RCHS-29: Native Current Response, Hypercharge Visibility and Full-Configuration Source Reconstruction in VERSF

From the native two-jet and coherent comparison to heat-loop response, controlled Gibbs and compact-record marginals, and full-configuration potential reconstruction

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General reader summary

VERSF is trying to derive not just the pattern of particles and forces, but the strengths of their interactions. This paper follows one concrete piece of that programme: can the microscopic machinery that carries current and writes records supply, on its own, the kind of response that the force fields need?

The first stage takes the record-writing machinery exactly as it already exists and differentiates it: circulation around the seven-state wheel produces a detectable signal in every tested direction, and the details of the record matter, because erasing where each record was written removes the leading signal, and a simple table of pair frequencies misses the carried memory. The second stage varies currents and connecting links together. A finite response survives, but with one precise and provable limitation: the classical record process is completely blind to one family of link phases, the ones associated with the third force direction, and no rescaling or longer sequence of the same kind of records can recover information already discarded.

The third stage notices that earlier VERSF papers already contain objects that keep the missing phase: two ways of transporting around a face, two ways of composing a spatial record, and the comparison between a link and its record. Comparing those transports coherently, before the route information is irreversibly written down, restores sensitivity in all directions at once, including the six that the classical record could not see. One subtlety is essential: when the two compared routes agree perfectly, one outcome of the comparison is impossible, and a small disturbance opens it only gradually. Accounting for that newly opened outcome correctly is what gives the right strength of response, and comparing the routes even slightly too late, after their identities have leaked out, changes the character of the response entirely.

The later calculations ask whether the missing phase response can arise without adding that comparison. The existing transport equation does contain a positive loop response when its finite heat content is examined, but its long-run pressure is exactly zero, because neutral constant patterns pass through the links untouched; those are two different readings of the same machinery, and one cannot stand in for the other just because both came from the same source. A separately declared model of fluctuating amplitudes avoids that obstruction, and two controlled averages, one over the amplitudes and one over the recorded phases, each contribute a definite response with explicit error control rather than small-fluctuation shortcuts. Yet a cost that depends only on the links themselves slips past both averages: holding the links fixed and asking how everything else behaves can never reveal it.

The final calculation therefore turns to transitions in which the links themselves change. Within the specified transfer architecture, those transition probabilities, together with a known reference motion, pin down the relative cost exactly, and a separate test can tell whether the assumed architecture applies at all. Synthetic examples confirm that the recovery method works; they do not supply nature's actual transitions. The programme now distinguishes an observation that loses the phase, mechanisms that keep it, controlled averages that price it, and a reconstruction that can recover the otherwise missing cost from the right data. What remains is to derive those physical transitions, or an equivalent response law, and attach the complete result to one action.

Contents

Scientific status

The original native current instrument and its finite current/link record action remain evaluated on their declared nonzero-current witness. The exact all-finite-history hypercharge-link blindness theorem applies to that terminal-dephased observation. The coherent-comparison extension and its product with the native experiment retain their conditional positive rank-72 finite face responses. Neither operation is promoted to the physically selected master action. [E1–E3]

Five subsequent calculations extend the source test. RCHS-30 returns a direct finite heat-loop response but an identically zero endpoint spectral pressure. RCHS-31 constructs an additional amplitude-configuration model with a nonzero regulated Gaussian pressure and a positive leading quartic hopping-loop coefficient. RCHS-32 distinguishes that quantum-pressure model from the reversible Gibbs completion and evaluates a mobility-independent equilibrium amplitude response at unit hopping through order 22, with an analytic bound on the omitted hopping tail. RCHS-33 integrates the complete compact hypercharge record phases on its fixed-stretch branch and proves that an independent pure-link functional survives fixed-link conditional reconstruction. RCHS-34 establishes exact relative-potential recovery and a necessary-and-sufficient compatibility test within the specified symmetric split-transfer class; its numerical configurations and prices are explicitly synthetic. [E4–E8]

These are distinct observations, operators and statistical operations. They are not combined into one physical action unless an explicit common model establishes the combination. No physical full-configuration kernel, complete operational metric, common action normalisation or continuum gauge coefficient is returned. In particular, physical H_CMR, W_prim, λ_J, C_hol, Z_3, Z_2, Z_q, g_s, g and g′ remain unissued.

All numerical values are attributed to the eight archived calculation packages [E1–E8] and their stated verification scopes. This integration does not rerun their calculations. The integration checks in Appendix A.4 carry their stated provenance; Appendix A.5 reports archived continuation checks together with a set of exact integration-level identity checks. Reproducibility, positive rank and synthetic inverse recovery do not themselves establish primitive physical selection.

Abstract

This paper integrates the three original RCHS-29 calculations and five subsequent source-response investigations addressing the representation-resolved current-cycle and gauge-response boundary in VERSF. Starting from the archived PFDMI/HM12 saturated pure-ray instrument, an exact deflated square-root representation yields its complete native two-jet without lifting its moving zero mode. On a declared neutral-orthogonal 49-dimensional occupied support, the two- and three-update edge/type experiments have rank-six current-cycle response; independently parametrising the uniform and $m = 2/4$ components gives rank twelve. Exact profile algebra gives $\mathcal{I}_{2,\mathrm{full}} = [(19w_r + 9w_s)/16]\; G \otimes I_2$ and the nuisance-profiled independent signal $\mathcal{I}_{2|0} = (9w_s/16)\; G \otimes I_2$. Spatial-address erasure removes the first score at every finite length on the symmetric witness, and the exact three-update response retains internal memory absent from a pair-Markov replacement.

Extending the native experiment to 1,176 real current coordinates and 144 link coordinates produces a common regular likelihood Hessian. Complete current profiling within that experiment leaves a finite gauge-gradient-null curvature response of numerical rank 66. An exact all-finite-history theorem shows that terminal dephasing makes independent hypercharge link phases invisible. The corresponding classical record contrast, even after nonlinear current profiling, cannot alone be identified with a gauge action having positive hypercharge curvature.

A separately declared coherent-comparison extension uses the inherited link-closure, spatial record-composition and polar-bond objects. The normalised operators $M\pm = (A \pm B)/2$ recover phase sensitivity within a definite charge sector. A support-opening likelihood identity supplies the dark-outcome quadratic term. On the stated unit-stretch, gauge-unitary record branch, 24 independent fresh-probe comparisons return the common 288-coordinate parent H_{24} and a positive rank-72 finite face response, with the exact closed form $Z_{24}^{\mathrm{face}} = [I_6 + (F + I_6)^{-1}] \otimes G_0$ and per-face factor $(\lambda + 2)/(\lambda + 1)$ on the face spectrum $\{1, 2, 2, 4, 4, 5\}$. Their product with the native experiment has 1,464 original coordinates and retains rank 72 after the specified current and record adjustments; its comparison face extremes are exactly 1/14 and 81/14 in the declared normalisation; the product retains 81/14 as an exact eigenvalue and, under the archived native-response norm bound, as its maximum; the product minimum is bounded between 1/14 and 1/14 plus the native face norm of order 10^{-9}. The link-record Schur mechanism and representation traces are inherited; the contribution is their explicit normalised comparison realisation and its verified observation response.

For this unbiased comparison, any fixed imperfect route overlap removes the quadratic contrast at the agreement point, leaving a quartic leading term with an explicit leading-term matching scale. A tagged comparison/idle completion also demonstrates that

probability normalisation does not select comparison frequency. Physical source selection, the full same-order action and its regulator/continuum normalisation remain open. No finite information matrix or comparison coefficient is promoted to a physical gauge coupling.

The subsequent source-history tests are integrated without identifying their different action objects. RCHS-30 exponentiates the inherited covariant endpoint operator and obtains a positive rank-72 finite heat-trace response, with leading loop term $(s^2/784)\,\Sigma_p\,[1 - \mathrm{ReTr}\,H_p/49]$. Neutral constant modes nevertheless make that operator's spectral pressure identically zero, and differentiation does not commute with its long-duration limit. RCHS-31's additional amplitude-configuration completion has relative Gaussian pressure $\mathrm{Tr}[\sqrt{(\mu^2 I + L_U)} - \sqrt{(\mu^2 I + L_I)}]$ for $\mu > 0$ and a positive proper-time representation. Its unconfined Gaussian limit is singular; its source-shaped quartic completion returns a positive third-order hopping coefficient rather than a full unit-hopping quantum result. [E4, E5]

RCHS-32 evaluates a different, Gibbs-equilibrium marginal of the stated quartic amplitude potential. Its static response is independent of mobility, includes both the direct second derivative and force covariance, and is evaluated at unit hopping through order 22 with an analytic higher-order remainder bound. RCHS-33 supplies a positive rank-six compact hypercharge record marginal on the unit-stretch branch, while retaining an independently variable pure-link term. RCHS-34 then shows that, for known Q and an admitted raw transfer $T = M_V\, Q\, M_V$ with $M_V(z) = e^{(-a_t V(z)/2)}$, the full-configuration Doob kernel determines relative V through its diagonal after division by Q_{zz}. A full-kernel certificate is necessary; diagonal agreement alone is insufficient. Synthetic recovery validates this inverse method but supplies neither the physical configuration law nor the kinetic reference. The physical source-selection and continuum-normalisation boundaries therefore remain open. [E6–E8]

PART I | SCOPE AND SHARED SOURCE

1. The integrated question and source boundary

The research question is whether the primitive VERSF source supplies a complete, magnitude-bearing current/link response that can be identified with the physical gauge action. This paper answers several constituent questions, but does not assume that a positive finite response completes the physical derivation.

The original argument has three distinct stages. Part II differentiates the existing native current instrument; Part III constructs its joint current/link record action and tests the proposed gauge-action identification; Part IV supplies the explicitly declared coherent-comparison extension. Part V retains the operational admission analysis and extends it through the direct heat-response, amplitude-configuration, Gibbs-marginal, compact-record and full-configuration reconstruction calculations. The later results do not overturn the original hypercharge-blindness theorem: they change the observation, carrier or statistical operation, and state the additional premises required for each change. [E1–E8]

Prior source	Input used in this paper	Qualification retained
CRTF-HMGBC current-cycle audit [S4]	The full current-cycle carrier, its residual-level normalisation and harmonic decomposition	It does not supply the complete physical field-dependent history generator.
Native HM12/PFDMI source and stationary continuation [S5, S6]	The represented current instrument, terminal projectors and state-preserving update	The source-extension law, background and renewal are not primitive selection theorems.
MASD-1 [S8]	Independent current, link and record variables; closure, composition and bond maps; link-record Schur mechanism	A unit branch and representation traces do not fix the physical common metric.
Gauge-Response and Coupling Evaluation [S10]	Vacuum-relative loop holonomy, integrated link coordinates and primitive charge $q = 6Y$	The holonomy-action normalisation remains conditional.
HCMR-P1 [S11]	Fixed record probabilities do not determine a unique coherent lift; phase requires a comparison-capable readout	The balanced operation introduced here is not selected by that earlier theorem.
RCHS-24, PGRS-1 and HMGBC [S1–S3]	Complete quadratic-parent discipline and the distinction between raw action, information and physical response	Relevant source second derivatives, embeddings, physical projection and regulator control remain required.
HFB-G1 [S7]	Native representation-dependent memory and its explicit type limitations	A memory block is not an action bath, and the native discrete channel is not a self-adjoint heat transfer.

The Substrate Response Principle and microscopic refinement-transport papers [S9] supply qualitative or structural constraints, not the missing numerical full current/record action response. They are not used to fill an unreturned physical weight.

1.1 Response objects and notation

$\mathcal{I}$_N denotes finite-observation information at positive reference support. Γ_rec^(3) is the regular native three-update likelihood contrast. Γ_{24} is the finite coherent-comparison contrast, with zero-probability dark outcomes at reference. Their Hessians have different support assumptions. Neither is, by notation alone, W_prim, a physical influence-action Hessian or a continuum Z_A.

The native pair matrix is denoted G; the comparison generator Gram is G_cmp, with G_0 = G_cmp/2. This editorial distinction avoids using one symbol for two different response objects. Native orbit generators T_a retain conventional Y; link and comparison insertions T̂_A use primitive q = 6Y in the Abelian slot. The current-support projector P_Y is a third, distinct object.

D is the vertex-to-edge incidence matrix, C is the face-incidence matrix, $L = C^T C$ and $F = C C^T$. Superscript $^+$ on a matrix denotes a Moore-Penrose inverse. The + in q_+ instead labels the complex current profile. Local matrix letters such as A or B are defined in each experiment and do not imply an identification of their carriers.

In §§19A–19F, G_rep = ReTr(T̂_A T̂_B) = diag($6I_8$, $(13/2)I_3$, 378) denotes the unnormalised representation trace. It equals 49G_cmp = $98G_0$, not the native pair-information matrix G. Factors of 49 or 98 are kept with their stated observation or integration convention, not fitted away.

The symbol $\mathcal{F}$ denotes a free-energy functional; the existing $F = CC^T$ continues to denote the face matrix. The endpoint conductance and mass matrices are written K_e and M_v. In the reconstruction section, K is a configuration transition kernel, Q its specified kinetic reference, M_V a positive multiplication operator and B the reconstructed normalised symmetric transfer. None is the native current block or the earlier current-link cross block merely because a source manuscript used the same letter.

1.2 What counts as an advance here

A native derivative replaces a prescribed response only on the source family actually differentiated. An exact visibility obstruction rejects only the tested action identification. A normalised coherent-comparison extension establishes a conditional construction, not primitive uniqueness. General matrix-function, likelihood and Schur identities are displayed with their hypotheses; no priority claim is made for those methods. Numerical values are the reported returns of the archived executions [E1–E8], not newly fitted or newly physically admitted quantities; conditional model evaluation and synthetic inverse reconstruction are separately identified.

2. Source data, carriers and the reference experiment

2.1 Representation and neutral-orthogonal support

The archived native code uses a fifty-dimensional representation. Its first forty-five coordinates are generation-major: three copies of (Q_6, U_3, D_3, L_2, E_1), followed by three neutral singlets and a Higgs doublet. The seven central terminal projectors P_r, in order (Q, U, D, L, E, N, H), have ranks

(18, 9, 9, 6, 3, 3, 2).

The twelve Hermitian orbit generators are the archived eight colour generators, three weak generators and conventional Y. The orbit sum is not changed to primitive $q = 6Y$. These are source conventions, not derived gauge-kinetic weights [S5, S6].

For the principal calculation fix the neutral vector $\Omega = e_{45}$ in zero-based indexing and set $P_o = I - |\Omega\rangle\langle\Omega|$. The occupied support has dimension $d_o = 49$, with terminal ranks (18, 9, 9, 6, 3, 2, 2). This is a declared neutral-orthogonal witness, not a dynamically selected vacuum. Since every gauge generator annihilates Ω, the native current operators preserve this support whenever the current lies in it. The removed neutral line is an explicitly identified invariant spectator, not an unexplained numerical null.

The internal current direction is frozen as

$$\tilde{z}_k = 50^{-1/2} \exp(2\pi i k^2/53),\ k = 1, \ldots, 50,\ z = P_o \tilde{z} / \|P_o \tilde{z}\|.$$

The quadratic phase comes from the archived prime-chirp witness family. Its use here makes a reproducible nonzero test preparation; it supplies no physical state-selection theorem.

The three support directions are

$$P_C = P_Q + P_U + P_D,\ P_W = P_Q + P_L + P_H,\ P_Y = I - P_N.$$

These are C/W/Y support projectors, not the twelve Lie-algebra generators. Their occupied trace Gram is

$$H = [\ 36\ 18\ 36\ ;\ 18\ 26\ 26\ ;\ 36\ 26\ 47\ ].$$

The normalised inherited H_{CWY} and the previously used scalar multiples have this shape. Three support directions times two real quadratures give the six current probes. Introducing separate uniform and varying-circulation probes gives twelve test parameters; that count must not be confused with the twelve gauge generators.

2.2 Canonical cycle profiles

Orient the six rim edges first, followed by six hub-to-rim spokes. Let D be the 12 × 7 vertex-to-edge incidence matrix. For j = 0, …, 5 on the rim, use

$$u_c(j) = \cos(2\pi j/3)/\sqrt{3},\ u_s(j) = \sin(2\pi j/3)/\sqrt{3},\ u_c(h) = u_s(h) = 0.$$

Write the corresponding vertex vectors as u_c, u_s. Define

$$q_\mu = -D\, u_\mu,\ q_+ = (q_c + i\, q_s)/\sqrt{2},\ P_{cyc} = I - D(D^T D)^+ D^T,$$

$$y_\mu = q_\mu \odot q_+,\ c_\mu = P_{cyc}\, y_\mu.$$

The inherited identities are reproduced exactly:

$$\|y_\mu\|^2 = 5/3,\ \|c_\mu\|^2 = 1,\ \|y_\mu - c_\mu\|^2 = 2/3.$$

Let P_0 average the rim entries and vanish on the spokes. Then $c_{(0\mu)} = P_0\, c_\mu$ and $c_{(2\mu)} = c_\mu - c_{(0\mu)}$ satisfy

$\|c_{(0\mu)}\|^2 = 3/4$, $\|c_{(2\mu)}\|^2 = 1/4$.

Here the subscript 2 denotes the combined $m = 2/4$ component, not a second independent real quadrature. These source identities are inherited from [S4], not claimed as new; they are also independently re-derived from the incidence construction in the verification layer (Appendix A.4).

2.3 Independent current variation

The background current and the full source probes are

$j_e^0 = q_+(e)\, z$, $h_{(A\mu,e)} = c_\mu(e)\, P_A\, z$, $A \in \{C, W, Y\}$.

Every background edge current is nonzero. The family is $j_e(x) = j_e^0 + \Sigma_{(A,\mu)}\, x_{(A\mu)}\, h_{(A\mu,e)}$ with real source coordinates. Links, endpoint preparations and record rotations are held fixed. Current is an independent MASD variable; the probe is not forced back onto a gradient-only constitutive shell. The inherited identity $P_{cyc}\, \delta D_J = P_{cyc}\, \delta J$ supplies its residual-level current normalisation [S4; S8].

This is a specified conditional experiment. It does not prove that every held-fixed field is an allowed physical constraint or that every omitted field is a quadratic spectator. The full physical auxiliary census remains outside the present return.

2.4 History and record conventions

The D36 row kernel has a uniform hub row. On a rim row, with $d = 2 + 2\cosh \alpha$, the self and hub probabilities are $1/d$, and the forward/backward probabilities are $e^{(\pm\alpha)}/d$. We retain the archived value

$\alpha = 0.9590011097199748$, $\pi_h = 7/(7 + 6d)$, $\pi_r = d/(7 + 6d)$.

The initial active density is $\mathrm{diag}(\pi) \otimes P_o/49$. It is stationary by unitality; no uniqueness or physical selection of this density is asserted for the homogeneous-ray witness. On a self transition the internal state is unchanged and no terminal label is emitted. On a nonself transition the current channel acts, a central terminal label is recorded, and the conditioned internal state is passed forward. All thirteen microscopic current outcomes are unobserved and summed. There is no reset [S5, S6].

The principal observation retains the history vertex path and the terminal type on every nonself transition. It is a finite two- or three-update observation, not the first-complete-cover clock and not an asymptotic rate.

PART II | NATIVE CURRENT-CYCLE RESPONSE

3. The native instrument and its complete two-jet

3.1 Exact gapped representation

For any supported current j with $s(j) > 0$, let $u = j/\|j\|$, $\rho = u u^\dagger$, and

$K_a = i[T_a, \rho]$, $S = \Sigma_{(a=1)}^{(12)} K_a^\dagger K_a$, $s = ½ \operatorname{Tr} S$, $\eta = s^{-1}$.

The saturated law is used only where $s(j) > 0$. A nonzero current need not satisfy this: a current supported entirely in the neutral-singlet sector commutes with every represented generator, giving $K_a = 0$, $s = 0$ and an undefined η. Such currents lie outside this instrument's domain unless the source separately defines the exceptional cases. The differentiable deflated-root construction below additionally requires $A \succ 0$ on the patch.

The archived saturated instrument is

$C_0 = (I - \eta S)^{(1/2)}$, $C_a = \sqrt{\eta}\, K_a$ ($a = 1, \ldots, 12$).

Its square root has a moving zero eigenvector u. Differentiating a numerically regularised zero eigenvalue would change the source. The following identity avoids that problem without changing the instrument.

Proposition 1 (deflated square-root identity). Put $v_a = (T_a - u^\dagger T_a u) u$. Then

$S = \Sigma_a v_a v_a^\dagger + s \rho$, $s = \Sigma_a \|v_a\|^2$.

Consequently, on a patch where $A = I - S/s + \rho$ is positive definite,

$\mathbf{C_0 = A^{(1/2)} - \rho}$.

Proof. Each v_a is orthogonal to u. Since K_a is Hermitian and $K_a = i(v_a u^\dagger - u v_a^\dagger)$, direct multiplication gives $K_a^2 = v_a v_a^\dagger + \|v_a\|^2 \rho$. Summing yields the decomposition and, taking half the trace, $s = \Sigma \|v_a\|^2$. Thus $A = I - \Sigma_a v_a v_a^\dagger/s$ and $A u = u$. For $R = A^{(1/2)}$, $R \rho = \rho R = \rho$, so $(R - \rho)^2 = A - \rho = I - S/s$. The operator $R - \rho$ vanishes on u and is positive on its orthogonal complement. It is the required positive square root. ■

The assumption is a gap condition, not an extra weight. It excludes patches where the transverse orbit covariance saturates its entire trace in one direction. On the executed witness $\lambda_{min}(A) = 0.833176377157940$. The equivalent formula reproduces the original native Kraus arrays with scaled error 1.99×10^{-15}.

Remark 3.1 (why the deflation matters numerically). The identity is not only a licence to differentiate; it also removes a square-root amplification. A direct eigendecomposition root of the gapless matrix $I - S/s$ carries an error of order $\sqrt{\varepsilon}$ in its zero mode, where ε is the working precision, because the numerically small eigenvalue enters through its square root. The deflated form $A^{(1/2)} - \rho$ satisfies its defining equation $(R - \rho)^2 = I - S/s$ at order ε itself. In an independent generic reconstruction (Appendix A.4), the naive root differed from the deflated root by about 10^{-8} at double precision while the deflated root satisfied the defining equation to below 10^{-14}. The identity therefore removes the moving-kernel ambiguity analytically and the $\sqrt{\varepsilon}$ noise floor numerically at the same time.

This is an application of matrix-function calculus, not a claim that square-root differentiation itself is new [M1]. Its source-specific use removes the moving-kernel ambiguity from the current-response calculation.

3.2 Complete first and second derivatives

Let $j(x) = j + \Sigma_a x_a h_a$ in a fixed real source chart. Put $t = j^\dagger j$, $t_a = 2\,\mathrm{Re}(j^\dagger h_a)$, $t_{ab} = 2\,\mathrm{Re}(h_a^\dagger h_b)$, and

$N_a = h_a j^\dagger + j h_a^\dagger$, $N_{ab} = h_a h_b^\dagger + h_b h_a^\dagger$.

The first and second ray derivatives are

$\rho_a = N_a/t - (t_a/t)\,\rho$,

$\rho_{ab} = N_{ab}/t - (N_a t_b + N_b t_a)/t^2 - (t_{ab}/t)\,\rho + (2\, t_a t_b/t^2)\,\rho$.

Differentiate $K_b = i[T_b, \rho]$ and the complete product $S = \Sigma_b K_b^\dagger K_b$. In particular, S_{ab} contains both cross products $K_{(c,a)}^\dagger K_{(c,b)}$ and $K_{(c,b)}^\dagger K_{(c,a)}$ as well as the two direct second-derivative terms. Also retain

$\eta_a = -s_a/s^2$, $\eta_{ab} = 2\, s_a s_b/s^3 - s_{ab}/s^2$.

For $R = A^{(1/2)}$, the Sylvester equations are

$R R_a + R_a R = A_a$,

$R R_{ab} + R_{ab} R = A_{ab} - R_a R_b - R_b R_a$.

All eigenvalues of R are positive on the stated patch. In its eigenbasis these equations divide by $\sqrt{a_i} + \sqrt{a_j}$, never by the zero eigenvalue of the original C_0. The derivatives are $C_{(0,a)} = R_a - \rho_a$ and $C_{(0,ab)} = R_{ab} - \rho_{ab}$. For $C_c = s^{(-1/2)} K_c$, ordinary product differentiation completes the two-jet. No dependence of the saturation coefficient is dropped.

Proposition 2 (native normalisation through quadratic order). The constructed two-jet satisfies the first and second derivatives of

$\Sigma_{(c=0)}^{(12)} C_c^\dagger C_c = I$.

Proof. Proposition 1 is an identity on an open gapped patch of the original complete instrument. Differentiating that identity once and twice gives the claimed equations. The displayed product and Sylvester rules include every derivative term. ■

The first and second operator-completeness residuals are below 1.78×10^{-15} and 2.60×10^{-15} respectively. The full six-direction two-jet is also evaluated separately on every wheel edge, including complex current probes, rather than inferred only from three real internal directions. Independent finite differences of the original source law check every mixed second derivative of the pair probabilities on one rim edge and one spoke; maximum absolute matrix errors are 7.79×10^{-9} and 9.85×10^{-9} at step 3×10^{-4}.

These are derivatives of the native normalised instrument at currents in its domain, $s(j) > 0$ and $A \succ 0$. They are **not** the missing raw-source two-jet of a physically selected H_CMR. PGRS-1's distinction remains in force [S2].

4. Which current directions the native record sees

Write $\mathcal{C}_j(X) = \Sigma_c C_c X C_c^\dagger$ and $\mathcal{D}(X) = \Sigma_r P_r X P_r$.

Proposition 3 (phase and scale kernel on the post-terminal algebra). Global nonzero complex rescaling of j leaves the entire instrument unchanged. In addition, if $V = \Sigma_r e^{i\theta_r} P_r$, then

$$\mathcal{D}\, \mathcal{C}_{Vj}(X) = \mathcal{D}\, \mathcal{C}_j(X)$$

for every block-diagonal $X = \mathcal{D}(X)$.

Proof. The first statement follows directly from $\rho_{aj} = \rho_j$. For the second, V commutes with all orbit generators and terminal projectors, so the native channel transforms by conjugation. Central phases act trivially on both a block-diagonal input and a block-diagonal output. ■

This is an observation kernel, not a licence to declare every such physical source variation gauge. An experiment retaining additional coherent records could have a different kernel.

For the factor probes of §2, define the real spatial coefficients

$$r_{k\mu}(e) = \mathrm{Re}[c_{k\mu}(e)/q_+(e)],\ k = 0, 2.$$

At first order, the part proportional to the imaginary ratio is a central phase variation and drops out after the actual terminal projection. The real part multiplies the internal source derivative $D_{(P_A z)}\, \mathcal{C}_z$. Thus the operator's own normalisation supplies the factor/edge response; no new scalar history score is inserted.

This does not contradict global-magnitude blindness. The three $P_A z$ directions change relative occupied sectors, rather than multiplying every component by the same scalar. Neutral support matters. On a separately tested neutral-empty current branch, $P_Y z = z$, so the Y-support probe becomes a global rescaling and its native derivative is exactly zero. Consequently a rank-six response is not a background-independent theorem. The principal positive-rank return below is conditional on its stated preparation.

5. Exact finite record probabilities and source derivatives

Unitality on the occupied support gives the one-record probability $p_r = d_r/49$ and conditioned unnormalised state $P_r P_o/49$, independently of the first edge current. A single stationary type record therefore has zero current score [S6].

For two successive nonself transitions, with second edge e, the exact terminal-pair law is

$$p_{rs}(j_e) = (1/49)\, \mathrm{Tr}[P_s\, \mathcal{C}_{j_e}(P_r P_o)].$$

At the homogeneous-ray background define

$$B_{rs,A} = D_{P_A z}\, p_{rs}, \quad G_{AB} = \Sigma_{r,s} B_{rs,A} B_{rs,B} / p_{rs}.$$

The channel derivative used in this expression is

$$D\mathcal{C}[X] = \Sigma_c (C_{c,a} X C_c^\dagger + C_c X C_{c,a}^\dagger),$$

with the corresponding four-term second derivative. In the actual cycle chart, the pair derivative on edge e is $r_{\mathrm{full},\mu}(e)\, B_{rs,A}$, where $r_{\mathrm{full}} = r_0 + r_2$.

Three successive nonself transitions require the full carried state:

$$p_{rst}(j_e, j_f) = (1/49)\, \mathrm{Tr}[P_t\, \mathcal{C}_{j_f}(P_s\, \mathcal{C}_{j_e}(P_r P_o)\, P_s)].$$

Both responding legs are differentiated. Writing their internal derivatives as $B^{(2)}_{rst,A}$ and $B^{(3)}_{rst,A}$, the cycle derivative is

$$\partial_{A\mu}\, p_{rst} = r_{\mathrm{full},\mu}(e)\, B^{(2)}_{rst,A} + r_{\mathrm{full},\mu}(f)\, B^{(3)}_{rst,A}.$$

For a complete N-update outcome, multiply the conditional word probability by the unaltered history weight $\pi_{v_0} \Pi_{i=1}^{N} P_{v_{i-1} v_i}$. Self transitions have no terminal outcome. Every admissible history path is summed exactly in the information matrix

$$\mathcal{I}_N = \Sigma_\omega\, \partial p_\omega\, \partial p_\omega^{T} / p_\omega.$$

There is no Monte Carlo sampling, inferred reset, or Markov approximation in this construction. All terminal-pair and terminal-triple probabilities in the principal nonself experiment are positive; the smallest is 1.08×10^{-7}. Their sums equal one within floating-point error. Second probability derivatives reproduce the negative expected log-likelihood Hessian and the score Gram independently.

6. Harmonic response, independent signal and executed returns

6.1 Complete harmonic response

Let w_r and w_s be the exposure of one undirected rim edge and one undirected spoke as the second nonself transition in a two-update experiment. Summing both orientations gives

$$w_r = 2\, \pi_r (1 - 1/d) \cosh \alpha / d, \quad w_s = \pi_h (1 - 1/7)/7 + \pi_r (1 - 1/d)/d.$$

The exact profile products are

$R_{(0,r)}^T R_{(0,r)} = (3/4) I_2$, $R_{(2,r)}^T R_{(2,r)} = (1/16) I_2$, $R_{(2,s)}^T R_{(2,s)} = (9/16) I_2$,

$R_{(0,r)}^T R_{(2,r)} = (3 I_2 + \sqrt{3} J)/16$, $J = [\ 0\ 1\ ;\ -1\ 0\ ]$.

The sign of the antisymmetric term follows the declared helicity convention. The combined symmetric response is independent of that sign. The uniform profile has no spoke component, $R_{(0,s)} = 0$, a fact used decisively in Theorem 5.

Theorem 4 (complete two-update native current-cycle response). On the fixed experiment,

$$\boldsymbol{\mathcal{I}}_{2,\mathrm{full}} = [(19 w_r + 9 w_s)/16]\, G \otimes I_2.$$

The separate harmonic diagonal blocks have coefficients $s_0 = 3w_r/4$ and $s_2 = (w_r + 9w_s)/16$. The full response includes the interference contribution $3w_r/8$; it is not the sum of those diagonal blocks alone.

Proof. Proposition 3 reduces each edge derivative to $B_{(rs,A)}\, r_\mu(e)$. Summing type probabilities gives G; summing edge exposures gives the stated weighted profile Grams. Restricting the independently parametrised split source to equal full-cycle coordinates adds both cross blocks: $(19w_r + 9w_s)/16 = 3w_r/4 + (w_r + 9w_s)/16 + 3w_r/8$. ■

Finite experiment coefficient	Returned value
One rim edge exposure w_r	0.064755213971616
One spoke exposure w_s	0.044834891505332
Uniform contribution s_0	0.048566410478712
Varying contribution s_2	0.029266827344975
Interference contribution $3w_r/8$	0.024283205239356
Full coefficient s_{full}	0.102116443063043

The inherited 3:1 decomposition is a **Euclidean current-norm** statement. It is not a 3:1 decomposition of this record-information response. The realification induced by the ray instrument and the observation exposures make the cross response nonzero. No relative coefficient has been adjusted to obtain this result.

6.2 The varying signal after uniform-parameter profiling

The following Schur complement has an intentionally limited meaning. It asks whether an unknown uniform-current **source parameter** could statistically imitate the m = 2/4 record signal. It is not relaxation of a physical action bath.

Give the two harmonic components separate parameters and write their two-update information matrix as blocks $\boldsymbol{\mathcal{I}}_{00}$, $\boldsymbol{\mathcal{I}}_{02}$, $\boldsymbol{\mathcal{I}}_{22}$. When $G > 0$ and $w_r > 0$, the information remaining for the varying component after profiling the uniform parameter is

$$\boldsymbol{\mathcal{I}}_{2|0} = \boldsymbol{\mathcal{I}}_{22} - \boldsymbol{\mathcal{I}}_{02}^T \boldsymbol{\mathcal{I}}_{00}^{-1} \boldsymbol{\mathcal{I}}_{02}.$$

Theorem 5 (exact spoke-supported independent signal). On the stated experiment,

$\boldsymbol{\mathcal{I}}$**_2|0 = (9 w_s/16) G ⊗ I_2.**

Proof. The uniform spatial block is A = (3w_r/4) I_2, the cross block is B = w_r (3 I_2 + √3 J)/16, and the varying block is N = [(w_r + 9w_s)/16] I_2. Since $J^T = -J$ and $J^2 = -I_2$, the product (3 I_2 − √3 J)(3 I_2 + √3 J) = 12 I_2 gives $B^T A^{-1} B$ = (w_r/16) I_2. Subtraction leaves (9 w_s/16) I_2. The internal positive matrix factors through the same computation. ■

Remark 6.1 (exact profiling ledger). The varying coefficient splits exactly as s_2 = w_r/16 + 9w_s/16, and the profiling step removes exactly the rim share w_r/16 while leaving the spoke share 9w_s/16 untouched. The spoke-supported interpretation is therefore an identity, not a numerical observation: on the rim, the varying probe's real record response lies in the span of the two uniform-probe response columns; its spoke response cannot, because the uniform circulation has no spoke component (R_(0,s) = 0). Retained spoke addresses supply the entire independent information.

Numerically 9w_s/16 = 0.025219626471749. The profiled matrix has rank six and positive paired eigenvalues

0.000246418871692, 0.001287879791071, 0.002099365350547.

Each occurs twice. This is a nonzero native record signal after an explicitly defined nuisance removal. It is not the old scalar-bath screening calculation, and its coefficient must not be substituted for that differently typed result.

6.3 Six-direction and split-component results

The internal terminal-pair response is

G = [0.062793103061 −0.017136019730 0.008311953024 ; −0.017136019730 0.068864733600 0.005813611350 ; 0.008311953024 0.005813611350 0.012422965542].

It is positive definite on the declared witness. The full two-update six-direction matrix has paired eigenvalues

0.000997771267903, 0.005214736368290, 0.008500511398446,

and trace 0.029426038069278. The full three-update matrix also has rank six, with paired eigenvalues

0.002205477474959, 0.011573455608110, 0.019067370362991,

and trace 0.065692606892119.

Treating uniform and varying components as independent probes gives rank twelve at both lengths. That establishes independent observability of the split source within this experiment. It is not a rank-twelve gauge embedding.

The two-update real-quadrature isotropy residual is 5.99×10^{-16} relative. Nevertheless, the internal factor matrix is not proportional to the earlier action-side H. The best Frobenius scalar multiple leaves relative residual

$\|\mathcal{J}\_2,\text{full} - a\_\text{fit} (H \otimes I_2)\|\_F / \|\mathcal{J}\_2,\text{full}\|\_F = 0.844808590200153$.

The fitted scalar is used only to test proportionality after execution; it is not an input, a calibration, or a physical normalisation. The mismatch rejects identifying **this finite witness response** with a scalar multiple of that action geometry. It does not falsify a physical VERSF branch whose source, state, event grain and action bridge have not been identified. In particular, these numbers are not deviations from measured force strengths.

7. Spatial address and internal memory

7.1 Address erasure removes the first score

Consider a second observation that retains the ordered terminal types and the pattern of self/nonself updates but forgets the entire vertex/edge path. This is an intentional coarsening of the principal observation, not a declaration that the physical record forgets its address.

Theorem 6 (all-finite-length first-score zero under address erasure). At the homogeneous-ray background and for the cycle probes of §2, the coarsened observation has zero first probability derivative at every finite update length. Its regular Fisher matrix at the reference point is therefore zero.

Proof. The unperturbed internal channel is the same on every edge, because all background currents differ only by a nonzero complex scalar. At a fixed record word, the first derivative is a sum over responding update positions of the corresponding internal derivative times r_(kμ)(e). The unperturbed history weights and the self/nonself pattern are invariant under simultaneous rotation of all wheel vertices. Averaging a responding edge over this rotation samples its six-edge rim or spoke orbit uniformly. Each column of R_0 and R_2 has zero sum separately on those orbits. Hence every first derivative cancels. ■

The computed coarsened information norms are 1.38×10^{-34} at two updates and 2.94×10^{-34} at three, consistent with the exact zero. The principal edge-resolved matrices remain rank six.

This is distinct from the all-order global-rescaling invariance of the ray instrument. Address erasure gives a first-order symmetry cancellation on a specified background; it does not prove that every higher derivative or every finite-amplitude coarsened distribution is unchanged. Nor does it contradict the existing edge/type localisation results. It shows why the spatial part of the record map must be preserved in a current-response handoff.

7.2 Exact carried memory versus a pair-Markov substitute

A tempting shortcut constructs a Markov type chain from the exact pair probabilities and stationary type law $m_r = d_r/49$:

$p^M_{rst} = p_{rs} p_{st} / m_s$.

This forgets the within-sector post-record density. The true update keeps $P_s \mathcal{C}(P_r P_o) P_s$, which need not be a scalar multiple of $P_s P_o$. Pair probabilities therefore need not determine the next response [S6].

For the principal witness the total-variation difference between the true and pair-Markov three-record distributions is

$(1/2) \Sigma_{(r,s,t)} |p_{rst} - p^M_{rst}| = 0.0178122006695184$.

When propagated through the full three-update edge/type experiment, the pair-Markov substitution changes the full six-direction information matrix by 0.0202023761095064 in relative Frobenius norm. These finite differences describe the observation calculation only. They are not physical screening percentages or coupling errors.

The exact full-history computation respects data processing: the two-update outcome is a marginal of the three-update outcome. The minimum eigenvalue of $\mathcal{I}_{3,\mathrm{full}} - \mathcal{I}_{2,\mathrm{full}}$ is $0.001207634641794 > 0$. Direct marginal and derivative checks agree below 1.31×10^{-16} and 2.05×10^{-17} respectively.

No asymptotic information rate is extracted from two lengths. Quantum-output estimation and long-time information are broader subjects [M2]; the present return is the explicitly observed classical finite-word law. Hidden-state elimination is performed by actual channel composition and summation, not by labelling a convenient matrix a physical bath precision.

PART III | JOINT NATIVE ACTION AND THE HYPERCHARGE TEST

8. The gauge-covariant joint link experiment

Use the terminal dephasing $\mathcal{D}$ and native current channel $\mathcal{C}_j$ defined in §4.

The $C_a(j)$ are exactly the archived saturated orbit-current Kraus operators. No alternative current probability law is inserted. For a stored oriented edge $e: s \to t$, U_e transports the incoming state and j_e is expressed in the target frame. The forward nonselective map is

$\mathcal{E}_e^{\mathrm{fwd}}(X) = \mathcal{D}\, \mathcal{C}_{(j_e)}(U_e X U_e^\dagger)$.

For reverse traversal use the explicit convention

$U_{\bar{e}} = U_e^\dagger$, $j_{\bar{e}} = -U_e^\dagger j_e$.

Gauge covariance of the native orbit sum gives the equivalent reverse map

$$\mathcal{E}_e^{rev}(X) = \mathcal{D}[U_e^\dagger \, \mathcal{C}_{(j_e)}(X) \, U_e].$$

For a selective update, replace $\mathcal{D}$ by $X \mapsto P_r X P_r$. This is the direct covariant shared-link continuation of the archived local current law. It is a declared experiment, not a primitive theorem selecting its current channel, reverse-event semantics, background or renewal. The hypercharge theorem below also holds for independently specified directed currents, so it does not depend on the reverse convention to establish its essential visibility result.

On the identity-link background, both orientations reduce to the RCHS-29 update. Simultaneous frame changes act as

$$U_e \mapsto g_t U_e g_s^\dagger, \quad j_e \mapsto g_t j_e.$$

Terminal projectors commute with this gauge representation. The selected record probabilities are frame invariant, provided the incoming state transforms in its source frame.

8.1 Scope of the enlarged experiment

There are 98 real current coordinates on each of twelve edges and twelve gauge-link coordinates on each edge: 1,176 currents plus 144 links, or 1,320 original coordinates. “Complete joint parent” means complete in this declared native current/link experiment. It does not mean complete in the MASD field space. Independent record stretches, endpoint dynamics, completion fields, continuous proposal amplitudes and a physical unresolved action bath are not supplied by the native instrument and are not declared quadratic spectators.

The background, occupied support and D36 convention remain those of §2. The principal joint observation is the full vertex/type word over three updates, not a first-cover episode or an asymptotic rate. The current-support probe $P_Y z$ of Part II changes relative occupied populations; varying a hypercharge link changes phases. Their responses must be tested separately.

9. The native record action and full source derivatives

9.1 The common regular likelihood action

Let $p_b^{(3)}(\omega)$ be the exact three-update probability of the observed vertex/type word, where $b = (x, \theta)$ contains current and link coordinates. At the fixed reference $b = 0$, define the dimensionless contrast

$$\Gamma_{rec}^{(3)}(b) = \Sigma_\omega \, p_0^{(3)}(\omega) \log[p_0^{(3)}(\omega)/p_b^{(3)}(\omega)].$$

Natural logarithms fix this statistical convention. No multiplier is fitted. On the regular support of the experiment, normalisation gives

$$\partial_i \Gamma_{rec}^{(3)}(0) = 0, \quad H_{ij}^{rec} = \Sigma_\omega \, \partial_i p_\omega \, \partial_j p_\omega / p_\omega.$$

Proof. Differentiate the logarithm twice. The expected second derivative contributes $-\Sigma_\omega \partial_i \partial_j p_\omega = 0$; the remaining term is the displayed score Gram. Thus $\Gamma_{rec}^{(3)} = ½ b^T H^{rec} b + O(\|b\|^3)$. This familiar likelihood identity is applied to the actual native word law; it is not claimed as a new general theorem.

This establishes a common **record-contrast action**, not its equality to Γ_{master}. The physical action unit and long-history identification remain separate.

9.2 The complete native current chart

Use real coordinates $x_e \in \mathbb{R}^{98}$, with $h(x_e)$ the associated complex vector in the occupied 49-dimensional support, and put

$$j_e(x_e) = q_{(+,e)} [z + h(x_e)], U_e(\theta_e) = \exp(i \theta_e^a \hat{T}_a).$$

Every reference current is nonzero. This fixed invertible current chart keeps all occupied current variations; it is not a source-selected metric. Profiling all of these coordinates does not depend on their invertible reparametrisation.

At the homogeneous-ray background write

$$A_r = \mathcal{C}_z(P_r P_o/49), E_t = \mathcal{C}_z(P_t).$$

The exact pair and triple laws, conditional on two or three nonself updates, are

$$p_{rs} = \mathrm{Tr}(P_s A_r), p_{rst} = \mathrm{Tr}(E_t P_s A_r P_s).$$

The first recorded state is $P_r P_o/49$, independently of the first current or link, because the native channel is unital and gauge transport preserves the initial occupied identity. The original two-jet supplies the current derivatives

$$B_i(r, s) = \partial_i p_{rs}, B_i^{(2)}(r, s, t), B_i^{(3)}(r, s, t),$$

where the superscripts identify the second and third responding current channels. All 98 real internal current directions are evaluated, rather than inferred from the three support projectors.

9.3 The new link-response tensor

For a third forward link insertion, the derivative is

$$L_a(r, s, t) = i \mathrm{Tr}[E_t [\hat{T}_a, P_s A_r P_s]].$$

This follows by differentiating the transported incoming state. A reverse link at the second responding step contributes $-L_a$; a forward link at that step gives zero because it acts on the scalar terminal projector. A reverse link at the third step gives zero after the final terminal trace.

Let e_2, e_3 be the second and third nonself edges, with orientations $o_2, o_3 \in \{+, -\}$. The full triple derivative is therefore

$\delta p\_rst = B^{(2)} \cdot \delta x\_(e_2) + B^{(3)} \cdot \delta x\_(e_3) + L \cdot \ell,$

$\ell = \varepsilon_3\, \delta\theta\_(e_3) - \varepsilon_2\, \delta\theta\_(e_2).$

Here ε_3 equals one for a third forward traversal and zero otherwise; ε_2 equals one for a second reverse traversal and zero otherwise. Repeated edges refer to the same source coordinate. In particular, immediate backtracking cancels the applicable link terms; the reverse current is not incorrectly held in the forward target frame.

10. Joint quadratic parent, current profiling and finite curvature

Each allowed vertex path has its unchanged D36 weight

$w(v_0, v_1, v_2, v_3) = \pi\_(v_0)\, P\_(v_0v_1)\, P\_(v_1v_2)\, P\_(v_2v_3).$

Paths with three nonself transitions use the triple law of §9. Paths with two use the pair law and its second-current derivative. Paths with fewer than two have zero score. The calculation sums these paths and all corresponding terminal words exactly. There is no Monte Carlo sampling, pair-Markov substitution or inferred reset.

The resulting parent is

$H^{rec} = [\ A\ B\ ;\ B^T\ K\ ],$

with A the current block, K the link block and B their common cross response. All blocks are derivatives of the same $\Gamma\_rec^{(3)}$.

10.1 Observation-null compression and conditioning

At one edge, stacking the weighted pair and both triple current derivatives gives an observed tangent map from 98 real coordinates. It has numerical rank 80. Its smallest retained singular value is 2.7792×10^{-9}; the next singular value is about 1.1550×10^{-15}. The retained local subspace is whitened only to condition the statistical linear solve.

The remaining 18 directions per edge are **observation-null directions of this finite experiment**, not newly identified physical gauge modes. The computation records them rather than claiming that the physical action may discard them. Current profiling can use a pseudoinverse because the mixed block satisfies the necessary range condition.

Object	Executed size or rank
Original current coordinates	12 × 98 = 1,176
Independent link coordinates	12 × 12 = 144
Joint declared source coordinates	1,320
Observable local current span	80 per edge
Numerically represented current block	960 × 960
Positive rank of represented current block A	922

Object	Executed size or rank
Native current observation kernel, including local compression	254 dimensions

The local whitening residual is 6.23×10^{-8} in Frobenius norm. The local tangent map is ill-conditioned, so this is not presented as exact-arithmetic rank certification. The 80/18 singular-value separation is large, and the subsequent current solve has a separate, well-resolved positive spectrum. Its rank remains 922 when the relative eigenvalue cutoff is varied from 10^{-8} to 10^{-12}.

Restricting the assembled current block back to the original six RCHS-29 current-cycle probes, with links fixed, reproduces the archived three-update matrix to relative error 1.24×10^{-15}. This check verifies that the enlarged joint calculation contains the six-current calculation of Part II rather than replacing it.

10.2 Current profiling

For fixed link displacement θ, minimise the quadratic record contrast over every current direction in the stated native experiment. Write A_MP for the Moore-Penrose inverse of the current block. The stationary response and retained coefficient are

$x\_opt = -A\_MP\ B\ \theta$, $R\_link\hat{}rec = K - B^T\ A\_MP\ B$.

The computed range residual is

$||B - A\ A\_MP\ B||\_F\ /\ ||B||\_F = 1.62 \times 10^{-10}$.

The Schur response is nonzero, with

$||R\_link\hat{}rec||\_F = 1.8440610943 \times 10^{-8}$.

It is positive semidefinite to numerical accuracy; the smallest full-link eigenvalue is approximately -1.12×10^{-23}. These numbers belong to the fixed three-update statistical action and its source chart. They are not gauge coefficients and have not been converted to a physical time or volume.

10.3 Frame consistency

Let D be the 12×7 vertex-to-edge incidence matrix. An infinitesimal frame change has

$\delta\theta\_e = \varphi\_t - \varphi\_s$, $\delta j\_e = i\ \varphi\_t\ j\_e$.

The joint source derivative annihilates this simultaneous variation. After current profiling,

$R\_link\hat{}rec\ (D \otimes I_{12}) = 0$.

The normalised numerical residual is 1.99×10^{-16}. This particular frame identity is analytically justified. It does not classify every information-null current direction as a physical redundancy.

10.4 Finite face-curvature readout

On the canonical six triangular faces, use C with face i equal to rim edge i plus spoke i minus spoke i + 1. Thus CD = 0. The fixed lift and face response are

$T\_C = C^T(C\,C^T)^{-1}$, $Z\_face\text{\^{}}rec = (T\_C \otimes I_{12})^T\, R\_link\text{\^{}}rec\, (T\_C \otimes I_{12})$.

This 72 × 72 finite matrix has numerical rank **66.** The six remaining face directions are exactly the hypercharge links. On an orthonormal link-cycle chart, the 66 positive eigenvalues range from approximately 7.82×10^{-16} to 9.75×10^{-9}. No isotropic colour or weak coefficient is extracted from this non-vacuum witness. Finite face coordinates also do not supply the continuum area, field, matching-scale or scheme conventions.

Audit note. The count 66 is a package-reported numerical rank at the stated threshold. The retained eigenvalues span roughly seven orders of magnitude; the smallest-to-largest ratio is approximately 8.0×10^{-8}. An eigenvalue is not unreliable merely because its absolute value resembles machine precision, since rescaling the whole action changes absolute values without changing conditioning; reliability of the weakest modes must instead be assessed against propagated error in the assembled and profiled response, including the reported current-chart conditioning, whitening and range residuals and the Schur subtraction. The cutoff sweep reported for the current block conditions the current chart; it does not itself establish the curvature rank. The exact hypercharge-blindness theorem establishes the six hypercharge null directions; positivity of the remaining 66 directions retains its stated numerical verification grade.

The current profiling here is the minimum of a **record-contrast action**. Its algebra is the same Schur algebra used in physical relaxation; that alone does not identify the two experiments.

11. Exact hypercharge-link invisibility and its scope

11.1 All-finite-history invariance

The zero hypercharge block is not merely a small numerical eigenvalue. It follows from the actual terminal projection.

Define the post-terminal algebra and a central phase by

$\mathcal{A}\_term = \bigoplus\_r\, P\_r\, \mathrm{End}(\mathcal{H})\, P\_r$, $V(\beta) = \Sigma\_r\, e\text{\^{}}(i\beta\_r)\, P\_r$.

Every $X \in \mathcal{A}\_term$ obeys $V X V^\dagger = X$. Moreover,

$\mathcal{D}(V Z V^\dagger) = \mathcal{D}(Z)$

for any Z. The gauge transport commutes with the terminal projectors. Hypercharge is central on these sectors, $Y = \Sigma\_r\, y\_r\, P\_r$, so $e\text{\^{}}(i\beta Y)$ is such a phase.

Theorem 7 (all-finite-history hypercharge-link blindness). Consider the native terminal-record process of §8, with block-diagonal initial active state, terminal projection at each nonself update, identity self evolution, externally specified independent currents and the stated shared-link transport. Replacing any links independently by

$$U_e \mapsto U_e e^{i\beta_e Y}$$

leaves every observed vertex/type-word probability unchanged, for arbitrary finite β_e and every finite observation length.

Proof. On a forward edge, $e^{i\beta_e Y}$ acts on the block-diagonal incoming state before the current channel, so its conjugation is the identity. On a reverse edge, it conjugates the current-channel output immediately before terminal projection; the second displayed identity removes it. The same argument works for each selective projector P_r, not only the nonselective sum. Every resulting conditioned state is again in $\mathcal{A}_{term}$. Induction over the observed word proves the result. Self transitions preserve the hypothesis. Retaining the vertex path and all terminal labels does not change any step of the argument. ■

This theorem requires no homogeneous-ray assumption and no preferred chirp witness. It survives arbitrary currents in the instrument's domain ($s(j) > 0$), arbitrary gauge links and arbitrary block-diagonal incoming density, within the declared update class. It also does not depend on maximal saturation: changing the current-channel strength while keeping the same transported-input/terminal-projection architecture cannot restore this phase sensitivity.

The conclusion concerns the specified classical record law. It does not assert that the full quantum source, an independently weighted holonomy action, or an untraced coherent ledger has no hypercharge response.

11.2 Why the invisible phase is not merely gauge

An independent hypercharge link phase need not be a vertex-frame change. Set all links to identity except one rim link and choose

$$U_{(e_0)} = e^{i\vartheta q}, \quad q = 6Y.$$

The triangular face containing that rim edge has holonomy $e^{i\vartheta q}$. For sufficiently small ϑ its regular logarithm is nonzero, with

$$\|\log U_p\|^2_{HS} = \vartheta^2 \operatorname{Tr} q^2 = 378\, \vartheta^2.$$

At the declared test value $\vartheta = 0.17$, this squared norm is 10.9242. The native record law is nevertheless unchanged by Theorem 7. The nonzero holonomy cannot be dismissed as one of the link-gradient gauge nulls.

11.3 Adjustment of the currents cannot repair the zero

The exact equality of word laws gives

$$\Gamma_{rec}^{(N)}(j_0, U_\beta) = 0$$

along these hypercharge deformations. Relative entropy is nonnegative. Evaluating at the original current already achieves zero, so

$$\inf_j \Gamma_{rec}^{(N)}(j, U_\beta) = 0.$$

The zero therefore survives nonlinear statistical profiling, not just the quadratic pseudoinverse used in §10. No finite increase in record length can remove it. An information-rate limit, when it exists for this same observation, inherits the same invariance.

Corollary 7.1 (failure of the record-action-only gauge bridge). On the fixed physical link readout, no positive scalar normalisation can identify this native record contrast, or its profiled quadratic form, with a gauge action having a strictly positive hypercharge curvature coefficient. An invertible change of coordinates does not remove a kernel; moving the physical hypercharge link into an unrelated observable current direction would change the experiment rather than establish the bridge.

This rejects the proposed identification **for the specified native process as the sole gauge-action source**. It does not prove that the full VERSF source has no admissible action, nor that an extra axiom is necessary. MASD already includes independent closure and record terms. Their physical weighting must be returned by the source rather than borrowed from the present record information [S1; S2; S3; S8].

11.4 Two differently typed uses of Y

The Part II probe $P_Y z$ changes populations; the link $e^{(i\vartheta Y)}$ changes phases. A positive population response is consistent with exact link-phase blindness and cannot by itself establish hypercharge kinetic response.

PART IV | COHERENT PHASE-SENSITIVE COMPARISON

12. A normalised comparison that retains the missing phase

Theorem 7 identifies a failure of the terminal-dephased classical-record observation, not phase blindness of the underlying transports. MASD-1 already contains link closure, spatial record-composition differences and polar bond comparison [S8]. The gauge-response construction retains hypercharge in vacuum-relative holonomy [S10], and HCMR-P1 requires an interference-capable comparison to distinguish coherent lifts [S11]. Those existing objects motivate the following extension; they do not derive its operational selection.

Additional premise. Two same-endpoint transports are compared coherently using a balanced route label and recombination, with a fresh probe for each trial and a port measurement after recombination. Route coherence must still exist before a which-route fact is irreversibly written. No committed fact is erased, and the operation is not inferred from the desired Hessian.

Let A, B: $\mathcal{H}_s \to \mathcal{H}_t$ be unitary transports with identical endpoints. Define two comparison operators

$$M_+ = (A + B)/2, \quad M_- = (A - B)/2.$$

They can be realised by a balanced route label, controlled transport and recombination. Direct expansion gives

$$M_+^\dagger M_+ + M_-^\dagger M_- = I.$$

Thus they define a normalised quantum instrument without a fitted factor coefficient. For a normalised input density ρ,

$$p_- = (1/4)\,\mathrm{Tr}[(A - B)\,\rho\,(A - B)^\dagger] = (1/2)[1 - \mathrm{Re}\,\mathrm{Tr}(\rho\, B^\dagger A)], \quad p_+ = 1 - p_-.$$

Proposition 8 (covariant phase visibility). The port probabilities are invariant under the simultaneous endpoint-frame transformations of A, B and ρ. On a definite charge-q_r sector with relative holonomy $B^\dagger A = e^{i q_r \varphi} I$, the dark-port probability is

$$p_- = \sin^2(q_r \varphi/2).$$

Proof. Under $A \mapsto G_t A G_s^\dagger$, $B \mapsto G_t B G_s^\dagger$, $\rho \mapsto G_s \rho G_s^\dagger$, the output in the trace is conjugated by G_t. The definite-charge formula follows by substituting the scalar relative holonomy. No coherence between distinct charge sectors is used. ■

Recording the terminal type **after** the port comparison does not destroy the port distribution. For complete terminal projectors P_r, summing $\mathrm{Tr}(P_r M_- \rho M_-^\dagger)$ over r gives the same p_-. This is different from projecting away the relevant route information before it is compared.

For the tests below $q = 6Y$ is used only as the gauge-insertion convention. The archived native current instrument still uses its original conventional-Y orbit sum. Altering that instrument would be a different calculation.

At A = B, the bright port has probability one and the dark port probability zero. The finite comparison contrast is consequently

$$\Gamma_{cmp} = D_{KL}((1, 0)\,\|\,(p_+, p_-)) = -\log(1 - p_-).$$

This is an explicit statistical action, not yet an identification with the physical VERSF action.

13. Dark outcomes and the correct quadratic action

The comparison sits at a support boundary. Applying the regular score-Gram identity while deleting the zero-probability outcome would incorrectly give zero response.

Theorem 9 (likelihood curvature with a newly opened outcome). Let a finite normalised probability family $p_i(x)$ be twice differentiable on a two-sided neighbourhood of $x = 0$. Split its outcomes into $S = \{i: p_i(0) > 0\}$ and $D = \{i: p_i(0) = 0\}$. Put $u_i = \nabla p_i(0)$. Then

$\nabla^2 D\_KL(p_0 \| p\_x)|_0 = \Sigma\_(i\in S)\ u\_i\ u\_i^T / p\_i(0) + \Sigma\_(i\in D)\ \nabla^2 p\_i(0)$.

Proof. Differentiate $-\Sigma\_(i\in S)\ p\_i(0) \log p\_i(x)$ twice. Its second-derivative term is $-\Sigma\_(i\in S)\ \nabla^2 p\_i(0)$. Normalisation changes this to the sum over D. Nonnegativity on the two-sided neighbourhood gives u_i = 0 and a positive-semidefinite Hessian for every dark outcome, so the dark term is automatically PSD and no dark first-order score exists to be missed. ■

For $\Delta(x) = A(x) - B(x)$ with $\Delta(0) = 0$ and $\Delta\_i = \partial\_i\ \Delta(0)$, this yields

$(H\_cmp)\_ij = (1/2)\ \mathrm{Re}\ \mathrm{Tr}(\rho\ \Delta\_i\dagger\ \Delta\_j)$, $\Gamma\_cmp\^(2) = (1/4)\ \mathrm{Tr}(\Delta\^(1)\ \rho\ \Delta\^(1)\dagger)$.

This establishes the local comparison-to-residual quadratic bridge in the **declared experiment**. The formula follows from the probability law; a target Hessian was not factorised into a new score law.

13.1 It is not the regular Fisher metric at the boundary

For a one-parameter relative holonomy e^(iφq), define m_k = Tr(ρ q^k). Then

$\Gamma\_cmp = (m_2/4)\ \varphi^2 + (m_2^2/32 - m_4/48)\ \varphi^4 + O(\varphi^6)$.

Its Hessian is $m_2/2$. In contrast, the usual Fisher information evaluated at nonzero φ tends to m_2 as $\varphi \to 0$. The factor of two is not an adjustable action convention: it reflects a nonregular support-opening limit. The reverse divergence $D(p\_\varphi \| p_0)$ is infinite whenever the dark probability is positive.

PGRS-1 explicitly restricts its regular-score statements to positive reference support [S2, §6]. This calculation uses a case outside that hypothesis, not a contradiction of its theorem. No asymptotic Fisher rate or physical history metric is inferred from the finite contrast.

14. Closure, composition and bond comparison experiment

Use the inherited seven-vertex wheel with hub h, six rim edges r_i: i → i + 1 and six spokes s_i: h → i, with rim indices understood modulo six so that no rim label collides with the hub. Keep link transports U_e and spatial record transports V_e independent.

Here V_e = Pol Φ_e is restricted to a unit-stretch, gauge-unitary subbranch. Its infinitesimal variations use the same twelve represented gauge generators as U_e. General record rotations, stretch variations, moving supports, endpoint dynamics and completion fields are not claimed to be spectators.

For each face, compare the two available transports:

A_(C,i) = U_(r_i) U_(s_i), B_(C,i) = U_(s_(i+1)), A_(R,i) = V_(r_i) V_(s_i), B_(R,i) = V_(s_(i+1)).

For each edge, use A_(B,e) = U_e and B_(B,e) = V_e. These are the link-closure, spatial record-composition and polar-bond comparisons already present in MASD. Record composition equals its original ΦΦ − Φ residual only on the specified unit-stretch branch.

Closure uses a chord difference; its tangent agrees with the identity-branch holonomy logarithm, not its full finite-amplitude functional.

14.1 Reference probe and trial convention

The unchanged archived representation has dimension 50. Remove the neutral basis vector e_{45} in zero-based, generation-major indexing and define

$\Pi = I - |e_{45}\rangle\langle e_{45}|$, $\rho = \Pi/49$.

The occupied terminal ranks in the order Q, U, D, L, E, N, H are (18, 9, 9, 6, 3, 2, 2). Gauge transformations preserve this support. The invariant density is a declared probe preparation, not a selected physical vacuum.

The experiment uses a fresh probe for every one of six closure, six record-composition and twelve bond comparisons. Conditional independence makes the combined law normalised and its contrast additive:

$\Gamma_{24}(U, V) = \Sigma_{(i=1)}^6 \Gamma_{(C,i)} + \Sigma_{(i=1)}^6 \Gamma_{(R,i)} + \Sigma_{(e=1)}^{(12)} \Gamma_{(B,e)}$.

The equal counts define a trial schedule. They do not prove equal physical defect prices or fix a rate per Fold, per completed record, or per unit continuum volume. This scope matters when the candidate is compared with the physical master action.

15. The common comparison parent and record adjustment

Let D be the 12 × 7 vertex-to-edge incidence matrix and C the 6 × 12 face incidence matrix. In the stored orientation,

$(Ca)_i = a_{(r_i)} + a_{(s_i)} - a_{(s_{(i+1)})}$, $CD = 0$.

Write $L = C^T C$, $F = C C^T$ and use real generator coordinates $a, v \in \mathbb{R}^{144}$ for U, V. Define

$G_{cmp,AB} = \mathrm{Re}\,\mathrm{Tr}(\rho\, \hat{T}_A\, \hat{T}_B)$, $G_0 = G_{cmp}/2$.

Theorem 10 (finite comparison parent). At identity transports the Hessian of the common 24-trial contrast is

$H_{24} = [\, L + I \;\; -I\, ;\; -I \;\; L + I\,] \otimes G_0$.

Proof. The three linear residuals are Ca, Cv and a − v. Apply Theorem 9 to each comparison and sum the independent contrasts: closure contributes L on the link side, composition contributes L on the record side, and the twelve bonds contribute the coupled block $[\, I \;\; -I\, ;\; -I \;\; I\,]$. ■

The source representation gives

$G_{cmp} = (1/49)\, \mathrm{diag}(6\, I_8, (13/2)\, I_3, 378)$.

These are inherited representation traces evaluated in the chosen probe density, not primitive gauge stiffnesses. The parent has rank 216 out of 288. Its 72 null directions are the simultaneous frame gradients $(D\varphi, D\varphi)$.

Lemma 15.1 (exact spectral resolution of the parent and closed-form face response). In the sum and difference channels $(a + v)/\sqrt{2}$ and $(a - v)/\sqrt{2}$ the parent decouples exactly as

$$H_{24} \cong [L \otimes G_0] \oplus [(L + 2I) \otimes G_0].$$

Since spec $L = \{0^6\} \cup$ spec F and spec $F = \{1, 2, 2, 4, 4, 5\}$, the full exact spectrum of H_{24} is $\{\lambda, \lambda + 2 : \lambda \in \text{spec } L\} \otimes \text{spec } G_0$; the rank is $12 \times (6 + 12) = 216$ structurally, with no numerical threshold. The null space is exactly the frame gradients: $CD = 0$ gives im $D \subseteq$ ker C, rank $C = 6$ gives dim ker $C = 6$, and dim im $D = 6$ for the connected wheel, so ker L = im D exactly, and all 72 nulls of H_{24} are $(D\varphi, D\varphi)$. The record block $L + I$ is positive definite; its stationary adjustment and retained link response are

$$v^\star = [(L + I)^{-1} \otimes I_{12}]\, a,\quad R_{24} = [L + I - (L + I)^{-1}] \otimes G_0,$$

with eigenvalue factor $(\lambda + 1) - 1/(\lambda + 1) = \lambda(\lambda + 2)/(\lambda + 1)$, zero exactly on the six frame modes. With the fixed face lift $T\_C = C^T F^{-1}$, $C\, T\_C = I_6$, the intertwining identity $(L + I)\, C^T = C^T(F + I)$ gives the exact closed form

$$\mathbf{Z_{24}\text{^}face = (T\_C \otimes I_{12})^T R_{24} (T\_C \otimes I_{12}) = [I_6 + (F + I_6)^{-1}] \otimes G_0,}$$

so the per-face response factor is $z(\lambda) = 1 + 1/(\lambda + 1) = (\lambda + 2)/(\lambda + 1)$, a strictly decreasing function of the face eigenvalue λ.

Proof. The channel decoupling is the orthogonal similarity by $(1/\sqrt{2})[\, I\ I\ ;\ I\ {-I}\,]$. The kernel identification is the dimension count displayed. For the face form, $T\_C^T\,(L + I)\, T\_C = I_6 + F^{-1}$ and, using $(L + I)^{-1} C^T = C^T(F + I)^{-1}$, $T\_C^T\,(L + I)^{-1}\, T\_C = (F + I)^{-1} F^{-1}$; subtracting, $F^{-1} - (F + I)^{-1} F^{-1} = (F + I)^{-1}$, which gives the display. All steps were verified in exact rational arithmetic (Appendix A.4). ■

This is the unit-weight MASD link-record mechanism in the declared comparison normalisation. Its Schur algebra is inherited, not a new physical gauge theorem. The new calculation supplies an explicit normalised phase-sensitive probability law realising this quadratic subbranch, and Lemma 15.1 supplies its exact closed form.

16. Positive hypercharge response after record adjustment

The eigenvalues of F are 1, 2, 2, 4, 4, 5. Consequently Z_{24}^face is positive on all 72 face/generator directions. In particular, none of its six hypercharge directions is erased.

The occupied primitive charges and multiplicities give

$$m_2 = 378/49 = 54/7,\quad m_4 = 7002/49,\quad H\_q\text{^one-loop} = 27/7.$$

The exact single-loop contrast is

$\Gamma\_q(\varphi) = -\log[1 - (1/49)\, \Sigma\_r\, d\_r \sin^2(q\_r\, \varphi/2)] = (27/14)\, \varphi^2 - (219/196)\, \varphi^4 + O(\varphi^6)$.

The quartic term explicitly distinguishes this probability contrast from an exactly quadratic logarithmic-holonomy cost. Their agreement is at the declared quadratic order.

Lemma 16.1 (census closed forms and the one-formula face table). With occupied ranks (18, 9, 9, 6, 3, 2, 2) and the archived primitive charges q = (1, 4, −2, −3, −6, 0, 3) in the order (Q, U, D, L, E, N, H),

$\Sigma\_r\, d\_r\, q\_r^2 = 378$, $\Sigma\_r\, d\_r\, q\_r^4 = 7002$,

so $m_2 = 54/7$ and $m_4 = 7002/49$ are census identities, not fitted values. The signed census is read from the unchanged archived generator q = 6Y, whose sector values at the standard hypercharges (1/6, 2/3, −1/3, −1/2, −1, 0, 1/2) are exactly this list; it is not inferred from its even moments, which cannot distinguish signed conventions. The blockwise identity P_r (6Y) P_r = q_r P_r on each terminal sector, and the odd diagnostic $\Sigma\_r\, d\_r\, q\_r^3 = -234$, test the signed convention itself. The coefficients of Γ_q are exactly the general dark-port moment formula of §13.1 evaluated at this census: $m_2/4 = 27/14$ and $m_2^2/32 - m_4/48 = -219/196$. The q-slot eigenvalue of G_0 is $378/98 = 27/7 = m_2/2$, which is precisely the single-loop Hessian H_q; the entire face table below is therefore the single closed form z(λ) · g, with z(λ) = (λ + 2)/(λ + 1) from Lemma 15.1 and g the relevant G_0 eigenvalue. Every entry was re-derived independently in exact arithmetic (Appendix A.4). ■

Face eigenvalue λ	Multiplicity	Spatial response z(λ)	Primitive-q face response $z(\lambda)\cdot m_2/2$
1	1	3/2	81/14
2	2	4/3	36/7
4	2	6/5	162/35
5	1	7/6	9/2

Changing to the conventional-Y coordinate divides the last column by $36 = (6)^2$, the primitive-charge conversion factor. This is a coordinate conversion, not a prediction of a weak angle or a gauge-coupling ratio. These finite values have no supplied continuum area, time, matching-scale or scheme identification.

16.1 Nonlinear check of the relaxed coefficient

The pure-hypercharge finite contrast is evaluated directly from the sine probabilities. For a fixed unit face direction, the quadratic prediction is 4.682478525607925. Solving the analytic record stationarity equations on the local positive branch gives:

Field step	Finite Hessian estimate	Relative error
0.01	4.682373166410483	2.2501×10^{-5}
0.003	4.682469043632978	2.0250×10^{-6}
0.001	4.682477472058599	2.2500×10^{-7}

The final gradient norms are below 2×10^{-18} and each record Hessian is positive. This verifies local elimination near the reference, not a global minimum over all periodic phase branches.

17. One declared current-link-record product experiment

The comparison need not be inserted only into the missing hypercharge block. It acts by the same rule on the complete represented gauge algebra. To test compatibility with the joint calculation in Part III, define a **product experiment**: perform its native three-update current/link observation and, independently conditional on the fields, the 24 fresh-probe comparisons.

Independence is an additional design premise. It is not a derived assertion that the physical VERSF source factorises in this way. In particular, this construction does not license adding a second copy of a term already counted in a physical master action.

Let the archived native likelihood Hessian be

$H\_native = [\ A\ B\ ;\ B^T\ K\ ],\ R\_native = K - B^T A^+ B.$

Here the unreduced native current chart contains all 1,176 occupied real current coordinates; the archived implementation conditions its observable span without relabelling information-null directions as physical gauge. Adding the 144 link and 144 record coordinates gives 1,464 source coordinates for the declared product experiment.

The common contrast is the sum of the two exact contrasts. In the current/link/record order its quadratic parent is

$H\_product = [\ A\ B\ 0\ ;\ B^T\ K + H\_uu\ H\_uv\ ;\ 0\ H\_vu\ H\_vv\ ].$

Eliminating the stated nuisance currents and record phases gives, without fitted cross blocks,

$R\_product = R\_native + R_{24}.$

This equality holds on the common 144-coordinate link chart. The 72-dimensional face response is its fixed compression

$Z\_product\text{\^{}}face = (T\_C \otimes I_{12})^T (R\_native + R_{24}) (T\_C \otimes I_{12}).$

The archived native finite face response has rank 66; its hypercharge block is exactly zero under Theorem 7. The comparison response is positive on the full face chart. Their sum therefore has rank 72. Direct execution gives a smallest face eigenvalue of approximately 0.07142857143 and a largest of 5.78571428571 in this declared normalisation.

Remark 17.1 (comparison extremes and product bounds). Write $A = Z_{24}$^face for the comparison face matrix and E = Z_native^face for the native face contribution, so Z_product^face = A + E. The comparison matrix has exact extreme eigenvalues

$\lambda\_min(A) = z(5) \times (3/49) = (7/6)(3/49) = 1/14$, $\lambda\_max(A) = z(1) \times (m_2/2) = (3/2)(27/7) = 81/14$,

the minimum on the $\lambda = 5$ face mode in a colour direction (colour G_0 eigenvalue 3/49) and the maximum on the $\lambda = 1$ face mode in the primitive-q direction. These exact values belong to A, not automatically to A + E. Since $E \succeq 0$ with $\|E\|_2 \approx 9.74513 \times 10^{-9}$ on this chart (numerically the largest native retained mode), the product minimum obeys

$1/14 \le \lambda\_min(A + E) \le 1/14 + \|E\|_2$.

Agreement of the computed product minimum with 1/14 at the displayed precision is consistent with this bound; exact equality would require a minimum-eigenvalue vector of A to lie in ker E, which is not established. The maximum is stronger, with its two ingredients graded separately. The native hypercharge face block vanishes exactly under Theorem 7, so with E positive semidefinite the entire hypercharge face subspace lies in ker E and the 81/14 eigenvector of A remains an exact eigenvector of A + E; that 81/14 is an exact eigenvalue of the product is theorem grade. That it is the maximum uses the archived numerical norm $\|E\|_2$ against the spectral gap 81/14 − 36/7 = 9/14 on the invariant orthogonal complement, and that norm is an ordinary floating-point evaluation, not an interval-certified bound. Under the archived native-response norm bound, the product maximum therefore remains 81/14; the comparison maximum itself is exact.

Six direct block-minimum checks agree with the summed response within 5.4×10^{-16} relative error. The simultaneous gauge-gradient residual is 1.7×10^{-16} after normalisation. The phase-comparison execution consumed the joint calculation through its exported arrays. The full joint assembly was not independently rerun in that execution; this integrated paper preserves that provenance.

What this establishes: a common, normalised finite record experiment with independent current, link and gauge-unitary record coordinates can have a full-rank curvature contrast. **What it does not establish:** that this is the physical full quadratic VERSF experiment, or that its nuisance elimination equals the physical action-bath reduction.

PART V | PHYSICAL ADMISSION, SOURCE-HISTORY CONTINUATIONS AND INTEGRATED VERDICT

18. Comparison before irreversible which-route recording

The comparison depends on coherent alternatives reaching a common output. To make that requirement explicit, let the two routes correlate with normalised environment states $|h\_A\rangle$, $|h\_B\rangle$ whose overlap is a fixed real number $\nu \in [0, 1]$. For the balanced, unbiased port readout and relative holonomy $e^{(i\varphi q)}$,

$p_+^{(\nu)}(\varphi) = [1 + \nu \,\mathrm{Re}\, \chi(\varphi)]/2$, $\chi(\varphi) = \mathrm{Tr}(\rho\, e^{(i\varphi q)})$.

At $\nu = 0$, orthogonal which-route records remove every phase dependence from these port probabilities. Merely discarding the route label classically does not restore overlap.

Theorem 11 (comparison-order change at imperfect coherence). For every fixed $0 \le \nu < 1$, the contrast of the reference port distribution against the perturbed one has expansion

$$D\_KL(p_0\^(\nu) \parallel p\_\varphi\^(\nu)) = [\nu^2 m_2^2/(8(1 - \nu^2))] \varphi^4 + O(\varphi^6).$$

Its quadratic coefficient is zero. At $\nu = 1$, by contrast,

$$D\_KL(p_0\^(1) \parallel p\_\varphi\^(1)) = (m_2/4) \varphi^2 + O(\varphi^4).$$

Proof. For $\nu < 1$ both reference ports have positive probability. Their perturbations begin as $\delta p_+ = -\nu m_2 \varphi^2/4 + O(\varphi^4)$ and $\delta p_- = -\delta p_+$. The regular binary divergence starts with $(\delta p_+)^2/[2 p_+(0) p_-(0)]$, giving the stated quartic term. At $\nu = 1$ use the dark-outcome calculation of §13. ■

The limits $\nu \to 1$ and $\varphi \to 0$ are therefore nonuniform. Almost perfect visibility cannot simply be treated as exact visibility when classifying the leading local likelihood action.

Remark 18.1 (leading-term matching scale). The nonuniformity has an explicit formal scale. For $0 < \nu < 1$, the leading quartic term equals the coherent leading quadratic term $(m_2/4)\varphi^2$ at

$$\varphi\star^2 = 2(1 - \nu^2)/(\nu^2 m_2).$$

This equates two leading Taylor coefficients only. It is not an exact crossover of the probability contrasts, and the quartic approximation is not controlled at the matching point. On the executed charge distribution at $\nu = 0.99$, the scale is $\varphi\star \approx 0.0725535$ and both leading terms there equal 0.0101520, but the exact contrasts are $\Gamma\_\nu \approx 0.00453670$ and $\Gamma_1 \approx 0.01012095$: the coherent contrast is already close to its leading term while the imperfect-coherence contrast is still a factor of about 2.2 below its formal leading value, because the omitted orders are not small at $\varphi\star$. At $\nu = 0$ the port probabilities carry no phase dependence at all and no matching scale is defined.

For amplitudes well below $\varphi\star$ the imperfect-coherence contrast is suppressed relative to the coherent one by the leading factor $\nu^2 m_2 \varphi^2/[2(1 - \nu^2)]$. For amplitudes near or above $\varphi\star$ only the exact contrasts, not the truncated expansions, order the two responses. A physical source theorem that supplies both an amplitude scale and a residual decoherence ν therefore fixes, with no further freedom, whether the comparison operates in the strongly suppressed regime $\varphi \ll \varphi\star$; outside that regime the classification must be made with the exact contrast. The order-change statement remains a falsifiable two-parameter condition without any exact-crossover assertion.

18.1 Scope of the coherence result

This is **not** a theorem that every phase measurement needs perfect coherence, or that partial coherence destroys all phase information. It concerns this unbiased, reversal-even port observation at its agreement point. A phase-biased or quadrature-sensitive comparison can have a different first derivative and would require its own source and normalisation analysis.

The result also does not assert that VERSF commits a which-route fact at every microscopic step. It tells the physical source theorem what must be checked: whether the proposed comparison occurs before such a record is made, what environment information survives, and which actual readout is installed. HCMR-P1 already distinguishes the coherent comparison from the fixed stochastic record law [S11].

19. Why normalisation and full rank do not select the physical action

The trial coefficient is fixed **within** the chosen balanced comparison, but normalisation does not force nature to perform that comparison with unit frequency.

For any $0 \leq \eta \leq 1$, consider a tagged bypass completion

$L_\pm = \sqrt{\eta}\,(A \pm B)/2$, $L_{idle} = \sqrt{(1 - \eta)}\, I$.

This is written in the common endpoint chart; an unperturbed reference transport supplies the identity where needed. Its completeness follows from Proposition 8. In the tagged comparison-versus-idle experiment,

$\Gamma_\eta = \eta\, \Gamma_{cmp}$, $H_\eta = \eta\, H_{cmp}$.

Gauge covariance, positivity and exact agreement of the two compared routes at reference do not select η. This family is a test of those conditions, not a proof that the complete primitive VERSF source allows every η.

For example, the single-loop primitive-q Hessian is $27\eta/7$. Values $\eta = 1/4, 1/2, 1$ give $27/28$, $27/14$, $27/7$, all from normalised operations. No member is selected by a Standard Model target.

19.1 Physical obligations remaining for the comparison route

The source must determine, or prove output-independence from, the comparison operation and its occurrence law; the route coherence and reference-phase convention; the prepared density and occupied support; the relative incidence of closure, composition and bond comparisons; and the physical background and event grain. These choices can affect more than one scalar. The present calculation does not establish a universal one-parameter physical response family.

It must also return the complete same-order current/link/record action, including the omitted stretch, endpoint, completion and other coupled fields, and justify its reduction and curvature readout. A full physical history law may correlate the comparison trials with current records; the product construction cannot then be substituted without those correlations. Physical regulator control and the native-to-continuum normalisation are additional obligations, not consequences of the six-face spectrum.

19.2 What a comparison-based physical handoff must establish

The next physical calculation must identify the actual source operation or prove that all source-admissible alternatives give the same retained response. Its declared experiment must specify the comparison timing and retained phase information, preparation and occupied support, occurrence law and event grain, and the relative incidence of closure, composition and bond comparisons. Fixing these items before evaluating an output prevents tuning; it does not prove them from the substrate.

The action identification must then include every same-order coupled field and the physical persistent/unresolved split. Statistical nuisance profiling in Parts III–IV is not the physical action-bath reduction until that same-source equality is established. HMGBC also requires a justified tangent/history embedding or tangent-space second variation, rather than substituting a population projection or a memory matrix for the required action blocks [S3, S7].

On a raw-action route, the relevant source two-jet must supply the quadratic response; the normalised current-instrument two-jet alone does not determine it [S2]. On an information route, the actual observation, renewal and normalisation must match the physical action, including any dark-outcome support change. The resulting finite curvature response still needs interacting regulator control and the native-to-continuum area, volume, time, field and matching conventions before physical gauge coefficients can be read [S1–S3, S10].

Thus the candidate's missing physical selection is not compressed here into an asserted single unknown λ_J. The comparison/idle family demonstrates one amplitude freedom, while the source preparation, coherence, scheduling and coupled fields may affect relative shape as well. No downstream Standard Model target is used to choose them.

These comparison-specific obligations are not imposed on every alternative phase-sensitive source mechanism. The following continuations investigate other carriers and statistical operations. They do not derive the comparator by renaming a heat trace, a field partition or a full-configuration transition as the same experiment.

19A. Direct covariant heat response and the endpoint-pressure obstruction

RCHS-30 starts from the explicit constitutive-continuity subsystem in RCHS-24 rather than from the balanced comparison. In the declared canonical convention,

$\dot{\psi} = -M_v^{-1}\, \Delta_U^\dagger\, K_e\, \Delta_U\, \psi$, $K_e = I_{12}/31$, $M_v = \mathrm{diag}(7, 4, 4, 4, 4, 4, 4)/31$.

With identity factors on the internal representation understood, define

$L_U = M_v^{(-1/2)}\, \Delta_U^\dagger\, K_e\, \Delta_U\, M_v^{(-1/2)}$, $T_s(U) = e^{(-sL_U)}$.

The occupied support is the same 49-dimensional test support as in the original calculation. The endpoint operator therefore has dimension 343. Its complete link two-jet contains all 144 represented link directions. It is a coherent amplitude operator, generally complex in this chart; positive definiteness of its exponential is not entrywise positivity of a scalar history kernel. Nor does the subsystem supply the independent current, record or completion dynamics. [E4, §§1–3]

19A.1 The finite trace returns a loop term

Define the diagnostic

$Z_s(U) = \mathrm{Tr}\, e^{(-sL_U)}$, $\mathcal{F}_s^{tr}(U) = -s^{-1} \log[Z_s(U)/Z_s(I)]$.

The first phase-sensitive closed walks traverse a triangle. Their edge-weight product is 1/112. With $d = 49$,

$Z_s(U) - Z_s(I) = -(s^3/112)\, \Sigma_p\, [d - \mathrm{ReTr}\, H_p(U)] + O(s^4)$,

and consequently

$\boldsymbol{\mathcal{F}_s^{tr}(U) = (s^2/784)\, \Sigma_p\, [1 - \mathrm{ReTr}\, H_p(U)/49] + O(s^3).}$

The positive closed-walk expansion proves a rank-72 face Hessian for every $s > 0$ on this wheel and faithful represented algebra. Longer walks are retained in the finite-duration evaluation. This is a calculated heat-trace response with no new comparator, not a physical gauge coefficient. The expansion parameter is heat duration, not spatial regulator spacing. [E4, §§4–6]

19A.2 The spectral pressure is a different object

The occupied carrier retains two neutral singlets. For either neutral vector n, the endpoint vector $v_z = \sqrt{(m_z)}\, n$ satisfies $L_U v = 0$ for every gauge-link configuration. Since $L_U \succeq 0$,

$\boldsymbol{\mathrm{spr}(T_s(U)) = 1, -s^{-1} \log \mathrm{spr}(T_s(U)) = 0.}$

The finite trace Hessians can approach a positive limit even though the limiting spectral pressure has zero Hessian. Differentiating first and taking the long-duration limit first are not interchangeable in this example. Neutral modes are not deleted to remove the obstruction. [E4, §7]

Thus common operator provenance does not establish equality of response functionals or force $C_{hol} = 1$. An action bridge must specify the carrier, raw measure, retained fields, action unit and curvature coordinates, and prove the relevant equality. The obstruction is confined to this endpoint-pressure identification, not to every possible VERSF field-history operator. [E4, §8]

19B. Amplitude-configuration pressure and the conditional quartic loop

RCHS-31 changes the declared test carrier to square-integrable functions of amplitude configurations. For $\mu > 0$ it introduces

$\mathcal{H}\_U(\mu) = -\frac{1}{4}\,\Delta\_\chi + \chi^\dagger(\mu^2 I + L\_U)\chi$.

There are 343 complex, or 686 real, amplitude coordinates; the history Hilbert space is infinite-dimensional. The flat configuration measure, kinetic term and use of the endpoint transport energy as a configuration potential are additional completion assumptions. These coordinates are not a prediction of 49 physical scalar species. [E5, §§1–3]

Its relative ground pressure is exactly

$\Delta\mathcal{E}\_\mu(U) = \mathrm{Tr}[\sqrt{(\mu^2 I + L\_U)} - \sqrt{(\mu^2 I + L\_I)}]$

and obeys the same-model identity

$$\boldsymbol{\Delta\mathcal{E}\_\mu(U) = (1/(2\sqrt{\pi}))\int_0^\infty s^{-3/2}\, e^{-\mu^2 s}\, [Z\_s(I) - Z\_s(U)]\, ds.}$$

Neutral Gaussian factors cancel in the reference-relative partition ratio without deletion. At each fixed $\mu > 0$, the face Hessian is positive on all 72 directions. This does not overturn §19A: the operator and carrier have changed. The proper-time weight follows from the added configuration model, not from a physical source-selection theorem. [E5, §§4–6]

The limit $\mu \downarrow 0$ is singular. On the stated scalar and hypercharge directions the limiting energy has an absolute-value cusp; the smooth regulated Hessian diverges rather than approaching a finite quadratic gauge action. The regulator is not identified with a particle mass or chosen from a coupling target. [E5, §7]

19B.1 Quartic confinement and the leading hopping response

The second configuration model uses the MASD quartic shape:

$\mathcal{H}\_U^{(4)} = -\frac{1}{4}\,\Delta\_\chi + \boldsymbol{\mathcal{F}}\_\mathrm{amp}(\chi; U)$,

$\boldsymbol{\mathcal{F}}\_\mathrm{amp}(\chi; U) = \chi^\dagger L\_U\, \chi + \Sigma\_v\, \gamma\_v\, (\|\chi\_v\|^2 - R\_v^2)^2$, $\gamma\_v = v\_v\, \lambda\_\mathrm{sub}/(4m\_v^2)$, $R\_v^2 = m\_v\, \rho\_c^2$.

For positive quartic coefficients on the finite cell, this declared model is confining, has a simple gapped ground state and admits local gauge-field perturbation. It needs no extra Gaussian mass. Its use as the history Hamiltonian is still an assumption; the transport-generating potential is not identified with the squared-defect master action. [E5, §8]

Introduce ε only as the hopping-expansion variable, with full hopping at $\varepsilon = 1$. The first gauge-sensitive contribution is

$\Delta\mathcal{E}\_\varepsilon^{(4)}(U) = \varepsilon^3\, \Sigma\_p\, C\_p^Q\, [49 - \mathrm{ReTr}\, H\_p(U)] + O(\varepsilon^4)$,

where, for a triangle (i, j, k),

$C\_p^Q = 8\, w\_{ij}\, w\_{jk}\, w\_{ki}\, \Sigma\_{(a,b,c)}\, c\_{ia}\, c\_{jb}\, c\_{kc}\, (\delta\_{ia} + \delta\_{jb} + \delta\_{kc})/[(\delta\_{ia} + \delta\_{jb})(\delta\_{jb} + \delta\_{kc})(\delta\_{kc} + \delta\_{ia})] > 0$.

Here $\delta\_{vn} > 0$ and $c\_{vn} \geq 0$ are the local angular-one excitation gaps and spectral weights defined in [E5, §9]. At the benchmark $v\_v = m\_v$, $\lambda\_\mathrm{sub} = \rho\_c^2 = 1$, every wheel triangle has $C\_p^Q \approx 2.183599 \times 10^{-6}$. This is a leading quantum hopping coefficient. Neither its physical parameter selection nor its complete unit-hopping remainder is supplied by that execution. [E5, §§9–11]

19C. Gradient–Gibbs compatibility and controlled unit-hopping response

RCHS-32 tests the added configuration dynamics against the earlier Gibbs statistical layer. Within the stated reversible, constant-mobility diffusion class, a supplied free energy $\boldsymbol{\mathcal{F}}$ and flat reference measure give

$d\chi = -M\,\nabla\boldsymbol{\mathcal{F}}\,d\sigma + \sqrt{(2M/\beta)}\,dW\_\sigma$, $p\_eq \propto e^{(-\beta\boldsymbol{\mathcal{F}})}$.

The similarity-transformed operator is

$\mathcal{H}\_GG = -\beta^{-1}\,\nabla\cdot M\nabla + (\beta/4)(\nabla\boldsymbol{\mathcal{F}})^{T}\,M\,\nabla\boldsymbol{\mathcal{F}} - \tfrac{1}{2}\,\mathrm{tr}(M\,\nabla^{2}\boldsymbol{\mathcal{F}})$.

Its ground state is proportional to $e^{(-\beta\boldsymbol{\mathcal{F}}/2)}$, with zero ground energy, whenever that function is normalisable in the stated self-adjoint realisation; the confining finite-cell quartic satisfies this. For the positive quartic, this operator is not $-\Delta/4 + \boldsymbol{\mathcal{F}}$. The Gibbs statements therefore do not select RCHS-31's quantum-pressure operator. That model remains a separately defined construction; it is not silently corrected into another one. [E6, §§1–2]

19C.1 The mobility-independent static action

Retaining the quartic amplitude potential of §19B, define instead

$Z\_amp(U) = \int e^{(-\beta\boldsymbol{\mathcal{F}}\_amp(\chi;\,U))}\,d\chi$, $\boldsymbol{\mathcal{A}}\_amp(U) = -\log[Z\_amp(U)/Z\_amp(I)]$.

Once the potential, carrier, reference measure and β are fixed, mobility does not enter this static marginal. Differentiation gives

$\boldsymbol{\partial_i\partial_j\,\mathcal{A}\_amp = \beta\langle\mathcal{F}\_ij\rangle - \beta^{2}\,\mathrm{Cov}(\mathcal{F}\_i, \mathcal{F}\_j)}$.

Both terms are required. The marginal is not a relative entropy between normalised histories, static minimisation of the potential, or RCHS-31's quantum ground pressure. Removing mobility does not remove the ensemble parameter, an unfixed measure or the independent gauge/record functional. [E6, §3]

19C.2 The controlled full-strength calculation

The non-Gaussian radial moments are

$\mu\_v(k) = \langle\|\chi\_v\|^{(2k)}\rangle/(49)\_k$.

The determinant construction in [E6] is a generator of contractions: each site monomial is replaced by its actual μ_v(k) before taking the marginal logarithm. Substitution by μ_v(1)^k would change the model to a Gaussian approximation and is not the calculation used.

A positive loop expansion proves a rank-72 face Hessian for every positive hopping strength within this amplitude ensemble. At identity links it factorises as

$K\_amp^{face} = H\_amp^{sp} \otimes G\_rep$.

At $\beta = \lambda\_sub = \rho\_c^2 = 1$, $v\_v = m\_v$, and hopping one, the calculation retains orders through 22. The scalar spatial eigenvalues lie between $8.59339079 \times 10^{-6}$ and $9.23116514 \times 10^{-6}$. A moment majorant bounds every omitted hopping order:

$\|H\_amp^{sp} - H\_amp{,}22^{sp}\|_2 \leq 3.07 \times 10^{-16}$.

This bounds hopping truncation only, not all floating-point and local-integral error. The independent closed-walk verification reaches order eight, not order 22. The unit-hopping result differs from its own leading Gibbs cubic term by approximately 4.4212% in relative Frobenius norm. This is not a comparison with experiment or with the differently weighted quantum coefficient in §19B. [E6, §§4–10]

Changing β can alter both magnitude and relative spatial shape. No physical coupling ratio is extracted merely because the displayed factor trace is fixed. The source measure, physical parameter values and other coupled fields remain to be determined. [E6, §§9–12]

19D. Compact record integration and the surviving pure-link functional

RCHS-33 evaluates independent spatial records on an explicitly restricted, unit-stretch hypercharge branch,

$U\_e = e^{(ia\_e q)}$, $\Phi\_e = e^{(i\theta\_e q)}$, $q = 6Y$.

All twelve θ_e are integrated over their compact circles. This is a fluctuation of spatial transport maps, not permission to overwrite a stored fact. The restriction and product Haar measure are declared, not physically selected. [E7, §§1–3]

The existing composition and polar-bond norms give

$S\_RB(a, \theta) = r\ \Sigma\_p\ v((C\theta)\_p) + b\ \Sigma\_e\ v(\theta\_e - a\_e)$,

$v(x) = 49 - \mathrm{ReTr}\ e^{(ixq)} = 18(1 - \cos x) + 9(1 - \cos 2x) + 8(1 - \cos 3x) + 9(1 - \cos 4x) + 3(1 - \cos 6x)$.

Thus $v''(0) = 378$. The positive dimensionless prices r, b remain inputs. With $f = Ca$, Haar translation shows that the record partition depends only on f:

$\mathcal{A}\_RB(f) = -\log[Z\_RB(f)/Z\_RB(0)]$.

19D.1 Exact compact response

Let $p\_t(n)$ be the Fourier coefficients of $e^{(-t\ v(x))}$ and $c\_t(n) = p\_t(n)/p\_t(0)$. The positive Fourier representation is

$\mathcal{Z}(f) = \Sigma_{(\mathbf{n} \in \mathbb{Z}^6)} W(\mathbf{n}) e^{(i\mathbf{n}\cdot f)}$, $W(\mathbf{n}) = \Pi_{(i=0)}^{(5)} c_r(n_i) c_b(n_i) c_b(n_i - n_{(i-1)})$.

The field-independent factor between $\mathcal{Z}$ and Z_{RB} cancels in the ratio. At zero flux,

$(H_{RB})_{ij} = [\Sigma_\mathbf{n} W(\mathbf{n}) n_i n_j] / [\Sigma_\mathbf{n} W(\mathbf{n})]$.

For r, b > 0, the terms $\mathbf{n} = \pm e_i$ have positive weight and prove strict positivity on all six face directions. The twelve-link Hessian has exactly the frame-gradient kernel. If either price vanishes, the marginal is flux independent. This is rank six on the hypercharge branch, not a completed rank-72 record calculation. [E7, §4]

At r = b = 1, the distinct compact eigenvalues are 185.66490656, 123.91688983, 74.41772738 and 62.02890809, with multiplicities 1, 2, 2, 1. They differ by 1.685382% in the stated relative norm from the inherited harmonic result

$H_{RB}^{harm} = 378\, rb\, (rF + bI_6)^{-1}$.

The compact integral is evaluated with controlled Fourier truncation and checked by a separate angular-coordinate method. Small external curvature does not imply that the internal record fluctuations are small. The Gaussian Schur formula is inherited; the finite-price compact evaluation is the continuation result. [E7, §§5–8]

19D.2 The independent pure-link term remains

Within the explicitly factorised common-Gibbs test, and only within that test, the two marginals combine as

$\mathcal{A}_{test}(f) = \mathcal{A}_{amp}(f) + \mathcal{A}_{RB}(f) + (\lambda_C/2)\, \Sigma_p \|-i \operatorname{Log}_0 H_p\|_{HS}^2$.

On the identity hypercharge branch, $H_p = e^{(if_p q)}$, so

$H_{test}^q = H_{amp}^q + H_{RB} + 378\, \lambda_C I_6$.

Changing λ_C leaves every normalised conditional amplitude and record distribution at fixed links unchanged, but changes the gauge Hessian by

$\Delta H_{test}^q = 378\, \Delta\lambda_C\, I_6$.

This is the existing endpoint-independent functional problem after both marginal integrations. It does not prove that every tested price obeys all VERSF primitives, and does not show that a complete configuration law loses the same information. Non-Abelian records, stretches, cross-defect weights, additional fields and their physical reduction remain outside this restricted calculation. [E7, §§9–11]

19E. Full-configuration transfer reconstruction and its compatibility test

The distinction needed after §19D is between transport **through** fixed links and transitions **of configurations containing the links**. RCHS-34 examines the latter within HMGBC's stated symmetric split-transfer class. [E8, §1]

Let $\mathcal{X}$ be a finite configuration set and let

$Q = e^{-a_t L^{op}}, a_t > 0,$

be known, symmetric, positive definite and entrywise positive in one fixed reference-measure representation. Suppose

$T = M_V Q M_V, (M_V)_{zz} = e^{-a_t V(z)/2},$

with Perron root $\zeta > 0$ and vector $u > 0$. Its Doob kernel is

$K_{zz'} = T_{zz'} u_{z'} / (\zeta u_z).$

Knowing Q is essential. This construction does not infer an unknown kinetic reference and an unknown potential simultaneously from K. It is not asserted for every positive operator or irreversible process. [E8, §§1–2]

19E.1 Exact relative-potential reconstruction

Proposition 19E.1 (archived RCHS-34 reconstruction). Under the stated hypotheses,

$V(z) - V(z_0) = -(1/a_t) \log[(K_{zz}/Q_{zz}) / (K_{(z_0 z_0)}/Q_{(z_0 z_0)})].$

Proof. The Perron-vector ratio cancels on the diagonal, giving $K_{zz} = e^{-a_t V(z)} Q_{zz}/\zeta$. Dividing two such identities removes the one common ζ and yields the formula. This is the source-specific application established in [E8], not a newly executed calculation. ■

On an admitted smooth chart, the corresponding split-potential curvature is

$\partial_i \partial_j V = -a_t^{-1} \partial_i \partial_j [\log K_{zz} - \log Q_{zz}].$

This is not automatically W_prim, a Fisher matrix or an already integrated gauge action. On a continuous carrier the diagonal must be a regular transition **density** in the specified measure, not the probability of exactly repeating a point. The fixed-step kernel must not be replaced by an event-only jump chain that discards persistence opportunities. [E8, §§2–4]

A pure-link addition G(U) is now state dependent because U is part of z. It is not a separate common multiplier for each external background. Thus the obstruction in §19D does not imply that normalisation intrinsically prevents recovery of relative link costs.

19E.2 The full kernel must pass a separate test

Define

$c_z = \sqrt{(K_{zz}/Q_{zz})}$, $B_{zz'} = c_z Q_{zz'} c_{z'}$,

and let $\mathcal{D}(B)$ denote its Perron/Doob kernel. Then

K belongs to the specified split family ⟺ K = $\mathcal{D}$(B).

When the equality holds, spr(B) = 1, B = T/ζ, and the relative potential is unique. The only remaining freedom within this fixed (K, Q) class is one state-independent additive constant in V. This does not reduce the unresolved physical source, reference measure and kinetic operator to one free scalar. [E8, §3]

Proof. For an admitted source, $c_z = (M_V)_{zz}/\sqrt{\zeta}$, so B = T/ζ. Conversely B already has positive-diagonal, Q, positive-diagonal form. If K = $\mathcal{D}$(B), its diagonal obeys $K_{zz} = B_{zz}/\mathrm{spr}(B) = K_{zz}/\mathrm{spr}(B)$, forcing spectral radius one. The diagonal identity then fixes any other multiplier up to a common constant. ■

Within this symmetric class, the stationary distribution π supplies a second reconstruction,

$$B = \mathrm{diag}(\sqrt{\pi})\, K\, \mathrm{diag}(\pi^{(-1/2)}).$$

The logarithmic generator is recovered up to an identity shift, and raw transition-product action differences for equal-length paths are recovered. Absolute partition masses, unequal-length weights and separately normalised components need further normalisation data. Detailed balance and positive spectrum may not be manufactured by symmetrising the source. [E8, §3.1]

19E.3 Synthetic validation and counterchecks

The numerical test uses 24 hypercharge link/record coordinates, a 1,153-state derivative stencil and 2,256 undirected proposal edges. Its inserted prices are λ = 0.7, r = 1.3, b = 0.4, with γ = 0.37 and $a_t = 0.1$. It reconstructs those inputs, rather than predicting them. Relative potential recovery is of order 10^{-14} absolute error; the three finite-price errors at step 0.02 are below 7.5×10^{-14}. All 300 independent Hessian entries are checked. A separate reference-kernel construction and off-diagonal recovery give a maximum potential error of 1.45×10^{-10}; that lower precision is retained. [E8, §§5–6, 9]

The counterchecks are part of the result. An irreversible circulation preserves all diagonal probabilities while failing the complete-kernel test. Ordinary row normalisation can pass the structural test but encodes a different potential. Exact time doubling preserves the logarithmic generator,

$$-(1/(2a_t)) \log B^2 = -(1/a_t) \log B,$$

but does not generally preserve the naive multiplication-heat-multiplication potential formula with Q simply replaced by Q^2. These tests constrain the source identification; they do not select the physical K, Q or event grain. No RCHS-32 or RCHS-33 integral is rerun or added to this synthetic potential. [E8, §§7–10]

19F. Revised physical source handoff

The combined frontier is now more specific than the original comparison-frequency question. The native observation cannot see hypercharge links; alternative phase-sensitive constructions have explicit responses; the Gibbs amplitude and compact-record marginals can be evaluated; and a complete configuration kernel can, within the stated class, retain the pure-link cost that fixed-link conditionals miss. None of those returns is yet the physical configuration law. [E1–E8]

For the RCHS-34 route, the required upstream return is one source-selected $K^{(n)}(z, dz')$ and its kinetic reference $Q^{(n)}$ on a common physical carrier that includes gauge-link changes with different holonomy. The source must fix the measure, support, reference branch, step and retained-record semantics. The full-kernel certificate must pass without post-hoc symmetrisation, row normalisation or replacement of the proposal law. A kernel generated from inserted closure prices and then inverted is not the required return.

Once admitted, reconstruct V and the normalised raw operator, preserve their complete relevant two-jet, and evaluate the common field response. The split-potential Hessian alone is insufficient where the kinetic reference or embeddings contribute field dependence. Every same-order current, amplitude, record phase and stretch, support, completion, unresolved and matter contribution must be included or shown irrelevant by the same source. Only proved redundancies are quotiented, and physical auxiliary reduction remains distinct from statistical nuisance profiling or a separately defined compact integral. [S1–S3; E8]

An independently derived field-force or forced-response law may supply the equivalent physical information without obeying this symmetric split architecture. Failure of its certificate rejects that representation, not every possible irreversible VERSF source. The physical curvature embedding, action unit, regulator convergence and continuum matching still have to be established before reading Z_3, Z_2, Z_q or couplings. These obligations are not met by another synthetic inverse test or further precision on a fixed-link marginal. [E8, §10]

20. Consolidated claim ledger and falsifiers

The original three experiments and the five later source-history calculations refer to different observations, carriers and statistical operations. Their ranks, response coefficients and verification scopes must be reported with those distinctions. A later conditional construction does not upgrade an earlier finite response to physical source selection.

Object	Result in this integrated paper	Status and scope
Native current instrument and two-jet	Exact equivalent gapped-root expression; first and second derivatives evaluated	Native source-extension law on a nonzero-current gapped patch; not a

Object	Result in this integrated paper	Status and scope
		physical raw H_CMR two-jet
Original current-cycle response	Rank six at two and three updates; split harmonic probes give rank twelve	Finite edge/type observation on the stated neutral-orthogonal witness
Independent varying-circulation signal	$\mathcal{J}\_2\|0 = (9w\_s/16)\ G \otimes I_2$	Exact statistical nuisance result; not an action-bath screening coefficient
Address-erased current score	Zero at every finite length on the symmetric witness	First-order observation cancellation, not general all-order invariance
Joint native current/link action	1,320 original coordinates; profiled finite face rank 66	Complete only in the declared current/link experiment
Native hypercharge-link visibility	Exactly absent at every finite length under Theorem 7	This classical record action alone cannot be a positive full gauge action
Balanced coherent comparison	Normalised phase-sensitive port law; dark-outcome quadratic contrast	Constructed extension using existing transports; operational selection unproved
Comparison action after record adjustment	Rank-216 parent out of 288; positive face rank 72 with closed form $[I + (F + I)^{-1}] \otimes G_0$	Unit-stretch gauge-unitary record branch and stated 24-trial schedule
Product with native action	1,464 original coordinates; retained face rank 72; comparison extremes exactly 1/14 and 81/14; product maximum 81/14 under the archived native-response norm bound, product minimum bounded by the native face norm	Conditional independence of fresh-probe comparisons and native records
Imperfect route coherence	Quartic contrast for fixed overlap below one, with a formal leading-term matching scale $\varphi\star^2 = 2(1 - \nu^2)/(\nu^2 m_2)$	This unbiased readout at its agreement point; the scale matches leading coefficients, not exact contrasts
Comparison occurrence rate	Tagged idle family preserves normalisation and scales the Hessian	Normalisation alone does not select physical frequency

Object	Result in this integrated paper	Status and scope
Covariant endpoint heat trace	Positive rank-72 face response and derived leading Wilson-type term	Finite trace diagnostic of the inherited endpoint subsystem; not its spectral pressure [E4]
Endpoint spectral pressure	Identically zero from retained neutral constant states	Exact obstruction on that endpoint carrier; derivative/long-duration limits differ [E4]
Gaussian amplitude-configuration pressure	Positive rank 72 for fixed positive regulator and exact proper-time bridge	Added field-configuration model; unconfined Gaussian limit singular [E5]
Quartic quantum completion	Finite-cell confinement and positive leading third-order hopping coefficient	Full unit-hopping quantum response not returned [E5]
Gibbs amplitude marginal	Mobility-independent static response; unit hopping through order 22 with all-higher-order tail bound	Conditional potential, measure and parameters; truncation bound is not total numerical error [E6]
Compact record marginal	Positive rank six for all positive record/bond prices	Hypercharge-only, unit-stretch branch; not a complete record-field integration [E7]
Pure-link contribution after both marginals	Changes total curvature while leaving fixed-link conditional laws unchanged	Exact within the explicitly factorised Gibbs test; not a full-source no-go [E7]
Full-configuration reconstruction	Relative split potential and normalised raw operator fixed by admitted K, Q	Exact class-scoped inverse theorem; physical inputs unreturned [E8]
Link-update numerical validation	Synthetic nonlinear prices and Hessian reconstructed; diagonal-only, row-normalisation and time-grain tests executed	Verification of the inverse method, not primitive gauge-price prediction [E8]
Physical source and couplings	Not returned by any of [E1–E8]	Full physical configuration law, H_CMR, W_prim, λ_J, C_hol, Z_3, Z_2, Z_q, g_s, g, g′ remain unissued

20.1 Falsifiers

The following finite tests, each decidable within the declared experiments, would falsify the corresponding claim of this paper.

F1 (instrument fidelity). The gapped-root expression fails to reproduce the archived native Kraus law, or a saturation or moving-kernel derivative term is shown to be omitted from the two-jet. The completeness identities of Proposition 2 fail beyond numerical precision.

F2 (harmonic formula). The exact word-probability sums fail to return $\mathcal{I}_{2,\mathrm{full}} = [(19w_r + 9w_s)/16]\, G \otimes I_2$, or the interference cross blocks are shown to be absent from the correctly restricted split source.

F3 (independent signal). The uniform-profiled two-update matrix deviates from $(9w_s/16)\, G \otimes I_2$, or a nonzero coarsened first score is exhibited at finite length on the symmetric witness against Theorem 6.

F4 (memory). The pair-Markov reconstruction is shown to reproduce the exact three-record law on the principal witness, contradicting the carried-state distinction.

F5 (frame and convention integrity). The joint derivative fails the simultaneous frame test $R_{\mathrm{link}}^{\mathrm{rec}} (D \otimes I_{12}) = 0$, or the stated forward/reverse conventions are shown to be applied inconsistently between the current and link insertions.

F6 (hypercharge blindness). Any finite vertex/type-word probability of the declared native process, with its independent currents held fixed, is shown to change under $U_e \mapsto U_e e^{i\beta_e Y}$ at any length, contradicting Theorem 7. Exhibiting some other current with a positive contrast along those deformations does not contradict §11.3, whose profiled infimum is already achieved at the reference current; only a positive contrast at fixed currents, or a positive current-profiled infimum along a pure hypercharge-link deformation, falsifies the claim.

F7 (comparison completeness and covariance). The comparison instrument fails $M_+^\dagger M_+ + M_-^\dagger M_- = I$, or its port probabilities change under the simultaneous endpoint-frame transformation of Proposition 8.

F8 (dark-outcome curvature). The executed one-loop family fails either explicit value: the contrast curvature $\Gamma_q''(0) = 27/7$ at the agreement point, or the positive-support limit $\lim_{(\varphi\to 0,\, \varphi\neq 0)} \mathcal{I}(\varphi) = 54/7$. No regular positive-support Fisher matrix exists at the dark-outcome boundary itself; the factor-of-two distinction of §13.1 is between these two well-defined quantities, and its failure on the executed family falsifies the support-opening claim.

F9 (closed-form parent). The 24-trial parent deviates from $[L + I, -I; -I, L + I] \otimes G_0$, its null space is shown to differ from the frame gradients $(D\varphi, D\varphi)$, or the face response deviates from $[I_6 + (F + I_6)^{-1}] \otimes G_0$ on the declared branch (Lemma 15.1).

F10 (signed census and source fidelity). The claimed unchanged representation fails if the preserved archived generator violates the blockwise identity $P_r(6Y)P_r = q_r P_r$ for any terminal sector r, with q = (1, 4, −2, −3, −6, 0, 3) in the declared order (Q, U, D, L, E, N, H), or if a declared source change has been omitted from the provenance record. On the occupied support, the diagnostic traces $\Sigma d_r q_r^2 = 378$, $\Sigma d_r q_r^3 = -234$ and $\Sigma d_r q_r^4 = 7002$ must also agree, and the Γ_q coefficients must satisfy Lemma 16.1. The cubic trace is an unweighted source-convention diagnostic, not an anomaly calculation. Neither the even moments nor the cubic diagnostic replaces the direct blockwise check.

F11 (product compatibility). The product link response fails to equal R_native + R_{24} on the common 144-coordinate chart, the face response fails Z_product^face = $(T\_C \otimes I_{12})^T$ (R_native + R_{24}) $(T\_C \otimes I_{12})$, the product face maximum deviates from 81/14 beyond the archived native-response norm bound, or the product face minimum leaves the interval [1/14, 1/14 + $\|$Z_native^face$\|_2$] (Remark 17.1).

F12 (coherence order). A fixed overlap $\nu < 1$ is shown to yield a nonzero quadratic term for this unbiased readout at its agreement point, or the exact contrast values quoted at the leading-term matching scale in Remark 18.1 fail on the executed family.

F13 (heat versus pressure). The inherited endpoint heat trace fails its stated leading triangular coefficient or positive finite face rank, or a gauge link is shown to lift the retained neutral constant endpoint modes. A positive derivative-before-limit Hessian may not be substituted for the Hessian of the limiting pressure. [E4]

F14 (configuration and Gibbs typing). The regulated Gaussian pressure fails the exact proper-time identity, or the confining quartic fails the stated leading spectral-loop formula under its hypotheses. Identifying $-\Delta/4 + \boldsymbol{\mathcal{F}}$ with the same-$\boldsymbol{\mathcal{F}}$ reversible Gibbs operator without the derivative-potential terms invalidates that identification, not the separately defined quantum model. [E5, E6]

F15 (controlled Gibbs calculation). The radial moment substitution, positive loop expansion or analytic majorant fails for the stated ensemble. An omitted-tail claim must retain its norm and benchmark; independent verification through order eight may not be described as a separate verification of all 22 orders. The 4.4212% comparison is with the Gibbs cubic term only. [E6]

F16 (compact record calculation). The original matrix residuals fail to reduce to S_RB on the declared branch, the compact integral disagrees with its positive Fourier representation, or its flux dependence fails to vanish when either price is zero. A rank-six hypercharge calculation may not be reported as integration of all record directions. [E7]

F17 (configuration inverse). An admitted fixed (K, Q) pair of the stated split class fails relative-potential recovery, or the equivalence K = $\mathcal{D}$(B) fails. The test is not passed by matching only the diagonal, using an unknown replacement reference, or presenting inserted prices as predicted outputs. [E8]

F18 (normalisation and event grain). Ordinary row normalisation, irreversible circulation or time doubling is shown to be treated as preserving the original split potential without the required full-kernel and generator tests. The source's normalisation and step cannot be chosen retrospectively from the recovered curvature. [E8]

20.2 Mathematical and numerical checks

A claimed local result fails if the gapped expression does not reproduce the native instrument, if saturation or moving-kernel derivatives are omitted, if differentiated completeness fails, or if exact word probabilities do not reproduce the response. The harmonic formula must retain both interference cross blocks. The current and link derivatives must use the stated forward/reverse conventions and pass the simultaneous frame test.

The hypercharge result is established by the actual terminal algebra and induction, not by numerical rank. The coherent comparison must be complete and gauge covariant with matching endpoints. Its likelihood Hessian must retain the dark-outcome term. Record profiling must reproduce the direct finite contrast on its stated local branch, and the product result must reproduce the common block minimum. Appendix A records the archived verification results and their limits.

20.3 Conditions that prohibit physical promotion

A finite information matrix may not be renamed as a force stiffness. An observation-null direction may not be declared physical gauge merely to remove it. The native discrete channel may not be replaced by a self-adjoint heat transfer, and statistical profiling may not be called a physical bath without the missing identification.

The positive comparison response may not be presented as a primitive selection theorem, as a physical coupling ratio from representation traces, or as a proof that an exactly balanced comparison occurs once per physical Fold. The zero reference probability may not be discarded to force use of a regular Fisher formula. Partial coherence may not be equated with exact coherence at this support boundary. The product construction may not double-count a physical source term or omit physical correlations by assuming independence.

Changing record length is not regulator refinement. Exact subdivision of an existing link holonomy is not interacting continuum convergence. Choosing a preparation, frequency or coefficient because it improves a gauge, flavour or mass target would invalidate the claimed source derivation.

The later heat trace, quantum configuration pressure, Gibbs marginal, compact record integral and reconstructed split potential must not be relabelled as one common action. Their positive responses are not additive merely because they concern the same gauge generators. The sole Gibbs addition used here is the explicitly factorised RCHS-33 test, with its remaining pure-link term retained. RCHS-34's synthetic potential is not another contribution to that marginal.

A field-independent constant left by a fixed full-configuration reconstruction is different from a separately adjustable constant for each external gauge background. Knowing the kinetic reference is part of the reconstruction hypothesis, not a freedom removed by normalising K. No physical spatial-refinement claim follows from a finer derivative stencil, a larger Fourier window, more hopping orders or longer Euclidean duration.

20.4 What is inherited and what is established by these executions

The wheel geometry, occupied census, current profiles, primitive charge conversion, MASD residuals, quartic shape, conditional Gibbs layer and HMGBC split-transfer architecture are inherited at their stated grades. The original source-specific returns [E1–E3] are the native current two-jet, independent varying-circulation signal, address and memory results, joint likelihood calculation, exact hypercharge obstruction and coherent-comparison realisation.

The continuation returns [E4–E8] are the direct heat-loop calculation and pressure distinction; the additional amplitude-configuration pressure and leading quartic quantum loop; the Gibbs-compatibility test and controlled equilibrium response; the full compact hypercharge record integral and pure-link conditional-reconstruction boundary; and the class-scoped full-configuration inverse with synthetic validation and counterchecks. Their consolidation is not a new calculation or an additional physical closure certificate. Standard spectral, Gibbs, Fourier, Schur and Perron/Doob methods retain their established mathematical provenance.

21. Scientific conclusion

The original RCHS-29 results remain intact. The native representation-valued instrument has been differentiated through second order; its tested current-cycle signal and joint current/link likelihood action have been evaluated; and the exact terminal-algebra theorem explains why that classical observation cannot alone supply hypercharge curvature. A separately declared coherent comparison of existing transports supplies a conditional positive rank-72 finite response, not its primitive physical selection. [E1–E3]

The later calculations extend the argument without identifying unlike response objects. The inherited endpoint heat operator contains a direct Wilson-type loop term, while its spectral pressure remains zero. A different amplitude-configuration operator has a nonzero regulated pressure and a confining quartic alternative, but its additional kinetics are not selected by the prior Gibbs statements. The Gibbs route instead gives a mobility-independent static amplitude marginal with a controlled unit-hopping evaluation. Compact integration then supplies the nonlinear hypercharge record contribution on its stated fixed-stretch branch. These are calculated mechanisms and contributions, not final force strengths. [E4–E7]

The remaining pure-link term is invisible to conditional amplitude and record laws with the links fixed, but need not be invisible to one complete configuration transition law. Within the specified HMGBC split class, a known kinetic reference and an admitted full-configuration kernel determine the relative potential and normalised raw operator; a full-kernel certificate prevents diagonal agreement from being mistaken for source identity. The numerical validation recovers deliberately supplied prices. It does not provide the missing physical kernel. [E8]

The completed work is therefore an integrated finite-response, marginal-evaluation and source-reconstruction programme. The uncompleted work is the primitive

selection of the full configuration law or equivalent field response, its complete physical quadratic action and its continuum normalisation. The next substantive calculation must return information about changes of gauge-link configurations themselves, not repeat a fixed-link marginal or another inserted-price inverse test. No physical W_prim, λ_J, C_hol, Z_3, Z_2, Z_q or gauge coupling is issued. Machine-readable unreturned values remain null, not zero.

APPENDICES | VERIFICATION AND PROVENANCE

Appendix A. Verification record

The tables in A.1–A.3 report the original archived calculations [E1–E3]. A.4 records the independent verification layer performed when those three executions were integrated, in exact arithmetic where the objects permit it. A.5 reports the archived continuation verification in [E4–E8], together with a short set of exact identity checks performed at this integration. Separate verifiers mean different computational routes within the corresponding packages, not external research-group replication.

A.1 Native current two-jet and finite records

The original native package [E1] contains the unchanged archived sources/native_law.py; the analytic native two-jet; an exact history-path summation; a separate finite-field verifier; and a full six-direction second-derivative check on each edge. No measured Standard Model value is used. All computations are deterministic.

Verification	Returned error or result
Gapped-root evaluator vs archived native Kraus law	1.99×10^{-15} scaled
Native completeness	2.69×10^{-15} scaled
First differentiated completeness	1.77×10^{-15} absolute
Second differentiated completeness	2.60×10^{-15} absolute
Local gauge-covariant channel check	3.46×10^{-16} scaled
Central-phase derivative after terminal projection	3.67×10^{-16} absolute
Global complex-scale derivative	1.35×10^{-16} absolute
Pair derivatives, all 72 edge/probe columns, step 10^{-4}	4.10×10^{-11} scaled
Three-record derivatives, four specified edge pairs, step 3×10^{-4}	2.82×10^{-10} scaled
Full mixed pair-probability second derivatives, rim/spoke	below 9.85×10^{-9} absolute
Exact symbolic spatial identities	10 of 10 pass
Pair factorisation against exact profile formula	7.85×10^{-18} scaled
Independent m = 2/4 Schur formula	3.63×10^{-18} scaled

The scaled error is $\|A - B\|/\max(1, \|A\|, \|B\|)$ unless a relative error is explicitly identified. The primary Kraus-operator finite differences show the expected decrease from steps 10^{-3} to 3×10^{-4}. At 10^{-4} the second operator derivative begins to expose subtractive roundoff. All three step results are retained; monotonic convergence beyond the optimal step is not claimed.

The independent verifier differentiates the archived native law rather than calling the primary jet builder. It checks all seventy-two first edge/probe directions, twenty-four three-record derivatives on four predetermined edge pairs, a nontrivial local gauge-covariance case, and exact symbolic wheel identities. The separate second-derivative verifier uses the analytic jet for the prediction and the archived law for finite differences, checking all twenty-one independent mixed pairs on both a rim and a spoke. These are separate computational routes, not an external independent research-group replication.

A.2 Joint native action and hypercharge test

The primary calculation uses the analytic native jet and exact weighted word sums. The finite-field verifier instead calls the archived OrbitLaw source, constructs the transported forward and reverse maps directly, and differentiates actual probabilities. It does not use the primary jet to generate its finite-field predictions.

Check	Executed result
Reconstructed reference triple law	Relative error 8.61×10^{-16}
96 link derivative cases at step 10^{-3}	Maximum absolute error 4.00×10^{-13}
Nonzero link derivatives at that step	Maximum relative error 7.43×10^{-7}
Ten dense full-current derivative cases at step 10^{-4}	Maximum relative error 1.05×10^{-8}
Nonidentity finite gauge covariance	Maximum relative error 2.28×10^{-15}
Finite hypercharge link twists, both orientations	Maximum relative error 2.25×10^{-15}
Return to original RCHS-29 six-current response	Relative error 1.24×10^{-15}
Minimise quadratic parent vs retained Schur form	Relative agreement better than 1.1×10^{-15}

The link derivatives are small. Reducing their finite-difference step below 10^{-3} eventually increases relative roundoff error, even though the absolute discrepancies remain around 10^{-12} or smaller. The package retains all step values rather than claiming monotonic convergence beyond the numerical optimum.

A.2.1 Direct likelihood-action check

A separate verifier evaluates the complete finite three-update KL contrast using the original field-dependent source. For a link direction chosen from the computed largest retained mode, the predicted Hessian is k_prof = 9.7451290573 × 10^{-9}.

The current displacement is its calculated stationary nuisance adjustment, not a fitted change. The symmetric finite-contrast calculation gives:

Field step	Relative Hessian error
10^{-3}	2.498×10^{-4}
3×10^{-4}	2.248×10^{-5}
10^{-4}	2.498×10^{-6}

The step dependence is consistent with the quadratic Taylor prediction. The original six-current probe is also checked, with relative Hessian error 2.69×10^{-10} at step 10^{-4}. A pure hypercharge-link test gives numerical KL about 1.65×10^{-34} at finite amplitude 0.17, consistent with the analytic exact zero. These tests verify the **statistical action**, not its physical selection.

A.3 Coherent comparison and joint product

The following results were executed in the phase-sensitive continuation [E3] and are retained here with the same scope. The primary code uses the archived representation builder unchanged, apart from copying its final generator and multiplying the copy by six for primitive gauge insertion. The independent verifier reconstructs the representation from elementary matrix units rather than importing that builder. It also solves the record problem as a residual least-squares problem rather than reusing the primary block-reduction routine.

Check	Executed discrepancy
Independent representation reconstruction	Exactly zero in the exported arrays
Independent residual-parent reconstruction	1.33×10^{-16} relative
Record minimiser, independent least-squares route	8.23×10^{-16} relative
Reduced residual action	3.73×10^{-16} relative
Independent finite face response	3.40×10^{-16} relative
Finite comparison completeness	1.25×10^{-15} absolute Frobenius bound
Nonidentity local gauge transformation, port probabilities	2.78×10^{-17} absolute bound
Terminal-type sum after comparison	6.94×10^{-18} absolute bound
Direct matrix versus charge-sine loop probability	1.39×10^{-17} absolute bound
Joint product minimum versus summed reduced response	5.35×10^{-16} relative bound

Four dense 288-coordinate directions were checked against the exact nonlinear comparison contrast. The maximum symmetric finite-difference error falls from 1.23 ×

10^{-6} at step 10^{-2} to 1.23×10^{-8} at step 10^{-3}. These directional tests verify the analytic Hessian; they are not an exhaustive numerical census of all mixed derivatives.

The high-precision one-loop calculation separately checks the support-opening limits. At $\varphi = 10^{-4}$, $2\Gamma\_q/\varphi^2 = 3.857142834795918$, approaching 27/7, whereas the positive-step Fisher value is 7.714285505816327, approaching 54/7. Imperfect-overlap tests reproduce the quartic coefficient in Theorem 11. The proof, not numerical closeness, establishes its zero quadratic term.

A.4 Independent integration verification

The following checks were performed independently at integration, in exact rational or symbolic arithmetic where the objects permit it and to double precision otherwise. They are integrity checks on the exact statements displayed in this paper, not a rerun of the archived numerical experiments; all quoted experiment values (G, ranks, residuals, eigenvalue lists, α, k_prof, the §16.1 direction) remain at the archived packages' provenance.

1. Census identities: $\Sigma d\_r\, q\_r^2 = 378$ and $\Sigma d\_r\, q\_r^4 = 7002$ recomputed from the occupied ranks and primitive charges; $m_2 = 54/7$, $m_4 = 7002/49$, $m_2/2 = 27/7$ exact.
2. Γ_q series: the displayed −log expansion recomputed symbolically; coefficients 27/14 and −219/196 exact, and equal to $m_2/4$ and $m_2^2/32 - m_4/48$ (Lemma 16.1).
3. Theorem 11: the binary contrast expanded symbolically over general (ν, m_2, m_4); zero quadratic coefficient and quartic $\nu^2 m_2^2/[8(1-\nu^2)]$ exact; the $\nu = 1$ case returns $m_2/4$. The matching scale of Remark 18.1 follows by equating the two displayed leading coefficients; the exact contrasts quoted there at $\nu = 0.99$ and $\varphi = \varphi\star \approx 0.0725535$, namely $\Gamma\_\nu \approx 0.00453670$ against $\Gamma_1 \approx 0.01012095$, were recomputed to 30-digit precision from the executed charge distribution, confirming that the leading-term matching is not an exact crossover of the contrasts.
4. Wheel profiles rebuilt from the incidence construction of §2.2: $\|y\_\mu\|^2 = 5/3$, $\|c\_\mu\|^2 = 1$, $\|y\_\mu - c\_\mu\|^2 = 2/3$, $\|c_0\|^2 = 3/4$, $\|c_2\|^2 = 1/4$ reproduced; profile Grams $R_{0,r}^T R_{0,r} = (3/4)I_2$, $R_{2,r}^T R_{2,r} = (1/16)I_2$, $R_{2,s}^T R_{2,s} = (9/16)I_2$, $R_{0,r}^T R_{2,r} = (3I_2 + \sqrt{3}J)/16$ and $R_{0,s} = 0$ reproduced (antisymmetric sign at one helicity convention).
5. Theorem 5: the Schur step computed symbolically in (w_r, w_s); $(3I_2 - \sqrt{3}J)(3I_2 + \sqrt{3}J) = 12I_2$, $B^T A^{-1} B = (w\_r/16)I_2$, and $\mathcal{J}\_2|0 = (9w\_s/16)I_2$ per factor; the coefficient decomposition of Remark 6.1 and Theorem 4's sum $(19w\_r + 9w\_s)/16$ confirmed.
6. Exposure numerics: w_r, w_s, s_0, s_2, the interference $3w\_r/8$, s_full and $9w\_s/16$ recomputed at 30-digit precision from the displayed α formulae; all agree with the archived table to every printed digit.
7. Proposition 1: the decomposition $S = \Sigma v\_a v\_a^\dagger + s\rho$, the identity $s = \Sigma\|v\_a\|^2$, $A u = u$ and $(R - \rho)^2 = I - S/s$ verified on an independent generic 12-generator instance to 10^{-14}; the $\sqrt{\varepsilon}$ contrast of Remark 3.1 observed directly (naive gapless root off by $\approx 10^{-8}$, deflated root exact at working precision).
8. Comparison instrument: $M_+^\dagger M_+ + M_-^\dagger M_- = I$ and the two displayed forms of p_- verified on independent random unitaries to 10^{-15}.

9. Theorem 9: the dark-outcome Hessian formula verified symbolically on an independent four-outcome family with one dark outcome; KL Hessian equals the split-sum prediction exactly.
10. Lemma 15.1: CD = 0, spec F = {1, 2, 2, 4, 4, 5}, ker L = im D (exact dimension count), the channel decoupling of H_{24}, the rank-216 count, the intertwining $(L + I)C^T = C^T(F + I)$ and the closed form Z_{24}^face = $I_6 + (F + I_6)^{-1}$ per generator factor, all in exact rational arithmetic.
11. Representation traces: Tr $T_3^2 = 6$ per colour pair, Tr $T_2^2 = 13/2$ and Tr $q^2 = 378$ recomputed from the multiplet content of the occupied support, confirming G_cmp = $(1/49)\mathrm{diag}(6I_8, (13/2)I_3, 378)$ and the G_0 eigenvalues 3/49, 13/196, 27/7.
12. Face table and extremes: every entry of the §16 table recomputed as $z(\lambda)$ and $z(\lambda)\cdot m_2/2$; the comparison extremes identified exactly as $1/14 = z(5)\cdot(3/49)$ and $81/14 = z(1)\cdot(27/7)$, matching the archived decimals to every printed digit; 81/14 shown to be an exact eigenvalue of the product by the kernel argument of Remark 17.1, its maximality established under the archived norm bound via the 9/14 spectral gap, and the product minimum bounded within [1/14, 1/14 + ||Z_native^face||$_2$].
13. Support-opening limits: 2Γ_q/φ^2 and the positive-step Fisher value recomputed at $\varphi = 10^{-4}$ to 30-digit precision; both archived decimals reproduced exactly, approaching 27/7 and 54/7.

Items not reproducible at integration and carried at the archived report grade: the executed G matrix and its eigenvalue lists, all rank determinations of the represented current block, the whitening and range residuals, the §16.1 unit-direction prediction 4.682478525607925 and its stationarity solves, λ_min(A) on the witness, and every quoted package residual.

A.5 Archived continuation verification

Execution	Verification reported by its archive	Limit retained
E4 / RCHS-30	Independent incidence-factor assembly, matrix-exponential differentiation checks, finite field variations, neutral-state checks and a high-precision leading-loop test	Verifies the endpoint subsystem and trace/pressure distinction, not a full configuration-history source
E5 / RCHS-31	Independent Gaussian resolvent/spectral checks; radial Galerkin versus radial-grid quartic spectra; time-order and harmonic-limit checks	The quartic result is a leading hopping coefficient; no full unit-hopping quantum remainder bound
E6 / RCHS-32	Independent closed-walk and determinant calculations through order eight agree at approximately 3.8×10^{-15} relative response discrepancy; the order-22 result has a 3.07×10^{-16} analytic hopping-tail bound	Independent walk execution stops at order eight; the tail bound excludes roundoff and local quadrature error

Execution	Verification reported by its archive	Limit retained
E7 / RCHS-33	Positive Fourier/Bessel construction and separate angular-coordinate integration agree at approximately 10^{-15} relative error on converged grids; original residuals and finite phase changes checked	Hypercharge-only, fixed-stretch compact branch; truncation bounds are not interval-certified total errors
E8 / RCHS-34	Diagonal recovery of relative potential at approximately 10^{-14} absolute error; three inserted prices recovered below 7.5×10^{-14} at step 0.02; separate off-diagonal recovery at 1.45×10^{-10} maximum potential error	Synthetic 24-coordinate, 1,153-state diagnostic; the second method has lower precision and does not certify a physical proposal law

Reported precision refers to each archive's stated norm, benchmark and resolution. Analytic truncation control, floating-point agreement, physical regulator convergence and physical source selection are different claims. Neither a very small numerical residual nor its repetition in this integration closes the missing physical-source gate.

A.5.1 Integration-level exact checks

The following identities in §§19A–19E were re-derived symbolically at this integration. They are consistency checks on the displayed formulae, not reruns of the archived experiments.

1. Triangle edge weight: from $K_e = I_{12}/31$ and $M_v = \mathrm{diag}(7, 4, \ldots, 4)/31$, the spoke entries of L_U have magnitude $1/\sqrt{28}$ and the rim entries $1/4$, so each hub-rim-rim triangle has edge-weight product $(1/\sqrt{28})(1/4)(1/\sqrt{28}) = 1/112$, as displayed.
2. Heat-trace coefficient: the s^3 closed-walk expansion with endpoint dimension $343 = 7 \times 49$ gives the prefactor $1/(112 \times 343) = 1/(784 \times 49)$, reproducing the $s^2/784$ normalisation of $\mathcal{F}_s^{tr}$ exactly; a direct numerical trace on the scalar wheel with a single rim phase reproduces the $-(s^3/112)(1 - \cos \varphi)$ leading difference.
3. Proper-time identity: $\sqrt{a} - \sqrt{b} = (1/(2\sqrt{\pi})) \int_0^\infty s^{-3/2} (e^{-sb} - e^{-sa})\, ds$ applied termwise gives the displayed bridge between $\Delta\mathcal{E}_\mu$ and Z_s exactly.
4. Gradient-Gibbs operator: the displayed $\mathcal{H}_{GG}$ annihilates $e^{-\beta\mathcal{F}/2}$ as a formal differential identity, verified in exact symbolic arithmetic. For the confining finite-cell quartic and the stated self-adjoint realisation, this function is square integrable and supplies a zero ground eigenvalue. The differential cancellation alone is not a ground-state existence statement for every smooth $\mathcal{F}$: for $\mathcal{F} = -x^2$ at unit mobility and $\beta = 1$ the operator is $-d^2/dx^2 + x^2 + 1$, whose formal null function $e^{x^2/2}$ is not normalisable and whose normalisable ground function $e^{-x^2/2}$ has eigenvalue two.
5. Gibbs Hessian: $\partial_i\partial_j \mathcal{A}_{amp} = \beta\langle\mathcal{F}_{ij}\rangle - \beta^2\, \mathrm{Cov}(\mathcal{F}_i, \mathcal{F}_j)$ is the exact second-cumulant identity of the displayed marginal.
6. Record price function and signed census: $v(x) = 49 - \mathrm{ReTr}\, e^{ixq}$, recomputed from the occupied census (ranks (18, 9, 9, 6, 3, 2, 2), archived primitive charges (1, 4, −2, −3, −6, 0, 3)), reproduces the displayed five-cosine form, the $|q| = 3$ coefficient 8 = 6

+ 2, and $v''(0) = \Sigma d_r q_r^2 = 378$. The archived signed list equals 6Y exactly at the standard sector hypercharges (1/6, 2/3, −1/3, −1/2, −1, 0, 1/2). The even moments cannot distinguish signed conventions: the odd diagnostic $\Sigma d_r q_r^3 = -234$ separates the archived list from its even-moment-equivalent sign flips (which give +54), and the blockwise identity $P_r (6Y) P_r = q_r P_r$ on each terminal sector is the direct test of the preserved convention.

7. Harmonic comparison: the inherited formula $378rb(rF + bI_6)^{-1}$ at r = b = 1 has eigenvalues $378/(\lambda + 1)$ on spec F = {1, 2, 2, 4, 4, 5}, namely 189, 126, 75.6 and 63 with multiplicities 1, 2, 2, 1, matching the multiplicity pattern of the archived compact eigenvalues and their stated percent-level distance.
8. Reconstruction identities: the diagonal identity $K_{zz} = e^{(-a_t V(z))} Q_{zz}/\zeta$, the recovery formula of Proposition 19E.1, the equivalence $K = \mathcal{D}(B)$ with spr(B) = 1 and $B = T/\zeta$, and the time-doubling generator identity in §19E.3 were re-derived from the stated hypotheses.

The archived matrices, spectra, hopping series, Fourier integrals and synthetic reconstructions in [E4–E8] are not rerun here and remain at their package provenance.

Appendix B. Reproducibility record

B.1 Frozen execution packages

The original numerical sources are the three previously delivered packages [E1–E3] listed below. Five later continuation packages [E4–E8] are listed in B.3. Each retains its own experiment, source manifest, code, arrays and verification record.

Execution	Package	Principal content
E1: native current	Native current package	Native law, analytic two-jet, exact record sums, harmonic response and first/second-derivative checks
E2: joint action	Joint action package	Full native-current/link parent, current profiling, face response and direct finite likelihood verification
E3: coherent comparison	Phase comparison package	Comparison law, phase-sensitive parent, support-opening and coherence tests, product response and separate verifier

E1 archive: RCHS-29_Reproducibility_Package.zip **E2 archive:** RCHS-29_Continuation_Reproducibility_Package.zip **E3 archive:** RCHS-29_Phase_Comparison_Package.zip

E2 consumes the original native source and E1 results. E3 consumes unchanged E2 joint/face arrays rather than independently rerunning the full joint assembly. That dependency is retained. No original package is relabelled as a physical source-selection certificate.

B.2 Reproduction commands

Run the commands from the corresponding extracted package directory, using the recorded or compatible NumPy/SciPy/SymPy environments. The original E1 record reports Python 3.13.5, NumPy 2.3.5 and SciPy 1.17.0; the respective package environment records are authoritative for each execution.

Native current package (E1):

```
OPENBLAS_NUM_THREADS=1 python code/run_rchs29.py
OPENBLAS_NUM_THREADS=1 python code/verify_rchs29.py
OPENBLAS_NUM_THREADS=1 python code/verify_cycle_twojet.py
OPENBLAS_NUM_THREADS=1 python code/verify_neutral_support.py
```

Joint native action package (E2):

```
OPENBLAS_NUM_THREADS=1 python code/run_all.py
```

The principal E2 arrays are results/internal.npz, results/joint.npz and results/face_response.npz. They preserve the conditioned current chart, joint blocks, minimum-current map, link response and fixed face/gauge geometry.

Phase comparison package (E3):

```
OPENBLAS_NUM_THREADS=1 python code/run_comparison.py
OPENBLAS_NUM_THREADS=1 python code/verify_comparison.py
```

Its JSON/NPZ outputs retain the complete finite response, rank thresholds, finite-difference steps and physical null entries. Input manifests identify snapshots before evaluation; delivery manifests identify the resulting package. Hashes establish snapshot reproducibility, not external preregistration or physical uniqueness.

The exact product-subdivision check in E3 preserves an existing link holonomy. It does not establish interacting regulator convergence or how comparison density scales with refinement. None of the finite-history calculations establishes an asymptotic information rate.

B.3 Continuation packages and dependency record

Reference	Archive	Main return
E4	RCHS-30_Reproducibility_Package.zip	Covariant endpoint heat response, triangular coefficient and neutral-pressure test
E5	RCHS-31_Reproducibility_Package.zip	Additional amplitude-configuration model, Gaussian pressure and leading quartic quantum loop
E6	RCHS-32_Reproducibility_Package.zip	Gradient-Gibbs compatibility and controlled equilibrium amplitude marginal

Reference	Archive	Main return
E7	RCHS-33_Reproducibility_Package.zip	Compact hypercharge record marginal and explicit pure-link remainder
E8	RCHS-34_Reproducibility_Package.zip	Relative-potential reconstruction, synthetic kernel validation and counterchecks

For each of E4–E8, run from that archive's extracted calculation directory:

```
OPENBLAS_NUM_THREADS=1 python code/run_calculation.py
OPENBLAS_NUM_THREADS=1 python code/verify_calculation.py
```

Each package's own README, environment and machine-readable outputs are authoritative for its parameters and error definitions. These commands are reproduction instructions, not a statement that they were rerun during this integration.

E4 retains the archived endpoint representation and distinguishes it from the complete field-history carrier. E5 consumes that endpoint operator while adding its declared configuration model. E6 uses the same amplitude potential but a different statistical operation; it does not finish E5's quantum unit-hopping calculation. E7 consumes the existing E6 amplitude arrays unchanged and joins them only within its explicitly factorised Gibbs test. E8 reruns neither marginal and adds neither to its synthetic reconstruction potential.

The original current, comparison and later marginal actions are not summed into a physical master action. Hashes establish snapshot integrity and reproducibility, not primitive uniqueness or external preregistration. All physical output fields remain unreturned.

B.4 Integration check record

The additional checks listed in Appendices A.4 and A.5.1 are manuscript-integration checks, separate from the eight archived numerical executions. Their consolidated script and execution log are distributed together with this manuscript as

```
rchs29_integration_checks.py
rchs29_integration_checks_output.txt
```

and any redistribution of the manuscript without them leaves the integration-check record unreproduced from the supplied materials. The script is self-contained apart from standard NumPy, SciPy, SymPy and mpmath. The log records the execution date and the SHA-256 hash of the manuscript file present in the working directory at run time, so a recorded hash identifies the exact manuscript text a given run checked.

One implementation limit is stated rather than hidden. The script enters the corrected signed charge list $q = (1, 4, -2, -3, -6, 0, 3)$ manually and checks the manuscript's displayed identities against it; that is an internal-consistency check, not by itself fidelity to the archived generator. When the phase-comparison package's saved generator array is passed to the script as an optional path argument, it additionally performs the blockwise comparison $P_r(6Y)P_r = q_r P_r$ against the preserved source. Without that input, archive fidelity rests on direct inspection of the preserved native_law.py, run_comparison.py and saved generator array, as recorded in the external review, not on this script.

Twenty-five core checks are executed, covering the signed census and its odd diagnostic, the Γ_q moment coefficients, Theorem 11 with the leading-term matching-scale contrasts, the face geometry and closed-form Z_{face}, the comparison extremes and the product-maximum spectral-gap argument, the heat-trace triangle coefficient, the proper-time identity, the gradient-Gibbs formal identity with its normalisability counterexample, the compact record price function, the harmonic eigenvalue comparison and the reconstruction identities. These checks validate displayed formulae; they do not rerun, and their success does not re-certify, the archived numerical experiments.

Appendix C. Sources and provenance

[S1] K. Taylor, *RCHS-24: The Quadratic Gauge Release and Conditional First-Fact Endpoint Reduction Theorem in VERSF*, especially the source-response and pass-criterion sections. The current/record/state, raw/Fisher and physical-weighting distinctions are retained.

[S2] K. Taylor, *PGRS-1: Primitive Gauge-Response Selection in VERSF: source two-jet execution, a covariant identifiability test, and the unclosed physical-weighting gate*, working paper PGRS-1-R0, 6 September 2026. The source two-jet versus normalised-score distinction and the restriction of non-identifiability claims to their tested classes are inherited, not re-proved as new physical results.

[S3] K. Taylor, *The VERSF History-Measure, Generation-Geometry and Branch-Closure Theorem* (HMGBC-1), especially §§16, 19 and 56A.2–56A.11. These sources control the physical transfer, tangent embedding, persistent projection, information/action distinction and execution grade.

[S4] K. Taylor, *CRTF-HMGBC Current-Cycle Raw-Transfer Derivative Execution*, 2 September 2026. Source of the full current-cycle profiles, inherited 3/4 to 1/4 split, conditional scalar-score executions and the missing physical generator derivative. The old 2.53% scalar-score coverage is not applied to the new native experiment.

[S5] K. Taylor, *HM12 State-Conditioned Source Continuation*, archived native_law.py, as preserved in the HFB-G1 package. Supplies the exact generation-major representation, terminal projectors and saturated pure-ray current instrument. The source file is preserved unchanged in the native calculation package [E1].

[S6] K. Taylor, *HM12 continuation: stationary active state and multi-record current response*, 5 September 2026. Source of the state-preserving channel, stationary one-record zero and previous single-direction pair/triple information calculations. The present six-direction harmonic response and exact profile/projection formulas are distinct executions.

[S7] K. Taylor, *HFB-G1 hard execution attempt: Native representation-resolved record memory and the physical-admission outcome*, 6 September 2026. Source of the previously executed rank-42 native internal-memory block and its explicit non-identification with a physical action bath. That block is not counted anew in this paper.

[S8] K. Taylor, *The VERSF Master Substrate Action and Constitutive-Descent Theorem* (MASD-1). Independent (ρ, U, J, Φ) variables, common six-defect architecture, physical-direct response and benchmark/physical separation are consumed at their stated grades.

[S9] K. Taylor, *The Substrate Response Principle* and *Microscopic Origin of Refinement Transport in VERSF*. Their stated scope does not provide a numerical full current-record action response: the former is a qualitative constraint programme and the latter retains microscopic matter-coupling/normalisation obligations. They are not used to fill the missing physical weights.

[S10] K. Taylor, *The Gauge-Response and Coupling-Evaluation Theorem in VERSF*, especially §§8–12, 21 and 34.2. Integrated link coordinates, vacuum-relative holonomy, primitive charge q = 6Y and the conditional holonomy-Wilson bridge are inherited. Limited uniqueness and the unclosed physical-coupling gate remain controlling.

[S11] K. Taylor, *HCMR-P1: Event-Level Preparation, revised source-currency manuscript*, §§24–28, and its revised source-currency companion. Resolved-mark rephasing invariance, coherent-lift non-uniqueness and the interference-capable readout requirement are consumed. The paper does not select the balanced comparison used in Part IV.

[E1] K. Taylor, *RCHS-29: Representation-Resolved Current-Cycle Source Response in VERSF*, working calculation, 6 September 2026, and RCHS-29_Reproducibility_Package.zip. Source of the native two-jet, rank-six/rank-twelve current response, harmonic/nuisance identities, address-erasure theorem, memory comparison and verification outputs retained in Part II.

[E2] K. Taylor, *RCHS-29 Continuation: Joint Current-Link Record Action and the Hypercharge-Visibility Test in VERSF*, 6 September 2026, and RCHS-29_Continuation_Reproducibility_Package.zip. Source of the joint 1,320-coordinate likelihood experiment, exported current/link matrices, current profiling, rank-66 finite curvature result and exact all-finite-history hypercharge theorem.

[E3] K. Taylor, *RCHS-29 Phase-Sensitive Continuation: Coherent Loop Comparisons, Dark-Outcome Curvature and a Conditional Action Bridge in VERSF*, 6 September 2026, and RCHS-29_Phase_Comparison_Package.zip. Source of the normalised comparison construction, support-opening theorem, 288-coordinate comparison parent, rank-72 finite responses, 1,464-coordinate product experiment, coherence-order result and occurrence-rate boundary.

[E4] K. Taylor, *RCHS-30: Covariant Heat-Transfer and Holonomy-Response Test in VERSF*, working calculation, September 2026, and RCHS-30_Reproducibility_Package.zip. Source of the inherited-endpoint heat two-jet, finite loop response, leading triangular coefficient, neutral spectral-pressure obstruction and derivative/long-duration distinction. Its trace is not the full physical action.

[E5] K. Taylor, *RCHS-31: Amplitude-Configuration History Pressure and Quartic Loop Response in VERSF*, working calculation, September 2026, and RCHS-

31_Reproducibility_Package.zip. Source of the explicitly added configuration completion, Gaussian pressure/proper-time identity, unconfined cusp and positive leading quartic hopping coefficient. Physical completion selection and the full quartic quantum unit-hopping response remain open.

[E6] K. Taylor, *RCHS-32: Gradient-Gibbs Compatibility and Controlled Finite Gauge Response in VERSF*, working calculation, September 2026, and RCHS-32_Reproducibility_Package.zip. Source of the class-scoped Gibbs transformation, mobility-independent static response, non-Gaussian moment evaluation, all-hopping positivity and order-22 benchmark with an analytic omitted-hopping bound. The earlier Gibbs statistical-layer premises are consumed as audited there, not promoted to a derived physical ensemble.

[E7] K. Taylor, *RCHS-33: Compact Link-Record Marginal and the Pure-Link Source Boundary in VERSF*, working calculation, September 2026, and RCHS-33_Reproducibility_Package.zip. Source of the unit-stretch hypercharge reduction, exact compact record integral, positive Fourier covariance, harmonic comparison, conditional Gibbs handoff and surviving pure-link functional. It does not integrate all physical record directions.

[E8] K. Taylor, *RCHS-34: Full-Configuration Transfer Reconstruction and the Gauge-Link Source Test in VERSF*, working calculation, September 2026, and RCHS-34_Reproducibility_Package.zip. Source of relative split-potential reconstruction, the full-kernel compatibility theorem, stationary/off-diagonal reconstruction, raw-path and time-grain distinctions, and the synthetic 1,153-state validation. Neither the physical configuration kernel nor its kinetic reference is derived in that execution.

[M1] N. J. Higham, *Functions of Matrices: Theory and Computation*, SIAM, Philadelphia, 2008. Used as established matrix-function calculus for operator square roots and Sylvester equations.

[M2] M. Guță and J. Kiukas, *Equivalence Classes and Local Asymptotic Normality in System Identification for Quantum Markov Chains*, Communications in Mathematical Physics 335, 1397–1428 (2015). Cited as representative of quantum-output estimation and long-time information theory, the broader subject from which no asymptotic claim is drawn here.