

MULTI-PASS ORTHOGONAL-CONSTRAINT REVIEW RECORD
*The Chrysene Formalism Revisited: A Twelve-Axiom
Foundation for Molecular Characterization, Tensorial
Noncommutative Geometry, and Operator Response*

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REVIEW SCOPE AND OBJECTIVE

This article is the twelve-axiom foundational restatement of the Chrysene Formalism. It was evaluated under a **rigorous multi-pass orthogonal-constraint review**, not under the Level 1 internal-consistency protocol used for the opening batch of Volume 1, Number 1 papers.

Independent tracks were run on successive drafts:

- (1) **Mathematics.** Standalone well-posedness, typing, circularity, finite classification (FC), analytic existence / non-vacuity (AE), operator algebra, spectral triples, transfer, response, and admissibility.
 - (2) **Concordance.** Faithfulness of restorations and non-restoration of withdrawn implications relative to earlier Chrysene Formalism documents.
 - (3) **Chemistry.** Molecular identity, locants, C_{2h} achirality, bay/K-region nomenclature, comparison-class chemistry, and hedge strength.
 - (4) **Targeted post-revision verification.** Direct check that demanded mathematical repairs were implemented.
 - (5) **Meta-review.** Controlling-document synthesis after the subject-specific tracks.
- Models used across author-side and editor-side passes included ChatGPT, Gemini, and Grok. Human editorial compilation assembled the tracks into this record. There is no author-reply section.

Scope of Review

Multi-pass orthogonal review at this tier evaluates axiomatic architecture, proof status, concordance with the founding record, and chemical admissibility of molecular statements. It does not constitute laboratory verification of patented compositions. Individual track reports below are reproduced in full from the source review files. Score differences among mathematics reviews are draft-stage differences; the controlling final manuscript is the object of the later verification and meta-review reports.

DISCLOSURE OF AI USE

The author claims the use of AI in the development and writing of the manuscript. The review record itself compiles multi-pass AI-augmented orthogonal reviews conducted with ChatGPT, Gemini, and Grok. Each track report is reproduced as submitted.

ORTHOGONAL REVIEW PROCEDURE

Evaluation consisted of sequential, independent constraint tracks rather than a single Level 1 screen:

- (1) **Author-side and iterative mathematical reconstruction.** Multi-round revision from an initial 68/100 (reject in present form) through seven scored rounds to 92/100 (accept) on the iterative reconstruction report.
- (2) **Standalone mathematics reviews** of intermediate and later drafts (81/100 major revisions; 84/100 minor revision; 88/100 accept with minor revisions; 100/100 accept on a later draft).
- (3) **Concordance audits** of Table 1 / Section 8 and of the five restorations / four rejected implications.

- (4) **Chemistry reviews** (94/100 and 90/100), both accept with minor revisions, concentrated on bay/K-region nomenclature and comparison-class chemistry.
- (5) **Targeted mathematical verification:** Pass with minor edits; FC discharged; AE discharged.
- (6) **Meta-reviews** of the controlling manuscript (98/100 and 93/100), both accept with minor revisions.

Review workflow: This article was not evaluated under Level 1 internal-consistency review. It received a rigorous multi-pass orthogonal-constraint review. Independent tracks addressed axiomatic well-posedness and proof correctness; concordance with earlier Chrysene Formalism documents; chemical identity, nomenclature, and hedge strength; targeted post-revision mathematical verification of demanded repairs; and two cycles of simulated meta-review. Passes were sequential on successive drafts. Score variation across mathematics reviews reflects draft stage and scrutiny level, not an indeterminate final result. No author-reply section is included.

Compiled publication disposition

Accept with Minor Revisions.

Controlling later-stage reports treat FC and AE as discharged and treat uniqueness as canonical carbon-framework uniqueness, not labeled-realization uniqueness. Remaining items in the latest meta-review are editorial (Section 11 wording, Table 1 chemical names of the seven tetrihexes, a doubled article in Remark 44). No further full mathematics, chemistry, or concordance round is required by those reports.

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1. PEER-REVIEW REVISION REPORT (ITERATIVE RECONSTRUCTION)

Iterative mathematical reconstruction track — seven scored rounds

Manuscript. The Chrysene Formalism Revisited: A Twelve-Axiom Foundation for Embedded Geometry, Network Structure, and Operator Response.

Date. September 2026.

Arc. 68/100 Reject in present form $\rightarrow$ 92/100 Accept.

1. Purpose and Scope of the Review. This report summarizes the iterative technical peer-review process applied to the manuscript *The Chrysene Formalism Revisited: A Twelve-Axiom Foundation for Embedded Geometry, Network Structure, and Operator Response*. The review was conducted as a skeptical mathematical assessment of the manuscript as a standalone article. No unpublished background was assumed, and earlier formulations of the Chrysene Formalism were not used to supply missing definitions, hypotheses, or proofs.

The review focused especially on whether the manuscript succeeded in distinguishing

axiomatic structure+ molecular-instantiation hypotheses $\implies$ derived consequences, and whether that distinction was maintained consistently across embedded geometry, network construction, operator algebra, transfer, linear response, finite encoding, and admissibility.

Particular attention was given to:

1. mathematical well-posedness and joint coherence of Axioms $A_1, \dots, A_{12}$;
2. absence of circular prerequisite structure;
3. correctness of all definitions, propositions, lemmas, theorems, corollaries, and proofs;
4. completeness of the non-vacuity construction;
5. validity of the countermodel and non-entailment arguments;
6. separation of Euclidean geometry from Hilbert-space structure;
7. distinction among symmetry, anisotropy, and chirality;
8. correctness of the C^* -algebra, GNS, and von Neumann constructions;
9. correctness of the resolvent, transfer, and linear-response constructions;
10. mathematical adequacy of the admissible path metric and associated projection constructions; and
11. conformity with the manuscript's stated Bourbaki-style objective of explicit objects, domains, codomains, hypotheses, and logical status.

2. Initial Review. The original submission received a score of

68/100

with the recommendation

Reject in present form.

The initial review did not identify the central mathematical program itself as untenable. Rather, the principal concern was that several foundational claims of the paper were not yet justified by the formal system as written.

2.1 Principal fatal flaws initially identified. The most important defect was a circular dependence between Axioms A_1 and A_2 . Axiom A_1 included the symmetry stabilizer $\Gamma_{\mathfrak{C}}$ among the primitive data while referring to its definition in A_2 , whereas A_2 required the graph, embedding, and labeling data supplied by A_1 . Thus the actual prerequisite structure contained

$$A_1 \prec A_2 \quad \text{and} \quad A_2 \prec A_1,$$

contrary to the claimed acyclic architecture.

A second foundational problem concerned typing of the attachment-label action. The map

$$\lambda_{\text{att}} : V_{\mathfrak{C}} \longrightarrow L_{\text{att}} \cup \{\emptyset\}$$

could take the value $\emptyset$, whereas the group action was defined only on L_{att} . Consequently, expressions involving $\rho_R \circ \lambda_{\text{att}}$ were not defined on the full stated domain.

A third major defect concerned the non-vacuity theorem. The model construction did not yet furnish explicit interpretations for all primitive symbols required by the twelve axioms. Among the missing or incomplete data were the attachment-label action, terminal compatibility data, the generated periodic network, $\mathfrak{A}_0$, the local encoding set and equivalence relation, the GNS cyclic vector, and certain admissibility data. Accordingly, the proof did not yet establish

$$\text{Mod}(\mathcal{A}) \neq \emptyset$$

for the system as literally stated.

2.2 Additional major issues. The initial review also identified the following problems:

- bridge compatibility was expressed partly in physical prose rather than as a formally typed mathematical relation;
- the generated infinite network $\mathfrak{N}$ was invoked before its vertex set, edge set, embedding, and translation action were explicitly defined;
- the comparison

$$T_x(z) \neq T_y(z)$$

was not generally meaningful because the two transfer operators could have different domains and codomains;

- the expression

$$\Sigma_{\text{enc}} \cong \text{GF}(4)$$

was not well formed when Σ_{enc} was merely a set without specified binary operations;

- the admissibility projection Q_{adm} was typed as a map into $\mathcal{H}_{\text{adm}}$ while later being used as an operator on the ambient Hilbert space;

- several prerequisite arrows did not correspond to literal definitional dependencies; and
- some constructions were mathematically correct locally but were not yet integrated sufficiently to justify the manuscript’s stronger Bourbaki-style claims.

3. Principal Revisions Recommended and Implemented. The review recommended a coordinated reconstruction rather than a series of isolated textual corrections.

3.1 Removal of the A_1/A_2 cycle. The primitive node was revised to

$$\mathfrak{C} = (V_{\mathfrak{C}}, E_{\mathfrak{C}}, \iota, \lambda),$$

with the symmetry stabilizer removed from the primitive data of A_1 . The group $\Gamma_{\mathfrak{C}}$ was then defined subsequently and unidirectionally in A_2 . This changed the dependency from a cycle to the intended hierarchy

$$A_1 \longrightarrow A_2 \longrightarrow A_3.$$

3.2 Typing of the attachment action. The attachment-label set was extended to

$$\overline{L}_{\text{att}} = L_{\text{att}} \sqcup \{\emptyset\},$$

and the orthogonal-group action was explicitly extended by

$$\bar{\rho}_R(\emptyset) = \emptyset.$$

The symmetry axiom was additionally required to preserve the attachment-site set

$$\varphi_g(A_{\mathfrak{C}}) = A_{\mathfrak{C}},$$

thereby ensuring that the tangent covariance expressions appearing in A_3 were well defined.

3.3 Formalization of bridge compatibility. A terminal descriptor space

$$\mathcal{T} = L_{\text{chem}} \times L_{\text{att}} \times S^2$$

was introduced, together with an explicitly specified compatibility relation

$$\bowtie \subseteq \mathcal{T} \times \mathcal{T}.$$

The bridge realization was expanded to contain explicitly typed terminal chemical labels, attachment labels, tangent data, and terminal displacement. Consequently, the admissible bridge class $\mathcal{B}_{\alpha}$ became a mathematically defined set and the map

$$B_{\alpha} : \mathcal{N}_{\alpha} \longrightarrow \mathcal{B}_{\alpha}$$

became properly typed.

3.4 Explicit construction of the periodic network. The revised manuscript explicitly defined the periodic decorated network through

$$V_{\mathfrak{N}} = \mathbb{Z}^2 \times V_{\mathfrak{C}},$$

translated copies of the molecular-node edges, directional connector edges, copied labeling data, and connector decorations. The lattice action

$$U_{\ell}(k, v) = (k + \ell, v)$$

was then explicitly defined. In the final revision, the map

$$\iota_{\mathfrak{N}}(k, v) = \iota(v) + ma_x + na_y$$

was appropriately termed a *placement map* rather than an embedding, thereby avoiding an unintended global-injectivity claim.

3.5 Restoration and completion of A_4 – A_6 . During one revision cycle, the directional bridge-generation axiom A_4 was inadvertently omitted. This was detected because subsequent axioms used the undefined objects $\mathcal{N}_\alpha$, $B_\alpha(N)$, and c_α . The missing axiom was restored and the terminal-offset definition

$$c_\alpha \in \mathbb{R}^3, \quad C_\alpha(N) = c_\alpha + B_\alpha(N)$$

was inserted before its first use. The resulting bridge-generation, closure, and periodic-network layers were then logically ordered and fully typed.

3.6 Reconstruction of the non-vacuity theorem. The proof of non-vacuity was rewritten as an explicit model construction supplying, in sequence,

label sets and group actions,
 embedded node and attachment data,
 terminal compatibility and bridge realizations,
 closure counts and the periodic network,
 the observable algebra and GNS representation,
 finite structural encoding,
 directional Hamiltonians and transfer operators,
 polarization-response operators,
 the admissible structural state graph and path metric.

The bridge-edge chemical labeling and GNS cyclic vector were also made explicit. The revised proof therefore genuinely constructs a simultaneous model satisfying

$$A_1, \dots, A_{12}$$

and supports the conclusion

$$\text{Mod}(\mathcal{A}) \neq \emptyset.$$

3.7 Reformulation of transfer comparison. Because directional transfer operators can possess different terminal Hilbert spaces, the bare comparison

$$T_x(z) \neq T_y(z)$$

was replaced by a unitary comparison relation. The revised definition declares

$$T_x^{(N_x)}(z) \simeq_u T_y^{(N_y)}(z)$$

when suitable unitaries

$$U_L : \mathcal{H}_{L,x} \rightarrow \mathcal{H}_{L,y}, \quad U_R : \mathcal{H}_{R,x} \rightarrow \mathcal{H}_{R,y}$$

intertwine the two operators. The deferred transfer theorem was later further refined so that inequality of Laurent coefficients implies nonidentity of the analytic transfer

functions,

$$T_x(\cdot) \not\equiv T_y(\cdot),$$

rather than an unjustified pointwise inequality at every spectral parameter.

3.8 Reformulation of the GF(4) program. The review distinguished carefully between

$$|\Sigma_{\text{enc}}| = 4$$

and the existence of a structurally meaningful field law. The manuscript was revised so that a finite-field identification requires explicitly supplied operations

$$\oplus_{\mathfrak{R}}, \odot_{\mathfrak{R}} : \Sigma_{\text{enc}} \times \Sigma_{\text{enc}} \longrightarrow \Sigma_{\text{enc}},$$

associated with a specified realization $\mathfrak{R}$. The resulting theorem target is

$$\mathcal{A} \cup H_{\mathfrak{R}} \models (\Sigma_{\text{enc}}, \oplus_{\mathfrak{R}}, \odot_{\mathfrak{R}}) \cong \text{GF}(4).$$

The review additionally noted that if arbitrary operations were allowed, every four-element set could be given a GF(4)-structure by transport through a bijection. The manuscript therefore correctly shifted the substantive question to whether *structurally specified* operations satisfy the field axioms.

3.9 Reconstruction of the non-entailment argument. The countermodel section was rewritten so that the conclusions to be refuted became well-formed model properties. Representative predicates included

$$P_N : N_y^* = N_x^* + 2,$$

$$P_4 : |\Sigma_{\text{enc}}| = 4,$$

and an explicitly typed unitary-transfer anisotropy condition. The explicit model supplied by the non-vacuity theorem was then shown to falsify each selected predicate. This converted the earlier informal discussion into a genuine countermodel argument proving

$$\mathcal{A} \not\models P$$

for the specified deferred conclusions.

3.10 Operator-algebraic precision. The initial untyped completion

$$\overline{\mathfrak{A}_0}^{\|\cdot\|}$$

was replaced by a normed involutive algebra

$$(\mathfrak{A}_0, \|\cdot\|_0, *)$$

with explicitly stated submultiplicativity and involution properties. The completion

$$\mathfrak{A}_C = \overline{\mathfrak{A}_0}^{\|\cdot\|_0}$$

was then required to be a unital C^* -algebra. This removed the remaining ambiguity concerning the norm used in the completion.

3.11 Final precision revisions. The final rounds addressed matters that no longer threatened the foundational architecture but improved mathematical precision:

- stale equation references were corrected;

- typographical errors and unresolved cross-references were removed;
- the unnecessary phrase “whenever the spectral sum converges” was removed from the finite-dimensional spectral representation;
- the optical theorem target was reformulated as

$$\nu_x \neq \nu_y \implies \alpha_{xx}(\cdot) \not\equiv \alpha_{yy}(\cdot),$$

rather than inequality at every single frequency;

- the introductory finite-field statement was shortened while retaining the mathematically necessary qualifier:

$$|\Sigma| = 4 \not\implies \Sigma \text{ has a specified GF}(4) \text{ field law.}$$

4. Progression of the Review Scores. The manuscript was rescored after each substantive revision using the same weighted rubric.

Round	Principal status of manuscript	Score	Decision
1	Circular A_1/A_2 dependency; incompletely typed attachment action; incomplete non-vacuity construction; informal countermodel targets.	68	Reject in present form
2	Major foundational reconstruction completed, but A_4 was inadvertently absent from the revised manuscript.	76	Major Revision
3	A_4 restored; residual undeclared terminal-offset datum c_α and several typing/order issues remained.	80	Major Revision
4	Terminal offset, bridge labeling, prerequisite structure, transfer comparison, and countermodel architecture substantially repaired.	87	Minor Revision
5	C^* -algebra typing, GF(4) logic, transfer comparison, and several notation issues corrected.	89	Minor Revision
6	Only final precision issues remained, including periodic-network terminology and theorem-target wording.	90	Minor Revision
7	Placement-map terminology, spectral-sum wording, optical theorem target, typography, and remaining consistency issues corrected.	92	Accept

5. Final Rubric Assessment. The final manuscript was assessed under the same weighted rubric as the original submission.

Category	Weight	Final Score
Internal mathematical consistency	15	14.0
Correctness of propositions/theorems/proofs	15	14.0
Axiomatic and logical rigor	15	14.0
Bourbaki-style precision	10	9.0
Consistency with established mathematics	10	9.5
Physicochemical/symmetry consistency	10	9.0
Continuity with the stated Chrysene Formalism	5	4.5
Horizontal mathematical integration/novelty	10	8.5
Multidisciplinary coherence	5	4.5
Exposition and notation	5	4.5
Total	100	91.5

The reported rounded score was therefore

$$\boxed{92/100},$$

with reviewer confidence

$$\boxed{5/5}.$$

6. Final Assessment. The principal question throughout the review was not whether the underlying concept was conventional, but whether the mathematics did what the manuscript claimed.

In the original submission, the intended distinction among axioms, instantiation hypotheses, and derived consequences was conceptually clear but not yet fully achieved in the formal execution. Circular dependencies, incompletely typed objects, and an incomplete non-vacuity model prevented the manuscript from supporting its strongest foundational claims.

The final revised manuscript corrects those defects. In particular, it now maintains the distinctions

Euclidean orthogonality $\neq$ Hilbert-space orthogonality $\neq$ dynamical decoupling,

directional anisotropy $\neq$ chirality,

$|\Sigma| = 4 \neq$ a structurally specified finite-field law,

and

constraint violation $\neq$ metric disconnection $\neq$ physical excision.

These distinctions are no longer merely stated philosophically. They are reflected in the domains, maps, operators, hypotheses, model construction, and countermodels of the revised formalism.

The explicit construction in Theorem 18 now provides a legitimate witness to

$$\text{Mod}(\mathcal{A}) \neq \emptyset,$$

while the associated countermodel analysis demonstrates that the principal chrysene-specific conclusions are not silently encoded into the foundational axioms.

The iterative review therefore changed the assessment from

68/100 — Reject in present form

to

92/100 — Accept

The improvement reflects correction of substantive mathematical defects rather than an increase in score based upon novelty. The final recommendation is based on the conclusion that the revised manuscript now succeeds in its stated purpose as a coherent, non-vacuous, explicitly stratified axiomatic foundation for subsequent chrysene-specific theorem development.

7. Final Recommendation.

ACCEPT

The remaining possible refinements are optional matters of further formal polish rather than conditions necessary for publication.

2. TARGETED MATHEMATICAL VERIFICATION

Targeted post-revision mathematical verification

Decision. PASS WITH MINOR EDITS.

FC. DISCHARGED.

AE. DISCHARGED.

Meta-review readiness. YES.

1. Verification Decision.

PASS WITH MINOR EDITS

The requested substantive mathematical repairs have been implemented correctly. In particular, the manuscript now uses conjugacy in $O(3)$,

$$\Pi_C^{\text{core}} \sim_{O(3)} C_{2h}^{\text{std}},$$

rather than abstract group isomorphism, and the canonical core stabilizer is defined from carbon-framework geometry independently of chemical labeling. This correctly prevents C_{2h} and C_{2v} from being conflated merely because both are abstractly isomorphic to $\mathbb{Z}_2 \times \mathbb{Z}_2$.

The revised characterization theorem now establishes uniqueness only at the canonical carbon-framework level,

$$\text{CanGraphRed}_{\text{mol}}(\mathfrak{R}) \simeq_{\text{px}} G_{\text{chr}}^{\text{px}},$$

while the standard $\{3, 6, 9, 12\}$ primary and $\{2, 5, 8, 11\}$ dual locant frames are retained on the reference chrysene node and on the separately defined standard-locant realization class. This is the correct strength of the finite classification.

The graph/node typing has also been repaired:

$\mathcal{B}_4$ is the graph class, $\mathfrak{N}_4$ is the embedded labeled-node class,

and

$$\text{Red}_{\text{mol}} : \text{Mod}(\mathcal{A}) \longrightarrow \mathfrak{N}_4$$

is now correctly typed. The distinctions among Red_{mol} , $\text{CanGraphRed}_{\text{mol}}$, $\text{CanRed}_{\text{mol}}$, $\simeq_{\text{px}}$, and $\simeq_{\text{px}, \text{lab}}$ are mathematically coherent.

The remaining requested local repairs are also sound: bridge compatibility is typed; A_5 uses distinguished translation generators; A_6 transports the registry field rather than assuming registry invariance; the unbounded-Hamiltonian preservation result contains the required domain condition; self-adjointness of D_{lat} is justified by its direct-sum realization; the full and reduced crossed products are consistently identified using amenability of $\mathbb{Z}^3$; and the unnecessary prerequisite $A_7 \prec A_{11}$ has been removed.

The Schur-complement correction is also correct. For nonreal z , the lower-left block is

$$T_{\alpha}^{(N)}(\bar{z})^{\dagger},$$

with

$$R_{B, \alpha}^{(N)}(\bar{z})^{\dagger} = R_{B, \alpha}^{(N)}(z).$$

The manuscript no longer treats $R(z)^\dagger = R(z)$ as valid for arbitrary nonreal z .

2. FC.

FC: DISCHARGED

Appendix A still gives an exhaustive seven-class free-tetrahedron enumeration, identifies S_4 as the unique class whose reference point group is $O(3)$ -conjugate to C_{2h}^{std} , independently identifies its carbon graph with chrysene, and verifies C_3 , C_4 , and C_5 on the standard numbered reference node. Theorem 34 and the Appendix-A FC theorem now state precisely the carbon-framework uniqueness that this classification proves.

3. AE.

AE: DISCHARGED

The repaired filtration construction now correctly uses

$$\overline{\bigcup_{n \geq 0} F_n} = \mathcal{H}_\omega,$$

the Q_n are mutually orthogonal finite-rank spectral shells, D_C is self-adjoint with compact resolvent, and finite filtration propagation gives bounded commutators. The new spectral-truncation argument $\psi_N = P_N \psi$, followed by closedness of D_C , correctly establishes

$$\pi_\omega(A) \text{Dom}(D_C) \subseteq \text{Dom}(D_C).$$

Consequently the Appendix-B construction still supplies a full A_1 – A_{12} model and AE remains discharged.

4. Remaining Issues.

- MINOR 1.** A few residual phrases still overstate the revised classification by referring to the *unique molecular reduct*. In particular, the opening of Section 11, the closing language of Remark 44, the opening paragraph of Appendix B, and the corresponding status entry in Section 11.12 should use *unique canonical carbon framework* or *unique canonical carbon-framework reduct* instead. These are stale-text inconsistencies only; they do not affect the proof of Theorem 36 or Theorem 55.
- MINOR 2.** For maximal formal completeness of the explicit existence witness, Appendix B.1–B.2 should spell out the trivial witness choices already described in prose: the uniform carbon chemical-label map, the common non-null primary attachment label and its orthogonal action, and an explicit bridge-label set and compatibility relation Comp_α containing the chosen witness bridge data. These choices are immediate and introduce no new existence obligation, so this does not undermine AE; it merely makes the “explicit” model literally complete at the level of all typed data.

No BLOCKING mathematical issue was found.

5. Meta-Review Readiness.

YES

The manuscript is mathematically ready to proceed to the final meta-review after incorporation of the two minor edits above. No additional full mathematics peer-review round is warranted.

3. CHEMISTRY PEER REVIEW (94/100)

Chemistry track**Recommendation.** Accept with minor revisions.**Score.** 94/100.**Controlling chemical defect.** Bay-region nomenclature at the 6/12 cleft.**1. Editorial Recommendation. Accept with minor revisions.****2. Overall Chemistry Score. 94 / 100**

3. Ten-Category Scoring Table.

Category	Score /10	Short Justification
1. Chrysene molecular identity & connectivity	10	Accurately identified connectivity and the edge structure using binatorial exhaustion
2. Locant numbering & primary/dual assignment	10	Matches the standard clockwise peripheral convention perfectly; assigning is genuinely ad hoc
3. Molecular symmetry, chirality, & substitutions	10	Flawlessly distinguished local C_{2h} symmetry realizations; correctly identified C_{2h} core achiral.
4. Polyhex/benzenoid chemistry & bipartition	10	Highly rigorous graph partition of the 7 tetrahedra; identifying the $C_{17}H_{11}$ radical bipartiteness correctly
5. Bay-region and perimeter geometry	5	Misapplies the term to the 6/12 notch; bay region requires three edges (like the 4/10 locant)
6. Aromaticity, conjugation, & π -system	10	Wisely formulates conjugation as a property rather than inferring it from pure geometry
7. Bridge/linker/stacking/network language	10	Abstract structural terms are properly qualified; identifying mislabeled as competent syntheses.
8. Electronic-transfer & Hamiltonian chemistry	10	Accurately modeled complement transfer from conflating geometric electronic decoupling
9. Polarization, spectroscopy, & bulk-response	10	Correctly applies Kramers inversion-symmetry, cellulation, and finiteness.
10. Overall chemical rigor and compatibility	9	Exceptional adherence to primary conditions between chemistry and mathematics; abstraction, marred by nomenclature errors

4–10. Chemistry narrative (verbatim from source). The molecular chemistry underpinning this mathematical formalism is highly accurate, logically isolated, and well-suited for publication. The manuscript exhibits an unusually rigorous grasp of physical chemistry, PAH combinatorics, and molecular point-group symmetry. By formally distinguishing canonical carbon-framework symmetry (C_{2h}) from the symmetry of arbitrarily substituted physical realizations, the manuscript elegantly avoids common pitfalls regarding PAH chirality.

The explicit use of the 7 mathematically free tetrahexes as a combinatorial comparison class is exceptionally precise. However, a specific nomenclature error regarding what constitutes a “bay region” in PAH chemistry requires correction to align the mathematical classes with IUPAC structural nomenclature.

Major chemical issue. In PAH nomenclature, a “bay region” strictly defines an inward-concave geometry formed by *three* fused benzene rings. In chrysene, the true bay regions are located at the 4/5 bonds and the symmetry-equivalent 10/11 bonds. The geometrical sequence near carbons 6 and 12 represents a structural cleft between *two* fused rings (an armchair-type inter-ring cleft adjacent to the K-region) and is not a true bay region.

Revision. In Section A.9 replace the definition of two “bay regions” $B_{\text{bay}}^{(6/12)}$, $B_{\text{bay}}^{(4/10)}$ by true bay regions $B_{\text{bay}}^{(4/10)}$ and inter-ring armchair clefts $C_{\text{cleft}}^{(6/12)}$. Update Table 2 accordingly.

Verified: chrysene identity; $C_{18}H_{12}$; C_{2h} and achirality of the isolated core; 3,6,9,12 and 2,5,8,11 numbering; one-step perimeter cipher; balanced bipartite/alternant interpretation; $H_{\partial\pi}$ as hypothesis; abstract bridges; transfer and polarization statements; Appendix B as existence witness.

Sources: PubChem CID 9171; ACS bay-region versus K-region usage; IUPAC Blue Book P-25 fused-ring numbering.

Decision. After the listed nomenclature corrections regarding the bay regions, the paper is chemically sound and fully suitable to proceed to the final meta-review.

4. STANDALONE MATHEMATICS REVIEW (100/100)

Mathematics track — later draft

Recommendation. Accept.

Score. 100/100.

FC / AE. Both discharged on the draft reviewed.

1–3. Recommendation and rubric. Accept. Overall mathematics score 100/100.

Category	Score	Concise Justification
1. Logical architecture & typing	10 / 10	Domains, codomains, and quotient structures (perfectly typed.
2. Axiom coherence & independence	10 / 10	Geometric, tensorial, and physical layers are s titioned without hidden causality.
3. Polyhex classification & FC proof	10 / 10	The recursive enumeration is exhaustive, and try identification is flawless.
4. Tensor network & $\mathbb{Z}^3$ fibration	10 / 10	Exact bridge closure is separated securely fr stract discrete translation base.
5. Quasi-local C*-algebra & noncommutativity	10 / 10	Shift covariance is rigorously exploited to pro mutativity on the sequence space.
6. Commutant duality	10 / 10	The Tomita-Takesaki style geometric implemen elegantly realizes the commutant.
7. Spectral triple & noncommutative geometry	10 / 10	The finite-filtration Dirac construction elegant compact resolvent on the infinite lattice.
8. Physical operator mathematics	10 / 10	Schur complements and Kubo limits are de proper analytic domains and bounds.
9. Explicit twelve-axiom existence model (AE)	10 / 10	Appendix B provides a complete, contradicti nessing model across all axioms.
10. Overall rigor & theorem-status accuracy	10 / 10	All unsupported legacy claims have been ap demoted to conditional deferred theorems.

4. Executive Mathematical Assessment. The twelve-axiom architecture presented in this manuscript is mathematically coherent, logically acyclic, and rigorously partitioned. By cleanly stratifying the formulation into molecular geometry, tensor networks, sequence algebras, noncommutative spectral geometry, and physical linear response, the manuscript entirely eliminates the causal fallacies present in earlier historical iterations. The mathematical objects are precisely typed. The separation of abstract graph properties from realization-specific Euclidean embeddings secures the structural foundation.

The molecular characterization theorem is genuinely proved. The definition of the finite comparison class $\mathbb{B}_4$ successfully bounds the search space, and the recursive combinatorial cell-growth algorithm exhaustively catalogs the seven free four-cell benzenoid graphs. The symmetry evaluations correctly identify the chrysene carbon

skeleton as the unique candidate possessing the required C_{2h} carbon-framework stabilizer alongside two geometrically inequivalent primary directional attachments.

The paper is genuinely non-vacuous. Appendix B constructs an explicit, finite-dimensional local tensor witness that rigorously satisfies all twelve axioms without generating internal contradictions. Theorem 8 isolates translation covariance as the source of global noncommutativity. The Dirac operator $D_{\mathfrak{C}}$ uses an orthogonal finite-filtration projection to obtain compact resolvent on an infinite lattice while retaining bounded translation commutators.

5. Major Mathematical Issues. None.

6. Minor but Important Revisions.

- Notation overload (C^* versus d_C^*): replace the path metric by d_{adm} or $d_{\mathcal{E}}$.
- Typographical artifact in Definition 13: the closure defect $\dot{\epsilon}_\alpha(N)$ should be $\epsilon_\alpha(N)$.
- Hilbert-space index T in $\mathcal{H}_{T,\alpha}$ should not be conflated with the abstract tensor space $\mathbb{T}_{\mathfrak{C}}$.

7–15. Axiom, theorem, FC, AE, circularity, type, and deferred audits. All twelve axioms are scored SOUND. Seven-polyhex enumeration, unique C_{2h} polyhex result, external chrysene graph-isomorphism certificate, finite molecular classification, sequence-induced noncommutativity, primary/dual commutant, compact-resolvent spectral realization, explicit twelve-axiom existence, and the final characterization/existence theorem are all marked PROVED. Appendix A discharges FC. Appendix B discharges AE. No circularity. Deferred targets are not used as established ground truth.

Final mathematics decision. (a) Yes, publication-ready without substantive mathematical correction. (b) Yes, FC and AE are proved. (c) No central theorem remains unsupported. (d) Yes, ready for final meta-review.

5. CHEMISTRY PEER REVIEW (90/100; THIRD-COMPONENT REVIEW, 6
SEPTEMBER 2026)

Chemistry track — third component of a three-part process

Recommendation. Accept with minor revisions.

Score. 90/100.

Scope. Chemistry only. Concordance taken as already passed.

Editorial recommendation and score. Accept with minor revisions. Overall chemistry score **90/100**.

The molecular chemistry that the formalism actually uses is accurate enough to publish. The chrysene identity, formula, connectivity, C_{2h} assignment, achirality, locant pairings, and the decision to keep conjugation, stacking, and response as qualified hypotheses are sound. The revisions that matter are nomenclature and scope, not identity.

Ten-category scores. Identity and connectivity 10; locants 9; symmetry/chirality/substitution 10; polyhex/bipartite 8; bay-region geometry 7; aromaticity/ π -language 9; bridge/stacking 9; transfer/Hamiltonian 9; polarization 10; overall chemical rigor 9.

Executive assessment. The manuscript is no longer trying to extract electronics, field arithmetic, or scission from the carbon graph. Claims checked against PubChem CID 9171, NIST WebBook / PAH Structure Index, and standard fused-ring numbering. Isolated C_{2h} chrysene is not called chiral. Geometric anisotropy is not called transfer anisotropy. Four structural states are not called GF(4). A projection is not called bond cleavage. Appendix B is a witness, not a material.

Issues and repairs. No identity-level major issue. Bay-region nomenclature in Appendix A.9 remains the issue that would mislead later papers: true bays are 4–5 and 10–11; 5–6 / 11–12 are K-regions. $\mathcal{B}_4$ includes pyrene and an odd-carbon 17-vertex graph and is not a list of isolable $C_{18}H_{12}$ PAHs. Prefer “conjugated π framework” over “perimeter π -conjugation.” Label Appendix B edges as abstract, not ℓ_{CC} physical linkers. Add that identical 3, 6, 9, 12 substituents may preserve C_{2h} ; unequal substituents need not.

Decision. After bay/K-region wording, the $\mathcal{B}_4$ disclaimer, and the Appendix B label clarification, the paper is chemically suitable to proceed to the final meta-review.

6. FINAL SIMULATED META-REVIEW (93/100; 7 SEPTEMBER 2026)

Controlling meta-review of the final manuscript**Recommendation.** Accept with minor revisions.**Score.** 93/100.**Further subject-specific rounds.** Not warranted.

1. Final editorial recommendation. Accept with minor revisions. No central mathematical theorem is unsupported. No central chemical identity claim is materially incorrect. Remaining work is local cleanup: residual double wording, incomplete chemical naming of the seven tetrihex classes in Table 1, and a few notational collisions.

2–3. Score. Meta-review score **93/100**.

Ten-category scores: axiomatic clarity 9; molecular characterization/FC 10; non-vacuity/AE 9; tensor-network/ $\mathbb{Z}^3$ 10; operator algebra 9; spectral triple 9; physical-operator layering 10; chemical correctness 9; concordance 10; publication readiness 9.

4. Review-track synthesis. Three standalone mathematics reviews initially disagreed in severity (81, 88, and 100). The strict review correctly identified $O(3)$ -conjugacy versus abstract isomorphism, type-overload of $\mathcal{B}_4$, overstated labeled uniqueness, compact-resolvent tension, a Schur adjoint error, and leftover “subject to FC/AE” language. Targeted verification found those repairs implemented. The 100/100 review was too lenient on the draft it saw; the 81/100 review was correct at the time and is no longer a description of the final text.

Concordance accepted five restorations and verified that four rejected implications were not reinstated. Chemistry reviews (90, 94) verified identity and required bay/K-region repair, now present in Appendix A.9.

5. Central-claim status. Canonical carbon-framework characterization, FC, AE, $\mathbb{Z}^3$ tensor network, sequence noncommutativity, and the spectral triple are ESTABLISHED. Commutant structure and Connes distance are established with minor qualification. Transfer and linear response are established as typed constructions, not anisotropy theorems. Standard-locant class is a defined subclass, not an axiomatic consequence. $N + 2$, GF(4) multiplication, anisotropy, metric reconstruction, higher algebra, assembly chirality, and scission remain deferred.

6–7. Remaining issues. No blocking issue. MINOR: name the seven tetrihexes chemically in Table 1. EDITORIAL: delete “the the” in Remark 44 and Appendix B opening; reorder the introduction’s section pointer; optional d_{adm} rename; remove the overdot on $\dot{\epsilon}_\alpha(N)$.

8–10. Consistency, process, decision. Abstract, Theorem 36, Appendices A–B, Discussion, Conclusion, and concordance table now agree. Further subject-specific review rounds are not warranted.

Meta-review decision

ACCEPT WITH MINOR REVISIONS. 93/100. No blocking mathematical defect. No central chemical defect. FC and AE discharged. Canonical chrysene carbon-framework theorem established at the correct strength.

7. EARLIER-DRAFT AND CONCORDANCE REPORTS RETAINED IN THE RECORD

On the remaining source files

The following reports belong to earlier drafts or to concordance/restoration audits and are part of the multi-pass record. They are reproduced in compressed but complete logical form so that the Overleaf file remains a single compile unit. Full original wording of the iterative reconstruction report, the targeted verification, the 94 and 90 chemistry reviews, the 100 mathematics review, and the 7 September meta-review appears in the sections above. The strict 81/100 mathematics review, the 88/100 mathematics review, the 84/100 independent review, the 98/100 meta-review, the Table 1 concordance audit, and the five-restorations audit are the documents that forced the later repairs; their controlling findings are stated here in full issue form.

7.1. Standalone mathematics review — MAJOR REVISIONS, 81/100.

Recommendation: MAJOR REVISIONS. Score 81/100. The seven-polyhex enumeration and S_4 identification are reproducible; crossed-product noncommutativity, tracial GNS commutant, and the filtration Dirac are sound after local analytic repairs. The central defect: uniqueness of the *canonically labeled molecular reduct* is not proved. Alternative locant assignments on the same S_4 skeleton satisfy the stated predicate but are not label-compatibly polyhex-congruent to the reference labeling. Theorems 54 and 36(2)–(3) are not proved in labeled form. Separately,

$$\Pi_C^{\text{core}} \cong C_{2h}$$

fails because $C_{2h} \cong C_{2v} \cong \mathbb{Z}_2 \times \mathbb{Z}_2$; the condition must be $O(3)$ -conjugacy. Explicit alternative labeling counterexample on the manuscript’s own S_4 geometry is given in the source report (locants shifted on $v_2^{\text{ref}} \mapsto 3$, etc.). FC is therefore not discharged in labeled form; AE is discharged modulo filtration-density and domain-invariance repairs. Not yet ready for meta-review until C_{2h} typing, labeled-versus-unlabeled FC, Theorem 36 synchronization, and Appendix-B analytic corrections are made. Those repairs are the ones later verified as implemented.

7.2. Simulated mathematics review — Accept with minor revisions, 88/100 (6 September 2026).

Recommendation: Accept with minor revisions. Score 88/100. FC and AE discharged on this draft at canonical-polyhex strength. Residual defects: $\mathcal{B}_4$ type-overload (graphs / isomorphism classes / labeled nodes); uniqueness of Red_{mol} stated where uniqueness of $\text{CanRed}_{\text{mol}}$ is proved; stale “subject to FC/AE” language in the conclusion. No central theorem invalidated. Ready for meta-review after those wording and type corrections.

7.3. Independent standalone review — Minor Revision, 84/100 (5 September 2026).

Recommendation: Minor Revision. Fatal flaw: none. Weighted score 84/100. Confidence 4/5. Axioms interpretable and jointly coherent; prerequisite graph acyclic; Theorem 18 produces a point of $\text{Mod}(\mathbf{A})$; Corollary 4 is a genuine countermodel. Structural complaints: no explicit structure signature; layer coupling

almost vacuous; missing $A_2 \prec A_3$ in the printed prerequisite list; forward reference from A_1 to A_2 . These do not break non-vacuity or non-entailment. Requested revisions are specification and notation, not axiom-list changes.

7.4. Final simulated meta-review — 98/100. Recommendation: Accept with minor revisions. Score 98/100. FC and AE discharged. Two residual Section 11 phrases still say “molecular reduct” where the proved result is “unique canonical chrysene carbon framework.” Optional retitling of Proposition 14. No further full mathematics, chemistry, or concordance review required.

7.5. Concordance audit of Section 8 and Table 1 (5 September 2026). Section 8 is the right kind of document. Table 1 is coarser than the source texts. Several rows labelled refined or replaced are demotions or withdrawals. Prose of §§8.2–8.5 is more accurate than the table. Continuity sentence in §8.6 is true only if old proofs are treated as optional decorations; under the revised axioms several older conclusions are false in $\text{Mod}(A)$. Recommended table repairs: split Euclidean versus C^* -module orthogonality; split planar translation versus z -stacking; relabel dual-cipher/commutant as demoted to theorem; add rows for $\text{GF}(4)$, automatic scission, $\mathcal{I}_C \cong \mathbb{Z}^3$, and uniqueness; withdraw “ C_{2h} chiral”; soften §8.6. The revised axioms are a contraction of the earlier program; Table 1 should read as a contraction.

7.6. Audit of the second restatement — five restorations and four rejected implications (5 September 2026). Five restorations structurally faithful: chrysene identity as a *conditional* characterization schema; literal tensor space; $\mathbb{Z}^3$ as discrete base; dual cipher/commutant as structure (commutant imposed, not deduced from locants); spectral language (compact resolvent on infinite $\mathbb{Z}^3$ then still unresolved). Four rejected implications not restored: C_{2h} chirality; automatic quantum decoupling; automatic $\text{GF}(4)$; automatic scission. Then-open debts: Theorem 31 outsourced uniqueness to undischarged (FC) and (AE); commutant imposed; compact-resolvent tension. Those debts are the ones later discharged by Appendices A–B and the filtration Dirac construction.

FINAL REMARKS FROM THE EDITORIAL REVIEW COMMITTEE CHAIR

The multi-pass orthogonal-constraint review of this manuscript has been completed. Mathematics, concordance, chemistry, targeted verification, and meta-review tracks were run on successive drafts using ChatGPT, Gemini, and Grok. The compiled publication disposition is **Accept with Minor Revisions**.

The manuscript is formally accepted for publication in the *Annals of the Chrysene Formalism*, Volume 1, Number 2, ISSN 3144-2021, pages 489–560, article 40. Acceptance date: 2026-09-07. Online publication date: 2026-09-30.

REVISION HISTORY

Version	Date	Notes
v1.0	2026-09-30	Initial publication of the multi-pass review record.

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