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Symmetry-Compatible Information in the Chrysene Formalism

Axiomatic Realization, Coding Obstructions, Constructive Repair, and Falsifiable Molecular Models

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Review provenance and limits

This report records separate AI-assisted analytical review passes and their synthesis. These are simulated referee assessments, not independent human peer review. No reviewer identity, editorial decision, experimental validation, patent-based scientific endorsement, or literature-wide novelty certification is implied. Recommendations are analytical judgments for the author and human editors.

1 Executive assessment

The paper's strongest contribution is a precise separation of algebraic correctness from symmetry compatibility and physical realization. It exhibits a distance-one failure after identifying reversed representatives of a particular quaternary Hamming code, repairs the coordinate assignment, and obtains a reversal-invariant code with 40 message orbits and perfect radius-one orbit decoding. It also proves a representation-sensitive obstruction when reversal is coupled to alphabet Frobenius conjugation. These are sharply delimited mathematical statements, not demonstrations that substituted chrysene implements the code or uniquely explains biogenesis.

Controlling materials

The starting point was the figure-enhanced Article 100 manuscript and its exact Python checks. Review covered all fourteen sections and three appendices, the abstract, four manuscript figures and two tables. The final revision and companion proof coverage are reconciled below. Corpus comparison is source-specific; no complete audit of all one hundred papers or exhaustive external literature search is claimed.

2 Mathematics review

Track M: mathematical correctness and completeness

Initial recommendation: minor revision. The review found no substantive defect in the central finite conclusions and no counterexample to the stated obstruction or repair. General results remain conditional on their declared hypotheses.

2.1 Substantive findings

The finite-group orbit distance is well defined and satisfies the metric axioms. The invariant-code decoding argument uses uniqueness correctly, and invariance is presented as sufficient, not necessary. The reference parity-check matrix has rank two and the complete five projective columns over $\mathbb{F}_4$. The distance-one witness represents distinct code-message orbits, so the failure is not an artifact of comparing representatives of one orbit.

For the repaired matrix, $H_*R = AH_*$ and $A^2 = I$ establish invariance. The encoder, 16 fixed words, 40 code orbits, 544 ambient orbits and partition identity

$$16 \cdot 10 + 24 \cdot 16 = 544$$

are consistent. The quotient minimum distance is three. The semilinear obstruction correctly combines the even action of $\mathrm{PGL}_2(4)$, the odd Frobenius coset and the even permutation of five-coordinate reversal. Its restriction to linear $[5, 3, 3]_4$ codes is essential; it does not exclude nonlinear codes or alternative representations.

The exact channel calculation correctly distinguishes word-weighted and orbit-weighted averages: $B(p) + \frac{3}{4}Q(p)$ versus $B(p) + \frac{3}{5}Q(p)$. The correlated-error result does not require independent symbol errors. The joint feasibility separator, uncertainty bound, finite-dimensional operator statement and Schur-complement identity are sound within their explicit hypotheses. Classical symbol correction must not be interpreted as quantum error correction.

2.2 Numbered recommendations

M1. Measurable realization. Probability expressions require measurable symbol fibers. Equip the realization space with a sigma algebra, use the discrete sigma algebra on the finite alphabet space, and require the maps used to define stochastic events to be measurable. Pure finite algebra needs no such additional structure, and probability preservation under the action is not required.

M2. Empty-distance convention and perfect radius. Declare $\inf \varnothing = +\infty$ for orbit-separation expressions and specify that a radius-t perfect code has radius-t balls partitioning the ambient space. This closes singleton-orbit and radius ambiguity without changing the concrete counts.

M3. Explicit stochastic kernel. State $0 \le p \le 1$ and

$$W_p(y \mid c) = (1-p)^{5-d(c,y)}(p/3)^{d(c,y)}.$$

Interpret endpoints directly as probabilities. State $W_p(Ry \mid Rc) = W_p(y \mid c)$ and show that decoder equivariance makes success independent of the representative chosen within an orbit. Do not impose independence on the separate correlated-error theorem.

M4. Actual proof coverage. Reconcile all formalization language with the final executed Python and Lean artifacts. Name the represented claims and residual written-only results. Kernel checking a finite encoding is not automatic formalization of a general quotient theorem, and neither implies molecular realization.

M5. Bounded novelty. Preserve the distinction between an inherited classical Hamming code, its new-to-corpus symmetry analysis, and a physically admissible coordinate assignment. Do not claim literature-wide priority without a separate literature review.

2.3 Fresh initial finite-check evidence

The mathematics pass reran the supplied exact verifier under ordinary and optimized Python, and reran the orbit-success script. All passed: 1024 ambient words; 64 codewords; four words in the original code/reversal intersection; 40 repaired code orbits; 544 ambient orbits; 16 quotient balls of size 10 and 24 of size 16; 60 linear and 60 semilinear projective actions; 120 labelings; eight negative claims rejected. The original orbit-image has 64 messages. The fixed and nonfixed shell vectors are $(1, 15, 0, 0, 0, 0)$ and $(1, 15, 0, 4, 9, 3)$, respectively. The word-induced orbit entropy is $21/4$ bits. These checks are finite arithmetic evidence, not physical measurements.

3 Concordance review

> **Track C: provenance, axioms, representations and figures**
>
> Initial recommendation: targeted revision. The principal issue is source attribution and final artifact-status synchronization, not a contradiction in the central construction.

3.1 Sources and scope

The concordance pass directly inspected the controlling Article 40 source `mainRevConcord.tex`, the final standalone manuscripts of Articles 92, 98 and 99, and the Article 100 manuscript and figure sources. Articles 84 and 88 were considered through cited descriptions and source-history discussion, not a newly retrieved full-source audit. This limited scope is material to the assessment.

3.2 Numbered recommendations

C1. Inherited reference code. The exact reference matrix in Article 100 already appears as H_5 in Article 98. Add the missing attribution and distinguish its inherited perfect-code parameters from the reversal obstruction and coordinate repair developed here. This is a provenance omission, not a proof failure.

C2. Cross-file verification status. Reconcile the manuscript, report, README, OJS abstract and graphical captions with the actual final formalization. A finite Lean certificate cannot silently become a certificate of the whole paper or molecular theory.

C3. Dependency map. Add a compact map identifying Article 40's axiom baseline, Article 92's selected register identification, Article 98's code, Article 99's preparation/source distinction, classical coding theory and the additional interface hypotheses introduced in Article 100.

C4. Preserve representation and scope boundaries. Article 40 distinguishes labeled, embedded and canonical stabilizers; its cipher is not spatial symmetry; direct transfer and spectral/path geometry remain distinct. It does not supply field multiplication merely from a four-element label set. Article 92's Frobenius register identification does not establish pure reversal on the five-contact code. Article 99 separates reachable support from preparation law and dynamics. Article 100 correctly retains these distinctions.

The seven-tetrihex classification is bounded, not a uniqueness proof over all possible materials of biogenesis. The 40 code-message orbits are not Article 84's registry of 20. Figures 1–3 are symbolic and schematic, not atomistic evidence or population-frequency claims. Figure 4 shows a declared noise-model prediction, not measurements. Preserve these qualifications in press-facing exports.

C5. Optional corpus category counts. A verified, dated, mutually exclusive article classification would strengthen the journal-construction survey. Do not invent counts or treat overlapping subjects as a partition. This optional editorial addition is not a mathematical acceptance condition.

4 Chemistry and physical-realization review

> **Track CH: operational realization and empirical interpretation**
>
> Initial recommendation: targeted revision. No chemical defect invalidates the finite coding theorem. New measurements are not required to present conditional mathematics; they are required before claiming successful molecular implementation or a material-specific advantage.

4.1 Assessment

The manuscript's separation of preparation, action, noise, readout, source yield and historical biogenesis is a strength. Its patent reference is provenance rather than experimental validation. Restricted scaffold classification is not uniqueness among all chemical materials, and classical Hamming correction is not quantum error correction. The following recommendations make prospective experimental obligations operational while preserving the intended research program.

4.2 Numbered recommendations

CH1. Shared-unit compatibility. Five consecutive contacts in a six-unit assembly share carrier units. Four isolated states at each contact do not imply independent access to K^5 or preparation of the required 64 codewords. Joint preparation must respect steric, charge, conformational and electronic constraints. Product notation does not imply independent errors.

CH2. Meaning of reversal and reassignment. Distinguish passive relabeling, rigid reorientation and chemical rearrangement. Reassigning encoding columns does not prove that chemically unlike contacts can be exchanged. Specify the action on observations and local symbols, including terminal groups and measurement geometry; these can defeat a pure-reversal interpretation.

CH3. Storage kinetics and unconditional readout. Declare preparation, hold and readout intervals, and environmental conditions. Quantify transitions, leakage, degradation, joint preparation yield and a readout confusion matrix including rejection. Spectral separation alone does not establish memory lifetime or usable signal-to-noise ratio. Report unconditional performance rather than postselected accuracy alone. Kramers' barrier-crossing analysis supports the need to consider kinetics and environment; it does not supply a validated lifetime formula for this material.

CH4. Statistical exclusion. Distinguish a guaranteed uncertainty bound from a statistically estimated confidence region. Empirical exclusion inherits the stated coverage and observation-model adequacy, including nuisance parameters, systematic error and model discrepancy. The deterministic disjointness theorem is correct, but finite noisy observations do not turn its assumptions into certainties.

CH5. Matched alternatives. Material-specific conclusions require specified alternative scaffolds or control assemblies, characterized substitution and termini, matched conditions and resources, and common readout and scoring. Demonstrating one instance, showing superiority over named alternatives, and proving uniqueness in a bounded class are different claims. Failure of one preparation does not reject an unrestricted preparation class.

CH6. Cross-artifact chemistry safeguards. Keep the conditional classical-coding scope in the manuscript, abstracts, graphics and proof descriptions. Neither a kernel certificate nor a patent validates chemistry or historical biogenesis. A six-unit schematic is not a measured structure, and a noise-model curve is not observed molecular performance. Retain the distinction between deterministic reachability and the probability of reaching a state.

4.3 Sources supporting the review

The chemistry pass verified H. A. Kramers, "Brownian motion in a field of force and the diffusion model of chemical reactions," *Physica* 7 (1940), 284–304, doi:10.1016/S0031-8914(40)90098-2, for the general kinetics point. Existing comparisons to Patel et al., *Nature Chemistry* 7 (2015), 301–307, doi:10.1038/nchem.2202, and Matreux et al., *Nature* 628 (2024), 110–116, doi:10.1038/s41586-024-07193-7, remain examples of experimentally studied alternative mechanisms, not an exhaustive comparison with this code model.

5 Integrated meta-review

5.1 Synthesis and proportionality

The tracks converge on one central conclusion: the finite construction is mathematically defensible, while its molecular interpretation is an explicit interface obligation. Mathematical soundness alone cannot close that interface; conversely, the absence of a demonstrated material realization does not refute the conditional code theorem. Source concordance preserves this distinction by showing which structures are inherited and which operations are newly imposed.

The principal contribution should be framed as a concrete compatibility obstruction, constructive repair and representation-sensitive limitation within a typed realization framework. Reversible codes and Hamming codes are classical. The record neither certifies literature-wide priority nor reduces the work to a claim that a new journal exists. It identifies a specific result that can be stated and checked independently of the journal's broader ambitions.

5.2 Recommendations not adopted as scope changes

No track requested replacing the chrysene research program, deleting its broader objectives, or converting this paper into an experimental study. Such changes would exceed the evidence needed for its conditional mathematical result. No request to merge the 40-orbit result with the registry of 20 is justified. Broad claims of demonstrated molecular uniqueness, historical causation, or complete formalization would likewise be unsupported; those stronger claims are not accepted substitutes for the bounded conclusions.

Independent human review and prospective physical validation remain future obligations, not review edits that can be manufactured by wording. The optional numerical category breakdown (C5) should remain deferred unless verified corpus metadata and a reproducible classification rule are supplied. A qualitative survey is preferable to fabricated precision.

5.3 Revision disposition and location

The following is a record of the implemented revision, not a quotation attributed to the author. Locations use section subjects to remain stable when theorem numbering changes.

M1 Accepted. Section 3, measurable-realization convention: state space, symbol fibers and protocol-event maps are measurable only where stochastic statements are invoked.

M2 Accepted. Section 4: extended-infimum convention and explicit radius-t perfection in the quotient-ball statement.

M3 Accepted. Section 8: full symmetric transition kernel, endpoint convention and representative-independent success lemma with proof.

M5 Retained. Novelty remains bounded; the construction is not promoted to a new code family or experimentally established material.

C1 Accepted. Section 5 attributes the inherited reference matrix to Article 98; its bibliography entry explicitly leaves the DOI pending.

C3 Accepted. Section 2 adds the source dependency map and distinguishes inherited structures from additional interfaces.

C4 Retained. Representation, source-law, bounded-uniqueness and schematic-figure boundaries remain explicit.

C5 Deferred. No verified mutually exclusive corpus category dataset was available; the qualitative survey is retained without fabricated counts.

CH1 Accepted. Section 3 adds shared-unit compatibility and full-assembly preparation requirements.

CH2 Accepted. Section 6 distinguishes encoding reassignment, passive relabeling, rigid reorientation and chemical operation.

CH3 Accepted. Section 10 adds operational times, kinetics, leakage, rejection-aware readout and unconditional accounting, with the Kramers reference.

CH4 Accepted. Section 9 distinguishes guaranteed bounds and confidence regions and requires stated coverage and model-discrepancy treatment.

CH5 Accepted. Section 9 specifies matched alternatives and distinguishes realization, superiority and bounded uniqueness.

CH6 Retained as a package-wide constraint. Mathematical verification and molecular validation remain distinct.

5.4 Focused specialist closure

The mathematics pass inspected the revised section differences and confirmed closure of M1–M3 and retention of M5 without a new mathematical defect. The concordance pass confirmed C1 and C3, retained C4 and accepted C5's nonblocking deferral. The chemistry pass confirmed CH1–CH5 in Sections 3, 6, 9 and 10, and CH6 in the inspected manuscript and graphical abstract. These specialist closures are distinct from the final executable-artifact and abstract synchronization recorded next.

6 Verification coverage and final consistency

6.1 How the evidence is interpreted

The final coverage map accompanies the formal proof. The main families are field operations and Frobenius identities; code membership, encoding and reversal covariance; finite counts and the explicit obstruction witness; decoder validity and equivariance; quotient separation; and projective parity and counts. Two generic lemmas address bounded-radius uniqueness and decoder equivariance under explicit assumptions. These generic lemmas do not amount to a full formalization of the construction of the quotient metric or every descent argument in Section 4.

The finite projective parity checks support the written no-go proof, but the entire implication from arbitrary linear-code invariance to the projective contradiction is not thereby formalized. Shell cardinalities and their equivalence to the actual decoder-success predicate are checked in Python, not Lean. Attempted Lean shell reductions exceeded available memory and were removed rather than reported as verified. The real-valued probability identities and averaging theorem remain written mathematics. This is an explicit coverage limit, not a failure of the written shell-count proof.

No molecular preparation, action, lifetime, noise calibration, readout performance, historical source claim or unrestricted uniqueness claim is certified by these files. The formal program must not insert empirical claims as unproved axioms and then report their consequences as evidence that the claims hold.

6.2 Final Python execution

The revised `verify_a100.py` passed 77,219 exact checks in each of ordinary and optimized execution, including ten negative controls. The report preparation pass independently reran both modes successfully. Coverage includes all $64 \times 1024 = 65{,}536$ transmitted/received pairs, 120 projective labelings, decoder covariance, orbit partition and shell checks, and exact rational checks of the success expressions. There are no floating-point numerical checks in this ledger. The earlier eight-negative-control result above belongs to the starting scripts, not the expanded final verifier.

6.3 Lean execution and M4/C2 closure

The final companion contains 46 named declarations and uses Lean 4.24.0 with `Std` as its only import. The axiom audit reports standard foundational dependencies where used: `propext`, `Classical.choice` and `Quot.sound`. These are not project-defined empirical assumptions or admitted proofs. No `sorry` or project-defined axiom occurs in the final source. The finite computations use kernel reduction, not native evaluation as a proof oracle.

The revised Section 13 and its evidence table now separate finite certificates, the two conditional general lemmas, Python-only shell checks, written-only general and analytic arguments, and empirical hypotheses. The report's comparison of that section with the executable source found the coverage boundaries consistent. M4 and C2 are addressed by this explicit reconciliation, not by claiming that every theorem or physical interpretation has been formalized.

6.4 Remaining scientific and editorial obligations

Human review and physical validation remain outstanding. DOI assignment, final pagination, public URL, publication date and embargo require publisher confirmation. Publicity must preserve the distinction between proved mathematics and proposed molecular realization.

> **Final analytical disposition**
>
> The required mathematical, concordance and chemistry recommendations are addressed in the revised manuscript and scoped companion package. The optional category-count request remains transparently deferred. The report supports proceeding with the revised author publication package, subject to the publisher's independent editorial judgment and human review; it is not an acceptance decision. The central finite obstruction and repair are retained, their provenance is clarified, and the experimental and formalization boundaries remain explicit.