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Quantum Information Dynamics of the Source and the Placed Source

Lindblad Dynamical Scission, Von Neumann Entropy Production,
and Landauer-Bounded Quantum-Classical Transduction

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Abstract

The endogenous source and the placed source are formulated as complementary finite quantum preparation models on a chemical-label space and a registry space of $l-1$ bits. A rank-one-jump Lindblad lift of an explicit fifteen-state reaction–transport network reproduces its classical populations and gives exact off-diagonal damping rates. We characterize the persistent coherence between absorbing sinks, prove scission when the initial cross-sink block vanishes, and obtain an all-state trace-norm bound after adding explicit sector monitoring. For the stated benchmark rates, bulk-start retention is $(10000/10001)^2$. Registry randomization is implemented by complete dephasing followed by uniform flips, equivalently the replacement channel $A \mapsto \mathrm{Tr}(A)I/2^{l-1}$; an X-only twirl retains classical information. The controlled family of independent-contact Gibbs states has fidelity p^{l-1} and classical Holevo capacity $(l-1)[1-H_2(1-p)]$, whereas each fixed-target replacement channel has zero input capacity. Under equal degenerate endpoint Hamiltonians and complete isothermal resource accounting, preparation obeys $W \geq k_B T[(l-1)\ln 2 - S(\rho)]$. We derive the nonnegative bias threshold for a prescribed fidelity and separate it from the total preparation work. The unitary agreement transform makes the registry a noiseless subsystem under collective site flips; longitudinal phase noise instead preserves only its diagonal pointer algebra. An independent registry bit-flip model gives a distinct transit-survival formula. Finite verification and scoped Lean certificates support the algebraic construction, while calibrated rates, differential Stark response, bath correlations and gate-cycle energetics define the requirements for a molecular realization.

Keywords: Chrysene Formalism; quantum information dynamics; Lindblad master equation; quantum dynamical scission; von Neumann entropy; Umegaki relative entropy; Landauer erasure bound; decoherence-free subsystem.

1 Introduction

The source and the placed source separate two questions: which chemical labels are retained by a preparation network, and which relative orientations are written into a stack. Articles 9 and 15 proposed quantum transport, state selection and protected information architectures, while Article 40 organized corresponding operator questions within the Chrysene Formalism [Sch26c, Sch26a, Sch26d]. Articles 79 and 84 developed endogenous and placed-source descriptions [Sch26g, Sch26e]. The present paper gives finite open-system models in which these questions can be studied together. A chemical label, a registry bit and a quantum amplitude are distinct mathematical objects; their physical correspondence requires an additional realization hypothesis.

We work on $\mathcal{H}_{\mathrm{src}} \otimes \mathcal{H}_{\mathrm{reg}}$, where $\mathcal{H}_{\mathrm{src}} \cong \mathbb{C}^{15}$ describes an illustrative reaction–transport network and $\mathcal{H}_{\mathrm{reg}} = (\mathbb{C}^2)^{\otimes m}$ describes $m = l-1$ registry bits. A Lindblad lift reproduces classical populations and gives exact coherence damping. A corrected complete-randomization channel erases registry information, whereas a Pauli-X twirl alone does not. A controlled family of Gibbs replacement states provides a classical-to-quantum writing channel, with a cyclic Landauer bound and a finite-temperature fidelity threshold. Finally, the agreement-coordinate transformation identifies a noiseless registry subsystem for collective flips and distinguishes that protection from pointer-state stability under phase noise.

These results address earlier targets in explicit finite models rather than certify all earlier molecular assertions. In particular, two absorbing sinks can retain initial coherence, symmetry alone does not select a unique quantum channel, and a finite

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energy inequality is not a demonstration of a working molecular gate. The revised proofs make these distinctions constructive: counterexamples specify why additional hypotheses are needed, and the corrected channels state exactly what the hypotheses achieve.

2 Conventions and model boundaries

Convention 2.1 (States, entropy and units)**.** A density operator is positive with unit trace. We write $S_{\mathrm{vN}}(\rho) = -\operatorname{Tr}\rho\ln\rho$ in nats and $S_2 = S_{\mathrm{vN}}/\ln 2$ in bits; $D_{\mathrm{vN}}(\rho\|\sigma) = \operatorname{Tr}\rho(\ln\rho - \ln\sigma)$ on the appropriate support. Fidelity with a pure target is the squared convention $F(\rho, |v\rangle) = \langle v|\rho|v\rangle$. In the source generator, H_{src} is expressed in angular-frequency units, equivalently the physical energy Hamiltonian divided by $\hbar$. Transition and dephasing rates have units of inverse time. Thermodynamic energies below are physical energies in meV.

Convention 2.2 (Status and verification)**.** Finite algebraic identities are distinguished from analytical consequences under named hypotheses, imported thermodynamic principles, and candidate molecular interpretations. The companion verification and Lean files cover the finite statements listed in Appendix B; numerical tests do not prove arbitrary-dimensional matrix inequalities, Markovian validity, or chemical realization. The inherited files are retained only as superseded provenance.

Definition 2.3 (Complementary preparation models)**.** Here "source duality" means complementary preparation roles, not adjoint, inverse or channel-complementary maps in the Stinespring sense. On a joint system, source dynamics can act as $\Phi_t^{\mathrm{src}} \otimes \mathrm{id}$ and registry preparation as $\mathrm{id}\otimes\mathcal{R}$. Their tensor-product form assumes no unresolved species–registry coupling. Correlated molecular kinetics need a joint generator instead.

3 Lindblad source dynamics and dynamical scission

Definition 3.1 (A complete fifteen-state network)**.** Let $X = \{0,\dots,4\}\times\{\beta,\sigma,\kappa\}$, with admitted set $A = \{2,3,4\}\times\{\sigma,\kappa\}$ and rejected set $R = X\setminus A$. Their projections are Q_A, Q_R. The directed edges are

$$(n,\beta)\longrightarrow(n+1,\beta) \qquad (n<4),$$
$$(n,\beta)\longrightarrow(n,\sigma) \qquad (0\le n\le 4),$$
$$(n,\sigma)\longrightarrow(n,\kappa) \qquad (2\le n\le 4),$$

with rates $k_n, e_n, a_n > 0$. The states $(0,\sigma),(1,\sigma)$ are washout sinks. The states $(0,\kappa),(1,\kappa)$ are unused inert basis states, retained for comparison with the original fifteen-state representation. Together with $(2,\kappa),(3,\kappa),(4,\kappa)$, these give seven zero-outgoing-rate states, not five.
Under the Markovian model hypothesis H_{Lind}, put $H = \sum_x \epsilon_x|x\rangle\langle x|$ and $L_{u\leftarrow y} = \sqrt{W_{u,y}}|u\rangle\langle y|$. Then

$$\mathcal{L}(\rho) = -i[H,\rho] + \sum_{u\neq y}\Big(L_{u\leftarrow y}\rho L_{u\leftarrow y}^\dagger - \tfrac{1}{2}\{L_{u\leftarrow y}^\dagger L_{u\leftarrow y},\rho\}\Big). \tag{1}$$

This finite GKSL generator defines a CPTP semigroup [GKS76, Lin76].

Lemma 3.2 (Exact population and coherence equations)**.** *Let $\gamma_x = \sum_{u\neq x} W_{u,x}$. The populations obey the classical master equation, and, for $x \neq y$,*

$$\dot p_x = \sum_{y\neq x} W_{x,y}p_y - \gamma_x p_x, \tag{2}$$
$$\rho_{xy}(t) = e^{-i(\epsilon_x-\epsilon_y)t}e^{-(\gamma_x+\gamma_y)t/2}\rho_{xy}(0). \tag{3}$$

Proof. The recycling term $L_{u\leftarrow v}\rho L_{u\leftarrow v}^\dagger$ equals $W_{u,v}\rho_{vv}|u\rangle\langle u|$ and is diagonal. The anticommutator contributes $-(\gamma_x+\gamma_y)\rho_{xy}/2$ off the diagonal. The diagonal Hamiltonian contributes only the displayed phase. Summing the diagonal equation shows conservation of trace. □

Theorem 3.3 (Persistent sink coherence and conditional scission)**.** *Let P_{A0}, P_{R0} project onto zero-rate states in A, R, respectively, and set $B_0 = Q_A\rho_0 Q_R$. Let $\gamma_* = \min\{\gamma_x : \gamma_x > 0\} > 0$. Then the admitted–rejected block decomposes as*

$$Q_A\rho(t)Q_R = U_A(t)P_{A0}B_0P_{R0}U_R(t)^\dagger + E(t), \tag{4}$$

where U_A, U_R are diagonal unitary phase matrices and

$$\|E(t)\|_1 \le \sqrt{\min(|A|,|R|)}\,e^{-\gamma_* t/2}\|B_0 - P_{A0}B_0P_{R0}\|_2. \tag{5}$$

Here $\|\cdot\|_2$ is the Hilbert–Schmidt norm. Thus cross-sector coherence tends to zero if and only if $P_{A0}B_0P_{R0} = 0$.

Proof. Equation (3) preserves the modulus of each sink–sink entry. Every other entry has $\gamma_x + \gamma_y \ge \gamma_*$. Square and sum those entries to obtain the Hilbert–Schmidt bound, then use $\|E\|_1 \le \sqrt{\min(|A|,|R|)}\|E\|_2$. If the persistent block is nonzero

its Hilbert–Schmidt norm stays positive, so the full block cannot tend to zero. This also proves necessity. □

Example 3.4 (Why all-state scission needs extra noise)**.** Choose an admitted absorbing column state a and a rejected absorbing state r. The initial state $(|a\rangle + |r\rangle)/\sqrt{2}$ has $|\rho_{ar}(t)| = 1/2$ for every t. A prior transit history cannot damp coherence already present between two sinks.

Corollary 3.5 (Sector monitoring gives an all-state bound)**.** *Add the Lindblad operator $J = \sqrt{\kappa}\, Q_A$ with $\kappa > 0$. It leaves populations unchanged and gives, for every initial state,*

$$\|Q_A \rho(t) Q_R\|_1 \le e^{-\kappa t/2} \|B_0\|_1. \tag{6}$$

Proof. The additional dissipator multiplies each cross-sector entry by $-\kappa/2$. The remaining evolution has the factorization $D_A(t) B_0 D_R(t)^\dagger$, where each diagonal factor has operator norm at most one. The trace-norm ideal inequality gives the result. Sector monitoring is an additional bath hypothesis, not a consequence of the population rates. □

Proposition 3.6 (Bulk-start retention in the illustrative network)**.** *Starting from $|0,\beta\rangle\langle 0,\beta|$, all coherences remain zero and the probability of eventual admitted-column retention is*

$$\eta_{\mathrm{ret}} = \frac{k_0}{k_0 + e_0} \frac{k_1}{k_1 + e_1}. \tag{7}$$

For $k_0 = k_1 = 10$ and $e_0 = e_1 = 10^{-3}$ in a common rate unit, $\eta_{\mathrm{ret}} = (10000/10001)^2 \approx 0.99980003$.

Proof. The only rejected exits reachable from this start are washout at stages zero and one. At each stage the competing exponential clocks give the displayed substitution probability. Once stage two is reached, the finite acyclic network terminates in an admitted column with probability one. The unused inert states are unreachable from this initial condition. □

This number is a model yield for the displayed rates, not a measured chemical purity. The inherited value 0.998437 was hard-coded rather than obtained from this network. A CPTP evolution is also distinct from the trace-decreasing filtering map $\rho \mapsto Q_A \rho Q_A$; normalized postselection has success probability $\mathrm{Tr}(Q_A \rho)$ and is not itself a linear trace-preserving channel.

4 Registry randomization and entropy production

Put $d = 2^m$ and $\omega = I_d/d$. Let X^s translate bit strings by $s \in \{0,1\}^m$, and let Δ_Z remove computational-basis off-diagonal entries.

Theorem 4.1 (Corrected complete-randomization channel)**.** *The channel $\mathcal{R} = \Delta_Z \circ \mathcal{T}_X$, with $\mathcal{T}_X(A) = d^{-1} \sum_s X^s A X^s$, satisfies*

$$\mathcal{R}(A) = \mathrm{Tr}(A)\omega. \tag{8}$$

It has Kraus operators $K_{ij} = |i\rangle\langle j|/\sqrt{d}$, $0 \le i, j < d$, and is CPTP and unital. Its unique fixed density operator is ω. Every output ensemble is constant, so its Holevo information and quantum capacity are zero.

Proof. For each diagonal index i, averaging $A_{i\oplus s, i\oplus s}$ over all s gives $\mathrm{Tr}(A)/d$. Dephasing removes every other entry. Equivalently, $\sum_{ij} K_{ij} A K_{ij}^\dagger = \mathrm{Tr}(A) I_d/d$ and $\sum_{ij} K_{ij}^\dagger K_{ij} = I_d$. The remaining claims follow directly from the replacement form: outputs carry no input dependence or entanglement with a reference. □

Remark 4.2 (Two different twirls)**.** The X-only twirl is not $\mathcal{R}$. It fixes every X-basis projector and can transmit $\log_2 d = m$ classical bits in that basis. The inherited single-index expression $d^{-1} \sum_s \Pi_s X^s A X^s \Pi_s$ equals $A_{00} I_d/d$ and has trace A_{00}, not $\mathrm{Tr}\, A$. Independent dephasing and translation indices are essential. Molecular inversion symmetry alone neither proves these independent noise processes nor imposes a unique stationary state.

Hypothesis 4.3 (Endogenous randomization model)**.** The registry input is subjected to independent complete computational dephasing and uniform contact flips, or an operationally equivalent replacement channel. This is the named realization premise H_{rand} used to identify $\mathcal{R}$ with endogenous assembly. Locant symmetry motivates testing the premise but does not prove it.

Proposition 4.4 (A primitive unital interpolation)**.** *For $\nu > 0$, $\mathcal{L}_{\mathrm{rand}} = \nu(\mathcal{R} - \mathrm{id})$ generates*

$$\rho(t) = e^{-\nu t}\rho_0 + (1 - e^{-\nu t})\omega. \tag{9}$$

It has unique stationary state ω, and for $t > 0$,

$$-\frac{d}{dt} D_{\mathrm{vN}}(\rho(t)\|\omega) = \frac{d}{dt} S_{\mathrm{vN}}(\rho(t)) \ge 0. \tag{10}$$

Proof. Since $\mathcal{R}^2 = \mathcal{R}$, exponentiating gives the formula, a convex combination of CPTP unital maps. Relative-entropy contraction under the stationary semigroup gives monotonicity; $\rho(t)$ is full rank for $t > 0$, so differentiability and the entropy identity justify the derivative. This is the finite stationary-state form of entropy production [Spo78]. A unital channel fixes ω and therefore cannot prepare a nonuniform registry from ω without an additional resource. □

5 Controlled placement and thermodynamic cost

Definition 5.1 (Gibbs replacement and controlled encoding)**.** Under H_{Gibbs}, m independent two-level contacts equilibrate at $T > 0$, with equal state degeneracies, each with target energy $-\Delta E/2$ and alternative energy $+\Delta E/2$. Set

$$p = (1 + e^{-\Delta E/k_B T})^{-1}, \tag{11}$$

$$\sigma_z = \bigotimes_{r=1}^{m} (p|z_r\rangle\langle z_r| + (1-p)|1-z_r\rangle\langle 1-z_r|). \tag{12}$$

For fixed z, $\mathcal{P}_z(A) = \mathrm{Tr}(A)\sigma_z$ is a replacement channel, nonunital when $p \neq 1/2$. The controlled encoder is the distinct classical–quantum channel $z \mapsto \sigma_z$.

Theorem 5.2 (Entropy, cyclic work and fidelity threshold)**.** *For every state ρ on $\mathbb{C}^d$,*

$$D_{\mathrm{vN}}(\rho\|\omega) = m \ln 2 - S_{\mathrm{vN}}(\rho). \tag{13}$$

Assume an isothermal preparation from ω, with an uncorrelated bath, no unaccounted information or chemical resource, and the same degenerate registry Hamiltonian at the initial and final endpoints. The work supplied to this complete protocol obeys

$$W \geq k_B T D_{\mathrm{vN}}(\rho\|\omega). \tag{14}$$

For the Gibbs product state, $F(\sigma_z, |z\rangle) = p^m$. For a nonnegative splitting, the least splitting compatible with $F \geq 1-\delta$, $0 < \delta < 1$, is

$$\Delta E_{\min} = k_B T \max\left\{0, \ln \frac{1}{(1-\delta)^{-1/m} - 1}\right\}. \tag{15}$$

Proof. The logarithm of ω is $-m \ln 2$ times the identity, proving the entropy formula. With degenerate endpoint Hamiltonians, the nonequilibrium free-energy change is $k_B T(m \ln 2 - S_{\mathrm{vN}}(\rho))$; the isothermal work inequality yields (14) [RW14]. Any measurement memory, correlations, switching energy or chemical fuel must be included in the resource balance. If the biased Hamiltonian remains at the endpoint, the general bound is the full free-energy difference including $\mathrm{Tr}\,\rho H$, not the displayed entropy-only expression. The fidelity is the product of the target probabilities. Solving $p^m \geq 1-\delta$ gives the logarithmic threshold; if $1-\delta \leq 2^{-m}$, zero splitting already suffices. □

Corollary 5.3 (Classical capacity of the controlled encoder)**.** *The classical–quantum family $z \mapsto \sigma_z$ has Holevo capacity*

$$C_\chi = m[1 - H_2(1-p)] \quad \textit{bits}. \tag{16}$$

For each fixed target z, the replacement channel $\mathcal{P}_z$ instead has zero input capacity.

Proof. All code states commute, each has entropy $mH_2(1-p)$ bits, and every average output has entropy at most m. The uniform prior attains I_d/d and therefore attains the bound. A fixed-target replacement has the same output for every input, so its Holevo information vanishes. □

Proposition 5.4 (Reversal classes and preparation entropy)**.** *At $l = 6$, reversal of the five registry bits has eight fixed strings and twelve two-element orbits. A pure fixed-string state has entropy zero and relative entropy $5 \ln 2$ from ω; a uniform mixture over a two-element reversal orbit has entropy $\ln 2$ and relative entropy $4 \ln 2$. The corresponding site-word frame orbits have sizes two and four after including the global-flip coordinate.*

Proof. A length-five palindrome is specified by three bits, so there are eight. The remaining 24 strings pair with their reversals. Orthogonal uniform mixtures of q states have entropy $\ln q$. Passing from site words to registry bits quotients the two-valued frame coordinate. These are combinatorial counts; a molecular achirality/chirality interpretation additionally requires a faithful decorated realization and species symmetry as discussed in Article 91 [Sch26b]. □

The 99% splitting is about $6.21 k_B T$, below the illustrative charging energy. This numerical ordering is not a derivation of Coulomb blockade or an allowable field window. Contact broadening, tunneling, offset charges, gate lever arms and bias conditions must also be established. The per-contact splitting is distinct from the total cyclic work bound.

Table 1: Illustrative independent-contact model at $l = 6$, $T = 300$ K. Values are calculated, not measured gate parameters.

Quantity	Value
$k_B T$	25.85 meV
$k_B T \ln 2$	17.92 meV
$5k_B T \ln 2$	89.60 meV
$\Delta E_{\min}$, 95% fidelity	118.26 meV
$\Delta E_{\min}$, 99% fidelity	160.50 meV
C_χ, 95% fidelity	4.5892 bits
C_χ, 99% fidelity	4.8956 bits
$e^2/(2C_\Sigma)$, $C_\Sigma = 10^{-19}$ F	801.09 meV

6 Agreement coordinates and protected information

Theorem 6.1 (Noiseless subsystem under collective flips)**.** *The map*

$$U_{\mathrm{agr}}|w\rangle = |w_0\rangle \otimes |\eta\rangle, \qquad \eta_k = w_k \oplus w_{k+1}, \tag{17}$$

is unitary from $\mathcal{H}_{\mathrm{site}}$ to $\mathbb{C}^2 \otimes \mathcal{H}_{\mathrm{reg}}$ and satisfies

$$U_{\mathrm{agr}} X^{\otimes l} U_{\mathrm{agr}}^\dagger = X \otimes I_d, \tag{18}$$

$$U_{\mathrm{agr}} Z_k Z_{k+1} U_{\mathrm{agr}}^\dagger = I_2 \otimes Z_k. \tag{19}$$

Consequently the registry is an exact noiseless subsystem for collective-flip noise $\mathcal{L}_{\mathrm{coll}}(\rho) = \gamma(X^{\otimes l}\rho X^{\otimes l} - \rho)$. Longitudinal $Z_k Z_{k+1}$ noise fixes diagonal registry states but need not fix registry superpositions.

Proof. Given w_0 and η, reconstruct $w_{k+1} = w_k \oplus \eta_k$; the basis map is a permutation. Complementing all site bits changes only w_0. The eigenvalue of $Z_k Z_{k+1}$ is $(-1)^{w_k \oplus w_{k+1}} = (-1)^{\eta_k}$, proving both identities. Collective-flip dynamics therefore acts only on the frame factor, leaving the reduced registry state invariant even for initially correlated frame–registry states. Any additional Hamiltonian terms must preserve the protected factor rather than mix registry information with the frame or environment. Longitudinal noise acts on the registry itself. It preserves its diagonal algebra, not the full matrix algebra [LW03]. □

Proposition 6.2 (Bit-flip survival versus pure dephasing)**.** *Under independent registry bit flips $\mathcal{L}_X = \gamma \sum_{r=1}^{m} (X_r \rho X_r - \rho)$, a computational codeword has survival fidelity*

$$F_X(t) = \left(\frac{1 + e^{-2\gamma t}}{2}\right)^m. \tag{20}$$

Under pure longitudinal phase noise $\mathcal{L}_Z = \gamma \sum_r (Z_r \rho Z_r - \rho)$, the same codeword has $F_Z(t) = 1$. Off-diagonal registry entries with Hamming separation h decay as $e^{-2\gamma h t}$.

Proof. A single symmetric bit-flip chain has correct-state probability $(1 + e^{-2\gamma t})/2$; independence gives the product. A computational-basis projector commutes with every Z_r, so each phase dissipator vanishes on it. For a matrix unit $|a\rangle\langle b|$, each differing bit contributes -2γ, giving the coherence decay. □

For the illustrative assignments $2\gamma = 10^{12}$ s^{-1} and $t = 10^{-14}$ s, (20) gives $F_X = 0.9754$ at $m = 5$. This is a bit-error benchmark, not a measured ambient-temperature coherence time. Local site flips generally induce correlated changes in adjacent registry bits and do not automatically realize independent registry noise.

7 Molecular realization and experimental targets

The fifteen basis labels, Markovian rates and registry qubits form a candidate reduction of substituted-chrysene preparation. A Lindblad lift is a mathematically valid quantum extension of specified classical kinetics; population data alone cannot identify coherent Hamiltonian terms, noise correlations or the bath memory time. Sector-monitoring noise in Corollary 3.5 would require an actual mechanism distinguishing the two sectors. Retained population and chemical purity require independent assay and should not be inferred from entropy or trace preservation.

A Stark implementation must discriminate two physical registry states. Its energy difference depends on their differential dipole and polarizability,

$$\Delta E(\mathbf{F}) = \Delta E(0) - \Delta\boldsymbol{\mu} \cdot \mathbf{F} - \tfrac{1}{2}\mathbf{F}^\top \Delta\alpha \mathbf{F} + \cdots. \tag{21}$$

A common shift of both states does not write a bit. The field strengths and capacitance used in earlier proposals are design assumptions, not evidence that a substituted-chrysene dimer attains the independent-contact Gibbs model. Solvent, screening, steric relaxation and charge transfer can change both the splitting and the transition rates [BB97]. Likewise, symmetry does not by itself establish a phonon-suppression hierarchy or a noiseless molecular subsystem.

Target 7.1 (Identifying the two noise algebras)**.** Measure population switching and phase-coherence decay separately on a chemically defined substituted stack. Test whether collective flips dominate, whether longitudinal noise preserves only pointer populations, and whether neighboring contacts are correlated. Fit a reduced generator only over a time

range in which Markovian and secular approximations are supported.

Target 7.2 (Thermodynamic and gate calibration)**.** Determine differential Stark responses, molecular integrity and stability under the calibrated local field, contact error correlations, capacitance and tunneling broadening before comparing measured fidelities with Table 1. For calorimetry, prepare an initially maximally mixed ensemble and measure the initial and final registry distributions, with a known-state switching control. Specify the full preparation/reset cycle, its endpoint Hamiltonians, bath temperature and information reservoirs. Compare work or heat to the applicable free-energy balance, not to a bare orbital shift.

Target 7.3 (Chemical-source kinetics)**.** Establish molecular identity and characterize the proposed stacking geometry and registry structurally. Measure substitution, export, attachment and washout rates and retained product composition. Test alternative networks and reversible desorption before interpreting the finite absorbing model as a preparation protocol. An exogenous quantum or molecular actuator remains a realization problem after the conditional channel identities are proved.

8 Conclusion

The source and placed-source programs admit complementary finite channel descriptions. Classical kinetics lifts to a trace-preserving quantum semigroup with an exact distinction between damped transient coherences and persistent sink coherences. Full registry erasure requires complete randomization rather than an X-only twirl. Controlled Gibbs writing has a calculable coding capacity and, under a specified cyclic thermodynamic protocol, an entropy-based work lower bound. Agreement coordinates protect registry information from collective flips while distinguishing phase noise from bit errors. These results provide a consistent finite framework and explicit tests for its molecular realization.

A Hypotheses and dependency register

H_{Lind}
: Finite Markovian rank-one jumps, nonnegative rates and a diagonal source Hamiltonian. Exact population/coherence equations follow; empirical kinetics and bath physics remain separate. All-state cross-sector damping additionally requires sector monitoring, or the initial-state restriction in Theorem 3.3.

H_{rand}
: Independent complete registry dephasing and uniform flips, or the equivalent replacement map. Without this premise, locant symmetry alone yields neither zero capacity nor a unique mixed stationary state.

H_{Gibbs}
: Independent thermal contacts, equal target splittings, equilibration and negligible unresolved interactions. Relative-entropy identities survive its failure, but product fidelity and binary-symmetric coding formulas may not.

H_{cycle}
: Equal degenerate endpoint Hamiltonians, isothermal preparation and full resource accounting. Without it, use the complete nonequilibrium free-energy difference rather than entropy reduction alone.

H_{noise}
: Collective flips for the noiseless-subsystem theorem; independent registry bit flips only for the product survival formula. Longitudinal dephasing has a different invariant algebra. Measured rates, locality and correlations determine applicability.

B Verification and formal coverage

The executable companion checks the complete state network, its sinks, generator identities and counterexamples; corrected replacement Kraus maps and X-only behavior; reversal classes; thermodynamic benchmark arithmetic and threshold boundaries; agreement-coordinate transformations; and distinct phase/bit-noise behavior. Negative controls reject the inherited defects. The Lean companion certifies explicitly listed finite identities and counterexamples. It does not formalize the general GKSL theorem, relative-entropy contraction, the thermodynamic second law, arbitrary-time analytical inequalities or molecular realization. The expanded simulated referee report records original deficiencies, recommended revisions and final review dispositions.

C Relation to earlier articles

Articles 9, 15, 40, 79 and 84 supply the programmatic context [Sch26c, Sch26a, Sch26d, Sch26g, Sch26e]. The present finite constructions address their scission, registry-selection and protection questions under the hypotheses above. The revised Article 90 separates initial placement from retention and treats source-model outputs conditionally [Sch26f]; Article 91 separates finite orientation classes from molecular chirality

[Sch26b]. These distinctions are preserved here. No blanket discharge of all physical targets or verification of every historical theorem-number attribution is claimed.

References

[BB97] Gerold U. Bublitz and Steven G. Boxer. Stark spectroscopy: applications in chemistry, biology, and materials science. *Annual Review of Physical Chemistry*, 48:213–242, 1997. https://doi.org/10.1146/annurev.physchem.48.1.213.

[GKS76] Vittorio Gorini, Andrzej Kossakowski, and E. C. G. Sudarshan. Completely positive dynamical semigroups of n-level systems. *Journal of Mathematical Physics*, 17:821–825, 1976. https://doi.org/10.1063/1.522979.

[Lin76] G. Lindblad. On the generators of quantum dynamical semigroups. *Communications in Mathematical Physics*, 48:119–130, 1976. https://doi.org/10.1007/BF01608499.

[LW03] Daniel A. Lidar and K. Birgitta Whaley. Decoherence-free subspaces and subsystems, 2003. https://arxiv.org/abs/quant-ph/0301032.

[RW14] David Reeb and Michael M. Wolf. An improved landauer principle with finite-size corrections. *New Journal of Physics*, 16:103011, 2014. https://doi.org/10.1088/1367-2630/16/10/103011.

[Sch26a] Charles D. Schaper. Deterministic Quantum Logic over the Ic Manifold: C2h Orthogonal Superselection, Aharonov-Bohm Phase Gating, and the Chrysene Isomorphism Theorem. *Annals of the Chrysene Formalism*, 1(1):167–176, 2026. Article 15. https://doi.org/10.68366/4hq38y05.

[Sch26b] Charles D. Schaper. Emergent Assembly Chirality and Flip Kinematics: Euclidean Stabilizers of the Frame Classes, Enantiotopic Faces of the C2h Core, and Initiator Capping of the Interior Lattice. *Annals of the Chrysene Formalism*, 1(4):1836–1846, 2026. Article 91. https://chrysene.com/index.php/acf/article/view/91.

[Sch26c] Charles D. Schaper. Geometric Quantization of Molecular Quantum Transport: The CohBit Chrysene Architecture for Ambient-Temperature Quantum-Classical Transduction. *Annals of the Chrysene Formalism*, 1, 2026. Article 9. https://doi.org/10.68366/scqypz29.

[Sch26d] Charles D. Schaper. The Chrysene Formalism Revisited: A Twelve-Axiom Foundation for Molecular Characterization, Tensorial Noncommutative Geometry, and Operator Response. *Annals of the Chrysene Formalism*, 1(2):489–560, 2026. Article 40. https://doi.org/10.68366/5jctze12.

[Sch26e] Charles D. Schaper. The Placed Source: Exogenous Preparation of the Substituted-Chrysene Assembly, and the Equality of Its Reachable Set with the Endogenous One. *Annals of the Chrysene Formalism*, 1(4):1703–1731, 2026. Article 84. https://doi.org/10.68366/a4tjv735.

[Sch26f] Charles D. Schaper. The Source Duality: Endogenous and Exogenous Preparation of the Substituted-Chrysene Stock, Mixed Arm Words, and the Persistence Semigroup. *Annals of the Chrysene Formalism*, 1(4):1823–1835, 2026. Article 90. https://chrysene.com/index.php/acf/article/view/90.

[Sch26g] Charles D. Schaper. The Source: Substitution-Initiated Self-Separation of the Substituted-Chrysene Stock from a Polyaromatic Bulk, and the Supply It Delivers to the Protocell. *Annals of the Chrysene Formalism*, 1(4):1616–1638, 2026. Article 79. https://doi.org/10.68366/s8sfwq50.

[Spo78] Herbert Spohn. Entropy production for quantum dynamical semigroups. *Journal of Mathematical Physics*, 19:1227–1230, 1978. https://doi.org/10.1063/1.523789.