries, relaxation, or perfect compatibility generate generations?	Construction and consistency mechanisms failed; relational frustration became the next tested hypothesis.	Elimination synthesis	08 - The Failure of Encoding and the Emergence of Relational Frustration in IRMT(4).docx	Recovered formal record + notebook archive
REC-H09	Relational Frustration as the Origin of Structure	Can geometrically organized incompatibility influence the low spectrum?	Mesoscopic frustration produced a preliminary true-versus-control signal, later narrowed by broader path and defect audits.	Historical positive precursor	09 - Relational Frustration as the Origin of Structure(4).docx	Recovered formal record + notebook archive

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
REC-H10	Failure of Low-Rank Extraction and Emergence of Collective Structure	Can frustration be reduced to BBP-like low-rank modes or independent domains?	No. Low-rank extraction and domain locking failed; any surviving organization was distributed and collective.	Negative numerical audit	10 - Failure of Low-Rank Extraction and the Emergence of Collective Structure in IRMT(4).docx	Recovered formal record + notebook archive
REC-H11	Failure of Path-Dependent and Frustration-Based Mechanisms	Do path memory, non-Abelian holonomy, bottlenecks, or heterogeneous defects generate robust structure?	No tested static/path/defect construction separated reliably from matched controls.	Negative mechanism-class audit	11 - The Failure of Path-Dependent and Frustration-Based Mechanisms(4).docx	Recovered formal record + notebook archive
REC-H12	Failure of Fixed Geometric Mechanisms Under Sequential Causal Assembly	Can Padovan, Golden, rational, or shuffled fixed rotations win under causal freezing?	The preregistered Padovan criteria failed; fixed geometric targets were rejected.	Preregistered negative result	12 - The Failure of Fixed Geometric Mechanisms Under Sequential Causal Assembly(3).docx	Recovered formal record + notebook archive
REC-H13	Spectral Feedback as a Necessary Mechanism	Can local adaptive rules generate persistent low-mode separation?	Static/local/adaptive mechanisms failed; spectral feedback gave the first aggregate relational advantage but not stable triplet locking.	Numerical audit / mechanism precursor	13 - Spectral Feedback as a Necessary Mechanism for Generational Structure (4).docx	Recovered formal record + notebook archive
REC-H14	Persistent Three-Pair Spectral Organization from Relational Clifford Geometry	Does three-pair organization survive long times and controls?	Yes. TRUE Z3 relational geometry retained stronger three-pair separation while large asymmetry relaxed.	Numerically supported organization result	14 - Persistent Three-Pair Spectral Organization(4).docx	Recovered formal record + notebook archive

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
REC-H15	Symmetric Triplet Phase and the Threshold for Symmetry Breaking	Does layer-depth transport break the K approximately 1/3 symmetric triplet vacuum?	No at tested amplitudes. Exact (2,2,2) multiplicity persisted and motivated a larger-delta scan.	Negative threshold result	15 - Symmetric Triplet Phase and the Threshold for Symmetry Breaking(4).docx	Recovered formal record + notebook archive
REC-H16	Koide Reachability and the Dynamical Gap	Is the Koide region reachable, and is it a stable attractor?	Transient states reached near K=2/3, but the dynamics restored or passed through them; reachability was separated from stabilization.	Reachability / dynamical-gap audit	16 - Koide Reachability and the Dynamical Gap(5).docx	Recovered formal record + notebook archive
REC-H17	Locating the Structural Obstruction	Why do feedback modifications barely shift the protected low modes?	The available Clifford feedback maps the low-mode subspace mostly outside itself, suppressing first-order shifts.	Structural no-go / numerical audit	17 - Structural Obstruction Found(5).docx	Recovered formal record
REC-H18	Direct Triplet-Subspace Injection	What happens when the access obstruction is bypassed by construction?	The spectrum responded faithfully, but no Koide-preferred basin appeared.	Surgical intervention audit	18 - IRMT_Note18_StepC(5).docx	Recovered formal record
REC-H19	Static Direct Injection	Can the block-diagonal triplet perturbation reach Koide algebraically?	No. The linear block response had the wrong geometry for the required squared Koide pattern.	Algebraic/implementation no-go	19 - IRMT_Note19_StaticGeometry(5).docx	Recovered formal record
REC-H20	Vacuum-Coupling Mass Generation	Do simple substrate-natural Phi fields generate Koide-specific coupling amplitudes?	They produced only weak generic asymmetry, with no triplet specificity and no Koide-scale radius.	Negative mass-observable audit	20 - IRMT_Note20_PhiVacuumCoupling(5).docx	Recovered formal record

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
REC-H21	Directional Specificity in the S3-Breaking Plane - Revised	Does the apparent lepton-direction alignment survive replication?	No. At 32 seeds the signal matched controls and random-direction nulls; the original eight-seed result was a fluctuation.	Failed replication / controlling negative result	21 - R2(5).docx	Recovered revised formal record
REC-H22	The Equipartition Target	How can the open Koide problem be expressed as a clean norm-balance target?	Koide was reformulated as equality of symmetric and transverse squared norms; no substrate dynamics were derived.	Theoretical target reformulation	22 - IRMT_EquipartitionTarget(6).docx	Recovered theoretical record
REC-H23	Rare Path Geometry Search and Emergence of Hierarchical Phases	Can nonlinear geometric observables produce hierarchy, and what variable carries it?	Rare hierarchical projections were real but ordinary graph descriptors failed; the full projected operator became the active object.	Numerical search / projected-operator pivot	23 - End of the Geometric Amplification Phase(4).docx	Recovered formal record + notebook archive
REC-H24	Rank-One Collapse as the Dominant Driver of Hierarchical Projection	Which projected statistic best explains hierarchy?	Rank concentration dominated with corr(K,R) approximately 0.956; Koide appeared as a crossing near R approximately 0.80, not a stopping point.	Numerically supported hierarchy coordinate	24 - Rank-One Collapse as the Dominant Driver of Hierarchical Projection(4).docx	Recovered formal record + notebook archive
REC-H25	From Emergent Koide Structure to Frobenius Stabilization	Can explicit Frobenius feedback stabilize the Koide crossing?	Yes, including machine-precision adaptive convergence, but the stabilizer was imposed rather than substrate-derived.	Diagnostic effective stabilizer	25 - From Emergent Koide Structure to Frobenius Stabilization(5).docx	Recovered formal record + notebook archive
REC-H26	From Rank Collapse to Koide Stabilization	Can deficit-gated entropy halt collapse at the Koide rank coordinate?	The effective flow stabilized qR=1 and exact K=2/3 when q=q_K; q_K remained compatibility-selected rather than microscopically derived.	**Numerically supported effective stabilization**	26 - From Rank Collapse to Koide Stabilization(3).docx	Recovered formal record + notebook archive
EXPT 1	Recovered early IRMT-H experiment	The experiment is represented in the recovered early notebook/note corpus, but the final one-to-one historical ID crosswalk is not frozen.	Scientific interpretation is controlled by REC-H01 through REC-H08; no stronger experiment-specific inference is made from numbering alone.	**Recovered corpus / canonical ID pending**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 2	Recovered early IRMT-H experiment	The experiment is represented in the recovered early notebook/note corpus, but the final one-to-one historical ID crosswalk is not frozen.	Scientific interpretation is controlled by REC-H01 through REC-H08; no stronger experiment-specific inference is made from numbering alone.	**Recovered corpus / canonical ID pending**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
EXPT 3	Recovered early IRMT-H experiment	The experiment is represented in the recovered early notebook/note corpus, but the final one-to-one historical ID crosswalk is not frozen.	Scientific interpretation is controlled by REC-H01 through REC-H08; no stronger experiment-specific inference is made from numbering alone.	**Recovered corpus / canonical ID pending**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 4	Recovered early IRMT-H experiment	The experiment is represented in the recovered early notebook/note corpus, but the final one-to-one historical ID crosswalk is not frozen.	Scientific interpretation is controlled by REC-H01 through REC-H08; no stronger experiment-specific inference is made from numbering alone.	**Recovered corpus / canonical ID pending**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 5	Recovered early IRMT-H experiment	The experiment is represented in the recovered early notebook/note corpus, but the final one-to-one historical ID crosswalk is not frozen.	Scientific interpretation is controlled by REC-H01 through REC-H08; no stronger experiment-specific inference is made from numbering alone.	**Recovered corpus / canonical ID pending**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 6	Recovered early IRMT-H experiment	The experiment is represented in the recovered early notebook/note corpus, but the final one-to-one historical ID crosswalk is not frozen.	Scientific interpretation is controlled by REC-H01 through REC-H08; no stronger experiment-specific inference is made from numbering alone.	**Recovered corpus / canonical ID pending**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 7	Recovered early IRMT-H experiment	The experiment is represented in the recovered early notebook/note corpus, but the final one-to-one historical ID crosswalk is not frozen.	Scientific interpretation is controlled by REC-H01 through REC-H08; no stronger experiment-specific inference is made from numbering alone.	**Recovered corpus / canonical ID pending**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 8	Recovered early IRMT-H experiment	The experiment is represented in the recovered early notebook/note corpus, but the final one-to-one historical ID crosswalk is not frozen.	Scientific interpretation is controlled by REC-H01 through REC-H08; no stronger experiment-specific inference is made from numbering alone.	**Recovered corpus / canonical ID pending**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 9	Hasse Diamond Holonomy	Can diamond-holonomy constraints create causal spectral organization?	Diamond holonomy was implemented and verified, but later matched-control audits showed static holonomy was not a sufficient generation mechanism.	**Historical numerical precursor**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 10	Rigorous Discrete Energy Model	Can discrete relational consistency produce a structured low-energy phase?	Constraint energy could be reduced, but no robust generation-like spectrum separated from controls.	**Negative numerical result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 11	S3 Permutation Representation	Does an explicit S3 representation organize the low spectrum?	The representation was implemented exactly, but representation structure alone did not generate robust physical hierarchy.	**Representation audit / negative physical result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 12	True Relational Frustration	Can competing Z3 twists create a nontrivial structured phase?	Genuine frustration and low-energy configurations occurred; by themselves they did not establish stable generational structure.	**Historical numerical precursor**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 13	Frustration Amplifier	Does stronger incompatibility amplify a control-separated spectral signal?	Energy reduction increased, but robust spectral separation remained inconsistent.	**Negative numerical audit**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 14	Geometric Domain Frustration	Does mesoscopic placement of frustration matter?	A preliminary geometry-dependent signal appeared, later narrowed by larger path, bottleneck, and defect controls.	**Historical positive precursor**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 15	Structured Geometric Frustration	Can bottleneck-organized frustration outperform matched controls?	The test produced one of the first stronger relational signals, but later work showed static frustration was not sufficient as a complete mechanism.	**Historical positive precursor / later narrowed**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 16	BBP-Frustration Bridge	Can the frustrated phase support low-rank BBP extraction?	No. Low-rank probes failed to detach a reliable physical triplet.	**Negative numerical result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 17	Collective Domain Analysis	Is the surviving structure decomposable into stable mesoscopic domain modes?	No significant domain-mode locking was found; structure was classified as distributed and collective.	**Negative numerical audit**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 18	Chirality-Resolved Clifford Feedback Tests	Can chirality-resolved Clifford feedback create protected low-mode hierarchy?	The tested feedback variants did not produce a robust hierarchy; the route remained a diagnostic precursor.	**Negative numerical precursor**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 19	Path-Augmented Relational Frustration	Can path memory and relational frustration generate stable low-spectrum organization?	No reliable separation from matched controls.	**Negative numerical result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk

Experimen t	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
EXPT 20	Ensemble-Matched Causal Synchrony	Can recursive path composition create a causal advantage over a shuffled transport ensemble?	No robust ensemble-level structural advantage survived the matched comparison.	**Negative numerical result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 21	Relational Path-Space Frustration	Can non-compressible path-space constraints generate stable generations?	The path-space system carried genuine constraints but no reliable spectral separation from controls.	**Negative numerical result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 22	Non-Abelian Loop Holonomy	Can non-Abelian loop constraints generate persistent spectral organization?	Strong loop constraints were realizable, but no robust generational separation was obtained.	**Negative numerical result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 23	Bottleneck Holonomy and Geometric Control	Does localizing holonomy at bottlenecks create a geometry-specific signal?	No stable superiority over matched geometric controls was established.	**Negative numerical result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 24	Long-Time Four-Arm Comparison	Does TRUE relational Clifford organization survive to 1000 epochs?	Three-pair separation persisted while asymmetry relaxed. Historical Paper XI also reused EXPT 24 for a defect-model branch; file-level provenance therefore controls.	Numerical audit / legacy ID collision	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 25	Heterogeneous Defect Islands and Slab Control	Can heterogeneous defect topology produce stable low-spectrum structure?	No robust separation from matched slab/control ensembles was established.	**Negative numerical result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 26	Layer-Depth Symmetry-Breaking Threshold	Does causal layer-depth modulation move the symmetric triplet toward Koide?	Exact (2,2,2) organization persisted, but K remained near 1/3 at tested amplitudes. Some notebook branches reused the identifier for causal-hysteresis variants.	**Negative numerical result / legacy ID collision**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 27	Large-Delta Scan / High-Mode Self-Energy Audit	Can stronger depth forcing or high-mode coupling generate the missing hierarchy?	The large-delta dynamics restored the symmetric vacuum; the separate high-mode self-energy branch found negligible direct deformation.	**Negative numerical audit / legacy ID collision**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 28	Asymmetry-Stabilizing Feedback / Clifford Coupling Observable	Is the restoring force in alpha decay, or can Clifford observables supply hierarchy?	Channel asymmetry could grow without spectral hierarchy; global Clifford observables remained essentially democratic.	**Negative numerical audit / legacy ID collision**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 29	Nonlinear Geometric Amplification	Can nonlinear depth/path fields amplify hierarchy?	Most fields gave weak effects; rare geometries motivated the later dedicated rare-path search.	**Exploratory numerical precursor**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 30	Koide-Curve Driver / Rare Path Geometry Search	Can a phase-agnostic driver stabilize Koide, or can rare path fields produce hierarchy?	The driver did not establish a native basin; the separate rare-geometry branch found reproducible but unexplained hierarchical projections.	**Legacy ID collision / mixed outcome**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 31	Projected-Operator Hierarchy / Preregistered Causal Triplet Trial	Does triplet projection reveal hierarchy, and do fixed Padovan targets win preregistered tests?	Projection revealed hierarchy but the original trace construction was later gauge-corrected; the separate Padovan trial failed its criteria.	Partially retained precursor / legacy ID collision	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 32	Projected Operator Anatomy / Causal Hourglass	Which internal matrix features explain hierarchy, and can fixed causal geometry select it?	Simple democratic/off-diagonal descriptors did not explain the effect; fixed geometric selection did not close the mechanism.	**Diagnostic / legacy ID collision**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 33	Rank Concentration as Hierarchy Driver	What controls projected hierarchy?	Rank concentration dominated with corr(K,R) approximately 0.956; Koide was a crossing near R approximately 0.80, not an attractor.	**Numerically supported**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 34	Koide Feedback Stabilization Pilot	Can an explicit target-aware feedback drive the projected packet toward Koide?	The pilot showed controllability but used supplied target information; it is diagnostic rather than a native derivation.	**Target-aware diagnostic**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 35	Native Frobenius Equipartition Feedback	Does direct equipartition feedback stabilize K=2/3?	Yes across the tested ensemble, but the equipartition error was inserted explicitly.	**Imposed effective stabilizer**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 36	Operator-Level Frobenius Feedback / Causal Learning Agent	Can stabilization be moved from singular values into operator space?	Fixed-basis operator feedback was unstable or incomplete; a separate learning-agent branch used the same identifier.	**Diagnostic / legacy ID collision**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 37	Spectral-Adaptive Frobenius Feedback / Generation Coherence Agent	Does following the instantaneous spectral frame improve stabilization?	Adaptive feedback strongly improved convergence, while remaining imposed rather than substrate-derived.	**Effective diagnostic / legacy ID collision**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 38	Passive Geometry Search / Euler Spiral Agent	Can passive geometric descriptors or an ordered agent explain Koide landing?	No reliable passive predictor or majority-win agent was established; the missing requirement remained a stopping mechanism.	**Negative diagnostic / legacy ID collision**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
EXPT 39	Deep Spiral Final Verification	Does the ordered construction beat matched controls under preregistered criteria?	It passed aggregate coherence and angle-stability criteria but failed the required majority win rate.	**Preregistered negative result**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 40	Fixed Analytic q_K Robustness Test	Does the analytic q_K effective law survive substrate-size and density changes?	Yes at the projected-flow level: median K, R, and qR remained locked to the analytic fixed point across tested substrates.	**Numerically supported effective model**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 22B	Transient TRUE-versus-Shuffled Signal	Does a clean Z3 breaking test produce a relational advantage?	A transient signal motivated longer tests; it did not by itself establish a stable mechanism.	Historical numerical precursor	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 38A	Geometry-to-Collapse / Triplet-Closure Diagnostic	Do ordinary substrate descriptors explain near-Koide projected cases?	No clean predictor was found; static geometry did not supply a stopping rule.	Diagnostic / open	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 39A	Collapse Plus Maintenance Flow	Can entropy-like maintenance brake rank collapse?	Fixed maintenance created an interior attractor below Koide and exposed the need for state-dependent braking.	**Effective precursor**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 39B	Self-Normalized Deficit-Gated Entropy Screen	Can state-dependent entropy backreaction self-normalize?	The qR gate produced a strong interior attractor near R=0.8; q was still selected empirically.	**Superseded effective test**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 39C	Focused q Sweep Near 1.25	Is the empirical optimum a broad basin or an analytic clue?	The focused sweep confirmed qR approximately 1 and motivated q_K=1/R_K.	Numerical precursor	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 39D	Analytic q_K Deficit-Gated Entropy Sweep	Does q=q_K place the effective fixed point exactly at Koide?	Yes in the implemented projected flow: median K=2/3, R=R_K, and qR=1 to numerical precision.	**Numerically supported effective model**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 40B	q_K Convergence-Basin Check	Do under-collapsed cases approach the same fixed point with longer flow?	The audit supported the basin interpretation while retaining finite-time and initialization limitations.	**Numerically supported basin audit**	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 12.1	True Relational Frustration - Competing Z3 Twists	Can explicit incompatible Z3 constraints create structure?	Produced genuine frustration but not a robust physical triplet beyond controls.	Historical numerical precursor	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 13.1	Frustration Amplifier - Rigorous Revision	Does amplified frustration create a stable control-separated spectrum?	No robust separation was established.	Negative numerical result	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
EXPT 14.1	Geometric Domain Frustration - Mesoscopic Layers	Does mesoscopic placement improve the signal?	A preliminary geometry-dependent effect appeared but did not survive as a sufficient mechanism.	Historical positive precursor	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 15.1	Structured Geometric Frustration - SU(2) Fluid	Can structured bottleneck frustration organize a delocalized phase?	Produced one of the stronger early signals; later audits narrowed the conclusion.	Historical positive precursor	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 16.1	Rigorous BBP-Frustration Bridge	Can geometry-derived low-rank projectors detach generations?	No. The low-rank extraction route failed.	Negative numerical result	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 18D	Four-Component Chirality-Resolved Clifford Feedback	Can chirality-resolved feedback organize the protected low modes?	No robust low-mode hierarchy was established.	Negative numerical precursor	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 19B	Kinetic Cl(3) with Z3 Irrep Test	Does the proper Z3 eigenvector irrep produce stable organization?	The test did not close generation or Koide selection.	Historical diagnostic	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
EXPT 20B	Controlled Kramers-Broken Kinetic Cl(3) Test	Does controlled Kramers breaking unlock a physical hierarchy?	No stable target hierarchy was established.	Historical diagnostic	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 25B	Localization and Correct Koide Diagnostics	Are apparent Koide signals artifacts of localization or incorrect pair handling?	The diagnostic corrected interpretation and strengthened pair-aware controls; it did not supply a selection mechanism.	Diagnostic audit	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 29B	Spread-Maximizing Driver	Can a K-agnostic hierarchy driver break the symmetric vacuum?	It generated the first strong transient symmetry breaking and near-Koide visits, but not a stable basin.	Positive reachability precursor	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
EXPT 37B	Spectral-Adaptive Frobenius Feedback Sweep	Does the adaptive imposed flow converge without an accuracy ceiling?	Yes, machine-precision target convergence was achieved across the tested ensemble; the target remained imposed.	Effective diagnostic stabilizer	drive-download-20260630T142318Z-3-001.zip; formal recovered records 01-26; DOI pending	Recovered notebook archive + formal record crosswalk
M1	Raw Diamond-Density Divergence	Does raw minimal-diamond count per event converge?	No. Raw counts are ultraviolet dominated and non-extensive; a renormalized weighted observable is required.	**Negative result / precursor**	IRMT-M1 Experimental Note; public DOI pending	Corpus / author archive
M2	Renormalized Diamond-Wilson Geometry	Can an empirical weighted tensor produce a stable continuum plateau?	A finite-size empirical candidate was reported, but M3/M3B later selected k=2, r=1/2 and demoted the older plateau.	Superseded numerical candidate	IRMT Experimental Note M2; public DOI pending	Corpus / author archive
M2A	Weighted-Tensor Plateau and Symmetry	Does the empirical M2 tensor plateau and become rotationally clean?	Finite-size plateau and decreasing off-diagonal contamination were observed; asymptotic interpretation superseded by M3B.	Historical numerical result	M2 archive; public DOI pending	Corpus / author archive
M2B	Wilson Reconstruction of Weighted Tensor	Does explicit SU(2) Wilson response reconstruct the M2 tensor?	Reported close reconstruction and exposed trace-normalization ambiguity; physical continuum coefficient later replaced by M3.	Historical numerical result	M2 archive; public DOI pending	Corpus / author archive
M3	Analytic Continuum Diamond Test	What scaling gives a finite extensive continuum response?	Selected k=2, r=1/2 and the exact candidate $\xi_6=51/(1400\sqrt{\pi})$.	Analytic/numerical support	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
M3B	High-N Pair-Integral Continuum Test	Does the M3 limit survive to high N and does the M2 plateau decay?	M3 approaches a constant while the old M2 candidate decays; seven preregistered tests passed.	**Numerically supported continuum audit**	IRMT_M3B_highN_pair_integral.py; public DOI pending	Corpus / author archive
M4A	Electric-Magnetic Triplet Decomposition	Does the six-bivector response split into equal triplets?	Leading electric and magnetic triplet responses approach equality; 8/10 strict tests passed.	**Numerically supported / conditional**	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive
M4B	Unnormalized Frobenius Backreaction	Can the continuum response stabilize the effective packet?	Stable effective response was found; 6/7 tests passed, conditional on the chosen backreaction law.	**Effective numerical result**	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive
M4C	Exact Finite Wilson Response	Does the exact Wilson trace improve packet-scale closure?	Finite-angle dressing reduced the scale residual; 5/5 tests passed.	**Exact function + numerical comparison**	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive
M4D	D3 Phase Locking	Can the flavor azimuth be selected by the minimal oriented invariant?	The effective invariant selected the principal phase branch; 12/12 tests passed.	**Exact effective invariant test**	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive
M4E	Representation-Resolved Holonomy Audit	Is the commutant unique, and what does an unsourced Wilson action select?	The commutant classification was unique; an unsourced Wilson action selected zero connection.	**Exact classification / no-go**	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive
M4F	Singular-Value-Holonomy No-Go	Do singular values determine flavor frame or holonomy?	No; exact counterexamples were constructed.	**Exact no-go result**	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive
M4G	Exterior-Square Flavor Bundle	Does Λ^2 provide a canonical covariant flavor operator?	Exact covariance and rank amplification were established; causal specificity remained unproved.	**Exact representation result**	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive
M4H	Determinant-Holonomy Completion	Can one transport carry both Wilson scale and determinant phase algebraically?	Yes algebraically; 13/13 tests passed, without deriving the physical source.	Algebraic completion	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive
M4I	Response-Connection Closure Audit	Can the response-to-connection map be derived from the existing scalar theory?	No. Additivity/identity lift remained the missing lemma; 10/10 diagnostic tests passed.	**Negative diagnostic result**	Experiments & Notes M1-M4I; public DOI pending	Corpus / author archive
M5A	Full-Matrix Koide Stabilization and Pair-Closure Test	Tests $K \to 2/3$, $R \to R\_K$, $h \to 1$, and subordinate pair closure with preregistered controls.	Positive effective stabilization in the matrix model; does not generate connection phases.	**Numerical effective model**	IRMT_M5A_complete_bundle(4).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream
M5B	Kato / packet-holonomy precursor	Tests canonical transport of protected subspaces.	Exact metadata/outcome require archive reconciliation; later M5G/M5L show canonical/passive holonomy is insufficient.	**Archive reconciliation pending**	IRMT_M5B_complete_bundle(3).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream
M5C	Central-Current Audit	Tests whether packet-isospectral closed loops generate a central current.	No universal current of the required type was established.	**Negative audit**	IRMT_M5C_complete_bundle(3).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream
M5D	Packet-to-connection candidate audit	Tests an early determinant-current candidate.	Exact title and result require archive reconciliation; no active closure depends on it.	**Archive reconciliation pending**	IRMT_M5D_complete_bundle(3).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream
M5E	Protected transport candidate audit	Tests a candidate finite holonomy construction.	Exact title and result require archive reconciliation; later no-go tests supersede any closure claim.	**Archive reconciliation pending**	IRMT_M5E_complete_bundle(3).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream
M5F	Full Complex Polar-Factor Audit	Can the packet polar sector derive universal finite phases?	No. The polar sector remains independent; state-only rates are clock dependent and D3 leaves free one-forms.	**Negative audit**	IRMT_M5F_complete_bundle(3).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream
M5G	Static Polar-Factor and Pure-Gauge No-Go	Can static polar phases or closed Maurer-Cartan paths provide q_K and 1?	No. Hermitian phases are 0 or π; closed pure-gauge phases are $2\pi n$; singular values do not fix phase.	**Exact no-go**	IRMT_M5G_complete_bundle(3).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream
M5H	Raw Protected-Sector Holonomy Screen	Tests actual protected-sector link holonomies as phase sources.	The preserved package validates the analyzer on synthetic data only; the original scientific raw-link archive was not recovered.	**Analyzer validation; scientific input unavailable**	IRMT_M5H_analyzer_bundle(3).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
M5I	Connectivity-Defect Source Normalization Audit	Does a parameter-free link-staple defect scale converge to the required Wilson source ratios?	No complete parameter-free source normalization or channel assignment was derived.	**Negative numerical audit**	IRMT_M5I_complete_bundle(2).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream
M5J	Spectral Projection of Connectivity Defects	Can minimal-diamond staple defects projected through low modes derive the phase triplet?	No. The simple proxy failed; the actual protected U(2) holonomies remained the decisive target.	**Negative numerical audit**	IRMT_M5J_complete_bundle(2).zip; local recovered result bundle; consolidated DOI pending	Recovered result bundle; executable source not recovered unless embedded downstream
M5K	End-to-End U(2) Spectral-Feedback Wilson-Loop Screen	Can response-weighted feedback generate coherent target Wilson phases?	A transparent screen was run; it did not become an active derivation and used a newly implemented model.	Numerical screen / non-normative	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5L	Exact EXPT-24 Protected-Triplet Holonomy Audit	Do the documented edge links carry determinant Wilson phase?	No. Stored positive-sector links have determinant one and causal-diamond determinant phases remain zero.	**Exact implementation audit**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5M	Exact EXPT-31 Pair-Frame Gauge Audit	Is the trace-projected hierarchy invariant under independent U(2)^3 basis rotations?	No. Trace projection is gauge dependent; determinant-line projection is the correct covariant replacement.	**Exact gauge audit**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5N	Gauge-covariant packet precursor	Tests a corrected determinant-line construction.	Exact title and outcome require archive reconciliation; superseded by M5O/P/Q/R.	**Historical result; standalone archive unavailable**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5O	Gauge-Covariant Determinant-Line Rewrite of EXPT 39D	Does the effective q_K basin persist after replacing trace projection with determinant-line projection?	Yes in the tested flow; q remains externally selected and no holonomy is generated.	**Numerically supported effective rewrite**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5P	Determinant-Line 39D Flow with Pair Closure	Does target-free subordinate pair closure complete the determinant packet?	Tests joint K, R, and pair tolerances; remains an effective eigenvalue-space flow.	**Numerical effective model**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5Q	Completed Matrix/Packet Flow Candidate	Combines determinant packet dynamics and controls.	Serves as the input model for M5R; exact archive title should be confirmed before release.	**Historical result; standalone archive unavailable**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5R	Full-Corpus Validation of M5Q	Does the M5Q packet flow work across rare and control substrate cases?	Positive modulus-basin validation; q_K remains supplied, eigenframes are not evolved, and no central holonomy is generated.	**Numerically supported effective model**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5S	Response-Weighted Support One-Form Audit	Is A=(q_K,1,1)dh a genuine closed gauge connection?	No. It is reparameterization-invariant on an open path but exact on closed loops; charged promotion is constitutive.	**Exact no-go / boundary result**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5T	Support-Circle and Boundary-Transition Audit	Can identifying h=0 and h=1 turn the one-form into nontrivial holonomy?	A flat circle completion is mathematically consistent only if endpoint identification is added constitutively.	Conditional topology audit	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5U	Support-Cycle Topology Audit	Is the existing support dynamics itself periodic under h=0~1?	No. h is an interval variable with a fixed-point boundary, not a circle coordinate.	**Exact dynamical no-go**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5V	Compact completion candidate	Tests an additional compact phase/reset completion.	Exact title and outcome require archive reconciliation; no active microscopic closure resulted.	**Historical result; standalone archive unavailable**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M5W	Relative-Connection Action Audit	Can a convex relative-connection action realize the response-Jacobian map?	Yes after adding a new response-Jacobian matching principle; the principle is constitutive, not selected by existing dynamics.	Constitutive completion audit	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles

Experimen t	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
M5X	Diamond-Wilson and Support-Hessian Audit	Does the current action contain the packet-connection mixed Hessian?	No. Diamond-Wilson and support sectors are decoupled; a Hessian-connection intertwiner remains extra structure.	**Exact action-level no-go**	Standalone bundle not recovered; result retained from formal audit records / downstream embedded code where available	Core audit records and later M6 dependency bundles
M6D	Production-Scale Physical-Link Stabilization	Can link-native updates realize the packet target at production scale?	The tested link-level route did not provide complete protected holonomy closure.	**Exact/numerical audit**	IRMT_M6D_complete_bundle(4).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6E	Packet-Isospectral Null-Space Holonomy	Can packet-preserving null motion generate the required phase?	No; the packet-isospectral route was rejected.	**Exact/numerical audit**	IRMT_M6E_complete_bundle(4).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6F	Local Mixed Berry Curvature	Does local mixed curvature exist and carry orientation?	Yes locally; it supplies a real carrier but not the universal finite response law.	**Exact/numerical audit**	IRMT_M6F_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6G	Finite Ribbon Integration	Can local curvature integrate to a finite gauge-invariant phase?	Yes for specified ribbons, but not with universal packet scaling.	**Exact/numerical audit**	IRMT_M6G_complete_bundle(4).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6H	Protected-Ribbon Scaling	Does ribbon response scale universally across packets?	No universal magnitude/ratio was established.	**Exact/numerical audit**	IRMT_M6H_complete_bundle(5).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6I	Canonical Local Intertwiner Pilot	Does a canonical local intertwiner satisfy gauge and area-law tests?	Local gauge/area-law behavior was supported; coefficient universality remained open.	**Exact/numerical audit**	IRMT_M6I_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6J	Cross-Scale Intertwiner Confirmation	Does the local result persist across scale and packets?	Local geometry persisted, but the finite packet-to-phase map was not universal.	**Exact/numerical audit**	IRMT_M6J_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6K	Mixed Variation of Existing Action	Does the present action generate a packet-connection source?	No. The mixed variation vanishes exactly.	**Exact/numerical audit**	IRMT_M6K_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6L	Classification of Lowest-Order Mixed Operators	Do declared symmetries uniquely select the identity response map?	No. Independent common and relative coefficients remain allowed.	**Exact/numerical audit**	IRMT_M6L_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6M	Compact Packet Phase	Can one compact phase exactly encode the irrational response ratio?	No without extra charges/normalizations; the simplest compact completion fails.	**Exact/numerical audit**	IRMT_M6M_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6N	Charged Inter-Line Intertwiner	Can difference-charged fields source the full determinant current?	They source relative currents but are blind to the common determinant mode.	**Exact/numerical audit**	IRMT_M6N_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6O	Common Determinant Charge and Relative Roots	Does exterior-square representation supply common plus relative charges?	Yes exactly at the representation level; action weights remain unfixed.	**Exact/numerical audit**	IRMT_M6O_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6P	Exterior-Square Action Descent	Does the protected-block Wilson action produce the identity metric?	Yes at bare quadratic order: G_W=I and b_bare=0.	**Exact/numerical audit**	IRMT_M6P_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6Q	Mixed-Wedge Elimination	Is the bare metric protected after integrating mixed wedges?	No generically; Schur-complement corrections regenerate relative-channel terms.	**Exact/numerical audit**	IRMT_M6Q_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive

Experiment	Title	Primary question	Outcome / present interpretation	Scientific status	Archive location	Verification source
M6R	Chiral and Graded Protection	Do native chiral/graded partners cancel the correction?	No in the tested structures; engineered cancellation adds unselected structure.	**Exact/numerical audit**	IRMT_M6R_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
M6S	Closed-Packet Spectral-Gap Test	Do stabilized packets generate sufficient decoupling?	No. Tested invariant gap measures fail the required protection hierarchy.	**Exact/numerical audit**	IRMT_M6S_complete_bundle(3).zip; published archive 10.5281/zenodo.20953336	Recovered complete bundle + Paper XVI experimental archive
C1	Spectrum-Level Calibration	Calibrate a bounded finite-coherence temperature kernel.	Selected α_CMB and L_H; this is calibration, not prediction.	**Calibrated phenomenological model**	Zenodo record 21016051; DOI form to verify before frozen release	Corpus / author archive
C2	Pseudo-C_ell Map Robustness	Does the locked kernel improve the target across maps, masks, and resolutions?	Directional improvement across 30 correlated processing variants; bounded numerical support.	Locked numerical test	Zenodo record 21016051; DOI form to verify before frozen release	Corpus / author archive
C3	Direct Real-Space S_1/2 Test	Does the locked kernel improve direct large-angle temperature correlations?	Directional improvement across five maps; WMAP became typical while several Planck maps remained anomalous.	Locked numerical test	Zenodo record 21016051; DOI form to verify before frozen release	Corpus / author archive

Appendix H - Superseded and Retired Claims

This permanent correction record preserves original wording, the decisive reason for reclassification, the surviving narrow content, and the only language permitted in the active specification.

er	Context	Original claim / route	Category	Current status	Reason	Invalidated dependency	Surviving content	Active replacement	Prohibited wording	Reactivation gate
	Geometric Scaling of Relational Coherence	The coherence concentration is universally equal to the unity-compatible record count, $\kappa=N_{rec}$.	**Reclassified as conditional**	The scaling may hold in the adopted independent-record model, but the unit coefficient and universality are not derived.	The inverse-variance identification and independent Poisson accumulation assumptions do not fix a universal microscopic law.	Universal map from microscopic causal records to κ	The von Mises distribution and its Bessel moments remain exact once κ is specified.	Within the stated ensemble, κ may scale approximately with the number of coherent records; the microscopic coefficient and universality remain open.	“IRMT derives κ=N from first principles.”	Derive κ and its normalization fr frozen history measure or microscopic action across admiss substrates.
	Entanglement Correlations; CHSH Correlations	Unity conditioning derives the bipartite cosine correlator.	**Closure language withdrawn**	The cosine kernel is assumed or inherited before multiplication by the finite-coherence visibility.	No complete positive normalized probability law $P(a,b\mid x,y)$ is constructed.	Substrate → joint probability law → cosine correlator	The visibility factor $\eta=I_1/I_0$ is a valid moment of the adopted von Mises distribution.	IRMT currently defines a finite-coherence modulation of an assumed cosine correlator.	“The quantum cosine law is derived from Relational Unity.”	Construct $P(a,b\mid x,y)$ and derive th correlator operationally.
	Relational Locality and No-Signaling	IRMT proves operational no-signalling from Unity conditioning.	**Closure language withdrawn**	Frame covariance and phase averaging do not substitute for marginals of a complete joint probability law.	The required $P(a,b\mid x,y)$ is absent.	Joint probability law and marginal calculation	The conceptual separation between causal influence and global admissibility remains useful.	No-signalling is a completion criterion for the future probability law.	“No-signalling has been proved in IRMT.”	Derive P and prove setting-independent local marginals.
	CHSH Correlations and Tsirelson Asymptote	IRMT derives the Tsirelson bound and the full quantum correlation sector.	**Closure language withdrawn**	$S=2\sqrt{2}\eta$ follows algebraically only after assuming the cosine correlator and optimal settings.	Quantum-set restriction and exclusion of supraquantum boxes are not proved.	Complete probability set and its admissibility boundary	Conditional CHSH algebra for the adopted correlator remains correct.	IRMT has not yet derived the quantum correlation set or the Tsirelson restriction.	“IRMT reproduces or derives the full quantum entanglement sector.”	Construct the operational probab law and prove its attainable correlation set.
	Multi-Component Record Fields and Internal Symmetry	Multi-component relational records explain the gauge interactions of nature.	**Closure language withdrawn**	The construction establishes generic local unitary covariance, not the observed gauge group and representations.	No selection of SU(3)×SU(2)×U(1), chirality, hypercharge, or anomaly cancellation exists.	Kinematic frame group → physical gauge group	Unitary link transport and loop holonomy remain valid generic gauge geometry.	IRMT presently supplies a generic discrete gauge-covariant framework.	“The gauge interactions of nature are derived.”	Derive the physical group, representations, charges, chiralit and anomalies from the frozen st space/action.
	Spectral Action and Continuum Einstein Limit	Generic spectral-action machinery uniquely yields IRMT gravity and a relational Einstein equation.	**Closure language withdrawn**	Heat-kernel Einstein-Hilbert terms are generic imported mathematics and do not prove convergence of the active IRMT operator.	The active operator, normalization, source map, and backreaction are not jointly derived.	Actual D_rel → controlled continuum operator → coupled Einstein equation	The spectral-action route remains an optional external continuum bridge.	Suitable continuum spectral operators possess Einstein-Hilbert terms; applicability to IRMT remains open.	“IRMT uniquely derives Einstein gravity from its spectral action.”	Freeze D_rel and prove controlle convergence, normalization, and matter coupling.
I	Coherence Scaling and Structural Correlation Deficit	A universal laboratory correlation deficit is predicted from causal record counting.	**Reclassified as conditional**	The deficit depends on the unresolved κ(N) law and the assumed cosine correlator.	Both the microscopic coherence map and complete probability law remain open.	κ=N and full bipartite probability model	The asymptotic Bessel coefficient 1/2 is mathematically valid.	The stated deficit is a conditional output of the adopted scaling and correlation model.	“IRMT predicts a universal finite correlation deficit.”	Derive κ, $P(a,b\mid x,y)$, and the relev experimental observable from th core action.
I	Positive Grassmannian and Parke-Taylor Formula	Relational consistency physically derives scattering amplitudes and the Parke-Taylor structure.	**Exploratory archived**	A mathematical embedding/residue construction is available only after imposing familiar positivity and manifestation constraints.	No scattering dynamics, state preparation, or physical amplitude-selection principle is derived.	Relational substrate → physical S-matrix	The formal Grassmannian residue calculation may remain as a mathematical analogy.	Certain imposed relational configurations reproduce familiar positive-Grassmannian residue forms.	“IRMT derives the Parke-Taylor amplitude.”	Derive a physical scattering state space, dynamics, measure, and amplitudes from the core theory.
I	Valence Defects and Ensemble-Averaged Field Equations	Connectivity defects constitute physical matter and observed gauge currents.	**Reclassified as conditional**	Defects can source the selected discrete transport equations, but observed charges and representations are not derived.	The later Dirac/packet matter ontology is not integrated with the defect-current proposal.	Graph defect → observed particle/current	Discrete defect currents remain a candidate source mechanism.	Valence defects may source the chosen transport equations; their physical identification remains conjectural.	“Matter is derived as valence defects.”	Derive charge quantization, representations, and equivalence the active matter sector.
I	Standard Model Structure: Emergence of the Gauge Group	Internal record multiplicity yields the full Standard Model gauge group.	**Permanently retired**	Generic U(m) covariance allows many groups and supplies no unique subgroup-selection theorem.	Record dimension and representation are choices rather than outputs.	Generic local covariance → observed gauge content	Generic unitary frame covariance and Diamond-Wilson dynamics survive.	The Standard Model gauge group and representation content remain open derivations.	“The Standard Model gauge group emerges from record multiplicity.”	A unique/minimal group and representation theorem with ano cancellation.
I	Fermionic Records	Grassmann-valued records explain physical fermions, Pauli exclusion, chirality, and the observed spectrum.	**Reclassified as conditional**	Grassmann variables encode antisymmetry by definition but do not derive spin-statistics, chirality, masses, or representations.	A formal encoding is not a physical selection theorem.	Grassmann record space → observed fermionic sector	Grassmann-valued records remain an optional formal implementation.	Grassmann record variables can encode antisymmetry; their physical selection remains open.	“IRMT derives fermions and Pauli exclusion from Relational Unity.”	Derive the chiral quantum field content and spin-statistics structu from the core action.
II	Continuum Limit and Consistency	The discrete relational Dirac operator has been shown to converge to the Lorentzian continuum Dirac operator.	**Closure language withdrawn**	No controlled convergence theorem with a frozen operator, error norm, scaling regime, and boundary treatment exists.	Several operator discretizations remain possible.	D_rel → continuum Dirac operator	A Dirac-type discrete operator remains an active kinematic construction.	Continuum Dirac recovery is a formal target conditional on a specified scaling limit.	“The continuum Dirac equation is recovered.”	Freeze D_rel and prove converge with explicit error bounds.

er	Context	Original claim / route	Category	Current status	Reason	Invalidated dependency	Surviving content	Active replacement	Prohibited wording	Reactivation gate
II	Spectral Modes and Particle Interpretation	Localized low modes are established physical particles and mass equals spectral depth.	**Reclassified as conditional**	No operational map to quantum fields, dispersion, charges, or measured masses is derived.	The bulk-edge interpretation depended partly on the superseded random-matrix picture.	Eigenmode/eigenvalue → particle/mass	Localized modes remain plausible candidate matter excitations.	IRMT treats persistent low modes as candidate matter structures; their particle interpretation is open.	"Particles and their masses are derived from spectral depth."	Derive field-theoretic observables representations, dispersion, and n normalization.
II	Original chGUE Universality Hypothesis	The native relational Dirac operator belongs to the chiral Gaussian Unitary Ensemble.	**Permanently retired**	Paper X found localized/Poisson-like native behavior across the tested relational constructions.	The sparse causal operator does not exhibit the assumed dense chGUE universality.	Native D_{rel} → chGUE	chGUE remains useful only as a control ensemble.	Native chGUE universality is not part of active IRMT.	"The unperturbed IRMT operator is chGUE."	Only a genuinely revised operato with preregistered independent evidence could revive a new universality claim.
II	Marchenko-Pastur / BBP Generation Mechanism	A Marchenko-Pastur edge and BBP detachment generate the three fermion generations.	**Permanently retired**	The required native random-matrix ensemble premise failed.	No robust physical mapping from outliers to observed generations was independently established.	chGUE → MP edge → BBP outliers → generations	The need for spectral organization and protected low-dimensional structure survives.	BBP detachment is retained only as a historical control model.	"The three generations arise from BBP outliers."	A new independently derived mechanism must predict multipli representations, and robustness without the retired premise.
II	Spectral Chirality and Informational Anomalies	The relational Dirac framework accounts for physical chirality, index structure, and anomaly constraints.	**Closure language withdrawn**	No observed chiral representation content or anomaly-cancellation derivation is supplied.	Generic grading and Clifford structure are insufficient.	Dirac grading → Standard Model chirality/anomalies	Formal chirality and index-like structures remain mathematical resources.	Physical chirality, hypercharges, and anomaly cancellation remain open.	"IRMT explains chirality and anomalies."	Derive the complete chiral spectr and all anomaly cancellations.
V	Relational Dirac Sector and Matter Load	Localized spectral modes are established matter sources with energy density fixed by update frequency.	**Reclassified as conditional**	The map from discrete modes to a unique conserved $T_{\mu\nu}$ is not derived.	It inherits the unresolved particle interpretation and coarse-graining normalization.	D_{rel} eigenmodes → physical stress-energy	Update flux remains a candidate matter-source variable.	Localized spectral modes are candidate matter excitations whose continuum source map is open.	"The matter source is explicitly derived from the relational spectrum."	Derive matter and metric equatio jointly from one action.
V	Geometric Closure Bridge	Lovelock's theorem closes the IRMT gravitational derivation and uniquely yields the Einstein equation.	**Closure language withdrawn**	Lovelock classifies admissible continuum tensors after continuum assumptions are imposed; it does not derive the continuum metric or IRMT source map.	The discrete-to-continuum and matter-backreaction arrows remain open.	Discrete relational dynamics → continuum Einstein equation	Lovelock's theorem remains a valid imported uniqueness result within its domain.	If IRMT reaches the required continuum assumptions, Lovelock restricts the leading metric equation.	"Lovelock's theorem completes or proves IRMT gravity."	Prove the actual continuum limit coupled source dynamics before invoking the theorem physically.
V	Spin-Torsion and Correlation-Deficit Predictions	IRMT predicts measurable gravity-modulated entanglement deficits and spin-torsion effects.	**Exploratory archived**	No fixed coefficient, complete quantum probability law, or validated gravitational coupling determines the effects.	The proposed observables depend on unresolved cross-sector bridges.	Quantum deficit ↔️ gravity coupling ↔️ observable signal	The proposals remain useful future test families.	These effects are exploratory consequences of currently unclosed bridges.	"IRMT makes parameter-free spin-torsion or gravitational-entanglement predictions."	Derive the quantum and gravitati sectors, then preregister numeric predictions.
V	Dark Matter as Relational Lag	Dark-matter phenomena are explained by delayed relational update response.	**Exploratory archived**	No action, timescale, galactic/cosmological fit, or independent prediction was developed.	The route was not used in later validated work.	Relational update lag → dark-matter phenomenology	None beyond a speculative research idea.	Relational lag is an archived exploratory hypothesis, not part of active IRMT.	"IRMT explains dark matter as relational lag."	Develop a quantitative model tha outperforms appropriate dark-ma baselines under locked tests.
/	High-Coherence Early Universe	High shared ancestry explains homogeneity and flatness without inflation.	**Reclassified as conditional**	No perturbation spectrum, horizon calculation, flatness dynamics, or model comparison was supplied.	The causal-growth law and continuum cosmology are not frozen.	Causal ancestry → observed early-universe statistics	High coherence remains a qualitative early-universe hypothesis.	IRMT has not derived an alternative to inflation.	"IRMT solves the horizon and flatness problems without inflation."	Derive background and perturba dynamics and compare with inflationary data.
/	Spectral Condensation and the Formation of Matter	A cosmological BBP transition forms matter and three generations during network dilution.	**Permanently retired**	The native chGUE/BBP premise was falsified in Paper X.	No revised cosmological condensation mechanism replaced it.	Cosmological dilution → BBP transition → matter/generations	The broader question of dynamical matter formation remains active.	The BBP cosmological matter-formation mechanism is retired.	"Cosmic dilution produces BBP particle generations."	A new matter-formation action m produce stable fields and generat without the retired spectral prem
/	Relational Expansion and Friedmann Dynamics	The IRMT gravitational bridge already yields Friedmann equations.	**Closure language withdrawn**	The underlying gravitational bridge, scale factor, and time variable are conditional.	No unique causal-growth law or controlled FLRW limit exists.	Causal network dynamics → FLRW metric and Friedmann equations	Standard Friedmann equations remain a possible imported continuum limit.	Friedmann dynamics are a target conditional on a completed gravity and cosmology sector.	"IRMT derives Friedmann expansion."	Derive the continuum metric and expansion equations from the fro causal action.
/	Vacuum Informational Update Flux	A baseline relational maintenance cost explains and predicts dark energy.	**Reclassified as conditional**	No microscopic vacuum action or absolute value was derived; the tested simple running implementation failed in Paper XIV.	Conceptual interpretation and empirical implementation must be separated.	Vacuum update burden → observed dark-energy dynamics	The relational interpretation of vacuum energy remains a hypothesis.	The tested one-parameter running is rejected; no active quantitative dark-energy prediction remains.	"IRMT derives dark energy from vacuum update flux."	Derive a vacuum term from the c action and test it without retrospective tuning.
/	Overall Cosmological Framework	IRMT provides a complete unified alternative history from early universe to matter and acceleration.	**Closure language withdrawn**	Early-universe dynamics, matter formation, gravity, and dark energy are all conditional or partly retired.	Paper XIV leaves only a bounded CMB temperature-coherence target.	All cosmological subchains	A relational cosmology research framework and one bounded CMB target survive.	IRMT does not presently constitute a complete alternative cosmology.	"IRMT provides a unified replacement for ΛCDM."	Derive a complete background/perturbation model a outperform relevant baselines ur locked tests.
/I	Lemma A: Critical Coherence Threshold	A parameter-free collapse threshold follows from a Marchenko-Pastur spectral edge.	**Permanently retired**	The native chGUE/MP architecture was falsified by Paper X.	No revised threshold has been derived.	Native RMT edge → κ_c	The general idea that measurement may depend on finite relational coherence remains conceptual.	No active IRMT collapse threshold currently exists.	"IRMT predicts the critical coherence threshold κ_c."	Build a new measurement theory from the active probability and st space framework.
/I	Lemma B: Finite Rank and Rank Three	Finite coherence forces a unique observational projector of rank three.	**Permanently retired**	The argument depends on the obsolete spectral architecture and an unsupported claim about causal predecessors and Clifford rank.	Finite capacity does not uniquely select rank three or the measurement basis.	Causal geometry → unique rank-three measurement projector	Finite informational capacity may still motivate finite effective rank.	No unique observational rank is currently derived.	"Measurement rank three is forced by Poisson causal geometry."	Derive the measurement algebra projector from a valid operationa probability theory.

er	Context	Original claim / route	Category	Current status	Reason	Invalidated dependency	Surviving content	Active replacement	Prohibited wording	Reactivation gate
/I	Theorem C: Projection Necessity	Random phase accumulation makes the transport operator nonunitary, and projection is the unique restoration mechanism.	**Closure language withdrawn**	Random variation among unitary phase factors does not by itself produce a nonunitary operator; averaging and physical evolution were conflated.	The threshold and projector dependencies are also retired.	Phase dispersion → unitarity violation → unique projection	Measurement as relational consistency remains a possible conceptual program.	Projection necessity and uniqueness are not established.	“Indefinite superposition is unitarity-forbidden in IRMT.”	Define the physical state/evolutio map and prove any nonunitary transition from the core dynamic
/I	Coherence-Limited Superposition Timescale	Every system has a universal, environment-independent maximum superposition time predicted by IRMT.	**Permanently retired**	The timescale was calculated from the retired threshold mechanism.	No active coefficient or dynamics supports it.	κ_c and random-walk phase law → τ_sup	The search for intrinsic relational decoherence remains an open experimental idea.	IRMT currently predicts no universal intrinsic superposition timescale.	“IRMT predicts a residual decoherence floor or maximum superposition time.”	Derive a new timescale from acti dynamics before experimental comparison.
/I	Born Rule and Preferred Basis	Coherence-weighted projection derives the Born rule and uniquely selects the preferred basis.	**Permanently retired**	It relies on the retired threshold/projector architecture and lacks a complete operational probability law.	The overlap formula assumes much of the structure it claims to derive.	Retired projection update → Born probabilities and basis	Standard overlaps may remain ingredients of a future model.	No active IRMT derivation of the Born rule or preferred basis exists.	“The Born rule emerges from coherence-weighted projection.”	Derive outcomes, probabilities, a basis selection from the future joi probability/dynamics.
/I	Extension to Continuous Variables	The measurement mechanism extends to continuous-variable systems.	**Permanently retired**	The extension inherits the failure of the parent threshold/projection mechanism.	No independent continuous-variable derivation survives.	Retired discrete mechanism → continuous variables	None beyond possible future use of coherent-state mathematics.	No active continuous-variable measurement model exists.	“The IRMT collapse theorem applies to continuous variables.”	Rebuild after a valid measuremen theory is available.
/I	Complete Resolution of the Measurement Problem	IRMT completely solves the measurement problem.	**Permanently retired**	Threshold, projection necessity, rank, basis, and probability derivations are all retired or open.	Only a broad relational-consistency motivation survives.	All Paper VI quantitative lemmas	The conceptual idea that measurement must respect relational consistency may motivate future work.	The measurement problem is an open sector of IRMT.	“IRMT solves or closes the measurement problem.”	A new model must derive an operational probability law, outc dynamics, and empirical limits.
/II	Lemma A: Explicit Coarse-Graining Map	The flux-to-stress-energy coarse-graining map is explicitly and uniquely derived.	**Closure language withdrawn**	The tensor is constructed by analogy with kinetic theory and dimensional normalization, not derived from variation of the IRMT action.	Its coefficient and convergence remain unproved.	Discrete flux → unique continuum T_{μν}	The proposed symmetric flux-moment tensor remains a candidate coarse-graining map.	Paper VII supplies a conditional source ansatz rather than a unique theorem.	“Gap 1 is closed by an explicit derivation.”	Derive the map from the unified action and prove controlled convergence.
/II	Lemma B: Gravitational Constant	Newton’s constant is derived from the discreteness scale and diamond density with no external physical matching.	**Closure language withdrawn**	The Planck/discreteness scale is externally identified and the combinatorial diamond density is not independently fixed.	The 16π factor is a continuum convention, not a unique microscopic prediction.	Microscopic causal parameters → observed G_N	A single external discreteness scale could set the gravitational scale within the adopted bridge.	The absolute gravitational normalization remains externally anchored.	“IRMT derives Newton’s constant from first principles.”	Derive ℓ_c and the complete continuum coefficient from the fr action.
/II	Coherence Correction to G_eff	The same finite-record deficit that modifies Bell correlations produces a definite enhancement of gravitational coupling.	**Reclassified as conditional**	It inherits the unresolved κ=N law, assumed quantum correlator, and ad hoc coherence weighting of the gravity action.	No single action derives both sectors.	Quantum coherence deficit → gravitational coupling	The algebraic correction is valid if the weighting prescription is adopted.	The cross-sector relation is a conditional hypothesis.	“Quantum-correlation measurements determine gravitational coupling corrections in IRMT.”	Derive both effects from one actio and specify observables.
/II	Lemma C: Matter-Geometry Coupling	Particle mass and gravitational source strength are explicitly derived from spectral depth above the bulk edge.	**Permanently retired**	The bulk edge and BBP detachment picture are retired; the particle/source identification was not independently established.	The formula has no active spectral foundation.	BBP spectral depth → frequency/mass → stress-energy	Localized modes remain candidate matter structures.	No active formula derives particle mass or T_{μν} from spectral depth.	“Particle mass is the depth of a BBP-detached eigenvalue.”	Develop the active matter field ar derive its stress tensor by variatio
/II	The Closed IRMT Einstein Equation	The three gravitational gaps are closed and IRMT derives the Einstein equation with all coefficients fixed.	**Permanently retired**	Coarse-graining, G_N, matter coupling, continuum convergence, and backreaction remain open or imported.	One jointly varied matter-geometry action does not exist.	All Paper VII lemmas → closed Einstein equation	IRMT retains several conditional bridges to causal-set and continuum gravity.	Gravity remains an open foundational sector.	“The gravitational sector is closed.”	Derive source and geometry equations from one frozen action with convergence/error control.
/III	Original BBP Perturbation Interpretation	The Pauli/Cl(3) circular mass structure is physically generated by BBP detachment of the native relational Dirac spectrum.	**Permanently retired**	The native chGUE/BBP premise was falsified by Paper X.	The surviving Koide identity must be separated from the retired spectral story.	Native spectrum → BBP triplet → Koide amplitudes	The algebraic Cl(3)/Frobenius mass geometry survives conditionally.	Paper VIII’s BBP origin story is historical only.	“Koide masses arise from BBP detachment in IRMT.”	A new action must dynamically generate the physical packet and Frobenius relation.
/III	Main Theorem: K=2/3 for All Orientations	The Koide identity holds globally for all phase orientations without qualification.	**Restricted theorem statement**	The square-root masses are |s_a|; sign changes outside the positive-amplitude interval alter the global formula.	The physical fitted phase lies in the valid positive branch.	Signed amplitude → principal square-root mass	The theorem remains exact on the positive-amplitude branch containing the physical solution.	For the positive-amplitude branch, the circular parametrization yields K=2/3 independently of azimuth.	“K=2/3 for every orientation on the full circle.”	Provide a global piecewise absolu value theorem if broader coverag needed.
/III	First-Principles Koide Selection	The physical Frobenius amplitude r=√2 and Koide locus are selected from first principles.	**Closure language withdrawn**	The Pauli Frobenius norm is exact, but identifying it with the physical flavor amplitude is constitutive.	No microscopic packet action selects the equipartition.	Cl(3) norm → physical mass-vector latitude	Exact algebraic Koide geometry survives.	IRMT provides an exact Koide construction conditional on physical Frobenius equipartition.	“The Koide formula is fully derived from first principles.”	Derive physical equipartition fro the unified packet dynamics.

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VIII	Resolution of the Generation Problem	The same construction explains why there are exactly three fermion generations.	**Permanently retired**	The BBP mechanism is retired, and the protected triplet is not yet independently shown to equal the observed generations.	A three-component effective construction is not a generation theorem.	Triplet algebra → three observed generations	Three protected sectors remain an active effective matter architecture.	The origin of exactly three physical generations remains open.	“IRMT solves the generation problem.”	Derive generation multiplicity an representation content from the action.
X	Binary Tetrahedral Phase Selection	A binary-tetrahedral or related finite subgroup selects the physical charged-lepton phase.	**Exploratory archived**	The group permits candidate quantized phases but no substrate dynamics selects the required element.	Paper XV uses a different effective determinant-line/D_3 construction.	Finite subgroup availability → physical flavor phase	The finite-group geometry remains a mathematical possibility.	Binary-tetrahedral phase selection is not part of the active mass derivation.	“The flavor phase is selected by the binary tetrahedral group.”	Derive the subgroup and element from the frozen action and compa against the active bundle construction.
X	RG Correction to the Observed Phase	Two-loop running closes the residual phase gap and completes the charged-lepton prediction.	**Permanently retired**	Paper IX’s update acknowledges that the calculated shift is parametrically insufficient.	An unexplained contribution remained.	High-scale quantized phase → RG shift → observed phase	RG effects may exist but the proposed closure did not work.	The Paper IX two-loop phase correction is not an active explanation.	“Renormalization running explains the observed phase.”	A revised quantitatively sufficien mechanism must be derived independently.
X	UV Boundary Condition and Asymptotic Freedom	The Wilson coupling β is predicted from IRMT and the quartic running law establishes a new asymptotic-freedom result.	**Reclassified as historical matching**	β was fixed by matching an approximate external high-scale gauge coupling and an unverified density estimate.	The physical gauge group itself was not selected.	IRMT microphysics → unique UV gauge coupling/running	A historical dimensional scaling proposal remains documented.	The Paper IX UV coupling was matched, not predicted.	“IRMT derives the UV gauge coupling and asymptotic freedom.”	Revive only after selecting the ga theory and deriving its RG flow fr the action.
X	Complete IRMT Derivation Table	Quantum theory, gauge theory, gravity, generations, measurement, and charged-lepton structure have all been derived.	**Permanently retired**	Later falsification and audits reopen every major foundational sector except certain exact mathematical substructures.	The paper’s own update contradicts its original rhetoric.	All early paper dependencies	The table remains historically useful as a map of intended goals.	IRMT is a partially developed research framework, not a closed fundamental theory.	“The IRMT program is complete or nearly complete.”	All foundational gates in the Core Specification must pass under on action and independent replicatio
X	Falsifiable Predictions List	The listed numerical deviations and timescales are active parameter-free predictions of IRMT.	Reclassified item by item	Many entries depend on retired measurement, gauge, gravity, or spectral mechanisms.	Others lack fixed coefficients or operational observables.	Retired or open sectors → claimed predictions	Negative results and bounded CMB/packet observables remain valid where separately documented.	No Paper IX prediction is active merely because it appeared in the original list.	“IRMT predicts all quantities listed in Paper IX.”	Each item requires an active dependency chain, locked coeffic and preregistered observable.
K	Static and Local Candidate Mechanisms	Static locality, ancestry, memory, frustration, or constraint mechanisms are sufficient to generate the desired spectral organization.	**Empirically rejected route**	The tested static/local families did not outperform appropriate controls or produce robust target structure.	Positive results required feedback and richer transport, which remained insufficient for full theory.	Static/local construction → robust organized low modes	The negative results constrain future model design.	The tested static/local mechanisms are not active generation dynamics.	“Paper X established a static local microscopic mechanism.”	A materially new mechanism mu pass the same controls and target isolation tests.
K	Transport Richness as Complete Mechanism	Transport richness or delocalization alone solves generation and hierarchy.	**Empirically rejected route**	Transport richness changes spectral phase but does not by itself generate robust structured low modes or observed matter.	Delocalization is necessary-looking but insufficient.	Delocalized spectral phase → generations/masses	Transport richness remains an important control variable.	Transport richness is a prerequisite candidate, not a complete matter mechanism.	“Delocalization explains the generations.”	A new action must generate both phase and protected structure.
XII	Pure Rank Collapse as Koide Solution	Unopposed rank-one collapse dynamically solves the Koide problem.	**Empirically rejected route**	Pure collapse crosses the Koide band and continues toward R=1.	The overshoot problem requires a support/braking mechanism.	Rank concentration alone → stable Koide attractor	Rank concentration remains the strongest implemented hierarchy mechanism.	Pure rank collapse generates hierarchy but does not stabilize the Koide point.	“Rank-one collapse by itself selects K=2/3.”	Any revised pure-collapse claim r exhibit an intrinsic untuned stop principle.
XIII	Why the Law Does Not Contain Koide	The stabilization flow is fully Koide-agnostic and contains no target information.	**Reclassified as conditional**	The coefficient q is set to q_K=1/R_K so that the fixed point coincides with the Koide crossing.	The functional form is generic, but the active coefficient encodes compatibility with the target.	Generic flow → untuned Koide point	The flow uses general collapse/support variables and is not a direct mass fit.	The flow is structurally simple but its q_K value is compatibility-selected.	“The stabilization law contains no Koide information whatsoever.”	Derive q_K from microscopic susceptibilities without imposing Koide locus.
XIII	Unit Balance and Origin of q_K	Unit balance derives q_K from microscopic dynamics.	**Closure language withdrawn**	q_K follows exactly only after requiring the effective fixed point to coincide with the Frobenius/Koide locus.	No fundamental action independently outputs q_K.	Microscopic packet dynamics → q_K	The algebra q_K=1/R_K is exact within the effective flow.	q_K is an exact compatibility coefficient, not yet a microscopic coupling.	“q_K is derived from first principles by unit balance.”	An untuned action must yield the same coefficient across admissibl packets.
XIII	Dynamical Completion of Rank-One Collapse	Paper XIII completes the physical Koide sector.	**Closure language withdrawn**	Packet formation, protected-sector selection, q_K, absolute scale, flavor phase, and microscopic action remain conditional or open.	The paper closes only the adopted effective flow.	Effective stabilization → physical first-principles Koide theory	The effective flow robustly stabilizes its selected interior point in tested ensembles.	Paper XIII completes an effective stabilization model, not the microscopic matter sector.	“The Koide sector is fully derived and closed.”	Derive packet formation, coefficie selection, and action-level dynam
XIV	Negative Result I: Dark-Energy Running	The tested one-parameter finite-coherence dark-energy running improves Pantheon+ over ΛCDM.	**Empirically rejected route**	The best fit does not support the extra running parameter over ΛCDM.	The route failed under the reported likelihood analysis.	Finite coherence → simple late-time dark-energy running	The broader possibility of other cosmological manifestations remains open.	The tested dark-energy-running model is rejected.	“Paper XIV supports IRMT dark-energy running.”	A materially distinct model must specified and tested out of sample
XIV	Negative Result II: Direct Low-ℓ Power Suppression	A direct low-multipole power-suppression model is a robust replacement for ΛCDM.	**Empirically rejected route**	It did not robustly outperform ΛCDM.	The surviving result concerns a narrower large-angle temperature-coherence target.	Finite coherence → generic low-ℓ C_ℓ suppression	The locked real-space temperature kernel remains a bounded phenomenological model.	Direct generic low-ℓ suppression is not the active IRMT claim.	“IRMT explains the anomaly by suppressing all low multipoles.”	Any new spectrum model must b independently calibrated and tes
XIV	Negative Result III: Universal Polarization Suppression	The same suppression kernel applies universally to TT, TE, and EE.	**Empirically rejected route**	Polarization did not support the shared suppression.	The surviving target is temperature dominant.	Temperature kernel → universal primordial/polarization effect	A temperature-only phenomenological target remains.	Universal TT/TE/EE suppression is rejected.	“IRMT predicts the same low-ℓ suppression in temperature and polarization.”	Derive channel dependence microscopically before making polarization predictions.

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V	Exact Finite-Holonomy Wilson Response	The exact Wilson trace by itself fixes the absolute charged-lepton scale from first principles.	**Closure language withdrawn**	The Wilson function is exact, but its angle, packet normalization, 1/π factor, and electroweak input have distinct non-microscopic statuses.	The response-to-connection lift is constitutive.	Packet response → physical compact holonomy angle	The finite U(2) Wilson trace and its small-angle correction are exact group theory.	The packet-scale formula is exact conditional on the constitutive lift and external v_EW.	“The Wilson trace independently derives the absolute masses.”	Derive the angle, exposure, and packet coefficient from the unifie action.
V	D_3 Phase Locking	The physical charged-lepton flavor phase is microscopically derived by the lowest D_3 invariant.	**Closure language withdrawn**	The stationary point is exact within the chosen invariant, but the determinant phase carrier and boundary interaction are effective.	Competing invariants are not excluded by the present microscopic theory.	Microscopic determinant dynamics → unique D_3 boundary potential	The D_3 stationary-phase calculation remains an exact effective result.	The physical phase is selected conditionally by an adopted effective invariant.	“IRMT derives the flavor azimuth from the microscopic substrate.”	Derive the boundary interaction suppress competing invariants fr the core action.
V	Additive Determinant-Line Response Lemma	Stabilized packet responses necessarily and uniquely lift to determinant-line Lie-algebra coordinates with unit coefficient.	Reclassified as constitutive	Paper XVI proves the present action has zero mixed variation and symmetry permits independent singlet/relative coefficients.	Additivity does not fix normalization, exposure, or the identity response map.	Packet response → unique determinant current	The law is mathematically consistent and closes the effective model.	J_Ω=Ω_DW H_supp is the minimal constitutive closure law of v1.0.	“The additive response lemma is derived from the microscopic action.”	Derive a compact bounded mixed action whose variation gives and protects the identity map.
V	No Lepton-Mass Fits Implies First-Principles Derivation	Because no electron, muon, or tau masses are fitted, the construction is fully first-principles.	**Closure language withdrawn**	Absence of direct lepton-mass fitting does not remove constitutive laws, external v_EW, compatible target selection q_K, or effective interactions.	Parameter-free with respect to target data is not equivalent to microscopic derivation.	No target fit → fundamental derivation	The lack of direct lepton-mass fitting remains an important anti-overfitting fact.	The model is a constrained effective prediction with no direct lepton-mass calibration.	“No mass fit means the result is first-principles.”	Derive all upstream structures fr one action.
V	Mathematically Closed Charged-Lepton Derivation	Paper XV closes the charged-lepton mechanism except for a minor microscopic detail.	**Closure language withdrawn**	Paper XVI shows the remaining bridge is action-level and protection-level, not a cosmetic detail.	The source law, channel ratio, compact exposure, and mixed-wedge protection all remain unresolved.	Effective mass formula → microscopic theorem	Conditional on the constitutive law, the effective mathematics remains closed.	Paper XV is a constrained effective charged-lepton model, not a complete microscopic derivation.	“The charged-lepton problem is solved from first principles.”	One untuned action must produc packet, current, exposure, and protected finite holonomy.
VI	Packet-Isospectral / Null-Space Motion	Packet-preserving null-space motion generates the required determinant-line phase.	**Rejected microscopic route**	The tested packet-preserving motions do not produce the needed phase.	The null directions preserve the wrong data or yield insufficient response.	Packet isospectral motion → physical phase	The negative result constrains future holonomy dynamics.	Null-space motion is not the microscopic phase source in the tested construction.	“The missing phase is hidden in packet-preserving motion.”	A new mechanism must alter/sou the connection while preserving correct observables.
VI	Passive Berry / Ribbon Integration	Passive Berry curvature integration supplies a universal packet-to-phase map of the required magnitude.	**Rejected microscopic route**	Local curvature and finite phases exist, but the packet map varies across seeds and subordinate lines and does not scale coherently.	Carrier existence does not imply the required constitutive law.	Local transgression → universal finite response law	Genuine gauge-invariant orientation-sensitive local curvature survives.	Passive transgression is a carrier, not the complete source mechanism.	“The Berry phase derives the determinant response law.”	Add a dynamically sourced interaction and reproduce a univ protected map.
VI	Symmetry-Only Selection of the Identity Response	Gauge, pair, and orientation symmetries uniquely force J_Ω=Ω_DW H_supp.	**Permanently retired**	The general allowed linear response contains independent common and relative coefficients.	Symmetry permits both the desired map and competing maps.	Declared symmetries → unique response coefficients	The desired identity map is symmetry-compatible.	Symmetry alone does not select the response law.	“The constitutive law follows uniquely from symmetry.”	Derive the coefficients by variatic and prove stability.
VI	Single Compact Packet Phase	One compact phase field exactly encodes the common/relative packet response and fixes exposure.	**Rejected microscopic route**	The irrational q_K response ratio prevents exact closure of the one-parameter compact representation without extra structure.	Generator rescaling does not remove the problem without reintroducing free normalization.	One compact U(1) field → exact packet phase ratio	Compactness remains a desirable requirement for future constructions.	The simplest one-phase compact completion fails.	“Compactness fixes the missing phase law.”	A replacement must achieve compactness without duplicate fr charges or stiffnesses.
VI	Charged Inter-Line Fields	Difference-charged inter-line fields provide the complete determinant current, including the common mode.	**Rejected microscopic route**	Difference charges span the traceless/root channel and are exactly blind to the common determinant U(1).	The common mode requires a separate representation or field.	Inter-line difference fields → full common-plus-relative current	Inter-line fields remain valid sources of relative flavor currents.	Difference-charged fields cannot by themselves complete the source law.	“Inter-line fields solve the determinant-current problem.”	Derive a common-charge carrier without adding arbitrary duplica parameters.
VI	Exterior-Square Tight Frame as Dynamic Selection	The exact common-plus-root tight-frame identity dynamically fixes the identity response metric.	**Closure language withdrawn**	The representation fixes available charges but not equal dynamical weights of common and relative sectors.	Mathematical completeness of the frame is not an action principle.	Tight-frame identity → unique physical kinetic metric	The exact center-plus-root representation identity survives.	The identity metric is available, not dynamically selected by representation alone.	“The exterior-square identity derives the physical response metric.”	Derive the relative action weights from one microscopic interaction
VI	Bare Single-Trace Metric as Protected Final Metric	The bare protected-block Wilson action permanently fixes b=0 and the identity determinant metric.	**Restricted theorem statement**	The identity metric is exact at bare quadratic order, but mixed exterior-square sectors regenerate an allowed correction.	The protected truncation is not dynamically stable.	Bare protected action → full protected effective metric	G_W=I and b_bare=0 remain exact bare results.	The bare identity metric is not protected under generic mixed-wedge coupling.	“The Wilson action uniquely and permanently fixes the determinant metric.”	Prove a consistent truncation or a symmetry/gap that suppresses th Schur correction.
VI	Native Chiral or Graded Cancellation	Existing chirality or natural graded traces cancel the mixed-wedge correction.	**Rejected microscopic route**	Native partner contributions add rather than cancel, and natural supertraces do not preserve the desired metric.	Engineered phases/signs introduce new unselected structure or positivity problems.	Existing grading/chirality → exact protection	The negative theorem narrows viable future protection mechanisms.	No native chiral/graded cancellation protects the current model.	“The existing chiral structure removes the mixed correction.”	Any new cancellation must be act derived and preserve positivity, g invariance, and unitarity.

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XVI	Closed-Packet Gap Protection	The already stabilized packet automatically generates a sufficient mixed-sector gap to protect the determinant metric.	**Rejected microscopic route**	Static and reparameterization-invariant measures fail the preregistered decoupling hierarchy.	Finite-step apparent suppression is a numerical parametrization artifact.	Effective packet closure → automatic microscopic decoupling	The required protection condition is quantitatively defined.	The present packet dynamics do not supply the necessary protection.	“Packet closure automatically decouples mixed wedges.”	A revised action must generate a physical invariant hierarchy or ex decoupling symmetry.

Appendix I - Imported Mathematical and Physical Results

Imported results may be used conditionally and cited normally, but they are not IRMT derivations. Each row states both its legitimate use and the boundary it cannot cross.

ID	Imported result	External domain	Use within IRMT	Boundary / non-derivation statement
I-01	Maximum-entropy theorem on the circle	Shannon/Jaynes variational principle	Used to derive the von Mises form under normalization and fixed first circular moment.	Does not derive the physical completeness of the constraints.
I-02	Von Mises normalization and moments	Circular statistics / modified Bessel functions	$Z=2\pi I_0(\kappa)$ and $\eta=I_1/I_0$.	Imported special-function identities.
I-03	CHSH functional and Tsirelson bound	Quantum information theory	Provides the external target $2\sqrt{2}$ and standard optimal-setting algebra.	IRMT has not derived its attainable correlation set.
I-04	Finite-dimensional complex Hilbert spaces	Functional analysis / quantum kinematics	Supplies inner products, adjoints, projectors, and density operators.	Kinematics do not by themselves provide quantum probabilities.
I-05	Unitary bundle covariance and holonomy	Gauge/bundle theory	Defines local-frame transformations, path transport, curvature, and Wilson loops.	Does not select the physical Standard Model group.
I-06	Wilson lattice action and small-loop expansion	Lattice gauge theory	Connects traced loop loss to continuum $\mathrm{Tr}(F^2)$ under smooth isotropic limits.	Actual IRMT convergence and coupling normalization remain open.
I-07	Yang-Mills action	Continuum gauge theory	Provides the standard continuum kinetic target.	Imported, not derived by IRMT.
I-08	Clifford and Pauli algebra	Representation theory	Supplies $Cl(3)$, Pauli generators, and Frobenius norm $\sqrt{2}$.	Physical identification with mass amplitudes is conditional.
I-09	Singular-value decomposition and matrix perturbation theory	Linear algebra	Defines packet singular values, basis-invariant norms, and stability diagnostics.	Does not select the physical projector or field.
I-10	Shahshahani / simplex natural gradient	Information geometry	Derives the effective packet gradient from a declared scalar functional.	The choice of functional remains constitutive.
I-11	Causal-set local finiteness and Poisson sprinkling	Causal-set theory	Provides discrete causal volume and continuum sampling machinery.	IRMT does not derive the sprinkling law.
I-12	Benincasa-Dowker action	Causal-set gravity	Provides a known discrete curvature action and conditional Einstein-Hilbert limit.	Its applicability to the active IRMT ensemble is imported.
I-13	Spectral action / heat-kernel expansion	Noncommutative geometry and spectral theory	Provides generic curvature terms for suitable continuum operators.	Does not prove the active D_rel has the required limit.
I-14	Lovelock theorem	Differential geometry	Restricts second-order divergence-free metric field equations under stated assumptions.	Cannot replace the discrete-to-continuum derivation.
I-15	Alexandrov interval volume formulas	Lorentzian geometry	Used in exact minimal-diamond continuum integrals.	Assumes the target continuum geometry.
I-16	Hodge decomposition of bivectors in four dimensions	Differential geometry / representation theory	Supports electric-magnetic triplet decomposition.	Physical protected-sector identification remains conditional.
I-17	Exterior powers and determinant representations	Linear algebra / bundle theory	Produces determinant lines from rank-two sectors and exact charge identities.	Does not select the sectors dynamically.
I-18	Schur-complement integration	Linear algebra / effective theory	Gives $A-BC^{-1}B^\dagger$ after eliminating mixed variables.	Physical size of the blocks is model-dependent.
I-19	Berry/Kato connection and curvature	Geometric phase theory	Supplies gauge-covariant subspace transport and local curvature.	Passive geometric phase did not derive the required universal response.
I-20	D3 invariant theory	Finite-group representation theory	Classifies the lowest oriented cubic phase invariant in the minimal line sector.	Does not force a nonzero microscopic coupling.

ID	Imported result	External domain	Use within IRMT	Boundary / non-derivation statement
I-21	Koide relation and charged-lepton data	Particle phenomenology / PDG	Provides the empirical relation and comparison values.	The target data must be isolated from construction.
I-22	Electroweak scale v_EW	Standard Model phenomenology	Supplies the absolute external energy scale in the packet formula.	Not predicted by IRMT.
I-23	HEALPix, pseudo-C_ell, and map-space estimators	CMB data analysis	Provides standard map discretization and correlation estimators.	Pipeline choices require robustness tests.
I-24	WMAP/Planck maps and ΛCDM spectra	Observational cosmology	Supply external data and null ensembles.	Not IRMT-derived.
I-25	Pantheon+ supernova likelihood	Observational cosmology	Used to reject the tested simple dark-energy-running route.	Imported dataset and statistical framework.
I-26	Monte Carlo, bootstrap, and confidence intervals	Statistics	Quantifies numerical uncertainty and convergence.	Numerical support does not become a theorem.

Appendix I.1 - QREV-2026-07-04-01 Imported-Result and Negative-Control Addendum

Imported or diagnostic item

Item	Status	Accepted use	Boundary	Controlling records
Damped-PR negative control	[THM|EXT]	Boundary-proof diagnostic for R5-010; kappa*≈2.058215 under eta=I1/I0.	Does not assert that IRMT produces PR boxes; it rejects visibility-only proofs.	Records 1, 5, 6
Masanes-Galley-Mueller 2019	[EXT-DISPUTED]	Quarantined candidate reconstruction theorem for measurement postulates.	No load-bearing use for AX1J, full Born rule, POVMs, updates or measurement closure without future review.	Records 1, 5, 6; Appendix I

Appendix I.2 - QREV-2026-07-06-01 Measurement and Gauge Addendum

WN-Q7: full effects and mixed configurations are conditionally forced under RA1 + RA2-prime, with N3 required for mixed-state purification. WN-Q8 rev.1: ideal projective update is conditionally Lueders, while general POVM update is classified as apparatus-channel freedom. WN-G1 rev.1: genericity is excluded as a gauge-selection route, the stabilizer target is typed, the anomaly filter is corrected, and chirality is rowed as GG3.

Superseded items: WN-Q8 rev.0 U4 single-isometry POVM claim; unqualified WN-G1 two-branch anomaly theorem; under-specified GG2 3|2-only gate.

Appendix I.3 - Gravity and Cosmology Addendum QREV-2026-07-07-01

WN-GR1 adds three controlled imported/conditional facts: conserved flux does not imply conserved raw quadratic stress; spectral and Benincasa-Dowker gravity routes carry different obligations; and the causal-set manifoldlikeness problem is inherited as an external difficulty floor. The CMB diffusion connection is registered as a pointer only, with a shape-test retirement condition.

Scale ledger note. The active theoretical dimensionful imports visible in the v1.0 audit layer are v_EW and ell_c. Record 4 now pairs them as a reduction target: a derived dimensionless relation would reduce the independent scale inputs, but none is currently derived.

Appendix J - Open Problems

Each problem is written as a theorem or construction target with an explicit falsification condition and completion gate. These are the active derivational obligations of the program.

ID	Problem / theorem target	Required statement or construction	Pass condition	Falsification target	Priority / gate
OP-00	Unified microscopic specification theorem	Construct one bounded, gauge-consistent action or normalized transition/history law over all primitive variables, with every active coefficient classified.	No indispensable active sector may depend on an external constitutive arrow not represented in the action.	Failure of boundedness, covariance, well-posed variation, or reproduction of active effective limits falsifies the candidate.	Priority 0 / Core gate
OP-01	Operational probability theorem	Derive a positive normalized P(a,b|x,y) from the substrate, settings, and outcomes.	Positivity, normalization, composition, and operational setting definitions must be proved.	Any negative probability, normalization failure, contextual ambiguity, or target insertion falsifies the construction.	Priority A / Quantum gate
OP-02	No-signalling theorem	Prove local marginals are independent of remote settings for the derived P.	Σ_b P(a,b|x,y) independent of y and vice versa.	Any admissible configuration producing signalling marginals falsifies the theorem.	Priority A / Quantum gate
OP-03	Quantum-set / Tsirelson theorem	Characterize the full attainable correlation set and prove |S_CHSH|≤2√2 while the bound is approachable.	Must exclude supraquantum no-signalling boxes without inserting Hilbert-space quantum probabilities by hand.	A valid substrate state exceeding 2√2 or failure to reach the target regime falsifies the claim.	Priority A / Quantum gate
OP-04	Physical gauge-group selection theorem	Select SU(3)×SU(2)×U(1) from the frozen state space/action.	Selection must be unique or minimal under declared physical criteria.	Equally admissible non-isomorphic groups with no selection principle falsify uniqueness.	Priority B1 / Gauge gate
OP-05	Matter-representation and anomaly theorem	Derive chirality, hypercharges, representations, and anomaly cancellation.	All gauge and mixed anomalies must cancel for the derived spectrum.	Wrong charges, missing chirality, or nonzero anomalies falsify the candidate.	Priority B1 / Gauge gate
OP-06	Relational Dirac continuum theorem	Prove convergence of the actual D_rel family to a declared continuum Dirac operator.	Specify refinement, domains, resolvent/spectral norm, boundary conditions, and error rate.	Nonconvergence, regulator dependence, or inequivalent limits falsifies the claimed continuum operator.	Priority B2
OP-07	Gravity continuum theorem	Derive a controlled gravitational limit from the active IRMT operator/action.	Metric, curvature, source, normalization, and convergence errors must be jointly controlled.	Failure to recover the target field equation or existence of uncontrolled alternative limits defeats uniqueness.	Priority B2 / Gravity gate
OP-08	Matter-geometry back-reaction theorem	Derive matter and geometry equations from one action with conserved source.	Both directions of coupling and their covariance must be explicit.	Nonconservation, one-way insertion, or dependence on post hoc coarse-graining falsifies closure.	Priority B2 / Gravity gate
OP-09	Protected-projector theorem	Derive Π_T from the active operator without target data.	Selection must be stable across admissible seeds, size, basis, and perturbations.	Arbitrary spectral windows or target-sensitive projector choices falsify physical selection.	Priority C1
OP-10	Koide equipartition theorem	Derive the physical Frobenius latitude corresponding to K=2/3.	The stable packet must select equal democratic/transverse squared norms without using charged-lepton masses.	Failure of equipartition in the derived closed packet falsifies the claimed mechanism.	Priority C1 / Matter gate
OP-11	q_K selection theorem	Derive q_K=3(√2-1) independently of imposing R*=R_K.	q_K must emerge as a coefficient or susceptibility of the untuned action.	Any need to match the Koide point leaves the result constitutive rather than derived.	Priority C1 / Matter gate
OP-12	Packet formation and stabilization theorem	Generate the protected packet, pair closure, and locally/globally stable equilibrium from one action.	Must include off-manifold stability and basin conditions.	Overshoot, loss of closure, or coefficient tuning to the target falsifies the candidate.	Priority C1 / Matter gate
OP-13	Minimal-diamond regulator-independence theorem	Show k=2, r=1/2, ξ_6 and ξ_3 survive admissible discretizations/coarse-grainings.	Equivalent continuum estimators must agree within controlled errors.	Persistent regulator or ensemble dependence falsifies universality.	Priority C1
OP-14	Determinant-current derivation theorem	Derive J_Ω=ΩH_supp by variation of a compact bounded mixed action.	Common and relative coefficients, gauge transformation, and exposure must be fixed.	If the mixed variation remains zero or arbitrary coefficients survive, microscopic closure fails.	Priority C2 / Matter gate
OP-15	Mixed-sector protection theorem	Protect the bare determinant metric against mixed wedges.	Require B=0 by symmetry or a verified invariant hierarchy Δ_mix/g_mix² meeting the preregistered threshold.	A Schur correction above the allowed response-ratio tolerance falsifies protection.	Priority C2 / Matter gate
OP-16	Compact exposure theorem	Derive the finite line holonomy and exposure without identifying h=0~1 by fiat.	The connection must be compact, gauge-covariant, and reparameterization invariant.	Open-path exact one-forms, arbitrary seam identifications, or free winding normalization fail the gate.	Priority C2
OP-17	Microscopic CMB-kernel theorem	Derive F_ell, α_CMB, and L_H from substrate coherence and transfer physics.	No CMB target statistic may enter coefficient selection.	Need for C1 calibration or failure on locked external maps defeats first-principles status.	Cosmology open problem

ID	Problem / theorem target	Required statement or construction	Pass condition	Falsification target	Priority / gate
OP-18	Independent replication theorem-of-evidence	Obtain independent reproduction of central packet, continuum, CMB, and no-go results.	External teams must reproduce from archived code/data without author intervention.	Material unexplained discrepancies fail the replication gate and demote affected numerical claims.	Priority D / Replication gate
OP-19	Complete experiment-archive reconciliation	Link every EXPT and M-series identifier to immutable code, outputs, manifest, checksums, and DOI.	No registry row may remain metadata-pending at v1.0 freeze.	Missing or inconsistent archives prevent release-level reproducibility.	Priority 0 / Repository gate

Appendix K - Repository and DOI Registry

DOI RULE A DOI or public archive location is recorded only when verified from the corpus or supplied publication record. “Pending” is normative and shall not be replaced by an inferred identifier in a frozen release.

Registry ID	Object	File / archive name	Type	Repository / platform	DOI / persistent ID	Version / status
PAPER-01	IRMT Paper 1	IRMT (1) - Information Relational Manifestation Theory(10).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-02	IRMT Paper 2	IRMT (2) - Quantum Correlations and Gauge Structure from a Discrete Relational Substrate - REV 01(11).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-03	IRMT Paper 3	IRMT (3) - RELATIONAL DIRAC OPERATOR - SPECTRAL STRUCTURE AND THE PROBLEM OF GENERATIONS (11).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-04	IRMT Paper 4	IRMT (4) - The Emergence of Gravitation and the Einstein-Hilbert Action(10).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-05	IRMT Paper 5	IRMT (5) - Relational Cosmology(11).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-06	IRMT Paper 6	IRMT (6) - The Measurement Problem as Relational Consistency(11).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-07	IRMT Paper 7	IRMT (7) - Closing the Gravitational Sector(11).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-08	IRMT Paper 8	IRMT (8) - A First-Principles Derivation of the Koide Formula(11).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-09	IRMT Paper 9	IRMT (9) - Closing the Program(5).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-10	IRMT Paper 10	IRMT (10) - From Spectral Universality Failure to Spectral Self-Organization(5).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-11	IRMT Paper 11	IRMT (11) - The Koide Configuration in IRMT - Reachability(7).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-12	IRMT Paper 12	IRMT (12) - Rank-One Collapse and the Emergence of Hierarchy(12).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-13	IRMT Paper 13	IRMT (13) - Koide Stabilization from Deficit-Gated Entropy(9).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-14	IRMT Paper 14	IRMT (14) - Finite Relational Coherence and the CMB Large(9).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-15	IRMT Paper 15	IRMT (15) - Charged Lepton Masses(4).docx	Manuscript	Working corpus / PhilPapers	DOI pending / manuscript reported on PhilPapers	Current local working copy
PAPER-16	IRMT Paper 16	IRMT (16) - The Microscopic Origin of Determinant REV 01.docx	Manuscript	Working corpus / PhilPapers	Paper archive: 10.5281/zenodo.20953336; manuscript DOI pending	Current local working copy
DATA-CMB	IRMT XIV CMB experiment archive	IRMT_XIV_CMB_Experiments_v1.0.0.zip (not present in current sandbox)	Data/code archive	Zenodo record 21016051	DOI form 10.5281/zenodo.21016051 - verify before freeze	Published record reported by author
DATA-M6	IRMT XVI M6D-M6S archive	IRMT_M6D_complete_bundle through IRMT_M6S_complete_bundle	Data/code archive	Local recovered bundles + Zenodo	10.5281/zenodo.20953336	Recovered locally and published; M6A-M6C retained only as developmental dependencies where embedded

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Registry ID	Object	File / archive name	Type	Repository / platform	DOI / persistent ID	Version / status
DATA-HREC	Recovered formal experimental record set	Files 01-26: chGUE audit through post-EXPT-38 Koide stabilization synthesis	26-document historical/scientific record	Recovered author archive	DOI pending	Substantially complete best-available scientific narrative; includes revised failed-replication record
DATA-M5-GAP	M5 preservation-gap declaration	Original M5A-M5J source and non-synthetic M5H raw-link input not recovered	Governance record	Core Specification Appendix G/K	Not applicable	Results may be cited historically at reconciled status; highest reproducibility level not met
DATA-M5-LATE	Late M5 audit chain	M5K-M5X standalone bundles	Missing standalone archives / partial embedded code	Core audit records and downstream bundles	Not applicable	Do not infer missing files; retain formal results and exact archive limitation
DATA-M6-DEV	M6 developmental precursors	M6A-M6C	Developmental source fragments	Embedded in later bundles where available	Not applicable	Not separately treated as formal reported experiments unless future evidence establishes otherwise
DATA-M1M4	M1-M4I experiment archive	Experiments & Notes - M1-M4I	Data/code archive	Author archive	DOI pending	Public archive not confirmed
DATA-LEGACY	IRMT-H legacy notebook archive	drive-download-20260630T142318Z-3-001.zip	43-notebook code/output archive	Recovered author archive	SHA-256 b342b591056b9585e64c460499c2021704e085e1a14c72563300ee8db7083f78; DOI pending	Recovered and validated; three notebooks contain interrupted/error outputs
DATA-M5	M5 audit archive	M5A-M5J recovered result bundles; M5K-M5X not recovered as standalone packages	Data/output archive	Recovered author archive	Consolidated DOI pending	Best-available preservation: results/manifests present for A-J; original executable source generally absent; H is synthetic analyzer validation
RECORD-1	Core Specification Record 1	IRMT_Record_1_Claim_Ledger_v0.1.xlsx	Audit ledger	Working repository	DOI pending	Normative working source
RECORD-2	Core Specification Record 2	IRMT_Record_2_Definition_and_Notation_Ledger_v0.1.xlsx	Audit ledger	Working repository	DOI pending	Normative working source
RECORD-3	Core Specification Record 3	IRMT_Record_3_Action_Ledger_v0.1.xlsx	Audit ledger	Working repository	DOI pending	Normative working source
RECORD-4	Core Specification Record 4	IRMT_Record_4_Coefficient_Ledger_v0.1.xlsx	Audit ledger	Working repository	DOI pending	Normative working source
RECORD-5	Core Specification Record 5	IRMT_Record_5_Dependency_Graph_v0.1.xlsx	Audit ledger	Working repository	DOI pending	Normative working source
RECORD-6	Core Specification Record 6	IRMT_Record_6_Retired_and_Superseded_Claims_v0.1.xlsx	Audit ledger	Working repository	DOI pending	Normative working source
SPEC-01	Front Matter / Part I	IRMT_Core_Specification_v1.0_Front_Matter_and_Part_I_Working_Draft_0.2.0.docx	Specification document	Working repository	DOI pending	Working Draft 0.2.0
SPEC-02	Part II	IRMT_Core_Specification_v1.0_Part_II_Primitive_Structure_Working_Draft_0.3.0.docx	Specification document	Working repository	DOI pending	Working Draft 0.3.0
SPEC-03	Part III	IRMT_Core_Specification_v1.0_Part_III_Operators_and_Dynamics_Working_Draft_0.4.0.docx	Specification document	Working repository	DOI pending	Working Draft 0.4.0
SPEC-04	Part IV	IRMT_Core_Specification_v1.0_Part_IV_Observables_and_Emergence_Working_Draft_0.5.0.docx	Specification document	Working repository	DOI pending	Working Draft 0.5.0
SPEC-05	Part V	IRMT_Core_Specification_v1.0_Part_V_Sector_Status_Working_Draft_0.6.0.docx	Specification document	Working repository	DOI pending	Working Draft 0.6.0
SPEC-06	Part VI	IRMT_Core_Specification_v1.0_Part_VI_Corpus_Reconciliation_Working_Draft_0.7.0.docx	Specification document	Working repository	DOI pending	Working Draft 0.7.0

DOI RULE A DOI or public archive location is recorded only when verified from the corpus or supplied publication record. “Pending” is normative and shall not be replaced by an inferred identifier in a frozen release.

Registry ID	Object	File / archive name	Type	Repository / platform	DOI / persistent ID	Version / status
SPEC-07	Part VII	IRMT_Core_Specification_v1.0_Part_VII_Falsifiability_and_Governance_Working_Draft_0.8.0.docx	Specification document	Working repository	DOI pending	Working Draft 0.8.0
SPEC-08	Appendices	IRMT_Core_Specification_v1.0_Appendices_Working_Draft_0.9.1.docx	Specification document	Working repository	DOI pending	Working Draft 0.9.7 - experimental corpus reconciliation
SPEC-RC	IRMT Core Specification v1.0.0 release candidate	Pending assembled document	Specification release	Permanent repository pending	DOI pending	Not yet frozen

Appendix L - Revision History

The entries below are pre-release working history. Version 0.9.1 records the recovered experimental-corpus reconciliation. The normative post-v1.0 register begins only when version 1.0.0 is frozen and assigned an immutable repository record.

	Date	Component	Change summary	
	2026-06-30	Front matter	Created document identity, authority, status labels, precedence, and version-control framework.	Pre-release v
	2026-06-30	Part I - Foundational Status	Defined purpose, scope, claim boundaries, evidentiary taxonomy, and weakest-dependency rule.	Pre-release v
	2026-06-30	Part II - Primitive Structure	Froze provisional primitive kinematics, state space, symmetries, and admissibility rules.	Pre-release v
	2026-06-30	Part III - Operators and Dynamics	Catalogued operators/actions, separated dynamics from relaxation/iteration, and recorded missing mixed variations.	Pre-release v
	2026-06-30	Part IV - Observables and Emergence	Defined observables, measurement/probability gap, and continuum-promotion criteria.	Pre-release v
	2026-06-30	Part V - Sector Status	Created compact quantum, gauge, gravity, matter, and cosmology status boundaries.	Pre-release v
	2026-06-30	Part VI - Corpus Reconciliation	Reconciled Papers I-XVI, terminology, and active/deprecated/retired structures.	Pre-release v
	2026-06-30	Part VII - Falsifiability and Governance	Defined falsifiability, reproducibility, version governance, priorities, and completion gates.	Pre-release v
	2026-06-30	Appendices A-L	Compiled symbols, dimensions, coefficients, actions, graphs, paper/experiment registries, retired claims, imports, open problems, repositories, and revision schema.	Pre-release v
	2026-06-30	Appendices G, K, and L	Reconciled the recovered 43-notebook archive, twenty-six formal experimental/theoretical records, M5A-M5J result bundles, and M6D-M6S bundles; recorded legacy identifier collisions and permanent preservation gaps.	Pre-release

L.1 Post-v1.0 Change Register Schema

Version	Release date	Change proposal ID	Affected definitions/actions/claims	Reason	Tests performed	Dependency propagation	Deprecated/migrated items	Approver / evidence package
1.x.y	YYYY-MM-DD	CP-YYYY-NNN	To be completed	To be completed	To be completed	To be completed	To be completed	To be completed

INITIAL STATE No post-v1.0 changes exist because v1.0.0 has not yet been frozen. This appendix is initialized so the first release cannot be modified without a visible, versioned record.

Appendix L.2 - Governance Hardening Patch QREV-2026-07-04-01

This patch closes two remaining governance holes in the Q-series package. First, Record 5 now enforces the damped-PR negative control at row level: visibility damping alone cannot prove the quantum boundary. Second, MGM 2019 is quarantined as [EXT-DISPUTED], preventing a future zombie-import of a contested measurement-postulate theorem. The patch changes no completion gate and does not alter the 33% progress estimate.

Appendix L.3 - Measurement and Gauge Update QREV-2026-07-06-01

This patch integrates WN-Q7, WN-Q8 rev.1 and WN-G1 rev.1. It raises the working progress midpoint to 34.75 percent, with a working range of 32-38 percent, while keeping completion gates passed at zero. The quantum/measurement sector is structurally conditional rather than amorphous; the gauge sector now has no-go and target maps but no selection theorem.

Appendix L.4 - Gravity and Cosmology Survey Patch QREV-2026-07-07-01

This patch integrates WN-GR1. It adds a conservation negative control, rewrites the gravity route-selection obligations, records the manifoldlikeness floor, adds the scale-pair audit, and registers a retireable CMB diffusion pointer. No completion gate passes; the update is sector cartography and anti-overclaim governance.

Appendix Compliance Statement

The appendices are normative indexes to the working specification. Where an appendix reproduces a Record 1-6 ledger, the machine-readable ledger remains authoritative for row-level audit. Where a registry field is pending, the specification shall preserve that pending status until a verified archive or theorem supplies it.

END OF APPENDICES Appendices A-L now incorporate the best-available experimental corpus and record all known preservation limits. They remain a pre-release working volume until global notation rendering, cross-references, repository manifests, checksums, and release identifiers are frozen.

Appendix L.1 - Q-Series Revision Package QREV-2026-07-03-01

This appendix addendum records the incorporation of WN-Q1 through WN-Q6 into the Core Specification and the Records. It is an integration index, not an independent derivation. The authoritative row-level controls are the revised Records 1-7.

L.1.1 Revised ledgers and specification files

File family	Previous version	Integrated version	Q-series effect
Front Matter + Part I	0.2.0	0.2.1	Records 1-7 authority and premise-explicit imported theorem rules.
Part II	0.3.0	0.3.1	Operational regions, settings, outcomes, effects, free-setting semantics, RA1 and RA2.
Part III	0.4.0	0.4.1	Missing action-to-probability/preparation/ensemble bridge.
Part IV	0.5.0	0.5.1	Conditional P, no-signalling, cosine-Bessel law, BBBEW boundary, Born localization.
Part V	0.6.0	0.6.1	Quantum sector upgraded to a conditional theorem stack; status remains incomplete.
Part VI	0.7.0	0.7.1	Papers I-II and Q-series lifecycle reconciled.
Part VII	0.8.0	0.8.1	Quantum completion gates refined.
Records 1-7	v0.1 family	v0.2/v0.3 family	Claim, definition, coefficient, dependency, retirement, and version

			controls revised.

L.1.2 Adopted Q-series theorem capsules

Note	Incorporated content	Status	Correction / boundary	Destination
WN-Q1	Operational well-posedness and negative control against visibility-only quantum-boundary claims.	[THM]+[OPEN] gates	Visibility does not exclude supraquantum boxes by itself.	Parts IV-VII; Records 1,5,6
WN-Q2	Measure-route exclusion under M1-M3 and operational-layer proposal.	[THM|EXT]+[DEF]	Amplitude route uniqueness is restricted to retained assumptions.	Part II; Records 2,5
WN-Q3	Declared projective interface with positive normalized probabilities, no-signalling and cosine-Bessel correlator.	[THM|DEF-G0+CON-Ψ]	Hilbert interface and state are declared/imported, not substrate-derived.	Parts III-IV; Records 1,3,5,6
WN-Q4	Aggregation/diffusion record-statistics split.	[THM|ensemble]	Gaussian decay requires Gaussian increments or controlled limit; stochastic remainder corrected.	Part IV; Records 4,5,6
WN-Q5	BBBEW bipartite boundary under local effect and no-signalling premises.	[THM|EXT]	Requires LQ-POVM + AX1J + operational no-signalling; bipartite only.	Parts II,IV,VII; Records 1,2,5,6
WN-Q6	Rank-one Born weight localization.	[THM|RA1+RA2]	Correct bound $0 \le f0 \le 1/(d-1)$; full POVM/Born/update rule remains open.	Parts II,IV,VII; Records 1,2,5,6

L.1.3 Current progress snapshot

Overall audited completion is recorded at approximately 33%, with a working range of 30-36%. This is a progress-control estimate, not a probability that IRMT is true. The Q-series raises the quantum-sector organization and conditional mathematics while leaving the action-to-operational-probability bridge, full effect rule, preparation selection, and multipartite boundary open.

NO COMPLETION-GATE PROMOTION QREV-2026-07-03-01 passes no binary completion gate. It improves the dependency structure and conditional theorem inventory while preserving the weakest-arrow rule.

Revision History

Version	Date	Status	Controlled change
0.9.7	7 July 2026	Current working draft	Added WN-GR1 appendix addendum and revision entry.

Appendix M — Plateau Falsifiability and Laboratory Pass (QREV-2026-07-08-01)

M.1 WN-Q9 rev.1 — Depth-records crossover

N5 is structurally resolved under the minimal model + CON-noise: depth L produces diffusion while record count N produces aggregation. The normalized deficit law is (2sqrt(2)-S)/(2sqrt(2)) approximately L sigma^2/N. The absolute deficit is 2sqrt(2) times larger. Deep-regime recovery is finite but exponential in depth.

G-i of the CMB pointer passes in structure only. G-ii shape confrontation and G-iii temperature dominance remain open.

M.2 Record 8 v0.1 — Surplus and Falsifiability Register

Record 8 collects executable commitments and retirement conditions. It is a governance register, not a prediction register. Every entry remains conditional unless its full dependency string closes.

M.3 WN-P2 — EG-1 decision table

The commutant decision table places the protection boundary between permutation-type actions and genuinely mixing irreducible actions. Protection is restricted to the exact symmetric quadratic class. The actual XVI-11 action still has to be identified against the table.

M.4 WN-C1 — Predicted kernel family

Under angular multiplicative damping and Sachs-Wolfe fiducial input, the theory side of G-ii forces three signatures: quadrupole-dominant hierarchy, low-to-intermediate-ell overshoot, and high-ell recovery. The overshoot is the discriminant. A route death requires rerunning the pipeline with the realistic fiducial and calibration tolerances.

M.5 WN-L1 — Numerical laboratory

The lab verifies the declared theorem stack on random finite substrates and records negative controls. It also demonstrates that frame correction is load-bearing. The v1.1 script normalizes transports to SU(2); both v1.0 and v1.1 are archived.

M.6 Integration corrections

AX2-prime is defined as a residual additivity/coarse-graining consistency axiom for this package. The reader guide Tsirelson wording is softened; SR-6 remains WN-P1-dependent; WN-C1 table-count wording is conservative; A4 remains a guarded resonance, not a prediction.

QREV-2026-07-08-02 Appendix Consolidation Delta

This appendix update registers the July 8 targeted-gate consolidation directly in the maintained appendix layer. The loose addendum is superseded as a standalone maintenance object.

Appendix F / Paper and Note Status Matrix delta

WN-A2 is entered as an active working note: Record-Algebra Selection Theorem and conditional structural mapping of R5-129. WN-O2a is entered as an active working note: Exterior Parity and the ODD-Gamma Gate. WN-LS1 is entered as an active route note: Link-Weight Spectral Backreaction Route.

Appendix H / Superseded and Retired Claims delta

The Record Antisymmetry Principle is retired as a derivation strategy because it relocates antisymmetry into its definition. Soft-theta geometry variation is not adopted as a ledger-native route. Claims of solved topological triplication, defined Yukawas, solved R5-042, and solved Nielsen-Ninomiya/no-doubling are explicitly excluded.

Appendix J / Open Problems delta

O-R1: classify covariant record ideals beyond quadratic generation. O-6: compute the 3|2 versus 1|4 rank gate under the frozen action. O-7-prime: promote MAP from principle to theorem if possible. ODD-Gamma: freeze or derive the exterior-degree oddness of Gamma_ij. LS1-Conservation: prove a nontrivial discrete conservation/null identity for w_ij variation. LS1-Continuum: establish spectral convergence and metric/tetrad coarse-graining.

Appendix K / Repository and DOI delta

This package is a working consolidated package. DOI remains pending for frozen release. SHA-256 checksums are included in SHA256SUMS.txt.

Appendix L / Revision History delta

QREV-2026-07-08-02 consolidates the targeted-gates update into the maintained spec-and-ledger package: Part V 0.6.6, Appendices 0.9.7, Records 1-8 versioned delta sheets, and Working Notes Archive provenance.

Entry	Classification	Ledger action
WN-A2 / Theorem R	[THM | R1-R4, R2-prime boundary]	Strengthens R5-129; CON-Lambda retired as primary ansatz

WN-O2a	[THM] parity; [THM | ODD-Gamma] anticommutation	O-2a narrowed; no-doubling remains open
WN-LS1	[Route | candidate action]	R5-042 route strengthened; no closure
Rejected overclaims	[SUP / EXCLUDED]	Added to retired/superseded language rules

This consolidation supersedes the loose targeted-gates addendum as the maintained package context; the working notes remain provenance only.

IRMT External Reader Guide v0.1

What this is

IRMT is a single-author research program proposing a discrete relational substrate: a causal set of events carrying finite-dimensional complex fibers and unitary transports. This guide gives a professional physicist a fast path through the July 2026 package.

What is claimed, and what is not

The program claims coherent kinematics, exact theorems inside declared constructions, conditional Born/update localization, negative controls across several tempting routes, and a register of conditional falsifiable signatures. It does not claim a derived gauge group, state, framework, chirality, dimensionful constant, unconditional prediction, or completed gravity/cosmology sector.

Why read it

The strongest reasons are the no-go stack, the audit methodology, and the conditional quantum-boundary story. The Tsirelson boundary is not claimed to follow from the substrate alone. It holds conditionally once the local quantum effect algebra, joint assignment rule and operational no-signalling premises are supplied; deriving those premises remains a central open task.

Recommended three-hour path

Read Part I section 2; Record 5 Critical Breaks and Conclusion Paths; WN-P1/P2 and Paper XVI no-go material; WN-Q5-Q9; and Record 8. Then attack the highest-leverage assumptions.

What the author is asking for

Not endorsement: attack. Highest-value targets are the WN-Q6/Q7 axiom base, WN-P1/P2 protection gates, the manifoldlikeness and chirality floors, and the XIV/C1 kernel confrontation.

Contact and provenance: maintainer to insert contact channel. Full package includes working-note archive, SHA-256 manifest, and Records 1-8.

IRMT Core Specification v1.0 — Complete Working Draft 0.9.8 Master Package

Lab-Series Delta Addendum · QREV-2026-07-09-01

This addendum is the controlling pre-release delta for the lab-series update. It does not freeze IRMT v1.0.0 and does not promote any full sector to solved.

• Package version: Consolidated Working Package 0.9.8.

• Integrated notes: WN-OG1, WN-LS2 rev.1, WN-LS3 rev.3, WN-LS4 rev.2.

• Ledger updates: Records 1-8 each receive QREV-2026-07-09-01 delta sheets.

• Claim upgrades: ODD-Gamma theorem-grade for wedge/contraction Gamma-class; LS-Lab-1 localized source response; LS-Lab-2 rigidity-induced screened propagation; LS-Lab-3 near-massless long-range response and static attraction in finite ensembles.

• No full sector is promoted to solved. The package preserves all do-not-cite and excluded-wording rules.

Master Package Addendum - QREV Geometry Sector Update

Control ID: QREV-2026-07-10-01

Package version: Complete Working Draft 0.9.9

Integration date: 10 July 2026

This addendum integrates the LS5-LS9 geometry-sector working notes into the controlled specification and ledger structure. It preserves the do-not-overclaim boundaries: no continuum gravity, no Einstein equations, no stress-energy tensor, no force law, no geodesic dynamics, and no spin-2 claim are introduced.

Controlled results: WN-LS5 rev.1 registers robust long-range crossover/range behavior and attractive sign across declared finite ensembles while leaving the binding-range exponent unpinned. WN-LS6 rev.1 records direct decay-length scaling with finite-size stability and partial D_eff collapse. WN-LS7 rev.2 records an exact discrete link-current balance from w-stationarity of the shift-symmetric coupled candidate. WN-LS8 rev.2 records the tensor-structure split: rank-2 matter bilinear present, minimal geometry decoupled-vector, directionally coupled response reachable via one declared shift-symmetric term. WN-LS9 rev.1 records a partial spin-2/conservation frontier result: rank-2 conservation inconclusive due to quenched disorder, and directional coupling lifts scalar-copy degeneracy while leaving TT/spin-2 character open.

Updated tracker: overall audited program progress is approximately 45%, with a working range of 42-47%. This is a research-program progress estimate, not a claim that any full physical sector has closed. Full sector-completion gates remain at 0 by the binary sector standard.

Next registered gates: LS-Lab-8a disorder-averaged rank-2 conservation; LS-Lab-8b rotation-representation / TT test; LS-Lab-5b D_eff-indexed exact collapse; and action derivation/retirement for the longitudinal rigidity term.

Ledger fence: no continuum divT, no stress-energy tensor, no tensor gravity, no spin-2 representation, no Einstein equations, and no physical force law are claimed by this package update.