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REVIEW SCOPE

This file is the integrated review record of Article 49. It is not a section of the paper. The sequence separated mathematical validity, framework concordance, chemistry and physical-domain admissibility, targeted cross-track verification, and meta-review. The final controlling manuscript is authoritative. Earlier reviews are evidence about defects that were repaired, not substitutes for evaluation of the final text. The ledger is a manuscript-development record. It is not represented as independent blinded external peer review. There is no author-reply section.

Scope of Review

The manuscript is a model-relative extension of the twelve-axiom formalism. It introduces a dual-channel topology from the inherited x - and y -directional structures; a four-state Boolean channel lattice kept distinct from the dual-cipher alphabet and from any $GF(4)$ structure; a direct-sum transport model with a residual-coupling operator; the three-sector space $\mathcal{K}_{XB} = \mathcal{K}_x \otimes \mathcal{K}_m \otimes \mathcal{K}_y$; an exact memory-kernel representation; a finite-time observation space kept separate from the generated dynamical algebra; an Alexandrov/Heyting semantics for oriented reachability; a candidate substituted-chrysene crossbar with prospective falsification criteria; and a separately typed cognitive interpretation. Success in one discipline does not compensate for failure in another. M , C , and H are non-substitutable.

Compiled disposition

Accept with minor revision. After repair and verification the stage vector is $M = \text{PASS}$, $C = \text{PASS}$, $H = \text{PASS}$, $V_{\text{cross}} = \text{PASS}$. Initial scores were 85/100 (major revision), 91/100 (conditional pass), and 89/100 (conditional pass). The final simulated meta-review assigns 95/100. The H pass is domain admissibility of a conditional model. The physical-realization frontier and the cognitive-domain frontier remain open. Three publication-stage repairs remain: bibliographic metadata, the domain of the leakage supremum, and canonical citations for the standard tools.

Publication-stage repair

The leakage ratio is defined only where the denominator is positive. Require $\mathcal{T}_{xx}(\xi; \omega) + \mathcal{T}_{yy}(\xi; \omega) > 0$ on the claimed isolation-test domain, or take the supremum over the explicit subdomain where that sum is positive. Resolve the page-range and URL collision between the survey-article metadata and the Article 39 record in the bibliography, rather than leaving an editorial warning inside it. Add canonical citations for projection-operator memory equations, CPTP-map contractivity, finite-time observability, Alexandrov topology, Heyting algebras, and Kripke semantics.

CONTENTS

Review scope	1
1. Integrated score and disposition	3
2. Standalone mathematics review	3
3. Framework-concordance review	4
4. Chemistry and physical-domain review	4
5. Cross-track verification	5
6. Cognitive interpretation	5
7. Final simulated meta-review	5
Publication-stage repairs	6
Final summary	6
References	7
Revision history	8

1. INTEGRATED SCORE AND DISPOSITION

Stage	Score	Initial disposition	Final status
Mathematics (M)	85/100	Major revision; core viable	PASS after verification of the repairs
Concordance (C)	91/100	Conditional pass	PASS after repair and verification
Chemistry / domain (H)	89/100	Conditional pass	PASS as a conditional model; empirical frontier open
Cross-track (V_{cross})	—	Integration check	PASS after R37–R39
Meta-review	95/100	—	ACCEPT WITH MINOR REVISION

The sequence was M , then C , then H , then cross-track verification, then meta-review.

2. STANDALONE MATHEMATICS REVIEW

Stage M — initial score 85/100

Core architecture viable. Defects precluded immediate mathematical certification. After repair and targeted verification, $M = \text{PASS}$. The certification is manuscript-relative and hypothesis-relative. It does not certify the physical realization hypotheses or the cognitive domain-evidence claim.

Principal concerns: conflation of the generated von Neumann algebra with the linear observation space available from expectation values; omission of necessary nonzero-coupling hypotheses in two interaction results; insufficient typing of $X_{\mathcal{C}} \simeq \mathbb{Z}^3$ before group operations were used; overly strong non-Markovian language for the exact memory-kernel representation; comparison of bare coupling coefficients from differently normalized effective models; a stale x/y indexing reversal in the crossbar array terms; incomplete formalization of proof-preserving cognitive theorem transfer; and smaller metamathematical and notation issues.

The principal repair separates

$$\mathfrak{V}_T = \text{span}_{\mathbb{R}}\{\tau_t(A) : A = A^* \in \mathfrak{A}_{\text{acc}}, 0 \leq t \leq T\}$$

from

$$\mathfrak{D}_T = W^*(\{\tau_t(A) : A \in \mathfrak{A}_{\text{acc}}, 0 \leq t \leq T\}).$$

The real linear space $\mathfrak{V}_T$ is used for finite-time state discrimination. $\mathfrak{D}_T$ records multiplicative algebra growth. The finite-dimensional criterion is that $\mathfrak{V}_T$ equals the self-adjoint part of $B(\mathcal{K}_{\text{XB}})$ if and only if all density matrices are separated by the declared readout history.

The memory theorem proves the exact representation

$$\frac{dp}{dt} = P\mathcal{L}P p(t) + \int_0^t \mathcal{K}(t-s)p(s) ds + \mathcal{I}(t),$$

and does not infer CP-indivisibility, or any other specific criterion of quantum non-Markovianity, from the presence of $\mathcal{K}$ alone.

The cross-channel leakage bound remains

$$\|\Pi_y e^{-itH_{\varepsilon}^{\text{tr}}/\hbar} \Pi_x\| \leq \frac{|\varepsilon| |t| \|K\|}{\hbar},$$

with the probability bound capped at unity.

After repair the manuscript records an empty mathematical route deficit and route-external readiness: $\text{Front}(\Theta_{\text{math}}) = \{\emptyset\}$ and $\text{ExtReady}(\Theta_{\text{math}}) = 1$.

3. FRAMEWORK-CONCORDANCE REVIEW

Stage C — initial score 91/100

Conditional pass on presentation-level concordance and certification-frontier repairs. After repair, $C = \text{PASS}$. The definitional layer satisfies inherited-axiom inclusion, anchor-compatible non-vacuity, and equality of the protected identity theory.

Distinctions already preserved: directional inequivalence does not imply electronic isolation; $|\Sigma_C| = 4$ does not imply $GF(4)$; spectral geometry does not imply physical transport dynamics.

Required repairs: a presentation-level ordinary-concordance proposition, not model-reduct preservation alone; inherited-axiom inclusion, anchor-compatible non-vacuity, and equality of the protected identity theory for the pure definitional extension; $\text{ExtReady}(\Theta)$ to distinguish a premise-complete route from a certificate-complete route; separation of the inherited conjugated π -framework hypothesis $H_{\partial\pi}$ from the stronger transport-applicability premise H_{prop} ; distinction of external tensor-factor commutativity from the inherited primary-dual cipher commutant; and the statement that C3–C9 and C12–C6 locants are the inherited standard numbered chrysene frame, not newly derived nomenclature.

After repair,

$$\iota_*(\mathcal{A}_{\text{CF12}}) \subseteq \mathcal{A}_{\text{def}}, \quad \text{Mod}_{\text{anc}}(P_{\text{def}}) \neq \emptyset, \quad \text{IdTh}(P_{\text{def}}) = \text{IdTh}(P_{\text{CF12}})$$

on the protected identity fragment.

4. CHEMISTRY AND PHYSICAL-DOMAIN REVIEW

Stage H — initial score 89/100

The question was physical admissibility as stated, not experimental realization. Conditional pass. After repair, $H = \text{PASS}$ as a domain-admissible conditional model. The physical realization frontier remains open.

The revised three-sector architecture, C3–C9 into $\mathcal{K}_m$ into C12–C6, was accepted as substantially more defensible than an earlier two-wire identification in which the control path itself was treated as memory.

The realization family is $H_{\partial\pi}$, H_{chem} , H_{addr} , H_{prop} , H_{XB} , H_{prep} , H_{ctrl} , H_{state} , H_{mem} , H_{read} , H_{iso} , with H_{array} and H_{field} added only for stronger array- or Stark-specific claims.

Principal repairs: explicit chemical-instantiation and directional-addressability hypotheses; a generic direction-resolved transfer observable in place of transmission-only notation; worst-case leakage over the complete declared operating-state and environment family; single-crosspoint distinguished from finite-array realization; an independently calibrated hidden-state proxy S_m ; separation of hidden-state existence, persistence, and state-dependent readout; the CohBit-inspired mechanism limited to retained charge or electrostatic state unless further evidence is supplied; an optional reversible field-window premise for Stark-specific implementations; and separation of hidden-state preparation

H_{prep} from contemporaneous control-to-readout modulation H_{ctrl} . The transfer observable must be a nonnegative common-scale quantity before it enters the leakage ratio. Signed observables are converted through a prospectively declared magnitude, norm, or other leakage functional.

The pass does not close the frontier. A nonempty physical deficit remains until H_{chem} , H_{prep} , H_{state} , H_{mem} , H_{read} , H_{iso} , and H_{array} receive independent empirical support.

5. CROSS-TRACK VERIFICATION

Cross-track verification

$V_{\text{cross}} = \text{PASS}$ after the final R37–R39 integration repairs.

Transfer observables in leakage ratios are comparably normalized and nonnegative. Hidden-state preparation is distinguished from contemporaneous modulation. H_{prep} is in the physical certification frontier. The repairs do not reintroduce a cross-layer implication collapse. The empirical physical and cognitive frontiers remain explicitly open.

6. COGNITIVE INTERPRETATION

The cognitive interpretation was reviewed as a formal translation layer, not as evidence for a human neurobiological mechanism. The manuscript uses a proof-preserving interpretation $\tau_{\text{cog}} : P_{\text{flow}} \rightsquigarrow P_{\text{cog}}$ on a declared fragment. Under that hypothesis, $\mathcal{K}_{\text{hid}} = \mathcal{K}_x \otimes \mathcal{K}_m$ maps to the formal latent sector, and $\mathcal{K}_y$ maps to the formal immediately reportable sector.

Boundaries maintained: formal theorem transfer does not imply empirical cognitive adequacy; a successful crossbar realization does not imply identity with a human mechanism; the latent sector is not the logical negation of the reportable sector. Any biological target remains conditional on an independent domain-evidence certificate. The manuscript does not prove that a molecular axis is conscious or subconscious.

7. FINAL SIMULATED META-REVIEW

Meta-review — 95/100

Accept with minor revision. No further substantive mathematics, concordance, or physical-domain cycle is required before publication-stage revision. The review-state vector is $M = 1$, $C = 1$, $H = 1$, $V_{\text{cross}} = 1$ for the manuscript as stated. Open physical and cognitive frontiers are the correct representation of the evidentiary state, not a defect in the formal theory.

Category	Score
Mathematical well-definedness and typing	9.7/10
Proof validity and theorem strength	9.6/10
Non-vacuity and explicit construction	9.6/10
Article-39 framework concordance	9.8/10
Article-41 certification discipline	9.8/10
Physical/chemical domain admissibility	9.3/10
Experimental operationalization and falsifiability	9.6/10
Cognitive interpretation discipline	9.3/10
Cross-track consistency and circularity control	9.8/10
Exposition, literature apparatus, and editorial readiness	8.5/10
Overall	95/100

Four features were judged particularly strong. Dual-channel information topology is given a literal realization through subgroup, topology, quotient, metric, and lattice constructions. Direct leakage is distinguished from hidden-state modulation, in separate effective models, and the two are not equated without an explicit realization map. The hidden-state theory is operationalized: exact projection equation, finite-time observation space, independent state proxy, preparation/readout separation, and layer-localized falsification rules. The cognitive interpretation is downstream of the mathematical and physical definitions, not embedded inside them.

Publication-stage repairs. The bibliography contains a conflict between the supplied metadata for the survey article and the Article 39 record. Resolve the page-range and URL collision rather than retain an editorial warning inside the bibliography.

The leakage ratio

$$\eta(\xi; \omega) = \frac{\mathcal{T}_{xy}(\xi; \omega) + \mathcal{T}_{yx}(\xi; \omega)}{\mathcal{T}_{xx}(\xi; \omega) + \mathcal{T}_{yy}(\xi; \omega)}$$

is defined only where the denominator is positive. Require that sum positive throughout the claimed isolation-test domain, or define

$$\Omega_{\text{leak}} = \{(\xi, \omega) : \mathcal{T}_{xx} + \mathcal{T}_{yy} > 0\}$$

and take the supremum over it.

Publication would be strengthened by canonical citations for projection-operator memory equations, CPTP-map contractivity, finite-time observability, Alexandrov topology, Heyting algebras, and Kripke semantics. Exposition is the lowest category score, 8.5/10.

FINAL SUMMARY

The manuscript constructs a mathematically explicit class of dual-channel systems: structurally distinguished pathways, quantified residual leakage, a persistent hidden-state sector, hidden-to-readout modulation, exact reduced memory dynamics, finite-time observation and observability, a four-state Boolean channel topology, a separate non-Boolean reachability semantics, an experimentally falsifiable crossbar realization, and a separately typed cognitive interpretation whose empirical adequacy remains open. The meta-review finds that an initially intuitive dual-pathway analogy has been converted into a layered framework whose claims can be examined, repaired, tested, falsified, and certified at the appropriate logical level.

REFERENCES

- [Sch26b] C. D. Schaper. The chrysene formalism as candidate mathematics and candidate biogenesis. *Annals of the Chrysene Formalism* 1(2):476–488, 2026.

REVISION HISTORY

Version	Date	Notes
v1.0	2026-10-07	Review record published with Article 49.

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