Nonlinear Record Dynamics and the Force Strength Gap in VERSF

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6 November 2026

General reader summary

This paper investigates why an earlier VERSF calculation gave forces that were roughly half as strong as required. It identifies a possible explanation: the calculation treated physical records, the information retained when events occur, as too resistant to change. Allowing those records to fluctuate can reduce that resistance and strengthen the calculated interaction.

The tests show that this relaxation can be substantial, but its effect depends on what else is allowed to move. Records can soften the response while currents add stiffness. Changing the weights used for the different force sectors can reverse the overall result. The paper therefore explains a mechanism for the shortfall, but does not yet establish one correction that gives the measured forces.

The paper also calculates which quantum relationships survive recording and which quantities recording disturbs. It provides a precise test of whether a disturbance can later affect the current, including cases where the effect appears only after a delay. The remaining task is to apply that test to the complete physical evolution selected by VERSF, then calculate the joint response over large distances. The observed force strengths remain to be derived.

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Notation guide

Symbols are local to the indicated section. The table distinguishes reused notation without identifying the underlying physical carriers.

Symbol	Meaning	Location
a, b	Potential coefficients in Sections 2–13; transition probabilities a=1/D and b=cosh(α⋆)/D in Section 15.	Sections 2–13; 15
x	Compact link phase in the scalar action; endpoint amplitude vector in the constrained attachment.	Sections 2–13; Appendix D
q	Current coordinates on a supported chart; scalar entropy potential in the BCB comparison.	C–D; E3–E5
Π and Π_x	Stationary weight matrix or vertex metric (Section 15, Appendix D); ray projector I−uu† (Appendices B–C); Π_x is a site projector. P_r denotes terminal projectors.	Section 15; Appendices B–E
P, P♯, P_+	Driven site kernel, stationary time reversal and reversal-even matter kernel. P_+ is reversible; P is driven.	Section 15.1
H	Common-multiplier hypothesis when written as H in Section 9; a face matrix or Hamiltonian where explicitly defined.	Sections 7, 9; Appendix E
ℓ and $\ell(X)$	Logarithmic running interval; the linear dilation-defect map used in Proposition E1.	Section 9; Appendix E2
Z, s, g, r	Sector action weight; stiffness ratio or assumed boundary multiplier; enhancement; auxiliary residual. Relations apply only on their stated branches.	Sections 8–13
s	Record amplitude in Φ=s exp(iy) (Section 4); native instrument normalization in Eq. (24a) (Section 14); entropy variable in the BCB comparison (Appendix E3); otherwise the stiffness ratio or assumed multiplier of the row above.	Sections 4, 14; Appendix E3
D, D_y, D_J	Covariant incidence D(x) (Sections 2–13); phase covariance D_y (Section 4); 2+2cosh(α⋆) (Section 15); edge-difference matrix of the wheel (Appendix D); Master Action current defect D_J (Appendix C).	Sections 2–15; Appendices C–D
d	d(x)=D(x)1 (Section 2); protected vector (Appendices A–C); incidence row of the selected edge (Appendix D).	Section 2; Appendices A–D

Abstract

This paper establishes a conditional mechanism by which nonlinear record fluctuations reduce the restoring response of a field–current–record model. The response identity separates a direct restoring term from a connected fluctuation subtraction. Controlled local block removals under the raw unit-weight law show that isolated records relax 98.2 ± 0.3 per cent of their extra Gaussian stiffness and that currents supply most of the surviving excess; under the inherited sector weights records retain 84–91 per cent of that increment and the local model shows no enhancement. The response depends on the fluctuating blocks, retained loop and action weights. Weighted block removals resolve the competing record softening and current stiffening behind the local sign reversal; planar branch diagnostics and a frozen-field control delimit the interpretation of large-loop softening. These results do not establish a universal scalar enhancement or the physical three-sector response. Only under the additional common-factor hypothesis H does the mixed frozen-field record extrapolation plus bulk-current limit give $g \approx 1.7249$ and move the electromagnetic inverse coupling from 249.88 to 143.12, compared with 127.95. That scenario also changes the inferred matching scale and remains a sensitivity test.

The native recording operation preserves a calculable algebra of quantum correlations and generates positive conjugate-momentum noise. A conditional canonical attachment converts this disturbance into correlated endpoint and momentum changes, followed by Euclidean current response. Direct BCB action tests reject the specified identifications of that response with physical tick-current evolution. We derive a finite-regulator criterion for when an admitted Hamiltonian exposes a preserved current to recording noise, including delayed onset and an exact condition for its absence at all times. These results establish a relaxation mechanism and identify the missing physical propagation test. The full matter–record coupling, physical joint fluctuation law and observable force matching remain open; no additional fraction of the measured force-strength gap is established as closed.

1 The strength gap and the new calculation

The starting point is the 3 November 2026 paper Completed Event Weighting and Force Response in VERSF [1]. Its quadratic field–current–record model, fermion extension and index-seven blocking provide conditional total coefficients for colour, weak and hypercharge. Under its fixed normalization and zero finite conversion shift, the electromagnetic inverse coupling is 249.87821 for the spatial boundary and 250.7856 for the temporal boundary, compared with the benchmark 127.95. A two-input comparison predicts weak mixing near 0.2273 rather than the withheld 0.23122. The overall-strength deficit and relative-sector discrepancy are distinct.

That paper already shows why an unexplained doubling is insufficient. Halving the starting inverse-coupling boundary without a fitted common multiplier makes electromagnetism 3.77–4.15 per cent too strong after its stated transport. Its conditional participation test identifies a weak-mixing target near $\varepsilon = 0.0487$, but uses the weak benchmark to infer that target and does not derive the participation term on the same evolving carrier as the quadratic model. Those calculations and their limitations remain the reference comparison; they are not re-described here as new results.

The central question is whether source-selected fluctuations reduce the physical response by the required amount. The calculations establish two connected results: a conditional mechanism for reducing auxiliary stiffness, and an exact account of the correlations and momentum disturbance produced by the native recording operation. The remaining inference is whether one admitted real-time matter–record dynamics turns that disturbance into the gauge response. Table 1 separates these claims by evidence and scope. In particular, the BCB comparison tests an explicit proposed identification rather than treating the existence of a Hamiltonian as selection of the required evolution.

Table 1. Main results and the limits of their physical interpretation. Each row refers to its own stated model or carrier.

Result	Evidence established	Physical inference still required
Nonlinear relaxation	The connected response reduces stiffness in the declared branch; the mixed infrared diagnostic is g≈1.7249 (Sections 3 and 8–10).	A controlled bulk response and its identification with the three force sectors.
Local attribution	Under the raw unit-weight law, isolated records relax 98.2 ± 0.3% of their additional Gaussian stiffness and current activation leaves the larger local residual (Section 11). Under the inherited sector weights, records retain 84–91% of that increment and the record excess exceeds the current excess (Section 13, Table 13a).	The complete physical joint response; this percentage is not force-gap closure.
Normalization and sector controls	Inherited sector weights give normalized local stiffnesses about 1.03, 1.04 and 1.02; joint influence depends on propagation (Sections 12–14).	The physical response matrix and its representation-resolved observable conversion.
Native correlations and disturbance	Exact preservation and exposure identities; positive momentum noise with ranks six and 22 on the two declared charts (Appendices A–C).	The source-selected joint matter–current law and physical preparation.
Conditional propagation	A canonical attachment preserves the initial current and gives nonzero subsequent Euclidean response (Appendix D).	Admission of the same current, generator, clock and record coupling as physical.
BCB comparison and decisive test	Exact mismatches reject the tested direct maps. A Hamiltonian-orbit criterion distinguishes delayed noise from its absence at all times (Appendix E).	Evaluation on the full admitted matter–record carrier, followed by bulk force matching.

Sections 2–11 establish and test nonlinear relaxation, including boundary controls and local attribution. Sections 12–14 test common normalization, sector dependence and propagation. Section 15 and Appendices A–C derive the preserved correlations, their exposure under joint motion and the native momentum-noise tensor. Appendix D constructs a conditional recording-to-motion attachment. Appendix E compares it with BCB and gives a precise criterion for future current noise. The sequence narrows the missing physical identification; results from different branches are not added or multiplied together.

2 The nonlinear parent and its declared scope

Let x and y denote compact link and polar-record phases on an oriented spatial graph, and j a complex edge current. For edge e, the covariant incidence D(x) has target entry 1 and source entry $-\exp(ix_e)$; d(x)=D(x)1. Let C be the oriented face–edge incidence matrix. The source-checked scalar potential is

$$V = \frac{a}{2}\sum_f \mathrm{wrap}\left((Cx)_f\right)^2 + b\sum_f\left[1-\cos\left((Cy)_f\right)\right] + V_{\mathrm{rest}}. \quad (1a)$$

$$V_{\mathrm{rest}} = c\sum_e\left[1-\cos(x_e-y_e)\right] + \frac{w_J}{2}\parallel j - d(x)\parallel^2 + \frac{w_T}{2}\parallel D(x)^{\dagger} j\parallel^2. \quad (1b)$$

The raw coefficients are a=b=12/31, c=w_T=21/124 and w_J=75/434. The reference geometry assigns unit weight to each ambient real coordinate. Matter endpoints and record stretches are fixed at one; completion is independent on the inherited branch. The complex current has two real components per edge. These are explicit restrictions of the finite-model calculation, not a demonstration that radial matter, changing polar stretches, completion feedback or the full non-Abelian carrier can be omitted from the physical source.

For the joint calculations, the Hamiltonian is minus one half of the flat Laplacian on the retained-constraint tangent, together with the unexpanded potential in Eqs. (1a–b). This uses the residual action as the reference potential and the declared unit operational geometry as the generator. The source audit constrains how the actual operational generator and upstream potential must be obtained, but does not certify this restricted identification as the complete physical transfer. Agreement with the archived closure is therefore necessary source fidelity, not a complete physical normalization proof.

The frozen-field branch is different: x is an external static probe, the polar phases evolve, and the current is integrated with its ground-energy determinant. Internal field fluctuations are restored only in Sections 5–7. At fixed field, the bare closure is an external cost; its nonlinear global form does not enter internal field sampling. Releasing x makes that global form numerically material.

3 Nonlinear softening with a frozen external field

For a transverse probe of spatial eigenvalue λ, define the record and current corrections per λ as κ_R and κ_J. In the specified fixed-field branch, the ratio to its own quadratic reference is [2]

$$g(\lambda) = \frac{a+bc/(b\lambda+c)}{a+\kappa_R(\lambda)+\kappa_J(\lambda)}. \quad (2)$$

The numerator and denominator use the same probe, coefficients and action convention. A smaller denominator means a larger interaction diagnostic. The compact record histories are sampled with their free heat kernel and winding sectors. The current determinant is retained with the weights of this branch; it is not the differently normalized current threshold from another calculation.

Table 2. Fully same-box frozen-field response on the 8 × 8 × 32 periodic cubic regulator. Record uncertainties are Monte Carlo errors.

Wavelength	Record κ_R	Current κ_J	Diagnostic g
8	0.04245 ± 0.00102	0.0003873	1.2853 ± 0.0030
16	0.05399 ± 0.00084	0.0004636	1.5270 ± 0.0029
32	0.06006 ± 0.00080	0.0007409	1.6587 ± 0.0030

The longest tested wavelength gives approximately 66 per cent strengthening relative to this branch's matched Gaussian reference. It does not mean that 66 per cent of the experimentally defined shortfall has been removed. The cubic square-plaquette continuation, unit kinetic geometry, fixed endpoints and field treatment remain premises, and the observable has not been attached to all three physical sector responses.

A bulk-current calculation gives κ_J(0)=0.000377694488. Combining it with a linear extrapolation of the finite-width record values in λ defines a different infrared diagnostic, about 1.72–1.74. It is not a fully joint infinite-volume result. This distinction matters on a narrow 4 × 4 × 32 box: the fully same-box multiplier at wavelength 32 is 1.5122, whereas the record-plus-bulk-current diagnostic is 1.7249. A finite-torus holonomy term cannot be silently dropped when taking the small-momentum limit.

The record kinetic coefficient μ provides a sensitivity test. With potential and probe fixed, reducing μ increases phase fluctuations and can remove much of the residual record stiffness. Table 3 concerns this deliberately changed dynamics, not a source-selected parameter. Its infrared column combines a finite-width record extrapolation with the bulk current limit.

Table 3. Record kinetic sensitivity on the 4 × 4 × 32 regulator. The unit-weight baseline is inherited; other errors are sampling estimates.

Record μ	History T	Step h	Extrapolated κ_R(0)	Diagnostic g_IR
1	16	1/4	0.06135 ± 0.00104	1.7249 ± 0.0040
1/2	16	1/4	0.00024 ± 0.00049	1.9968 ± 0.0025
1/2	16	1/8	0.00117 ± 0.00059	1.9920 ± 0.0030
2	32	1/4	0.20015 ± 0.00080	1.3175 ± 0.0018

For a quadratic auxiliary Hamiltonian with constant kinetic metric, translating the oscillator to its static minimum changes the source energy by the Schur cost while leaving its fluctuation spectrum independent of the static probe. Its static curvature is therefore independent of μ. The sensitivity in Table 3 is nonlinear; it cannot be reproduced by merely relabelling a constant Gaussian oscillator's mass or rescaling the clock consistently across the whole reference.

Where the record and current curvatures are nonnegative, the denominator in Eq. (2) is at least a. The diagnostic is then bounded by [a+bc/(bλ+c)]/a, which tends to two as λ tends to zero when a=b. This bound belongs to the frozen external-field decomposition. It does not apply automatically once the internal field is part of the fluctuating integral. Nor does approaching two establish the measured strengths: the reference paper's exact-doubling matching control already fails that stronger test.

4 How the source determines record fluctuations

The source-resistance review [3] follows the common operational update law and the polar-record definition. On the admitted physical quotient, let z collect source coordinates, Q be the inverse operational metric, and y=f(z) the supported record-phase readout. Write a_t for the common scalar increment scale in that update law; D_y below is the phase covariance with this common factor removed. The leading quadratic variation is fixed by the covariance pushforward,

$$\mathrm{Cov}(\delta z \mid z) = a_t Q(z), \qquad D_y = J_y Q J_y^T, \qquad J_y = Df(z). \quad (3)$$

On positive support, D_y^{-1} is the normalized instantaneous marginal increment cost. In the leading Gaussian short-time approximation, holding the field increment x fixed instead gives the conditional covariance

$$D_{y|x} = D_{yy} - D_{yx} D_{xx}^{-1} D_{xy}. \quad (4)$$

All inverses are restricted to positive supports. Marginalizing increments, conditioning on a frozen increment and following the slow dynamics are different reductions. State-dependent drift, reference volume and upstream potential transform with the covariance. A short-time phase metric cannot alone substitute for the full frequency-dependent reduction used to obtain an observable response.

For a full-rank matrix record Φ=UH, write δU=UΩ with Ω anti-Hermitian. The derivative of the polar map is determined by

$$H\Omega + \Omega H = U^\dagger \delta\Phi - \delta\Phi^\dagger U. \quad (5)$$

For a scalar supported record $\Phi=s\exp(iy)$, δy is the imaginary part of $\delta\Phi/\Phi$. Unit Cartesian covariance consequently gives phase covariance $1/s^2$ and phase metric s^2. At $s=1$ the metric is one. A conformal operational factor multiplies this result and must be evaluated on the physical background; the polar map does not by itself select a universal one half.

The tempting half-weight has a precise but different meaning. On the equal-unit x/y branch, define shared coordinate $X=(x+y)/2$ and relative coordinate $r=x-y$. Then

$$\frac{1}{2}(|\dot{x}|^2+|\dot{y}|^2)=\frac{1}{2}\left(2\left|\dot{X}\right|^2+\frac{1}{2}|\dot{r}|^2\right). \quad (6)$$

Relative motion has inertia one half and shared motion has inertia two. Holding x fixed activates both terms and restores record inertia one. The potential, source and joint compact identifications transform together. Substituting the relative coefficient alone into the frozen-field record Hamiltonian is therefore not a valid coordinate change. The native-wheel harmonic check confirms that its actual shared and relative frequencies differ from those of that replacement.

The audit replaces an unspecified phase conversion by an explicit source-to-record calculation. It does not prove that complete dynamics cannot yield additional strengthening. The physical operational metric, background stretch, mixed couplings and responding matter and completion blocks remain to be evaluated together. A source-independent factor inferred from the target measurement would bypass that calculation.

5 Restoring internal field fluctuations and checking the closure

The joint seven-point test [4] retains the six-edge outer holonomy while integrating eleven internal compact field directions, twelve record phases and twenty-four real current components per time slice. The six boundary increments have induced covariance $I-11^{T}/6$. Thus forty-seven real coordinates fluctuate per time slice, without halving an ambient kinetic weight. The source generator and residual-potential attachments retain the qualifications of Section 2.

The complete current block must remain inside this joint law. Both its driving term $w_J\, d(x)$ and its precision change as the field changes. For the instantaneous static block, $A_J(x)=w_J\, I+w_T\, D(x)D(x)\dagger$ and the Gaussian mean is $A_J(x)^{-1}w_J\, d(x)$; $d(x)$ alone is not the conditional mean. Current histories also include the temporal kinetic precision. Adding a frozen-field current Hessian after sampling x and y would omit the joint reweighting. Conditional Gaussian current paths are therefore sampled alongside the compact fields.

Inspection of the controlling master executable finds the closure defect $\operatorname{Arg}\exp(iCx)$, squared in its weighted residual. A cosine closure has the same small-field Hessian but a different large-angle action. At a face angle π, the principal-log-square cost is 1.9102460131, while the cosine cost is 0.7741935484. Direct evaluation of Eqs. (1a–b) at a finite random configuration gives exactly the archived residual cost, 21.90699000729238 at printed floating precision.

The distinction changes the outcome. The cosine continuation produces a finite-cell diagnostic of roughly 4–5; the archived principal-log-square closure gives about 1.4–1.5. The larger value is not source-selected and cannot be used as an explanation of the strength gap. The correction came from the controlling executable, not from choosing whichever potential best matched the desired force size. The earlier source-resistance note's global two-cosine identification is qualified accordingly; its covariance and kinetic coordinate identities remain valid.

This is a substantive restriction on the proposed mechanism. Agreement of local Hessians is insufficient to fix a nonlinear fluctuation prediction. A force calculation must retain the complete source form, not only the quadratic stiffness around a selected background.

6 The native wheel response

At every imaginary-time slice the retained outer field holonomy is exp(iθ). Probe A shifts the six rim field phases by θ/6. Probe B also shifts the integrated rim record phases. Translation of compact record paths has unit Jacobian and preserves the free heat measure, so these are two estimators of the same partition function, not separate physical sectors. Define

$$F_T(\theta) = -T^{-1}\log Z_T(\theta), \qquad K = F_T''(0), \qquad g_{\mathrm{diag}} = K_G/K. \quad (7)$$

The free-energy curvature is measured by exact finite-probe reweighting, with both probe signs averaged. For θ=0.2, 0.4, 0.6 and 0.8,

$$R(\theta) = \frac{1}{2}\langle e^{-\Delta S(+\theta)} + e^{-\Delta S(-\theta)}\rangle, \qquad K(\theta) = -\frac{2\log R(\theta)}{T\theta^2}. \quad (8)$$

A linear fit in θ^2 gives the zero-probe intercept; the first-three-probe fit supplies a truncation control. Exact action differences include branch crossings. Using only the smooth second derivative of the principal-log potential would miss its branch contribution. Compact paths use exact free-heat loops, conditional winding bridges and constant shifts. The constrained rim winding integers are drawn jointly with their sum condition.

$$K_G = \frac{a+bc/(b+c)}{6} = 0.08415147265077. \quad (9)$$

The full quadratic field–record–current Schur calculation gives the same retained baseline whether the additional internal field directions relax or take their matching harmonic value. The nonlinear change therefore does not arise from substituting a half record inertia. Table 4 gives the source-checked joint runs.

Table 4. Native-wheel joint response with the principal-log-square closure. Errors are Monte Carlo estimates.

T	h	K from probe A	K from probe B	K_G / K_A
16	1/16	0.058817 ± 0.000542	0.058651 ± 0.000643	1.4307 ± 0.0132
16	1/8	0.058725 ± 0.000764	0.058658 ± 0.000768	1.4330 ± 0.0186
16	1/4	0.058636 ± 0.000478	0.058397 ± 0.000562	1.4351 ± 0.0117
32	1/8	0.057811 ± 0.001784	0.057604 ± 0.002010	1.4556 ± 0.0439

The matched frozen-field wheel control is about 1.20 times its Gaussian reference. Restoring the internal field produces a material additional response on this restricted cell while keeping the original unit weights. The runs support an enhancement diagnostic around 1.4–1.5, not a precise continuum value. They do not calculate the other cycle responses or the full SU(3), SU(2), U(1) matrices. Applying the same scalar factor to all three census coefficients would assume the ratio-preservation result still to be tested.

The larger cosine-closure result, the frozen-field spatial enhancement and the joint-wheel diagnostic are not successive pieces of one correction. Their potentials, responding variables or retained observables differ. None is added to the reference paper's three-sector boundary as a physically certified common factor.

7 Increasing the spatial block size

The connected spatial test [5] retains Eqs. (1a–b) and the unit kinetic geometry on open L by L square patches, for L=1, 2, 3 and 4. Faces share actual edges, and currents share actual vertices. There are $F=L^2$ faces, $E=2L(L+1)$ edges, $(L+1)^2$ vertices and $M=4L$ oriented outer boundary edges. This is a declared planar continuation of the square-face regulator; it is neither the native triangular wheel nor a three-dimensional periodic bulk regulator. Its one-square number need not equal Table 4.

The boundary holonomy is fixed to exp(iθ) at each time slice. All E−M interior field phases fluctuate; the M boundary phases fluctuate on the retained constraint with covariance $I-11^T/M$. All E record phases and 2E real current components also fluctuate, giving 4E−1 real coordinates per slice. Uniform field-only and field-plus-record boundary probes estimate the same curvature in Eq. (7).

A matched Gaussian reference is needed because raw boundary stiffness already falls geometrically with patch area. Let $H=C\,C^T$ on the face space. Eliminating the quadratic record field on the cycle sector gives

$$R_f = aI + bc(bH + cI)^{-1}, \qquad K_G = \left[\mathbf{1}^T R_f^{-1}\mathbf{1}\right]^{-1}. \quad (10)$$

To see this, let f=Cx and g=Cy. The minimum bond norm at fixed f–g is $(f-g)^T H^{-1}(f-g)$, while the closure and record terms are $a|f|^2/2$ and $b|g|^2/2$. Minimizing over g gives R_f. Minimizing $f^T R_f\, f/2$ under $1^T f=\theta$ then gives Eq. (10). This is the noncompact harmonic reference on the supported cycle sector. At the identity-link background, the static current correction is longitudinal and the boundary probe is a cycle, so the full-current quadratic minimization agrees. That statement does not justify removing currents in the nonlinear calculation.

Table 5. Planar boundary response at T=16 and h=1/4. Two independent seeds are pooled for each size.

Square cells	Gaussian K	Boundary K_A	Resistance K_A / K_G
1	0.42526124	0.38870971 ± 0.00054240	0.9140 ± 0.0013
4	0.11414392	0.06852425 ± 0.00115135	0.6003 ± 0.0101
9	0.05422115	0.00729574 ± 0.00118909	0.1346 ± 0.0219
16	0.03230087	0.00000159 ± 0.00092228	0.0000 ± 0.0286

Each baseline run has 10,000 burn-in sweeps and 80,000 production sweeps, storing every eighth configuration for 10,000 retained samples. The independent seed estimates are pooled with equal weight and their errors combined in quadrature. The normalized resistance falls from about 91 per cent to 60 per cent and 13 per cent, and becomes unresolved near zero on sixteen cells. This is not just the elementary decrease of unnormalized stiffness with area.

Table 6. Planar temporal controls. Each run retains 12,500 samples after 12,000 burn-in and 100,000 production sweeps.

Cells	T	h	K from probe A	K from probe B
4	16	0.125	0.06872913 ± 0.00171608	0.06775870 ± 0.00185524
4	32	0.25	0.06729781 ± 0.00166121	0.06702567 ± 0.00174442
16	16	0.125	0.00189142 ± 0.00112253	0.00163285 ± 0.00120830
16	32	0.25	-0.00059109 ± 0.00141399	-0.00010165 ± 0.00136812

Halving the time step at fixed T and doubling T at fixed step support the qualitative pattern within estimated sampling errors. The sixteen-cell curvature remains statistically compatible with zero. Its reciprocal is therefore not reported as a huge or negative force strength. Negative central values in individual runs are sampling estimates about an unresolved response, not a demonstrated physical instability.

The retained variable is a compact boundary holonomy, not a fixed real lift of the sum of principal face fluxes. Distinct total face-flux branches are admitted. To diagnose them, the Table 5 runs were repeated with the same seeds and an added measurement of $m(\tau)$, the integer in Eq. (15) with the window equal to the full patch. Every previously stored column is reproduced exactly. Table 6a reports the mean square and the fraction of stored time slices with $m \neq 0$. This is spatial principal-flux branch occupancy, not the temporal winding number of an individual link.

Table 6a. Spatial flux branches in the Table 5 ensembles. Two seeds per size; uncertainties are conservative block-jackknife estimates. The one-cell value vanishes by the retained constraint.

Patch side L	Mean m^2	Nonzero branch fraction (%)
1	0.00000 ± 0.00000	0.00 ± 0.00
2	0.05520 ± 0.00188	5.52 ± 0.19
3	0.30961 ± 0.00527	29.37 ± 0.48
4	0.61298 ± 0.00477	48.37 ± 0.27

Branch occupancy rises alongside the loss of boundary curvature: the nonzero fraction reaches 29.37 per cent at L=3 and 48.37 per cent at L=4. This supports branch mixing as a diagnostic of the weakening compact boundary observable. Correlation does not assign the curvature loss to branch crossings alone, and no mass gap or bulk source-to-source propagator is inferred.

A separate L=2 ablation freezes every unprobed field phase at zero while retaining fluctuating records and currents and the same boundary twist. With two seeds at T=16 and h=1/4, it gives $K_A = 0.098041 \pm 0.000369$ and $K_B = 0.097665 \pm 0.000606$, compared with joint $K_A = 0.068524 \pm 0.001392$. The matched Gaussian curvature is 0.11414392 in both L=2 cases, so the respective normalized responses are 0.8589 and 0.6003. Both comparison errors use blocks up to 1,000 stored configurations. Freezing the field removes spatial flux branches and materially reduces the softening. Because it removes both interior and boundary-tangent field fluctuations, it does not isolate the interior field or branch mixing by itself. This is a finite-regulator ablation, not an infinite-volume result [57]. For comparison, the frozen-field wheel control in Section 6 is about 1.20 times its Gaussian reference, a normalized response near 0.83. The

frozen-field square patch and the frozen-field triangular wheel therefore respond similarly; this is the only cross-geometry consistency check available in the paper.

This limits the interpretation of the wheel result. On this explicit planar continuation, a stable universal 1.4–1.5 multiplier has not emerged as the block grows. This does not disprove VERSF bulk forces or establish that every admissible spatial continuation has the same behavior. It identifies the observable that must be improved before the spatial test can narrow the measured force-strength discrepancy.

8 Record relaxation and auxiliary resistance

The factor-of-two scale has a structural origin within the frozen-field branch. At long wavelength, the quadratic record follows the field and contributes b in addition to the field closure a. Because the inherited coefficients obey a=b, the Gaussian response counts two equal stiffness contributions. Compact nonlinear record motion need not retain the full second contribution. This is a dynamical hypothesis about response, distinct from changing the primitive unit or inserting an overall normalization.

The response reduction can be written directly as a fluctuation identity. Set x=θu, where u is a normalized transverse link mode with spatial eigenvalue λ. Define $A_u=\int_0^T \sum_e u_e \sin(y_e(\tau))d\tau$ and $B_u=T^{-1}\int_0^T \sum_e u_e^2 \cos(y_e(\tau))d\tau$ in the frozen-field record ensemble at θ=0. Differentiating its log partition function gives

$$\kappa_R(\lambda) = \frac{c\langle B_u\rangle - \frac{c^2}{T} Var(A_u)}{\lambda} \quad (11)$$

The first term is the average direct restoring response. The second is the connected response of the fluctuating records and reduces that stiffness. Both terms must be evaluated under the same history law; the variance term cannot be chosen independently. The current contribution is retained separately on this frozen-field branch. Equation (11) follows from differentiating the finite-history measure and does not establish that this restricted measure is the full physical event law. Section 11 gives a corresponding identity for the joint interior-loop response and measures its two terms directly.

$$r = \frac{\kappa_R(0)+\kappa_J(0)}{a}, \quad g_{IR} = \frac{2}{1+r}, \quad s_{eff} = \frac{1+r}{2} \quad (12)$$

Equation (12) uses a=b and the infrared numerator 2a. For nonnegative auxiliary curvature, complete auxiliary relaxation approaches g=2; a positive residual leaves g below two. This explains why an approximately twofold gap is a relevant scale for this mechanism, while the exact-doubling control in [1] already shows that complete relaxation would overshoot the electromagnetic benchmark under that matching prescription. The near-complete relaxation that makes this scale reachable is a property of the raw unit-weight law: under the inherited sector weights the same record block retains 84–91 per cent of its Gaussian increment and the full local response shows no enhancement (Section 13, Table 13a).

Table 7. Calculated infrared diagnostic and matching requirements. Only the first row is calculated dynamics; the other rows are inferred targets under the common-factor hypothesis.

Status	Residual r	Record κ_R(0)	Enhancement g
Unit-weight mixed extrapolation	0.15946 ± 0.00269	0.06135 ± 0.00104	1.7249 ± 0.0040
Spatial matching target	0.040114	0.0151505	1.922865
Temporal matching target	0.036411	0.0137170	1.929736
Spatial target with fitted participation	0.081376	0.0311225	1.849496

The calculated mixed extrapolation retains about 16 per cent of an auxiliary stiffness equal to a, whereas the common-only matching would retain approximately 4 per cent. Reaching that target would require roughly three quarters of the remaining auxiliary contribution to relax. This is a requirement for the proposed explanation, not an achieved removal of the experimentally defined gap. The target κ_R values hold the inherited bulk-current value 0.000377694488 fixed; a joint physical reduction need not leave that value unchanged.

9 Conditional matching to the measured gap

A useful explanatory test can be performed without treating the missing identification as established. Hypothesis H states that one selected scalar diagnostic supplies a common multiplier of the complete colour, weak and conventional-hypercharge inverse-coupling boundary in [1], before observable running. Each scalar diagnostic is tested separately. Under H,

$$A_i(\mu^*) = s_{eff} A_i^*, \quad s_{eff} = 1/g_{diag} \quad (13)$$

For the spatial comparison A*=(6.01660209, 6.51660209, 10.52767015). The strong benchmark α_s=0.1180 determines the running interval; electromagnetism and weak mixing are then outputs. The calculation uses exactly the gauge-only two-loop evolution of [1, Eq. (72)], with zero finite conversion shift, the fixed massless Standard Model census and no running Yukawa or threshold corrections. With downward interval ℓ=ln(μ*/μ), dA/dℓ=b/(8π²)+B(1/A)/(128π⁴), b=(−7,−19/6,41/6), and B has rows (−26,9/2,11/6), (12,35/6,3/2), (44/3,9/2,199/18). The observables are α^{-1}=4π(A_2+A_Y) and $\sin^2\theta$_W=A_2/(A_2+A_Y).

Table 8. Conditional spatial-boundary transport under H. The scalar diagnostics are not fitted to the electromagnetic input. These are sensitivity scenarios, not certified VERSF coupling predictions.

Scenario	g	Assumed s	ℓ*	μ* (GeV)	α^{-1} at M_Z	$\sin^2\theta$_W
Unchanged boundary	1	1	59.74	8.019×10^{27}	249.88	0.208705
Same-box wavelength 32	1.6587	0.602874	32.92	1.799×10^{16}	149.00	0.221966
Mixed infrared extrapolation	1.7249	0.579732	31.36	3.778×10^{15}	143.12	0.223300
Exact-doubling control	2	0.5	25.98	1.751×10^{13}	122.85	0.228846
Frozen benchmark	n/a	n/a	n/a	n/a	127.95	0.231220

Here ℓ*=ln(μ*/M_Z), with M_Z=91.1876 GeV. Holding the strong benchmark fixed while rescaling the boundary changes both its values and its inferred location: μ* falls from 8.019×10^{27} GeV to 1.799×10^{16} GeV, 3.778×10^{15} GeV and 1.751×10^{13} GeV across the four scenarios, a span of 14.66 orders of magnitude. The unchanged case extrapolates the inherited gauge-only, fixed massless census for 59.74 e-folds from M_Z to a scale far above the Planck scale. Its validity over that interval is a premise of the transport model in [1], not evidence established by the present calculation. H is therefore not a strength change at a common fixed matching scale.

This calculation advances the explanatory claim in a precise conditional sense: if H is correct, the already calculated nonlinear response moves the electromagnetic value substantially toward the benchmark. The calculation rescales the starting boundary and reruns the evolution; it does not divide the already transported 249.87821 by a cell multiplier. The same-box case is the cleaner finite-regulator result. The infrared case additionally combines a finite-width record extrapolation with a bulk-current limit. Their small sampling errors do not quantify the uncertainty in H or in the omitted physical matching.

Neither scenario matches electromagnetism or weak mixing. Solving for the common factor that matches the strong and electromagnetic inputs reproduces s=0.5200572352 spatially and 0.5182055996 temporally, hence the targets in Table 7. The corresponding weak angles remain 0.227289 and 0.227230. A common softening can therefore address the dominant absolute-strength problem under H, while the smaller sector-dependent correction remains a separate requirement. No evidence in this scalar calculation proves preservation of the three-sector ratios.

The common-only target must not be confused with a simultaneous three-sector target. Including the earlier participation pattern $A^*_i(\varepsilon)=Z_i(1-\varepsilon n_i/49)+\eta_B Z_{F,i}$, with Z=(6,6.5,10.5), n=(36,26,47), Z_F=(6,6,10) and η_B=0.0027670154, reproduces ε=0.0486766111 and s=0.5406877596 when all three benchmarks are used. The corresponding auxiliary-retention target is r=0.0813755, or 8.14 per cent, and g=1.849496. It would require roughly half of the remaining unit-weight auxiliary response to relax. This is a three-input target, not a prediction: both the participation response and its joint attachment to nonlinear softening remain to be derived. The four-per-cent and eight-per-cent targets are alternative matching conditions, not corrections to be combined.

10 An interior response control

The outer-boundary test in Section 7 changes the size of the retained loop together with the size of its environment. To separate those choices, a new campaign [11] retains a central S by S square-loop holonomy inside an L by L open square patch. The same principal-log potential, unit ambient kinetic weights, fixed endpoints and stretches, and complete current law are used. All other field directions fluctuate; the external patch boundary is unconstrained. This is an interior-loop control on the declared planar model, not yet a three-dimensional bulk propagator.

The original edge orientations are preserved. If the retained circuit uses oriented signs $\sigma_e=\pm1$, its constrained covariance is $I-\sigma\sigma^T/(4S)$, implemented by an orthogonal sign change of the retained coordinates. The signed winding integers are sampled jointly. Probe A shifts the retained field links by $\sigma_e\theta/(4S)$; probe B also shifts their record phases. Both estimate the same free-energy curvature. Let p_f be one on the S^2 retained faces and zero elsewhere. The matched Gaussian reference generalizes Eq. (10):

$$K_G(p) = [p^T {R_f}^{-1} p]^{-1}. \quad (14)$$

Table 9. New interior-loop response at T=16 and h=1/4. Each row pools two independent seeds, with 10,000 stored configurations per seed after 10,000 burn-in and 80,000 production sweeps.

Patch L × L	Loop S × S	Gaussian K_G	K from probe A	K_G / K_A
3 × 3	1 × 1	0.43617178	0.39648 ± 0.00226	1.1001 ± 0.0063
4 × 4	2 × 2	0.11953380	0.07585 ± 0.00259	1.5759 ± 0.0539
5 × 5	1 × 1	0.43781611	0.39961 ± 0.00161	1.0956 ± 0.0044

For a single retained square, its closure contribution is exactly $a\theta^2/2$ for $|\theta|<\pi$. Consequently K=a+K_env is an exact separation for this probe. The Gaussian environmental contribution is K_G−a. The measured results are 3 by 3: K_env=0.00938 ± 0.00226, retaining 19.1 ± 4.6 per cent of the Gaussian environmental response; 5 by 5: K_env=0.01251 ± 0.00161, retaining 24.7 ± 3.2 per cent of the Gaussian environmental response. These fractions describe the combined environmental response. The controlled removals in Section 11 now resolve the contributions more directly on the three-by-three patch.

The approximately 1.10 total enhancement is therefore compatible with substantial relaxation of the additional Gaussian resistance. At this short scale that additional resistance is much smaller than a;

complete environmental relaxation would give K_G/a≈1.13 on these patches. In the frozen-field long-wavelength model, by contrast, the additional Gaussian record resistance tends to a and complete relaxation approaches a factor two. These are different scale-dependent responses. Section 11 tests whether the residual in the joint local calculation is attributable to records, currents or their interaction.

The two-by-two interior loop is softer and does not share the one-square multiplier. Let Φ_window(τ) be the sum of the principal face angles wrap((Cx)_f) over the retained S^2 faces. To monitor the compact branches, the new runs also retain the time-slice integer

$$m(\tau) = \frac{\Phi_{window}(\tau) - \theta}{2\pi}. \quad (15)$$

For the two-by-two loop, nonzero branches occur in about 4.62 per cent of stored time slices, while they are absent for the single retained square near θ=0 by construction. Branch occupancy is a diagnostic of the ensemble; it does not measure how much of the curvature reduction is caused by branch mixing. These data establish that the local softening survives moving the retained loop into an environment, but do not establish a probe-independent bulk enhancement.

Table 10. New temporal controls for the interior loops. Each run retains 12,500 configurations after 12,000 burn-in and 100,000 production sweeps.

L, S	T	h	K from probe A	K from probe B
3, 1	16	0.125	0.39746 ± 0.00222	0.39408 ± 0.00329
3, 1	32	0.25	0.40003 ± 0.00235	0.40024 ± 0.00313
4, 2	16	0.125	0.07602 ± 0.00498	0.07518 ± 0.00531
4, 2	32	0.25	0.07327 ± 0.00333	0.07205 ± 0.00307

The raw results include paired probe differences, first-three-probe fits, quarter-run estimates and all tested block sizes. The one-square and two-square probes remain distinct finite-scale observables. Temporal controls test the qualitative conclusions; they do not supply a continuum or infinite-history extrapolation. No reciprocal of a statistically unresolved curvature is used in the new matching scenarios.

11 Isolating the surviving auxiliary response

Four versions of the same planar model isolate the auxiliary contributions. The record switch controls record closure and field–record bonds; the current switch controls tracking and transport. Coefficients retain their original values whenever a block is active. Field closure, unit kinetic weights and geometry remain fixed. These removals are diagnostic deformations, not proposed physical laws or fits to measured forces. Inactive auxiliary coordinates are omitted when defining each control.

An exact construction separates the field closure. On an open planar patch let p select one retained face, $H = C\,C^T$, and $u = C^T H^{-1} p$. Then $C\,u = p$: the time-independent shift $x \to x + \theta u$ changes only that field-face angle. It translates the constrained compact measure while preserving temporal kinetic terms. For $|\theta| < \pi$, the field action changes by $T\,a\theta^2/2$. Write $S_{aux}(\theta)$ for the remaining record and current action on the shifted histories. Then

$$\frac{Z(\theta)}{Z(0)} = exp(-T\,a\theta^2/2)\,\langle exp(-\Delta S_{aux}(\theta))\rangle_0 \quad (16)$$

Every other field-face closure and branch is unchanged, making the environmental derivatives smooth despite the principal-log source. With both auxiliary blocks removed, Eq. (16) gives $K_{00} = a$ exactly for any

patch size, history length or time step in this restricted model. The old uniform loop shift and this distributed shift parameterize the same constrained partition function.

$$K = a + \frac{\langle S_{aux}'' \rangle - Var(S_{aux}')}{T} \quad (17)$$

Differentiating Eq. (16) gives the standard free-energy-curvature structure [13]; primes denote θ derivatives at zero. Conjugation x→−x, y→−y, j→j* makes S_aux′ odd, with exact zero mean. The primary estimator uses ⟨S_aux″−(S_aux′)²⟩/T. Probe A shifts x; probe B also shifts y by θu and has the same free energy. With currents off, probe B gives S_aux′=b∫sin((Cy)_p)dτ and S_aux″=b∫cos((Cy)_p)dτ. Current derivatives and their covariance with record derivatives remain included when currents are on.

Table 11. Controlled auxiliary-block removals for one interior square in a three-by-three patch. T=16, h=1/4; two independent seeds per row, 20,000 stored configurations per seed after 16,000 burn-in and 160,000 production sweeps. K uses the direct probe A estimator.

Active blocks	Gaussian K_G	Nonlinear K	Excess K − a
Field only	0.387097	0.387097 exact	0 exact
Field and records	0.436172	0.387997 ± 0.000142	0.000901 ± 0.000142
Field and currents	0.387097	0.396031 ± 0.000772	0.008934 ± 0.000772
Field records and currents	0.436172	0.398047 ± 0.001525	0.010950 ± 0.001525

The Gaussian extra record stiffness is K_G−a=0.04907501. With currents absent, the measured extra stiffness is 0.00090050 ± 0.00014239: only 1.83 ± 0.29 per cent of its Gaussian value survives. Thus 98.17 ± 0.29 per cent of the additional Gaussian record response has relaxed in this local joint model. This percentage concerns the record excess above a, not the total stiffness and not the experimentally defined force-strength gap.

The full-block value in Table 11 also checks the independent interior-loop executable: its K=0.398047 ± 0.001525 differs from Table 9's 0.39648 ± 0.00226 by 0.001567, or 0.57 combined standard errors. The agreement tests the same observable across two independent implementations; it is not a new physical calibration.

The direct response terms show the cancellation responsible for that result. For the record-only auxiliary block, probe A gives restoring contribution ⟨S_aux″⟩/T=0.0125197 and fluctuation subtraction ⟨(S_aux′)²⟩/T=0.0116192. Their correlated difference is the residual in Table 11. Both are measured under the same unaltered unit-weight kinetic law. A small final stiffness therefore need not mean a small direct restoring term; it can reflect a nearly compensating fluctuation response.

With records present, enabling the current block increases K by 0.010050 ± 0.001532. The current-only auxiliary control also retains a positive excess. On the raw unit-weight law the remaining local stiffness is therefore predominantly current-dependent, whereas the frozen-field infrared estimate in Section 3 assigned most of its residual to records. The two statements concern different retained observables and different fluctuating fields. The small frozen-field bulk-current number cannot be carried into the joint local problem as an unchanged correction. Under the inherited sector weights the attribution changes: Table 13a shows the record excess larger than the current excess, with records retaining 84–91 per cent of their Gaussian increment.

$$I = K_{11} - K_{10} - K_{01} + K_{00} \quad (18)$$

Here the first index denotes record activation and the second current activation. The nonadditive response is I=0.001116 ± 0.001715. Its size is not resolved reliably by this campaign, so the calculation does not establish independent additivity or a definite interaction correction. It does establish that removing the current block substantially changes the surviving local resistance. This is a sharper attribution than assigning the full K−a to records.

Table 12. Temporal controls for the block-removal test. One independent run and 20,000 stored configurations per row. A and B are correlated direct estimators of the same K.

Auxiliary blocks	T	h	K from A	K from B
Currents	16	0.125	0.397217 ± 0.000831	0.397217 ± 0.000831
Currents	32	0.25	0.398644 ± 0.001324	0.398644 ± 0.001324
Records	16	0.125	0.388170 ± 0.000167	0.387648 ± 0.001014
Records	32	0.25	0.388060 ± 0.000216	0.387942 ± 0.000949
Records and currents	16	0.125	0.401371 ± 0.001065	0.401433 ± 0.001991
Records and currents	32	0.25	0.398944 ± 0.001551	0.398937 ± 0.002227

Finite twists θ=0.2, 0.4, 0.6 and 0.8 are reweighted separately and extrapolated in θ^2 as an additional check on the direct derivatives. Probe differences are assessed with their paired covariance. Halving the time step and doubling the history length preserve the distinction between the small record-only residual and the larger current-dependent residual. These controls do not provide a continuum, infinite-history or spatial bulk extrapolation. The block removals have only been tested for the one-square observable on the three-by-three patch.

12 A test of common normalization

The local mechanism does not by itself justify Hypothesis H. Its missing content can nevertheless be stated as a basis-independent criterion. On the same physical retained quotient, let Γ_G and Γ_NL be the Gaussian and nonlinear free-energy Hessians with the same source normalization, background and observable prescription. Remove common null directions before inversion, and require Γ_G to be positive definite on the retained support. Define

$$W = \Gamma_G^{-1/2}\Gamma_{NL}\Gamma_G^{-1/2}, \quad s = \frac{tr\, W}{n} \quad (19)$$

Here n is the dimension of that support. A common inverse-coupling multiplier holds on the whole retained space precisely when W=sI, equivalently Γ_NL=sΓ_G. A scalar loop response supplies only one directional ratio and cannot establish this matrix equality. Off-diagonal responses and the representation-resolved directions must be included in the calculation.

$$\varepsilon_H = \frac{max_k\, |\lambda_k(W)-s|}{|s|}, \quad \varepsilon_H = 0 \;\Leftrightarrow\; \Gamma_{NL} = s\Gamma_G \quad (20)$$

Equation (20) assumes s≠0; a positive common stiffness also requires s>0. The λ_k are the generalized eigenvalues of (Γ_NL,Γ_G). Under any common invertible coordinate change, both Hessians transform by congruence and these eigenvalues are unchanged. Thus the test cannot be passed merely by relabelling or rescaling the source coordinates. For any retained direction v, its response ratio v^TΓ_NL v/(v^TΓ_G v) lies between the smallest and largest generalized eigenvalues; these extrema bound the error in replacing the matrix by one scalar.

The acceptance criterion is therefore operational: derive the retained physical response matrix from the source law, measure its generalized eigenvalues and uncertainty as regulators are varied, and transport its representation-resolved coefficients to the same observables. A common reduction must emerge from those data. If the eigenvalues differ, retain and propagate their sector dependence rather than impose an average multiplier. No physical Γ_NL is supplied by the present scalar campaign, so Eq. (20) is a falsifiable test and not a claimed validation of H. The different loop multipliers in Sections 6, 7 and 10 are not eigenvalues of this common matrix and cannot be used as such.

13 Testing the transition to three sectors

13.1 The normalization changes the fluctuating law

The precursor calculation [1, Sections 14.1–14.2] uses Z=(6,13/2,21/2), a=b=1/2, c=7/32, current and conservation weights one, and kinetic metric τZ_A I with τ=1/3. The simulations in Sections 3–11 instead use the raw scalar coefficients and unit kinetic weights. The PCN identification in [1] was explicit and conditional. It is not a change of the output units of the later nonlinear simulations: it changes the statistical law being sampled. In particular, the current coefficient is not obtained by the same uniform rescaling of all raw coefficients.

A new test retains the principal-log field closure, compact polar-record phase, complex current and one central face of an open three-by-three patch. Endpoints and record amplitudes remain frozen. It assigns the precursor potential coefficients to the same scalar nonlinear functional and gives every active real coordinate kinetic mass τZ_A. Applying that mass also to both real components of the complex current is part of this declared continuation. The sectors are independent copies; non-Abelian commutators, shared charged matter, physical radial dynamics and the source-selected record operation are not supplied by this construction. Its formal continuum action is

$$S_A = Z_A \int \left[\frac{\tau}{2}(\|\dot{x}\|^2 + \|\dot{y}\|^2 + \|j\|^2) + V_{PCN}\right] dt \quad (21)$$

The execution uses wrapped compact heat kernels with mass τZ_A and an exact conditional Fourier update for the current, at finite time step h. V_PCN denotes Eqs. (1a–b) with the coefficients just specified. No observed coupling is used to choose an input. This is a weighted scalar continuation, not the physical gauge theory restricted to three generators: Section 13.3 shows nonlinear information that would be lost in that identification.

Let U(θ) be the integrated, unweighted auxiliary potential under the exact twist of Section 11, and let ⟨·⟩_Z denote the weighted history law. Then the same translation identity gives

$$\frac{K_Z}{Z} = a + \frac{\langle U'' \rangle_Z - Z\, Var_Z(U')}{T} \quad (22)$$

Here a=1/2. Both the expectation and the connected fluctuation term depend on Z through the measure. Consequently the quadratic cancellation of kinetic parameters from a static Schur complement does not establish a common nonlinear response. At finite regulator and on a nondegenerate saddle, the usual saddle expansion also has K_Z=ZK_classical+O(1), so its fractional correction need not be independent of Z. Equation (22), rather than an assumed multiplier, is used in the measurement.

Table 13. Independent weighted scalar continuations at T=16 and h=1/8. Each row combines two seeds, each with 24,000 burn-in and 80,000 production sweeps, storing 10,000 configurations. s=K_NL/K_G; s<1 denotes softening. Labels specify inherited weights, not a physical force measurement.

Weight label	Z	Gaussian K_G	Nonlinear K_NL	s
Colour weight	6	3.380331	3.47314 ± 0.02193	1.02746 ± 0.00649
Weak weight	6.5	3.662026	3.82312 ± 0.02895	1.04399 ± 0.00791
Hypercharge weight	10.5	5.915580	6.05263 ± 0.05208	1.02317 ± 0.00880

The common unit-reference Gaussian curvature is K_G/Z=0.5633885493 for this observable. The central values in Table 13 show a small stiffness increase, with no substantial local softening. The primary pairwise differences of s are all below two estimated standard errors, so these runs do not establish a resolved splitting between the three weights. Agreement within that precision would still not validate a physical common multiplier: the model has only three independent scalar slots and measures a local response.

The sign reversal can now be resolved by the block switches of Section 11 at each inherited weight. The field-only response is exactly Z/2. With currents present but records removed, the Gaussian cycle correction is zero; with records present, the Gaussian normalized increment is 0.06338855. Table 13a compares the separate blocks under the same PCN law. All entries are divided by Z so their competition is visible. Each switched control pools two new seeds with the same T, h, burn-in and sample count as Table 13; the full-block column reuses Table 13 [57].

Table 13a. Weighted block attribution on the same central-face probe. R denotes records and J currents; the field remains active in every column. The last column is the fraction of the extra Gaussian record stiffness retained by the record-only control.

Z	Records only K/Z	Currents only K/Z	Both K/Z	Record residual
6	0.55328 ± 0.00032	0.53754 ± 0.00449	0.57886 ± 0.00365	84.05 ± 0.50%
6.5	0.55365 ± 0.00033	0.53453 ± 0.00382	0.58817 ± 0.00445	84.64 ± 0.52%
10.5	0.55746 ± 0.00050	0.52372 ± 0.00371	0.57644 ± 0.00496	90.64 ± 0.79%

The weighted record-only controls retain 84.0, 84.6 and 90.6 per cent of their Gaussian increment, in contrast with 1.83 ± 0.29 per cent under the raw unit-weight law in Table 11. Records still soften relative to their own Gaussian reference, but the subtraction is no longer nearly complete. Currents add a positive nonlinear increment despite their zero Gaussian cycle correction. Together the blocks exceed the full Gaussian reference, giving the sign reversal already seen in Table 13. This identifies competing contributions inside the stated scalar continuation; it does not derive physical force coefficients.

We do not impose block additivity: the interaction remainder $(K_{RJ}-K_R-K_J+Z/2)/Z$ is -0.01196 ± 0.00579, -0.00001 ± 0.00588, -0.00474 ± 0.00621, respectively. Increasing Z changes both potential weight and kinetic mass, and the raw-to-PCN comparison also changes coefficient ratios and τ. These tests therefore support the competition mechanism but do not isolate kinetic mass as its sole cause or establish a universal 1/Z law for the fluctuation subtraction.

Table 14. Temporal controls, one independent seed and 10,000 stored configurations per row. A and B are the equivalent direct twist prescriptions of Section 11. These are finite-regulator checks, not an extrapolation.

Z	T	h	s from A	s from B
6	16	0.0625	1.03833 ± 0.01057	1.00136 ± 0.02184
6	32	0.125	1.03442 ± 0.00989	1.05026 ± 0.02986
6.5	16	0.0625	1.04870 ± 0.01060	1.04377 ± 0.02259
6.5	32	0.125	1.03173 ± 0.01242	1.02754 ± 0.03020
10.5	16	0.0625	1.03704 ± 0.01338	1.02231 ± 0.02373
10.5	32	0.125	1.00850 ± 0.01040	1.01744 ± 0.03551

13.2 What this test does and does not decide

The direct zero-twist estimator is primary. Finite twists from 0.2 to 0.8 are retained as diagnostics; at the larger action weights their extrapolation can differ from the direct result and is not used to certify precision. Equivalent direct probes, independent seeds, quarter-run estimates and block errors are archived. No spatial-size sequence is included. In particular, a one-face test cannot determine whether the infrared response eventually softens. It does establish that importing the earlier unit-weight scalar correction into the precursor normalization is an additional dynamical assumption, not a consequence of the shared quadratic ratios.

For the three independent scalar copies, the response matrix is diagonal by construction. Its three normalized entries are the s values in Table 13. This small diagnostic is not the twelve-generator matrix required by Section 12, and its vanishing off-diagonal entries do not test physical mixed responses. No new electromagnetic, weak or strong coupling is obtained by running these local curvatures. The earlier 71–78 per cent reduction of the original electromagnetic-strength shortfall remains conditional on H; the new test adds no demonstrated physical gap closure.

13.3 Nonlinear charge information beyond the quadratic traces

The inherited census [15, Section 6.2] contains three generations of Q_L=(3,2,1/6), u_R=(3,1,2/3), d_R=(3,1,−1/3), L_L=(1,2,−1/2) and e_R=(1,1,−1), plus one complex Higgs doublet (1,2,1/2). All twelve Hermitian charge matrices were reconstructed on the 47-dimensional charged carrier, with tr_fund(T_aT_b)=δ_ab/2. Optional neutral states append zero blocks; the occupied-state and full-carrier distinction in [16, Section 2.1] does not affect these traces. The calculation reproduces diag($6I_8$,$(13/2)I_3$,21/2) and evaluates the fourth moments directly.

Table 15. Exact charge moments on the matter-plus-Higgs carrier, in the inherited conventional-hypercharge normalization. Each non-Abelian row applies to every generator in its normalized basis.

Factor	$\mathrm{Tr}\, T^2$	$\mathrm{Tr}\, T^4$	$\mathrm{Tr}\, T^4 / \mathrm{Tr}\, T^2$
Colour	6	3/2	1/4
Weak	13/2	13/8	1/4
Hypercharge	21/2	389/72	389/756 ≈ 0.51455

These moments enter a trace-chord continuation of a loop or covariantly transported relative holonomy U=exp(iθT):

$$\frac{Re\,Tr[I-exp(i\theta T)]}{Tr\,T^2}=\frac{\theta^2}{2}-\frac{\theta^4}{24}\frac{Tr\,T^4}{Tr\,T^2}+O(\theta^6) \quad (23)$$

At fixed conventional generator normalization, the normalized hypercharge fourth moment is 389/189≈2.058 times the colour or weak value. This is a statement about the expansion coefficient, not a force-strength ratio or a derived correction to a coupling. Replacing the trace by Z(1−cosθ) would assign the fourth-to-second ratio one to every factor and would miss this information. The trace-chord functional is an illustrative invariant continuation; the physical source must determine which nonlinear invariants actually occur and their weights.

Mixed-factor fourth moments are nonzero as well: $Tr(T_C^2T_W^2)=3/4$, $Tr(T_C^2Y^2)=11/12$ and $Tr(T_W^2Y^2)=5/8$ for any normalized non-Abelian generators in their respective factors. All 35 cross-factor pairs were checked. Since different factors commute, their contribution to Re Tr[I−exp(i(θ_AT_A+θ_BT_B))] includes $-Tr(T_A^2T_B^2)\theta_A^2\theta_B^2/4$. Quadratic mixed traces vanish, but this does not remove nonlinear interactions through the shared charged carrier. These vertices can contribute to a reduced Hessian after averaging and integrating out fields; their moments alone do not calculate that contribution or its connected subtraction.

The completed algebraic step therefore supplies concrete checks for a physical implementation. It must reproduce the full charge Gram, retain the higher and mixed moments required by its actual source functional, and evaluate the complete reduced Hessian with its measure and record conditioning. Neither charge algebra nor three scalar copies fixes that history law. The source-selection obligations identified in [17, Section 19.9] remain applicable. The present audit does not prove that the full VERSF corpus cannot supply them; it identifies what is absent from the executable continuation tested here.

14 Executing a joint current–record influence

14.1 The operation exists; its physical propagation is the issue

QCA-1 supplies a gauge-covariant current–record isometry [18]. RCHS-35 preserves its fixed-orbit history law when the current coordinates do not propagate between operations; the same source explicitly excludes general propagation and changes of current orbit from that preservation theorem [9, Sections XIV.11–15]. The later corpus review distinguishes this existing operation and selected first-moment matter transport from the still-required joint multi-time law [19]. Primitive costs and existing transport rules must therefore be retained, rather than reopened as fitting parameters.

A full 144 link–generator quadratic response was already evaluated in RCHS-36D [20]. Its factor-blind lift returned conditional coefficients but failed its own one-loop ratio-matching test. That is a different branch from the present paper. It demonstrates why merely increasing a matrix dimension is insufficient. The calculation below instead tests a concrete possible shortcut: whether an unspecified propagation between the existing operations is necessarily invisible to a joint observable.

14.2 Native instrument and declared finite extension

The QCA diagnostic address carrier has dimension 50: the 47 charged addresses of Section 13 plus three neutral addresses, ordered Q, u_R, d_R, L, e_R, N, H. The preparation is ρ=(I−|45⟩⟨45|)/49 in zero-based indexing. Seven invariant terminal projectors P_r select those blocks. For a normalized current ray u=j/‖j‖, all twelve charge generators enter the native instrument:

$$K_a=i[T_a,uu^\dagger],\quad s=\frac{1}{2}Tr\,\Sigma_{a=1\ldots12}K_a{}^\dagger K_a \quad (24a)$$

$$C_a = \frac{K_a}{s^{1/2}}, \quad C_0 = (I - \Sigma_{a=1\ldots12} C_a{}^{\dagger} C_a)^{1/2} \quad (24b)$$

The index a=1,…,12 includes conventional Y; C_0 is the positive square root. The record operators are P_rC_a, including a=0. The construction obeys Σ_a C_a†C_a=I and has charge Gram diag($6I_8$,$(13/2)I_3$,21/2). These definitions and the preparation are inherited; the extension that follows is a diagnostic choice, not a source-selected physical completion.

Choose j_0 with equal amplitudes on all 50 addresses and j_1 with the two Higgs amplitudes doubled before normalization. Their terminal weights differ, so they belong to different gauge orbits. Use a current carrier L^2(G,Haar)⊗C^2 with rays R(g)j_z, z=0,1, sharing the same group frame g. Between operations apply U_φ=exp(−iφσ_x) on the orbit label, leaving the group frame and address carrier unchanged. This mixing commutes with the group action. The initial label state is $|+\rangle\langle+|$ and the group-frame wavefunction is constant. Neither the two-orbit restriction nor φ is claimed to be physically selected.

At a fixed group frame, retain the four current-label density blocks X_zw, initially ρ/2. Tracing each fresh pointer and terminal record gives the exact joint channel

$$E(X)_{zw} = \Sigma_{r,a} P_r C_a(j_z) X_{zw} C_a(j_w)^{\dagger} P_r \quad (25)$$

Three operations, with two intervening applications of U_φ, are evaluated without resetting the current or address carrier. Their diagnostic probe weights are w=(3,2,1). This sums all unconditioned terminal histories for these operations; it does not reproduce the earlier 151-history completion experiment or identify three operations with three committed facts. In particular, no physical completion clock is inferred from w.

For charge generator T, twist the instrument on the forward and backward branches by opposite half-probes. At each operation the tilted channel is

$$E_{\theta,w}(X) = e^{iw\theta T/2}\, E(e^{-iw\theta T/2}\, X\, e^{-iw\theta T/2})\, e^{iw\theta T/2} \quad (26)$$

Let F_g(θ) be the trace after the three tilted channels and the intervening current unitaries. Average F_g over the common group frame before taking its logarithm:

$$F(\theta) = \int dg\, F_g(\theta), \quad \chi_T = -Re\, \partial_\theta{}^2\, log\, F(\theta)|_{\theta=0}, \quad F(0) = 1 \quad (27)$$

This is a dimensionless influence curvature measuring sensitivity to the imposed instrument twist. It is not a free-energy curvature, a gauge-action coefficient or a physical coupling. Keeping the quantum current and records in one channel removes the reset approximation for this test, but does not supply the spatial, matter, completion and field dynamics required by Section 12.

14.3 Exact sector response and checks

The first two probe derivatives are propagated analytically through the channel. With A_T(X)=i{T,X}/2, its first derivative is w(A_TE−EA_T), and its second derivative is w^2(A_T^2E−2A_TEA_T+EA_T^2). The product rule retains all cross-operation terms. The full group average is evaluated by the exact quadratic projection onto invariant tensors:

$$\Gamma_{influence} = diag(\chi_C I_8, \chi_W I_3, \chi_Y) \quad (28)$$

Specifically, χ_C and χ_W are the averages of −Re F″_g(0) over their eight and three generator directions at the identity frame. Their averaged linear terms vanish. For Y, the mean survives and χ_Y=−Re[F″_g(0)−F′_g$(0)^2$]. Averaging directional log curvatures instead would incorrectly remove frame-to-frame mean fluctuations. Gauge invariance enforces the block form in Eq. (28); it does not enforce

equal sector coefficients or equal changes in them. Vanishing mixed quadratic entries do not remove the mixed nonlinear vertices identified in Section 13.

Table 16. Exact group-averaged influence curvature for the declared three-operation extension. These dimensionless responses are not inverse couplings. No measured force input is used.

Current mixing φ	Colour χ_C	Weak χ_W	Hypercharge χ_Y
0	0.147570860	0.167496128	0.305817169
π/8	0.147611218	0.167892558	0.306444849
π/4	0.147676641	0.168547980	0.307494132
π/2	0.147691880	0.168746651	0.307852848
π	0.147570860	0.167496128	0.305817169

At φ=0 the normalized responses χ/Z are 0.02459514, 0.02576864 and 0.02912544. The largest is 18.42 per cent above the smallest, so this influence is already not proportional to the charge Gram. It uses the native instrument within the declared finite carrier and preparation; those choices are not a complete source-selected physical evolution. Since χ is not Γ_NL, the mismatch supports the need to test proportionality in Section 12 rather than refuting H for the physical response.

Relative to φ=0, φ=π/2 increases the colour, weak and hypercharge responses by 0.0820, 0.7466 and 0.6657 per cent respectively. Dividing by the fixed quadratic weights (6,13/2,21/2) leaves these unequal fractional changes unchanged. At φ=π/4, deleting current-label coherences after each propagation changes χ_Y by 0.000329696. The inter-operation law and retained coherence therefore matter for this observable. These small diagnostic changes are not estimates of the physical force gap or bounds on the effect in a bulk model.

Table 17. Deterministic verification of the finite joint calculation. Residuals are numerical checks, not physical uncertainty estimates.

Check	Largest residual or difference
Native isometry, both current rays	7.63e-14
Gauge covariance, 15 rotations on both rays	2.33e-15
Analytic curvature versus five-point differences, all 12 generators	1.77e-09
Independent alternating-history calculation at φ=π/2	5.57e-10
Propagation with identical instruments on both labels	2.78e-17
Return to φ=0 response at φ=π	0 to reported precision

14.4 What the calculation settles

This is an explicit construction-level counterexample to inferring propagation independence solely from the native instrument and gauge covariance. It is not a counterexample to a fully selected physical VERSF law: the two-orbit carrier, its mixing and the unconditioned preparation have not been admitted as that law. In particular, group averaging does not impose the local Gauss constraint or provide the required fermionic Fock-space realization. No physical bulk limit, running or observable conversion is performed.

The remaining route is now precise. Attach the existing operation, transport and completion rules to one physical joint evolution and calculate the retained source response, or prove that all admitted completions give the same relevant response. This diagnostic shows why that equivalence cannot simply be assumed from covariance. It contributes no new physical gap-closure percentage and does not validate the common multiplier H.

15 Attempting the source-derived propagation operator

15.1 The fixed part is the matter population writer

MCFR-1 v4 fixes the reversal-even matter writer $P_+=(P+P\sharp)/2$ at its declared PCN same-event premise plus representation grade [22, Sections 9.15–9.18]. Here P is the driven site-to-site history kernel and P♯ is its stationary time reversal. The reversal-even kernel used for the population embedding below is P_+, not P. MCFR explicitly supplies a canonical completely positive population embedding and leaves coherent extensions and full history–matter correlations unselected. This reconstruction does not reopen the population kernel, primitive action unit or event-grain premise as free parameters.

Using the archived drive $\alpha\star=0.959001109719975$, let $D=2+2\cosh\alpha\star$, $a=1/D=0.200305886207$ and $b=\cosh\alpha\star/D=0.299694113793$. The driven kernel P has uniform hub row $P(0,y)=1/7$. For rim site i, $P(i,0)=P(i,i)=a$, $P(i,i+1)=\exp(\alpha\star)/D=0.522615879875$ and $P(i,i-1)=\exp(-\alpha\star)/D=0.076772347711$, with rim indices taken cyclically. All other entries vanish. Its stationary law is $\pi=(7,D,D,D,D,D,D)/(7+6D)$, and $P\sharp(x,y)=\pi_y\,P(y,x)/\pi_x$ reverses the drive. These are the probabilities reconstructed by the archived executable [25].

Averaging P and P♯ gives P_+: its hub row remains uniform and each rim row has hub and self probabilities a and two equal neighbour probabilities b. Both kernels have 31 positive directed/self transitions, but only P_+ obeys detailed balance. Numerically, the Frobenius norm of $P_+-P_+\sharp$ is below 10^{-15}, whereas that of $P-P\sharp$ is 1.54444730. The stationary net traffic along each clockwise rim edge is 0.060231697817. Thus the odd circulation is already present on the driven site kernel; it is not an unreported extra mark kernel. The spectrum in Eq. (29) and all Kraus calculations use the reversible P_+ [22, Section 9.12; 24, Section 10.1].

15.2 The finite Fold is not its own positive heat transfer

On the two-dimensional E_2 rim harmonic, the population eigenvalue is negative. The full stationary-self-adjoint spectrum is

$$spec(P_+) = \{1, \tfrac{1}{7}-a, \tfrac{1}{2}, \tfrac{1}{2}, a-b, a-b, a-2b\} \quad (29)$$

In particular $\lambda_{E2}=a-b=-0.099388227586$. A self-adjoint heat exponential on this same carrier has strictly positive eigenvalues, so $-\log(P_+)$ cannot be the required self-adjoint heat generator. The valid Dirichlet generator $I-P_+$ instead gives $\exp(P_+-I)$, whose E_2 eigenvalue is 0.333074787348. This is a Poisson mixture of different Fold counts, not the original one-Fold update. Taking an absolute value or changing the clock would likewise require a source justification. This is a typing check on a proposed shortcut, not a contradiction between the discrete matter writer and the full HMGBC transfer.

HMGBC already distinguishes these objects [7, Section 56A.2]: its positive master transfer is built from the operational generator and reference potential on the complete carrier. Recovering a finite event or population marginal from it requires the actual preparation, projection and completion rule. The seven-site spectrum does not determine those data or the complete generator.

15.3 An explicit family with exactly the same population action

Write p(y|x)=P_+(x,y), Π_x=|x⟩⟨x| and D_0=diag√p(x|x). For an Abelian background let U_yx be the unit-modulus parallel transport from x to y. The following Kraus family is explicit for 0≤η≤1:

$$K_* = \eta^{1/2} D_0, \;\; K_x = [(1-\eta)p(x|x)]^{1/2} \Pi_x \quad (30a)$$

$$K_{yx} = p(y|x)^{1/2} U_{yx} |y\rangle\langle x|, \;\; y \neq x \quad (30b)$$

Define Φ_η(ρ)=Σ_k K_kρK_k†. Completeness follows because D_0^2 supplies the self-transition weights and the off-diagonal Kraus operators supply every remaining probability in each row. The family is completely positive and trace preserving, locally gauge covariant, and D_6 covariant at the zero-link background. It acts identically on every site-diagonal input, not just on one selected preparation. For arbitrary density matrices,

$$diag\, \Phi_\eta(\rho) = {P_+}^T diag\, \rho, \;\; [\Phi_\eta(\rho)]_{xy} = \eta [p(x|x)p(y|y)]^{1/2} \rho_{xy}, x \neq y \quad (31)$$

At η=0 this is the canonical classical channel. At η=1 its seven self-transition operators are coherently combined into D_0, while the 24 non-self transitions remain resolved. One dilation uses self-transition environment states |e_x⟩=√η|*⟩+√(1−η)|x⟩, where |*⟩ and the seven |x⟩ are orthogonal. Then ⟨e_y|e_x⟩=η for x≠y. The population law fixes their norms but does not fix these overlaps. Here η is a mathematical witness of omitted coherence information, not a proposed VERSF coupling or fitted constant.

Tensoring the zero-link family with the identity on any internal carrier preserves the entire internal marginal, even for correlated input states. The canonical case and its consequence for internal prices were already established in SGW-2 [23, Section 17.12]. The present extension retains that identity. Consequently, simply appending the fixed population writer to an independently supplied internal instrument does not select a new internal force price. The 49-dimensional MCFR factor and the 50-address QCA construction must also be joined by an explicit physical carrier map; equal occupied counts alone are not such a map.

15.4 A gauge-invariant observable distinguishes the extensions

The channel freedom is observable on a coherent working preparation. On adjacent rim sites 1 and 2, prepare a superposition dressed by the direct link, and read the coherence along the alternative path through the hub:

$$|\psi(U)\rangle = \frac{|1\rangle + U_{21}|2\rangle}{2^{1/2}}, \;\; O(U) = U_{20}U_{01}|2\rangle\langle 1| + h.c. \quad (32)$$

Both the preparation density and O transform covariantly under independent site phases, so their final expectation is gauge invariant. Set all links to one except U_{20}=exp(iθ) and U_{02}=exp(−iθ). The relative direct and two-link paths then measure a triangle flux. After one application of Φ_η, exact multiplication gives

$$C_\eta(\theta) = Tr[\Phi_\eta(|\psi\rangle\langle\psi|)O] = \eta a \cos\theta, \;\; \chi_\eta = -C_\eta''(0) = \eta a \quad (33)$$

Table 18. Identical source-fixed population dynamics, different triangle-coherence curvature. χ is dimensionless and is not a gauge-action stiffness or measured force strength.

Coherence η	Population update	Loop curvature χ
0	Exactly P_+	0.000000000000
0.5	Exactly P_+	0.100152943103
1	Exactly P_+	0.200305886207

The numerical implementation verifies the entire diagonal-algebra identity below 6×10^{-17}, twelve successive population updates below 3×10^{-16}, local gauge covariance below 4×10^{-16} and D_6 covariance below 3×10^{-17}. Kraus completeness and Choi positivity pass to rounding precision. Three five-point derivative checks reproduce Eq. (33) within 3.6×10^{-10}. These are deterministic calculation checks, not physical error bars.

15.5 The precise unresolved attachment

The witness settles a limited implication: the source-fixed population writer, complete positivity and covariance do not determine every gauge-invariant response of its coherent extension. The differing maps are not merely different Kraus representations of one channel, because Eq. (33) distinguishes them. No claim is made that all of them satisfy the complete physical VERSF axioms, the native joint history instrument, Gauss constraints or CAR/Fock requirements. The coherent preparation and loop readout are diagnostic choices; χ is not the free-energy Hessian required by Section 12.

If the physical event fully records which matter self-transition occurred, its orthogonal environment states would select η=0 in this family. That conclusion requires the record identification itself. The native directed transition marks (x→y) have conditional law P(x,y) as specified in Section 15.1; the reversal-even matter transition has $P_+(x,y)$. Since $P\neq P_+$ at nonzero drive, MCFR's direct-mark attribution theorem excludes their literal identification on that branch [22, Sections 9.12–9.17]. It would supply no such obstruction for P_+ compared with itself or at zero drive. The source also distinguishes transition Kraus labels from the entire physical R4 record [23]. Preserving an already written ledger does not determine the overlaps associated with the new working transition.

The population-operator reconstruction therefore fixes the first moment and isolates missing information in the spatial joint amplitude/record map. The native QCA operation remains intact, and its own current–carrier cross kernels can be derived explicitly, as the following subsection shows. The remaining attachment is between that operation and physical matter and current evolution, including the spatial transition environment overlaps, preparation, completion, operational metric and energetic response. HMGBC's transfer formula does not numerically supply these inputs, and MCFR's finite-Fold covariance still consumes its stated energetic-branch assumption. An admitted joint map could select the missing blocks, or a physical-observable equivalence theorem could eliminate them. The population witness alone supplies neither.

15.6 Correlations preserved by the native operation

The native operation supplies more information than a population law. Retaining two current alternatives j and k while tracing its new pointer and terminal registers gives the explicit operator kernel in Eq. (A1). At a fixed current, an operator is unchanged precisely when it commutes with every terminal projector and native recording amplitude, Eq. (A4). Between two retained current alternatives, the corresponding necessary and sufficient condition is the intertwiner relation in Eq. (A5). These are exact preservation

criteria without a recovery operation; they do not assume that invariant populations imply invariant quantum correlations.

For the two archived currents of Section 14, the terminal-resolved protected subspaces have dimensions 14, 6, 6, 4, 2, 2 and 0. Coherences within each such subspace, including entanglement with an untouched reference, survive unchanged. Cross-terminal coherences are removed from the reduced carrier when the terminal register is traced or read classically. An exact rank certificate identifies the complete fixed algebra: 292 protected matrix directions plus one scalar active identity at either fixed current; only the 292 protected directions remain fixed between these two currents. These dimensions describe the diagnostic address carrier, not physical particle counts or a fraction of the force gap.

For the inherited preparation, the reduced current coherence factor is 0.998140138730118, calculated from the native amplitudes by Eqs. (A2–A3). It is not the free spatial overlap η in Section 15.3; identifying the two would require the missing carrier and transition map. Thus the native operation has a definite correlation law, while its admission as the full physical event evolution remains conditional. The next attachment must transport these protected correlations through the actual evolving current, matter and completion maps. Appendix A and archive [26] give the derivation, exact certificate and numerical controls.

15.7 Following correlations through recording sequences

The fixed-current criterion can be propagated through a complete declared sequence [27]. The carrier is retained between operations, together with its correlations with an external reference. Equation (B1) composes the native cross kernels with intervening matter transports; Eqs. (B2–B3) express coherence between whole paths as an overlap of their record-history amplitudes. This overlap is generally not a product of one-step scalar overlaps. Tracing newly emitted outputs at each step is equivalent to tracing them at the end only if later evolution never couples back to them. A retained record or completion memory that re-enters the dynamics must remain in the joint state.

For sector-preserving unitary transports, Eq. (B5) gives the exact initial subspace that remains in the explicit dark protected class at every step. Gauge covariance supplies a sufficient exact case: if the current is rescaled and transported by the same represented gauge transformation as matter, the protected algebra moves with it. The statement is per recording opportunity; scalar changes may still affect the physical clock, event rate or completion. For unrestricted changing directions, a protected space at one current need not persist. An exact three-ray certificate reduces the common dark dimension from 34 to 4 to 0 on the declared address carrier (Table 22). This is not an instantaneous loss of all quantum information or a physical current-visiting law.

The executed 32-step tests preserve a logical Bell state under unchanged current, common scalar rescaling and matched gauge transport to numerical precision. Three prescribed directional paths instead give cumulative loss, with final fidelities 0.674930, 0.045774 and 0.023786 (Table 21). Fidelity, purity and reference negativity are separate diagnostics; none is a force-strength fraction. The paths and their amplitudes were fixed as sensitivity tests and are not selected physical fluctuations. Appendix B therefore establishes transport of the native preservation rules without claiming the physical event evolution.

15.8 The joint physical motion needed for recording exposure

The next calculation isolates the part of the physical source that this preservation test consumes [28]. If both the current and the matter vector change before recording, the first excited amplitude contains their two derivatives together, Eq. (B6). General matter evolution cannot be absorbed into current direction alone: it may rotate the generator algebra or mix terminal sectors. Only for gauge-compatible matter transport does the expression reduce to a transverse relative-current increment, Eq. (B8). Its leading

mean excitation is the positive contraction in Eq. (B10), which includes the current–matter cross moments. The required input is a joint second moment, including any mean contribution, rather than two separate fluctuation magnitudes.

A controlled test keeps both individual motion laws identical while changing their pairing. Moving current and matter together gives zero excitation; independent signs give a reference amount; opposite signs give twice that leading amount (Table 23). The result is calculated directly from the unchanged native amplitudes and checked against the derivative formula. It proves that marginal motion laws alone do not determine this recording observable. These joint laws are sufficiency witnesses, not alternative fully admitted VERSF theories. Pointer excitation is not itself a universal measure of entanglement loss.

The source reconciliation retains existing positive results. PJCK-1 supplies a conditional finite-Fold mean and covariance on its endpoint carrier [29]; the CRTF birth-current analysis constrains relative endpoint innovations and their invariant projective distribution under its stated preparation and symmetry premises [30]. Neither fixes post-birth current–matter pairing on the native recording carrier. The physical source must supply the map between these carriers and retain the same-event cross correlations. A known endpoint variance cannot be inserted into a different carrier as an identity map. Likewise, a stationary ray distribution does not determine its temporal transition law.

The required leading projection is explicit: a source-derived attachment maps the complete joint event moment into the relative-current moment, or into the general amplitude quadratic when matter motion is not gauge-compatible. On a smooth operational diffusion, the corresponding short-time quantity can be read from the joint diffusion tensor, Eq. (B14). Doob normalization changes drift but does not supply an omitted diffusion tensor; finite-Fold and jump laws require their actual transition weights. This narrows the computation without deriving the missing joint block. The full quantum current cross amplitudes, record-memory attachment, energetic response and bulk matching remain separate requirements.

15.9 What the corpus fixes and the relative current projection

The later source results narrow the unresolved input [37]. MCFR-1 v4 selects one shared representation-valued current on its PFDMI/RCHS branch and fixes the reversal-even matter population writer under the stated PCN same-event premises [22, Sections 9.1 and 9.15–9.18]. The oriented history remains P. These selections do not determine the full coherent extension or its joint current–matter correlations. CLSN-1 v13 retains the primitive action unit at its declared premise grade and places the remaining strength calculation in the representation-resolved relaxed response [31, Sections 17.89–17.109]. A new Born postulate or fitted overall multiplier is not the missing input. The unresolved object is the common physical evolution joining these already supplied operations.

The Master Action current defect gives a direct tangent attachment [35]. At a background with vanishing current defect, subtracting a common gauge-frame motion expresses the relative current change in terms of the defect increment, transported endpoint changes and link change, Eq. (C1). The current remains independently varied; setting its defect to zero for every fluctuation would add a constraint. On the declared 112-real-coordinate slice, the leading two-state exposure has rank 22. Only the covariance projected onto these directions is needed for this particular initial quadratic test, Eq. (C3). This does not make those directions a closed Markov system or identify them with the full 187-dimensional physical quotient. Conditional transfer and Schur calculations still require the physical metric and cross blocks [36].

15.10 Recording supplies a calculated momentum disturbance

The native operation supplies a further part of the dynamics without adding a Gaussian fluctuation law. QCA retains the current coordinate while its current-dependent amplitudes change conjugate observables

[18]. Applying the existing RCHS momentum identity to the protected states d,e gives an exact result: the positive added-noise tensor is the recording-exposure tensor of Appendix B, divided by two for the equal mixture of the two states [37; Eq. (C8)]. The derivative of the no-excitation amplitude cancels from this positive operator noise, but remains in the full local fixed-preparation second moment. Appendix C derives the cancellation and keeps those two quantities distinct.

The original QCA gauge-orbit calculation has six nonzero noise directions in the twelve generator labels for this preparation. Its nonzero eigenvalues are approximately 0.000172590, 0.002816841 and 0.002989431, each repeated twice. The tensor includes off-diagonal entries, so the disturbance is correlated in the inherited generator coordinates. On the larger relative-current chart the rank is 22 and the eigenvalues are exactly half the earlier two-state exposure eigenvalues. Quantizing this larger chart requires a measure and kinetic attachment beyond QCA's single-orbit construction. These dimensionless coefficients are preparation- and coordinate-dependent; neither rank is a particle count or a force-strength prediction. Tables 24–25 distinguish the two calculations.

15.11 From momentum disturbance to physical current motion

Completeness makes the native operation preserve the current-coordinate probability distribution exactly, Eq. (C4). Its computed momentum disturbance therefore cannot be inserted directly as the covariance of current increments. If an independently selected local kinetic Hamiltonian converts momentum to motion, the added operator noise propagates according to Eq. (C10) in the stated free local approximation. The complete variance also depends on coherent connection terms, the incoming state and cross correlations. The physical event can couple current, links, matter, record and completion, so this approximation is a conversion formula rather than a selected propagator. The positive advance is an evaluated disturbance source; physical kinetic propagation and the common coherent action attachment are still required before it determines the fluctuations entering the gauge response. The constrained-action attachment below tests a different, source-grounded route: current can depend on endpoint momenta, so the recording disturbance need not enter as an independent current momentum.

15.12 Attaching the disturbance to constrained action variables

The corpus supplies a concrete relation between current and the substrate endpoint variables [39–41]. In the unit current/continuity restriction, only the endpoint field carries a derivative with respect to the Euclidean parameter. The independently varied current is auxiliary at this order: its canonical momentum vanishes, and stationary reduction expresses it as a combination of endpoint amplitudes and endpoint momenta, Eq. (D2). Independence in configuration space does not imply an independently priced current inertia. The full Master Action metric and other responding fields remain necessary for physical admission [46].

Under the additional canonical quantization stated in Appendix D, the real components of this reduced current commute. The native isometry can therefore be admitted as a function of that observable. Its positive momentum-noise tensor then pulls back to correlated endpoint and momentum blocks, Eq. (D5). Those disturbance directions preserve every reduced current at the recording instant and preserve the weighted total endpoint amplitude. On a single hub-to-rim spoke, the two nonzero endpoint contributions are opposite; their added-noise correlation is −1 and their variance ratio is 16/49. These are exact results for the one-edge added contribution on the declared branch, not the total correlations of an arbitrary physical state.

15.13 Executed response and the real time boundary

The disturbance directions have now been propagated through the existing nonlinear Euclidean action equations [39,40]. A nonzero-current preparation on the seven-vertex cell returns initially vanishing

current disturbance followed by nonzero current response and explicit endpoint–current cross tensors. Table 26 records the response gains. Independent nonlinear endpoint/momentum perturbations converge to the variational solution. No independent current mass or force-calibrated coefficient enters this calculation.

The physical interpretation remains conditional. The substrate endpoint amplitudes are not yet particle positions, and the native fifty-address carrier is not identified with a physical Fock state by its dimension. The canonical current extension and the physical real-time generator on the same constrained carrier must still be derived. The weighted Euclidean action contains a velocity term with nonzero curl, Eq. (D12), so simply replacing its evolution parameter by physical time is not justified. The corpus already contains matter population transport, spatial fermion normalization and conditional temporal releases [18,22,42–44]; their identification with this disturbance is the remaining issue. This calculation advances the conversion mechanism without issuing a physical motion or force-strength prediction.

15.14 Physical selection from BCB and admissibility

The foundational audit distinguishes a Hamiltonian for a given admissible flow from selection of that flow [47,48,52,53]. BCB constrains reversible evolution under its stated quantum assumptions; finite distinguishability, persistent facts and physical admissibility constrain the carrier and allowed processes. Observable closure identifies how measurements are represented through commitment outcomes, but equality of the observable algebra alone does not fix their time-dependent distributions [54]. HMGBC supplies a concrete operational heat-transfer route on the full matter and unresolved-record carrier. Its Section 56A explicitly distinguishes a sealed execution protocol from a derived physical closure and retains named conditional inputs [7]. These results do not establish that the Appendix D Euclidean generator is physical time evolution.

The audit adds specific tests. The direct real-time reading makes the intended unit-amplitude background a radial saddle, and the natural real midpoint kernel has a nonzero forward/reverse cycle ratio that no positive scalar endpoint weighting removes. These results apply to the restricted branch and the stated scalar-transfer identification; they do not exclude a larger carrier, nontrivial time reversal or reduced memory. Equation (E2) identifies the leading added current noise from the physical Hamiltonian velocity. The proposition in Section E2 strengthens this into a criterion for delayed onset or absence at all times. A vanishing leading coefficient alone does not decide the latter. Evaluation requires the actual generator, current representation and physical clock.

15.15 Direct comparison with the BCB action

BCB already supplies an explicit field action [49], and its constraint representation contains a definite tick-current law [50]. Direct variation gives a conserved current equal to the gradient of a transformed entropy variable, hence a wave equation on a fixed Lorentzian background. Appendix E derives the corresponding multiplier-sector Hamiltonian and compares it with Appendix D using the same seven-vertex initial data. A literal tick-charge identification fails continuity. The more favourable spatial-current map, Eq. (E8), matches the current at one instant but gives different subsequent motion: the tested rim current begins at order σ^2 in the old Euclidean flow and at order t^4 in the declared BCB wave discretization (Table 27). A regular common clock conversion cannot remove that difference [51].

The minimal constrained tick Hamiltonian supplies a second obstruction under a literal recording attachment: its current and the momentum governing that current form a closed preserved subsystem, so a current-dependent recording operation produces no later added current noise there. This is a conditional result for the multiplier sector, not a theorem that the full BCB matter theory has no recording backreaction. Tick current, gauge matter current and the Appendix D edge amplitude current remain distinct until their physical map is derived. The leading BCB scalar matter Hamiltonian also has restoring

Lorentzian dynamics, unlike the tested Euclidean vacuum flow. These calculations identify failed direct matches while retaining the full matter–record coupling as the physical question.

16 What remains for a physical explanation

The established explanation is a conditional relaxation mechanism. Equations (11) and (17) identify the fluctuation subtraction, and Eq. (12) explains the factor-of-two infrared scale. Local block removal identifies the current contribution as the larger remaining excess under the raw unit-weight law; under the inherited sector weights records retain 84–91 per cent of their Gaussian increment and supply the larger excess, and the local scalar model then shows no enhancement. These results explain how the quadratic approximation can overestimate stiffness and distinguish the remaining joint response from isolated record resistance. They do not yet calculate the physical three-sector response matrix.

The branch restrictions matter to that inference. A relative-coordinate half inertia cannot replace the frozen-field record weight. Agreement of Hessians does not equate the cosine continuation with the archived principal-log closure. Boundary and interior-loop responses are different observables, and a small boundary curvature cannot be inverted into a physical bulk force. The weighted-sector control in Section 13 and propagation test in Section 14 explicitly show why the scalar enhancement cannot be transferred by assumption.

The recording calculations determine what must be propagated: the protected correlations, their exposure under joint motion and the positive conjugate-momentum noise. Appendix D gives one conditional conversion into endpoint and momentum changes and follows its Euclidean response. Appendix E rejects the tested direct BCB identifications. Tick current, gauge matter current and the reduced edge-amplitude current must therefore remain distinct until an action-derived map joins them. The local stiffness, coherence overlap, recording-excitation probability and momentum-noise tensor are intermediate observables; none alone is a measured force strength.

The next physical calculation must first specify one admitted carrier with its constraints, the full matter–record Hamiltonian and physical clock, the measured current operators, the native recording channel and the preparation or history law. The current identification must follow from the action and observable prescription, not from matching the desired force values. Retained records must be included when the Hamiltonian acts on them. With these objects fixed, Section E2 gives a direct test: compute the channel noise of the Hamiltonian current velocity, then higher Hamiltonian derivatives if the first coefficient vanishes. A nonzero operator coefficient establishes an available channel for added recording noise; the physical preparation determines whether it is populated.

An all-time negative result requires a closed Hamiltonian orbit inside the channel's multiplicative domain, or the equivalent finite-dimensional derivative test in Section E2. A zero first coefficient or a zero expectation in one preparation is insufficient. Even absence of added channel noise does not by itself prove unchanged current statistics: the channel may alter the mean or transported intrinsic covariance. The literal tick attachment in Section E5 has the stronger fixed-subsystem property, so its negative result is justified on its stated branch. These alternatives make the next calculation decisive without prescribing its answer.

After physical propagation is established, the same source must generate the joint fluctuations entering the response matrix of Section 12, on a controlled bulk carrier. Equations (19)–(20) test the common-factor hypothesis; the representation-resolved coefficients, observable conversion and running then determine force predictions. Any measured calibration inputs must be distinguished from withheld comparisons, with regulator and matching uncertainties reported. The approximately four-per-cent common-only stiffness target and eight-per-cent participation-adjusted target remain conditional matching requirements. No new gap-closure percentage follows from the propagation criterion alone.

F-NRD1 Failure of the specified scalar matching route

For the spatial H scenario, with the stated transport, zero finite conversion shift and the fitted participation pattern held fixed, the target auxiliary retention is r=0.0813755. A source-admitted, regulator-converged bulk evaluation on that same observable whose total uncertainty interval lies wholly above this value cannot supply enough softening through this route. With no fitted participation correction, the corresponding target is r=0.040114. A single finite regulator or a differently defined boundary curvature is insufficient for this falsification. The thresholds test these matching scenarios, not record relaxation in general or VERSF as a whole.

F-NRD2 Absence of propagated recording noise

For a fixed admitted recording channel and time-independent Hamiltonian on the full d-dimensional output carrier, the proposed added-noise route fails for a measured current J if every Hamiltonian derivative of J remains in the channel's multiplicative domain. Proposition E1 makes the finite test exact: check orders n=0 through d^2-1, or prove closure of a smaller invariant derivative span. Zero velocity noise alone is insufficient. This falsifier excludes added channel noise for that current and attachment; it does not exclude changes of its mean or intrinsic covariance, other interaction mechanisms, or unbounded and time-dependent limits without their own domain control.

F-NRD3 Failure of the common-factor hypothesis on an admitted response matrix

For an admitted representation-resolved response matrix Γ_{NL} with the same normalization, background and observable prescription as its Gaussian reference Γ_G, compute the generalized eigenvalues and the dispersion ε_H of Eq. (20) with their regulator uncertainty. H is falsified as an exact statement if ε_H is resolvably nonzero. For comparison, the fitted participation factors in Section 9 are (0.96423759, 0.97417159, 0.95331019) in colour, weak and hypercharge order. With generator multiplicities (8, 3, 1), their mean is 0.96581048 and their Eq. (20) dispersion is $\varepsilon_H \approx 0.012943$, or 1.2943 per cent. Their normalized full range is about 2.16 per cent; this is a different statistic from ε_H. The approximately 1.29 per cent dispersion is a reference tolerance for sector dependence comparable to that fitted participation pattern, not by itself a definitive boundary of usefulness. Whether a common factor is an adequate approximation must be assessed after observable transport against a declared uncertainty budget. The scalar loop multipliers of Sections 6, 7 and 10 and the normalized influence entries of Section 14 are not eigenvalues of this matrix and cannot trigger this falsifier.

17 Verification and reproducibility

The inherited numerical evidence is preserved in [2–5], with later campaigns in [11], [12] and [14]. The finite joint influence is archived in [21], the source-operator reconstruction and coherent-extension calculation in [25], the native correlation-preservation derivation in [26], the recording-sequence calculation in [27], the joint physical-motion reduction in [28], the constitutive and projected-covariance calculations in [35,36], and the corpus reconciliation and recording-noise calculation in [37], the constrained recording-to-motion derivation and calculation in [39], the axiom/selection audit in [47], and the BCB action comparison in [51]. Reported Monte Carlo errors do not bound regulator effects, omitted fields, physical-source attachment or observable matching. The latest reconciliation combines fresh cross-corpus discovery and targeted reading of governing and later passages with the earlier full-text audit [19]; it does not claim that every paper has been independently re-proved.

For the joint wheel, the archived principal-log potential agrees directly with the controlling master evaluator. Finite-probe action differences include principal-branch crossings. The current conditional Fourier solve was checked against dense precision, and the Gaussian Schur baseline was checked

independently. Exact free-heat proposals include winding sectors and the induced field constraint. Alternative probe forms, time steps and history lengths are retained with the raw samples [4].

For the planar extension, a native-wheel topology mode reproduces the original wheel sampler under the same seed: 2,000 finite-probe comparisons have maximum difference 1.51×10^{-14}. Independent full-potential evaluation of 2,000 random local action changes agrees below 1.7×10^{-14}. Graph checks verify the curl–gradient identity, oriented sum of faces equal to the boundary, and the constraint projector. Full-current and reduced Gaussian curvatures agree below 4×10^{-16}. All twelve production runs preserve the boundary holonomy [5].

The planar errors are the maximum block-jackknife estimates over blocks of 50, 100, 250 and 500 stored configurations; the logarithm and probe extrapolation are propagated through the jackknife. Quarter-run estimates and first-three-probe fits are retained. The wheel report uses its own archived block sizes of 250, 500, 1,000 and 2,000 stored configurations. These controls do not exclude unknown autocorrelation beyond the tested blocks. Equivalent probes are correlated estimators of one response and are not counted as separate physical confirmations.

For the new interior campaign, the outer-loop mode reproduces the archived planar sampler exactly under the same seed in 4,000 finite-probe comparisons. The signed constraint projector and curl–gradient identity are checked independently. Full-current quadratic minimization agrees with the face-space Gaussian formula below 4×10^{-16} for all tested geometries. Errors use the largest block-jackknife estimate from blocks of 50, 100, 250, 500 and 1,000 stored configurations; equal-weight seed means combine their individual errors in quadrature. The current update retains its precision-dependent conditional mean. The new transport reproduces the unchanged spatial value 249.87821084 and exact-doubling control 122.85166259 before testing the nonlinear scenarios. Source code, run plans, raw samples, controls, analysis and input hashes are retained in [11].

For the block-removal campaign, the exact bare-field result K=a is recovered by every stored finite probe. Independent analytic derivatives are checked against five-point finite differences on 288 random configurations, covering three patch sizes and both probe prescriptions; maximum first- and second-derivative discrepancies are below 8×10^{-12} and 4×10^{-8}. The discrete curl of the measurement shift agrees with the single-face selector to numerical precision. Statistical errors take the largest block-jackknife estimate over 50, 100, 250, 500, 1,000 and 2,000 stored configurations. Seed means are combined with equal weight and independent errors in quadrature. The archive retains all raw restoring terms, scores, finite-twist weights, block errors, paired estimator checks, quarter-run estimates and run plans. No measured coupling enters the new sampler.

The normalization-transfer archive [14] contains twelve new runs and 120,000 stored configurations. Independent full quadratic eliminations and analytic twist derivatives are checked at all three weights and three patch sizes; current Fourier precisions are checked against dense inversion for every time regulator. At Z=1, τ=1 and the original raw coefficients, the new executable reproduces the earlier sample output byte for byte under the same seed. Statistical errors are the largest block-jackknife estimates over 50, 100, 250, 500 and 1,000 stored configurations, with independent seed errors combined in quadrature. The twelve-generator reconstruction reproduces the charge Gram to 2×10^{-15} and checks the trace-chord fourth-order expansion along 30 random generator directions. Numerical success does not establish the omitted physical source attachment.

The joint influence archive [21] contains the complete 50-dimensional generators, two current rays, Kraus operators, preparation, terminal projector mask, fixed calculation plan, analytic derivative executable and all outputs. Five-point checks use h=0.004, 0.002 and 0.001 for every generator. The deterministic-swap check is implemented independently on the address carrier, and the identical-instrument control makes propagation invisible as required. The source audit identifies the native

operation and the limits of its frozen-current preservation theorem. It does not treat arbitrary covariant extensions as physically admitted.

The operator-attachment archive [25] reconstructs P, its stationary adjoint and P_+ from the inherited drive without a force input. It retains all Kraus matrices, the coherent preparation and loop readout, spectrum and Poissonisation comparison, derivative controls, exact diagonal-action and correlated-state marginal checks, and local-gauge and D_6 covariance tests. The accompanying derivation identifies the environment overlaps left unspecified by the population writer. Source excerpts preserve the explicit distinctions among the fixed first moment, the joint instrument, the energetic parent and the positive operational transfer.

The correlation archive [26] retains the exact cross-kernel derivation, unchanged input currents and preparation, numerical operators, and finite-field rank certificate. The same-current constraint ranks are 43 and 43 on 44 active unknowns; the cross-current rank is 44. Independent numerical checks verify the isometry, protected coherences, terminal dephasing, overlap identity and simultaneous gauge covariance. Appendix A reports their tolerances and separates these mathematical checks from physical admission. Its overlap is derived without a force input.

The sequence archive [27] retains the full carrier–reference state through 32 operations. Preserving cases keep fidelity and purity within 1.35×10^{-14} of unity. Independently enumerated two-step histories agree with the cross-kernel recursion within 8.89×10^{-16} and verify the history-overlap identity within 2.02×10^{-15}. The cumulative norm identity agrees within 1.12×10^{-16}. The final common-dark-space rank is certified exactly over a finite field. These are mathematical checks on the declared carrier and paths.

The joint-motion archive [28] retains identical current and matter sign marginals across all three pairing laws. Direct native probabilities approach the leading coefficient with maximum discrepancy 1.565×10^{-9} at step 0.001. Gauge-frame covariance holds within 1.98×10^{-15}; a general non-gauge amplitude derivative agrees within 6.33×10^{-11}; and a non-centred correlated latent law checks the second-moment contraction within 9.95×10^{-14}. The diffusion Doob product rule is verified symbolically, including off-diagonal diffusion. Output states pass trace, Hermiticity and positivity checks. These validations do not establish physical source selection.

The recording-noise calculation [37] differentiates the complete native instrument, including its positive square-root complement. The exposure/noise identity agrees with the archived 22-direction arrays to 5.27×10^{-15} in matrix norm; the no-excitation cancellation has residual 7.85×10^{-15}. Independent nonlinear central differences decrease quadratically, with maximum full-derivative error 4.31×10^{-8} at step 10^{-4}. Exact gauge-orbit paths give 2.84×10^{-9} at that step. A separate two-current overlap verifies the full local second-moment tensor. Positivity, completeness and Hermiticity checks pass. The archive retains all tensors, derivatives, unchanged inputs and consulted source passages; no measured force value enters the calculation.

The constrained-motion archive [39] preserves the unchanged native instrument and earlier noise arrays. The Cartesian noise tensor pulls back to both earlier charts within 1.34×10^{-14}; the canonical current Poisson-commutator matrix has norm 8.21×10^{-17}. Two integration tolerances agree within 1.42×10^{-12}. Independent nonlinear perturbations at amplitudes 10^{-3}, 3×10^{-4} and 10^{-4} converge to the variational response with errors 2.65×10^{-5}, 2.39×10^{-6} and 2.65×10^{-7}. The analytic initial current slope and full nonlinear native derivative are checked separately. The archive includes source excerpts, explicit branch assumptions, all response matrices and input hashes. These checks validate the conditional construction and Euclidean sensitivity, not physical-time evolution.

The selection archive [47] verifies the classical symplectic identity, two independent Hamiltonian-Hessian constructions, the exact Euclidean circulation and a finite-channel check of Eq. (E2). The BCB comparison archive [51] verifies the displayed action variations and entropy transformation symbolically. Exact

rational arithmetic gives the continuity defect, the remote-edge derivative mismatch in Table 27 and closure of the multiplier Hamiltonian subsystem. Differentiating the original phase-space equations independently reproduces the transformed-current acceleration. The source PDFs, inputs, code, results, dependency versions and hashes are retained. These are restricted action and matching checks; they do not certify a complete physical regulator or quantum matter–record generator.

The additional proposition in Section E2 is proved directly from a Stinespring representation, a norm-convergent Hamiltonian expansion and finite-dimensional linear algebra. Its three-level control is fully specified there: exact symbolic multiplication gives zero velocity noise, nonzero acceleration noise and the leading expectation $\frac{t^4}{6}$ at $\hbar$=1. The channel formula and the dilation factorization agree exactly. This verifies the distinction between delayed onset and all-time protection; the control is not a proposed physical VERSF Hamiltonian.

The source-resistance review searched the public and uploaded corpus for the operational metric, polar phase, temporal reduction and relevant source laws, then read controlling passages closely [3]. Its later public inventory contains 611 linked documents representing 608 distinct byte sets. Discovery coverage is not a claim that all corpus theorems were re-derived. The finite-model geometry remains explicitly distinguished from a certified complete physical operational metric.

The review checks [57] preserve the sector executable's source and block switches. Twelve new weighted runs remove records or currents at each of the three weights, with two independent seeds per setting. Eight planar diagnostic reruns reproduce all original sample columns exactly while adding spatial branch statistics; two further runs freeze the L=2 field. Analysis retains independent seed estimates, quarter-run checks and block-jackknife errors through 1,000 stored configurations. The matching-scale audit independently integrates the stated two-loop system with a different solver, and the kernel audit separates the driven P from reversible P_+. These checks improve reproducibility and interpretation; they do not establish source admission of the scalar continuation.

18 Conclusion

Nonlinear record dynamics supplies a quantitative mechanism by which the quadratic calculation can retain too much auxiliary stiffness. In the specified infrared branch, equal bare field and record contributions permit an enhancement approaching two. The available mixed extrapolation gives about 1.7249, while independent local controls show near-complete relaxation of isolated record stiffness and a larger residual from current activation under the raw unit-weight law. Under the inherited sector weights the record block retains 84–91 per cent of its Gaussian increment and the local model gives no enhancement, so the H scenario rests on the raw unit-weight branch alone. These findings identify the relevant joint response; they do not establish one universal correction across carriers or sectors.

The recording analysis adds a separate exact result: the native operation preserves specified quantum correlations and produces a calculable positive momentum-noise tensor. Its conditional attachment generates subsequent Euclidean current response. The tested BCB tick and leading matter identifications do not reproduce that flow, and the literal tick attachment leaves a closed preserved subsystem. These failures exclude the stated direct maps while leaving the full physical matter–record reduction open.

The remaining physical question now has a precise mathematical test. For the added-noise mechanism, an admitted Hamiltonian must carry the measured current into directions exposed to the native recording channel. Section E2 distinguishes immediate or delayed noise transfer from absence of added noise throughout the Hamiltonian orbit, and states the preparation and finite-regulator limits. Establishing that connection would supply a propagation mechanism; deriving the joint history law, bulk sector response and observable matching would still be required for force strengths. The electromagnetic values 149.00 and 143.12 remain conditional scenarios. The paper closes with an explanation of the possible stiffness

deficit and a defined physical test, without claiming an additional fraction of the measured force-strength gap as closed.

References

[1] Taylor K. Completed Event Weighting and Force Response in VERSF. 3 November 2026. The supplied 53-page manuscript, especially Sections 14.6–14.10, 15.5 and 16. This is the reference paper advanced here.

[2] Taylor K. Large Distance Dynamics in VERSF; Record Kinetic Weight and the Force Response Gap in VERSF. Calculation records and reproducibility archives, 4 November 2026. Large_Distance_Dynamics_Reproducibility.zip; Record_Kinetic_Weight_and_the_VERSF_Force_Gap.txt; Record_Kinetic_Weight_Reproducibility.zip. Frozen-field nonlinear histories, same-box and bulk-current distinctions, and kinetic sensitivity.

[3] Taylor K. Source Determined Record Resistance in VERSF. Corpus review and executed polar and relative-motion calculation, 4 November 2026. Source_Determined_Record_Resistance_in_VERSF.txt; Source_Determined_Record_Resistance_Reproducibility.zip. Its global two-cosine source identification is corrected by [4]; the covariance and kinetic identities are retained.

[4] Taylor K. Joint Field Record and Current Fluctuations in VERSF. Executed seven-point-cell test and nonlinear closure audit, 4 November 2026. VERSF_Joint_Fluctuation_Test.txt; VERSF_Joint_Fluctuation_Reproducibility.zip. Archived master executable, exact source-form comparison, current Fourier checks, raw samples and temporal controls.

[5] Taylor K. Spatial Joint Field Record and Current Response in VERSF. Executed planar-block continuation and boundary-probe audit, 4 November 2026. VERSF_Spatial_Joint_Boundary_Test.txt; VERSF_Spatial_Joint_Reproducibility.zip. Connected open square patches, structural checks, raw production runs, seed and temporal controls, and matched Gaussian references.

[6] Taylor K. The Renormalised Standard Model Parameter Closure Theorem in VERSF. Sections 64.4.1B–H. Common operational covariance and defect lift; controlling passages identified in [3].

[7] Taylor K. The VERSF History Measure Generation Geometry and Branch Closure Theorem. Sections 4, 11A and 56A. Operational heat metric, upstream potential and history-rate distinctions; controlling passages identified in [3].

[8] Taylor K. The Post Commitment Atomic Operation. Section 46R. Independently varied polar-record phase and its link compatibility; controlling passages identified in [3].

[9] Taylor K. Configuration Dynamics Refinement Geometry and Record Conditioned Curvature Response in VERSF. RCHS-35, 130-page supplied version, 22 September 2026. Sections IV.13–17 and XIII.5–6 concern auxiliary reduction and the slow temporal metric; Sections XIV.11–15 provide the current–record construction, frozen-current preservation and its scope limits.

[10] Taylor K. Nonlinear History Response and Background Selection in VERSF. Sections 7.4–7.5 and 8.1. Local scalar chart and operational measure distinguished; executable source-form audit retained in [4].

[11] Taylor K. Interior Loop Response and Conditional Gap Matching in VERSF. New numerical campaign and matching analysis, 4 November 2026. VERSF_Interior_Response_and_Gap_Matching_Reproducibility.zip. Signed interior constraints, ten production runs, branch diagnostics, matched Gaussian references, two-loop transport, exact input provenance and raw data.

[12] Taylor K. Auxiliary Response Attribution and Common Normalization Tests in VERSF. Exact one-face response separation, fourteen controlled numerical runs, derivative checks and matrix acceptance criterion, 5 November 2026. VERSF_Auxiliary_Response_Attribution_Reproducibility.zip.

[13] Vettorazzo M, de Forcrand P. The helicity modulus in gauge field theories. 2003. arXiv:hep-lat/0311007. https://arxiv.org/abs/hep-lat/0311007. Standard twist-response context; the VERSF model and calculations in this paper are separate.

[14] Taylor K. Sector Normalization and Nonlinear Charge Audit in VERSF. Twelve weighted scalar runs, normalization identity, full charge-generator reconstruction and higher-moment checks, 5 November 2026. VERSF_Sector_Normalization_and_Charge_Audit_Reproducibility.zip.

[15] Taylor K. Coarse Graining and Chiral Fermion Survival in VERSF. October 2026, Section 6.2. The supplied 27-page manuscript; inherited representation census and quadratic determinant factorization.

[16] Taylor K. Charge Participation and Coarse Graining in VERSF. October 2026, Section 2.1. The supplied 23-page version; occupied preparation census and full operator carrier distinguished.

[17] Taylor K. Source History Weighting and the Coarse Grained Gauge Action in VERSF. Strengthened version, 1 November 2026, Section 19.9. Source selection, joint recording, complete reduction and physical matching requirements.

[18] Taylor K. VERSF Quantum Current Action Attachment. QCA-1, 21 September 2026. VERSF_Quantum_Current_Action_Attachment.md. Native fifty-address instrument, current-retaining isometry and construction-grade scope.

[19] Taylor K. VERSF Current Record Corpus Review. 28 October 2026. VERSF_Current_Record_Corpus_Review.txt. Existing operation, first-moment transport and remaining joint-correlation obligations distinguished.

[20] Taylor K. RCHS-36D: Full 144 Link HMGBC and RG Matching Test. 8 September 2026. RCHS-36D_Full_144_Link_HMGBC_and_RG_Matching_Test.md. Earlier conditional factor-blind matrix calculation and unsuccessful ratio matching; a separate branch from the present nonlinear probes.

[21] Taylor K. Joint Current–Record Propagation and Influence in VERSF. Exact finite construction and independent controls, 5 November 2026. VERSF_Joint_Current_Record_Influence_Reproducibility.zip.

[22] Taylor K. Matter Census and Family-Current Geometry Reduction in VERSF. MCFR-1 v4, 11 October 2026, Sections 8.2, 9.1 and 9.12–9.18. Shared-current representation, fixed same-event population writer, canonical CP embedding, coherent-extension scope and conditional energetic covariance.

[23] Taylor K. Physical Matter, Higgs and Record Weighting in VERSF. SGW-2, updated v7, Sections 17.11–17.16. Internal-marginal identity, exact record retention and the distinction between transition labels and physical records.

[24] Taylor K. Information Sharing, Record Overlap, and Aggregation in VERSF. Strengthened version, 1 November 2026, Section 10.1. Explicit archived D36 kernel, stationary law and source drive.

[25] Taylor K. Source Population Operator and Joint Propagation Attachment in VERSF. Exact operator reconstruction, coherent-extension witness and controls, 5 November 2026. VERSF_Source_Propagation_Attachment_Reproducibility.zip.

[26] Taylor K. Correlation Preservation by the Native Matter–Record Operation in VERSF. Exact kernel, fixed-algebra derivation, finite-field rank certificates and numerical controls, 5 November 2026. VERSF_Native_Correlation_Preservation_Reproducibility.zip.

[27] Taylor K. Following Quantum Correlations Through Native Matter Record Evolution in VERSF. Ordered history recursion, protected-space transport and 32-step controls, 5 November 2026. VERSF_Correlation_Transport_Through_Recording_Sequences.txt; VERSF_Correlation_Transport_Reproducibility.zip.

[28] Taylor K. Physical Joint Motion and the Loss of Protected Quantum Correlations in VERSF. Joint amplitude response, source-weighted exposure and same-marginal witnesses, 5 November 2026. VERSF_Physical_Joint_Innovation_Selection_Attempt.txt; VERSF_Physical_Joint_Innovation_Reproducibility.zip.

[29] Taylor K. PJCK-1 Exact Finite-Fold Correlated Same-Source Matching in VERSF. Draft 4, 4 October 2026, Sections 3–8 and 12–16. Semidirect source architecture, conditional endpoint Fold covariance and carrier distinctions.

[30] Taylor K. The Physical C/W/Y Radial-Current Tangent Field and Existing-Instrument Score Descent in VERSF. CRTF-1-D6, 28 August 2026, Sections 19K–19L-A (CRTF-EX2J, CRTF-EX2K and the relational endpoint-handshake theorem). Conditional birth attachment, invariant current-ray law and handshake form theorem; source excerpts retained in [28].

[31] Taylor K. CLSN1 Source Extension v13. 9 October 2026, Sections 17.72–17.79 and 17.89–17.109. Compatible current/link motion, source attachment and operational versus energetic response, later temporal and PCN results, and the remaining representation-resolved physical response.

[32] Taylor K. Exact Fold Balance and the Mixed Response Closure Test. SGW3 continuation, 16 October 2026. Stationarity and its completion derivative distinguished; source excerpts retained in [28].

[33] Taylor K. Joint History Transfer and Coarse Gauge Response. Finite-branch assembly attempt, 1 November 2026. VERSF_Joint_History_Transfer_Assembly_Attempt.pdf. Conditional phase-parent execution and the remaining physical source identification.

[34] Chetrite R, Touchette H. Nonequilibrium Markov processes conditioned on large deviations. arXiv:1405.5157, 2014, Section IV and Appendix C. https://arxiv.org/html/1405.5157v3. Standard Doob-transform identities, not a physical VERSF source law.

[35] Taylor K. MASD Joint Motion and Projected Metric Calculation in VERSF. 5 November 2026. VERSF_MASD_Joint_Motion_and_Projected_Metric_Calculation.txt; VERSF_MASD_Joint_Motion_Reproducibility.zip. Constitutive tangent attachment, 22-direction exposure projection and conditional Schur controls.

[36] Taylor K. Visible Fluctuation Strengths and Correlations in VERSF. 5 November 2026. VERSF_Visible_Fluctuation_Strengths_and_Correlations.txt and accompanying reproducibility archive. Conditional Gaussian-transfer and metric calculations. Its broad earlier current-injection wording is narrowed by the MCFR v4 reconciliation in [37].

[37] Taylor K. Corpus Reconciliation and Native Recording Noise in VERSF. 5 November 2026. VERSF_Corpus_Reconciliation_and_Native_Recording_Noise.txt; VERSF_Corpus_Recording_Noise_Reproducibility.zip. Dark-state exposure/noise identity, original-orbit and larger-chart tensors, full nonlinear derivative checks and source excerpts.

[38] Taylor K. Configuration Dynamics Refinement Geometry and Record Conditioned Curvature Response in VERSF. RCHS-35 Integrated Main Paper Updated R23, Sections XII.11–XIII.1. General native momentum identities, positive added variance and distinction from full preparation-dependent work.

[39] Taylor K. From Recording Momentum Disturbance to Coupled Substrate–Current Response in VERSF. 6 November 2026. VERSF_Recording_Disturbance_to_Current_Matter_Motion.txt; VERSF_Recording_to_Motion_Reproducibility.zip. Corpus reconciliation, constrained canonical attachment, native noise pullback and Euclidean variational response.

[40] Taylor K. Action-Derived Evolution Attempt in VERSF. ADE-1, 20 September 2026, Sections 3–7. VERSF_Action_Derived_Evolution_Attempt.md. Unit current/continuity restriction, auxiliary elimination and Euclidean endpoint–current equations.

[41] Taylor K. Temporal Response Reduction in VERSF. VERSF_Temporal_Response_Reduction.md. Exact endpoint velocity metric, temporal-connection reduction and unselected transverse kinetic coefficients.

[42] Taylor K. Joint Energetic Action and the Same-Carrier Source Test in VERSF. 20 September 2026, Sections 4–6. VERSF_Joint_Energetic_Action_Attempt.md. Dynamical reduction, conditional real-time equations and kinetic/static distinctions.

[43] Taylor K. Action-Derived Mode Map. 22 September 2026, Section 3. Action_Derived_Mode_Map.md. Auxiliary-current response, conditional contact covariance and the absence of a separate current-velocity term in the evaluated slice.

[44] Taylor K. Revisiting the VERSF Kinetic Calculation Against the Corpus. Revised 29 September 2026. CLSN1_Kinetic_Coefficient_Attempt.md. Inherited spatial fermion normalization and exact joint matter–loop transport, with temporal attachment retained as a separate requirement.

[45] Taylor K. On the Origin of Energy Conservation in the VERSF Framework. Corrected text, Sections 11–12. The identification of the cost function with the physical generator is Conjecture 1; boundary-flux matching and state-dependent clock qualifications remain explicit.

[46] Taylor K. The VERSF Master Substrate Action and Constitutive-Descent Theorem. Revision (11), Sections 13–19A. Independent current, continuity defect, complete residual cross metric and primitive dimensional ledger.

[47] Taylor K. VERSF Axioms and the Selection of Physical Evolution. 6 November 2026. VERSF_Axioms_and_Physical_Evolution_Selection.txt; VERSF_Axiom_Selection_Reproducibility.zip. Primary-source audit, Euclidean admission diagnostics and the short-time channel-noise identity.

[48] Taylor K. The Hamiltonian as an Admissibility Generator in VERSF. Website edition, Sections 1 and 6–9, pp.5 and 10–13. https://versf-eos.com/wp-content/uploads/2026/01/The-Hamiltonian-as-an-Admissibility-Generator-in-VERSF.pdf.

[49] Taylor K. Bit Conservation and Balance Fold v3 A Complete Lagrangian Field Theory Unifying Particle Physics and Gravity from Information-Theoretic Principles. Website edition, Sections 9, 12, 14 and 16.1. https://versf-eos.com/wp-content/uploads/2025/11/Bit-Conservation-and-Balance-Fold-Lagrangian.pdf.

[50] Taylor K. A Unified Informational Field Theory The VERSF Constraint and Lagrangian Representations. Website edition, Sections 2–5 and 9, pp.7–11 and 16. https://versf-eos.com/wp-content/uploads/2026/04/A-Unified-Informational-Field-Theory.pdf.

[51] Taylor K. Does the BCB Action Produce the Calculated Current–Matter Evolution. 6 November 2026. VERSF_BCB_Hamiltonian_Evolution_Matching.txt; VERSF_BCB_Evolution_Matching_Reproducibility.zip. Exact action variation, constrained Hamiltonian, wave/current comparison and recording-subsystem checks.

[52] Taylor K. Physical Admissibility A Constraint-Based Foundation for Physics. Revision (25), pp.12–14. Constraint completeness and the additional inputs needed for a particular Hamiltonian; source excerpts archived in [47].

[53] Taylor K. Bit Conservation and Balance. BCB-Paper (1), Appendix G, pp.76–79. Continuous reversible quantum evolution and the generator of a specified unitary flow; source excerpts archived in [47].

[54] Taylor K. The Fold Saturates Observable Physics Sufficiency and Observational Closure in VERSF. Revision (2), Sections 2–4, especially pp.9–14. Observable and correlation closure; source excerpts and the dynamical-selection distinction archived in [47].

[55] Stinespring WF. Positive Functions on C*-Algebras. Proc. Amer. Math. Soc. 6(2), 211–216 (1955). Theorem 1 and Section 3. https://doi.org/10.1090/S0002-9939-1955-0069403-4.

[56] Choi MD. A Schwarz Inequality for Positive Linear Maps on C*-Algebras. Illinois Journal of Mathematics 18(4), 565–574 (1974). https://doi.org/10.1215/ijm/1256051007. Multiplicative-domain characterization for unital completely positive maps.

[57] Taylor K. Nonlinear Record Review Checks in VERSF. 6 November 2026. VERSF_Nonlinear_Record_Review_Checks.zip. Weighted block removals, spatial flux-branch measurements, L=2 frozen-field ablation, driven-kernel audit and independent two-loop matching-scale calculation, with sources, plans, raw samples and analysis.

Appendix A Correlations preserved by the native recording operation

This appendix derives which coherences the existing QCA-1 operation preserves and how its discarded outputs reduce others [18; 9, Sections XIV.11–15]. It replaces an unspecified overlap by an explicit native-operator expression. The result is exact for that operation on its declared current and address carriers. QCA-1 itself calls its quantum-current implementation conditional: selection by the full Master Action, the physical preparation and clock, local Gauss/Fock admission and completion remain distinct obligations. Consequently these are native-operation preservation laws, not a completed derivation of physical force strengths. The executable and exact algebra certificates are archived in [26].

A1 The joint kernel and the meaning of discarding records

Retain the Hermitian $C_a(j)$, including $C_0(j)$, of Eq. (24), and put $L_{ra}(j)=P_rC_a(j)$. For an input current density kernel ρ(j,k), the full isometry has output blocks $L_{ra}(j)\rho(j,k)L_{s\beta}(k)\dagger$ tensored with $|a,r\rangle\langle b,s|$. The current coordinates j and k need not be set equal before the calculation. Keeping the current, carrier, pointer and terminal register together preserves all input inner products and all entanglement with an untouched reference, since V†V=I. This is preservation in the joint output, not a statement that each subsystem is unchanged.

$$\mathcal{E}_{jk}[X] = \Sigma_{r,a} P_r C_a(j) X C_a{}^{\dagger}(k) P_r \quad \text{(A1)}$$

Equation (A1) is the current–carrier kernel after both new output registers are traced. If only the excitation pointer is discarded, the terms with a=b remain but terminal-register cross terms $|r\rangle\langle s|$ can still exist jointly with the carrier. Tracing or classically reading that terminal register removes these r≠s output coherences. Within a single terminal sector, the C_a action determines what survives. This distinction matters: merely labelling an output as a "record" does not establish which quantum outputs have physically been discarded or permanently committed. The diagnostic terminal sectors are not automatically previously written R4 facts [23, Sections 17.13–17.16].

For a product input χ(j)χ(k)*ρ with Trρ=1, discarding the carrier as well multiplies the current off-diagonal kernel by Gρ(j,k). Completeness gives Gρ(j,j)=1. The terminal projectors cancel from this final trace, although they remain essential in Eq. (A1):

$$G_\rho(j,k) = Tr[\rho\, \Sigma_a C_a{}^{\dagger}(k) C_a(j)], \;\; |G_\rho(j,k)| \le 1 \quad \text{(A2)}$$

$$1 - Re\; G_\rho(j,k) = \tfrac{1}{2}\Sigma_a \| [C_a(j) - C_a(k)]\rho^{1/2} \|_F{}^2 \quad \text{(A3)}$$

The vectors $\{C_a(j)\sqrt{\rho}\}$ in the direct-sum Hilbert–Schmidt space have unit norm, so their inner products form a positive Gram kernel and prove the bound in Eq. (A2). Expanding the squared norm proves Eq. (A3). Thus G=1 precisely when $C_a(j)\sqrt{\rho}=C_a(k)\sqrt{\rho}$ for every a. Coherence magnitude is unchanged, |G|=1, precisely when these vectors agree up to one common phase. The criterion is on the occupied support when ρ is rank deficient. For a correlated incoming current–carrier state, Eq. (A1) still applies, but a single state-independent scalar G generally does not. A common global phase of j leaves its ray projector and every C_a unchanged exactly.

A2 Exact preservation as a commutant condition

At fixed j, $\mathcal{E}_{jj}$ is trace preserving and unital: the C_a are Hermitian, $\Sigma_a C_a{}^2=I$, and $\Sigma_r P_r=I$. Its complete space of unchanged operators is therefore the commutant of its Kraus operators and their adjoints. In the present factorization this has the particularly simple form

$$Fix(\mathcal{E}_{jj}) = \{X : \; [X, P_r] = 0, [X, C_a(j)] = 0 \; \forall r, a\} \quad \text{(A4)}$$

For completeness, the Hilbert–Schmidt norm identity for a unital, trace-preserving channel makes the sum of squared Kraus commutators vanish on any fixed operator and its adjoint. Conversely, commuting with every Kraus operator and adjoint fixes X. Here $\Sigma_a L_{ra} L_{ra}\dagger = P_r$ and $\Sigma_r L_{ra} = C_a$, so their commutant is exactly the one in Eq. (A4). This supplies a necessary and sufficient criterion, rather than inferring coherence preservation from population invariance.

The same argument on a finite direct sum of retained current coordinates gives the condition for an unchanged off-diagonal current–carrier block:

$$\mathcal{E}_{jk}[X] = X \;\Leftrightarrow\; P_r X = X P_r, \;\; C_a(j) X = X C_a(k)\; \forall r, a \quad \text{(A5)}$$

Equation (A5) concerns exact preservation without a recovery operation and uses the common pointer labels in the declared native isometry. An independently current-dependent redefinition of the pointer basis changes this joint extension; it cannot be treated as a harmless Kraus relabelling while leaving the current cross kernel unchanged. A simultaneous physical gauge-frame transformation remains covariant. Neither Eq. (A4) nor Eq. (A5) asserts that a frozen current is the actual dynamical source.

A3 Protected coherences in the inherited current example

Write $u = j/\|j\|$, $v_a = (T_a - u\dagger T_a u)u$ and $D = \mathrm{span}\{u, T_1 u, \ldots, T_{12} u\}$. Directly, $K_a = i(v_a u\dagger - u v_a\dagger)$ and $S = s|u\rangle\langle u| + \Sigma_a |v_a\rangle\langle v_a|$, with $s = \Sigma_a \|v_a\|^2 > 0$. Every vector orthogonal to D therefore obeys $C_0 d = d$ and $C_a d = 0$ for $a > 0$. To survive the terminal readout as well, restrict such vectors to one terminal sector:

$$D_r = Ran(P_r) \cap D^{\perp}, \;\; \mathcal{E}_{jj}[|d\rangle\langle e|] = |d\rangle\langle e|, \;\; d, e \in D_r \quad \text{(A6)}$$

The full matrix algebra on each D_r is preserved, including its off-diagonal coherences and entanglement with a reference. For d and e in different terminal sectors, the reduced operator $|d\rangle\langle e|$ is instead removed by the terminal trace. This is a concrete distinction between correlations invisible to the recording operation and correlations distinguished by its output label.

Evaluate the unchanged archived current j_0 with equal amplitudes on all 50 addresses. The second archived current j_1 doubles only the two Higgs amplitudes before normalization. Neither current is claimed to be physically selected; using them together is the two-orbit diagnostic extension of Section 14. Their terminal-resolved active spans are the same. Let A be their orthogonal complement to the direct sum of the protected spaces. Table 19 gives its block dimensions and those of D_r.

Table 19. Exact dimensions for the two archived currents. These count address subspaces, not physical particle species or a percentage of the force gap.

Terminal	Carrier dimension	Active dimension	Protected dimension
Q	18	4	14
uR	9	3	6
dR	9	3	6
L	6	2	4
eR	3	1	2
N	3	1	2
H	2	2	0

The protected spaces have total dimension 34 and A has dimension 16. On A, a terminal-diagonal operator has 44 complex unknown entries. An exact finite-field rank certificate gives rank 43 for each same-current commutator system and rank 44 for the cross-current intertwiner system. The identity supplies the matching same-current upper bound; no active cross-current fixed operator remains. The certificate uses Gaussian-rational generators, exact normalizations $s_0=1649/1250$ and $s_1=125/98$, and the algebraic ratio $\sqrt{(80801/78125)}$, specialized modulo the prime 1000033. It is an exact rank certificate, not a floating-point rank threshold.

$$Fix(\mathcal{E}_{zz}) = (\bigoplus_r \mathcal{B}(D_r)) \oplus \mathbb{C}I_A, \quad z = 0,1 \quad \text{(A7)}$$

The complex dimension of Eq. (A7) is 293: 292 protected matrix directions plus the scalar active identity. Active-to-protected fixed blocks cannot occur: the intertwiner equations would force their active image into the same terminal's protected space. For the current cross block j_0,j_1, precisely the 292 protected matrix directions survive; the active scalar no longer does. Numerical singular values independently separate the active zero mode from the next singular value by 0.184 and 0.303 at the two currents, while the cross-current system has minimum singular value 0.103. These checks corroborate the exact certificate.

A4 Calculated attenuation without a fitted overlap

For the inherited preparation $\rho=(I-|45\rangle\langle 45|)/49$ in zero-based indexing, Eqs. (A2–A3) give $G\rho(j_0,j_1)=0.998140138730118$, real to numerical precision. The squared-difference expression gives $1-\mathrm{Re}\,G=0.001859861269882$. Thus this particular reduced current coherence is slightly attenuated while its phase is unchanged. This value is not the free η in Section 15: the two calculations concern different carriers, and no spatial matter–current attachment identifying them has been supplied.

Table 20. Current coherence after repeated frozen-coordinate native operations. The carrier is retained between operations; no current or carrier reset is made.

Number of operations	Retained current coherence factor
1	0.998140138730118
2	0.996319890458266
3	0.994532747656544

These values come from composing $\mathcal{E}_{j0j1}$ on the retained carrier and then tracing it. They are not assumed to be powers of the one-step overlap. All joint-isometry, protected-subspace and cross-terminal checks pass below 1.7×10^{-14}; the norm identity agrees within 2×10^{-16}. Five simultaneous gauge transformations of both currents and the preparation preserve G within 5×10^{-16}. This is a covariance check on the diagnostic construction, not a replacement for physical Gauss-state admission.

A5 What this derives and what remains physical

The native operation now supplies an exact answer at a specified current: the commutant in Eq. (A4) identifies the unchanged carrier correlations; Eq. (A5) identifies unchanged correlations between retained current alternatives; and Eq. (A3) calculates how distinguishable output amplitudes reduce the current coherence. Orthogonal terminal output labels remove cross-terminal coherences from the reduced carrier, while within-terminal protected matrix algebras survive. Keeping the complete quantum output preserves information globally.

These fixed-current subspaces need not remain protected under actual current propagation, spatial transport or completion. Preservation throughout an event requires the physical intermediate evolution to carry the relevant protected algebra into the next one, and the actual record-conditioned sequence must use its full cross kernels. Requiring preservation for an entire family of currents imposes the intersection of their conditions; covariance alone does not give that intersection. The dimensions in Table 19 must therefore not be extrapolated to a generic source history or identified with a physical family census.

Old-fact retention remains a separate constraint. SGW-2 permits working dynamics within an unchanged old-history sector and explicitly distinguishes working terminal labels from complete written facts [23, Sections 17.13–17.16]. Preserving those old probabilities does not automatically preserve their quantum cross blocks, fix the new spatial transition environment overlaps, or identify the 50-address native instrument with the 49-dimensional MCFR completion. The required physical derivation must join those carriers and record maps through the same source evolution.

The present advance is therefore an explicit correlation-preservation law for the existing native instrument, with calculated nontrivial protected coherences and calculated attenuation. The physical current trajectory, joint matter attachment and energetic gauge response remain unreturned. No further percentage of the measured force-strength gap is claimed as closed.

Appendix B Correlation transport and the physical joint source

This appendix extends Appendix A through complete declared histories and identifies the leading source-weighted recording exposure [27,28]. The 50-address native operation is unchanged. The sequence results are exact conditional statements and executed controls; the physical current and matter law, its quantum extension and completion are not selected by choosing the examples. The calculation concerns correlations and pointer excitation, not a new energetic gauge coefficient.

B1 Ordered kernels and whole history coherence

For prescribed current paths J and K and carrier transports U, retain the full current cross block X between recording opportunities. With $L_{ra}(j)=P_rC_a(j)$, the recursion is

$$X_n = \mathcal{E}_{j_n k_n}[U_n{}^J X_{n-1} (U_n{}^K)^\dagger] \quad \text{(B1)}$$

A general current-changing quantum propagator instead acts on both input current coordinates before the native kernel is applied; its full integral kernel must be retained. Equation (B1) is a path-conditioned restriction, not a selection of path probabilities or coherent amplitudes. Classical averaging, when justified, averages complete compositions. Retained memory must be included if later operations interact with prior outputs.

For the complete record word $h=(r_1,a_1,\ldots,r_n,a_n)$, let $A_h[J]$ be the ordered product $L_{rnan}(j_n)U_n{}^J\cdots L_{r1a1}(j_1)U_1{}^J$. For a product path-label/carrier preparation with carrier state ρ, the final scalar overlap is

$$G_\rho[J,K] = Tr[\rho \Sigma_h (A_h[K])^\dagger A_h[J]] \quad \text{(B2)}$$

$$1 - Re\ G_\rho[J,K] = \tfrac{1}{2}\Sigma_h \|(A_h[J] - A_h[K])\rho^{1/2}\|_F{}^2 \quad \text{(B3)}$$

Completeness makes each history-amplitude family a unit vector in a direct-sum Hilbert–Schmidt space; expanding their squared difference proves Eq. (B3). Exact unchanged coherence requires equality of every occupied-support history amplitude; unchanged magnitude permits one common phase. Correlated input current/carrier states require their actual cross blocks, not a state-independent scalar factor.

The native frozen channels are unital and trace preserving. For $Y=\mathcal{E}_{jk}[X]$, direct expansion gives a cumulative loss identity:

$$\|X\|_F{}^2 - \|Y\|_F{}^2 = \Sigma_{r,a}\|X(L_{ra}(k))^\dagger - (L_{ra}(j))^\dagger Y\|_F{}^2 \quad \text{(B4)}$$

Unitary transports preserve this norm, so the nonnegative losses telescope through Eq. (B1). This is an operator-norm statement, not an entanglement monotone or a prohibition on recovery using retained outputs.

B2 Transport of the explicit protected subspace

Write $D(j)=\mathrm{span}\{j,T_1j,\ldots,T_{12}j\}$. For sector-preserving transports let $S_n=U_n\cdots U_1$ and $S_0=I$. The initial vectors that remain in the dark protected class throughout a path, including its initial current, are exactly

$$B_r[J] = Ran(P_r) \cap span\{S_n{}^\dagger j_n, S_n{}^\dagger T_a j_n\}^\perp \quad \text{(B5)}$$

The span in Eq. (B5) runs over n=0,…,N and a=1,…,12. Pulling the orthogonality conditions for S_nd back to the initial vector proves the result; every matrix on this subspace is transported without native-record loss. This describes the explicit dark class, not every possible recoverable code. If $j_n=\alpha_nV_nj_{n-1}$ with nonzero α_n and matter uses the same represented gauge V_n, covariance transports its protected algebra exactly. A common scalar factor leaves the normalized instrument unchanged, but need not leave event rates or completion unchanged.

Table 21. Retained logical Bell state after 32 recording operations on declared paths.

Evolution	Bell fidelity	Purity	Negativity
Unchanged current	1.000000	1.000000	0.5
Common scalar rescaling	1.000000	1.000000	0.5
Matched gauge transport	1.000000	1.000000	0.5
Directional path ε=0.1	0.674930	0.466464	0.337141
Directional path ε=0.3	0.045774	0.025342	0.000516761
Directional path ε=1.0	0.023786	0.022319	1.8244e-16

The initial logical Bell state uses two archived vectors d,e in the protected Q-sector subspace and an untouched two-dimensional reference. Directional paths are normalized u+ε[cos(nπ/4)d+sin(nπ/4)e], with identity matter transport. Matched gauge transport uses exp{0.17i(T_1+0.7T_3−0.4T_9+0.3T_{12})} each step. The scalar factor is [1+0.2sin(n)]exp(0.13in). These are fixed sensitivity fixtures, not physical clocks or source-selected amplitudes. Near-zero negativity establishes only numerical positivity of the partial transpose, not separability in a 2-by-50 system.

Table 22. Common dark dimensions across three specified current rays with identity matter transport.

Rays included	Q	uR	dR	L	eR	N	H	Total
Equal-address ray	14	6	6	4	2	2	0	34
Plus first integer ray	2	0	0	0	1	1	0	4
Plus second integer ray	0	0	0	0	0	0	0	0

The final zero in Table 22 has an exact certificate: the current/generator span has full row rank in every terminal block modulo prime 1000033 with i mapped to 649529. Specialization cannot increase rank, so full row rank certifies the characteristic-zero result. The exact Gaussian-integer rays and fixed seed are retained in [27]. This proves absence of a common dark vector across those rays, not instantaneous complete decoherence or their physical visitation. Over all unrestricted nonzero-response rays of this 50-address construction, the common fixed algebra is scalar: commuting with [T,p_j] for every ray and one non-scalar T forces commutation with the full matrix algebra. This quantifier is not a physical source-support assumption.

B3 Joint matter and current amplitude response

Start from a normalized old dark vector d. A smooth event changes j to j+εξ+O(ε^2) and acts on matter by exp(−iεH)+O(ε^2), where H is Hermitian. Differentiating the excited amplitudes gives

$$F_{a,d}(\xi, H) = [D_j C_a[\xi]]d - iC_a(j)Hd, \quad a > 0 \quad \text{(B6)}$$

$$p_{exc} = \varepsilon^2 \Sigma_{a>0} \|F_{a,d}(\xi, H)\|^2 + O(\varepsilon^3) \quad \text{(B7)}$$

The zeroth-order excited amplitudes vanish, so their first derivatives determine the leading probability. Summing terminal outcomes uses $\Sigma_r P_r$=I and does not alter this probability. For a real latent event vector z, stack these amplitudes into the real-linear map F_d. Source averaging contracts Re(F_d†F_d) with E[zz^T], including the mean term and all current–matter cross moments. Differentiability and an integrable

remainder are required. General non-gauge H must use Eq. (B6); a current-only rotation does not capture it.

For the gauge-compatible special case, write the matter and link transports as exp(iεG_m) and exp(iεG_l), and the independent current increment as $\varepsilon\eta_1$. With $\Pi=I-|u\rangle\langle u|$ and $u=j/\|j\|$, covariance reduces the first amplitude to the transverse relative motion

$$w = \frac{\Pi[\eta_1 + i(G_l - G_m)j]}{\|j\|} \quad \text{(B8)}$$

Let $\mu_a=\langle u,T_a u\rangle$, $s=\Sigma_a\|(T_a-\mu_a I)u\|^2>0$ and $q_a=(T_a-\mu_a I)d$. The native derivative on an old dark vector is $i[T_a u\langle w,d\rangle - u\langle w,T_a d\rangle]/\sqrt{s}$. Resolving $T_a u$ into its component along u and its orthogonal component gives the positive matrix

$$M_d = dd^\dagger + \frac{1}{s}\Sigma_a q_a q_a{}^\dagger, \;\; q_a = (T_a - \mu_a I)d \quad \text{(B9)}$$

$$E[p_{exc}] = \varepsilon^2 Tr(M_d Q_{rel}) + O(\varepsilon^3), \;\; Q_{rel} = E[ww^\dagger] \quad \text{(B10)}$$

$$Tr(M_d Q_{rel}) = 0 \;\Leftrightarrow\; Ran(Q_{rel}) \subseteq ker(M_d) \quad \text{(B11)}$$

Equation (B11) follows by writing the trace as a squared Frobenius norm. Summing M_d over an orthonormal code basis tests zero leading excitation of the whole old dark code. Strict positivity of Q_rel on the transverse space gives positive leading excitation for every nonzero old dark vector. A leading zero alone is not an all-orders preservation theorem. Pointer excitation is also not itself a universal entanglement-loss fraction.

Writing w=w_j−w_m makes the physical cross-correlation requirement explicit:

$$Q_{rel} = E[w_j w_j{}^\dagger] + E[w_m w_m{}^\dagger] - E[w_j w_m{}^\dagger] - E[w_m w_j{}^\dagger] \quad \text{(B12)}$$

B4 Weights supplied by the physical source

A classical pre-record event representation must supply the joint configuration increment and matter transport. For a positive raw transfer T and Perron function R, the normalized weights have the form

$$K(dY', d\omega|Y) = \frac{R(Y\prime)}{\lambda R(Y)} T(dY', d\omega|Y) \quad \text{(B13)}$$

The applicable second moment integrates $w(\omega)w(\omega)\dagger$ with these weights, conditional on the retained state and its quantum preparation. If the raw source already includes native outcomes, its one joint instrument must first be disintegrated; adding the same Born weights twice is not permitted. A source-derived linear map w=Bz gives $Q_{rel}=B\,E[zz^T]B\dagger$. Thus the endpoint covariance in PJCK [29] can be consumed only after its relative current–matter attachment B and other same-event correlations are derived. Neither its scalar value nor an invariant birth-current marginal supplies that map [30].

For a smooth diffusion realization, let $A=b^i\partial_i+(1/2)a^{ij}\partial_i\partial_j$ be the operational Markov generator on real physical coordinates. Its carré-du-champ is $\Gamma(f,g)=A(fg)-fAg-gAf$, with coordinate coefficients a. The Doob transformation retains this diffusion tensor and adds a times the gradient of log R to the drift [34]. A source-derived relative attachment therefore gives the initial short-time recording-test expansion

$$E[p_{exc}] = dt\, Tr(M_d B a B^\dagger) + o(dt) \quad \text{(B14)}$$

This does not determine the event cadence or prove a continuous repeated-measurement limit. Finite-Fold covariances can change under Doob weighting; jump laws require their transformed jump rates and finite amplitudes. A Laplace–Beltrami realization makes a the inverse operational metric, not automatically the inverse energetic gauge Hessian. HMGBC prescribes the source construction [7], while the later phase-parent execution still leaves its complete physical identification open [33]. Stationarity

alone cannot supply an omitted joint response [31,32]. A positive configuration kernel also does not select the full quantum current cross amplitudes.

B5 Identical individual motions with different joint exposure

Let s_j and s_m be signs, and set j′=exp(iεs_jG)u and U=exp(iεs_mG), with $G=T_1+0.7T_3-0.4T_9+0.3T_{12}$. Keep their individual marginals uniform and vary only their correlation c:

$$Pr(s_j, s_m) = \frac{1+cs_js_m}{4}, \quad -1 \le c \le 1 \quad \text{(B15)}$$

$$Tr(M_d Q_{rel}) = 2(1-c)\ell_d, \quad \ell_d = 0.0007905760688305594 \quad \text{(B16)}$$

Here ℓ_d=q†M_dq with q=iΠGu. Equation (B16) gives zero for matched signs, the reference amount for independent signs, and twice that amount for opposite signs. These are conditional witnesses that separate joint-source information from marginal fluctuation data. Their physical admission is not asserted.

Table 23. One native operation at ε=0.3 with identical individual motion laws.

Pairing	Pointer probability	Bell fidelity	Negativity
Opposite signs	0.000272156607	0.999844708	0.499922703
Independent signs	0.000136078304	0.999922354	0.499961262
Matched signs	5.01774475e-31	1.000000000	0.500000000

The reference-state comparison mathematically undoes the known matter transport in each branch before averaging. It isolates the native-record change in the corresponding matter frame; it is not a proposed recovery operation or an assumption that an observer can access the branch label. Both individual sign marginals are identical in all rows. The small numerical loss is a property of this fixture, not a physical rate estimate.

An invariant current-ray distribution is likewise insufficient: a frozen-ray kernel and an independent fresh-ray kernel preserve the same invariant marginal while imposing different temporal coupling. This does not establish that either is physically admitted. The source must select the joint update and its weights, including the retained record, or prove that all admitted alternatives give the same relevant observable. Equations (B6–B14) state the leading calculation that can consume that return; the energetic force response and its bulk matching remain unreturned.

Appendix C Relative current projection and native momentum noise

This appendix joins the constitutive tangent and recording-exposure calculation to the native momentum identities [35–38]. It keeps the same 50-address instrument and inherited protected vectors d,e. The general isometry identities were already given in RCHS-35; the new result here is their exact reduction to the exposure tensor and its evaluation on the present preparation. A physical current measure, full coherent implementation, kinetic response and Gauss/Fock admission are not selected by this calculation.

C1 The relative current tangent and visible projection

Let the Master Action current defect be D_J=J−κ(ρ_t−Uρ_s), with J independently varied. At a background D_J=0, define x_s=δρ_s−$\Omega_s\rho_s$ and x_t=δρ_t−$\Omega_t\rho_t$ for anti-Hermitian frame variations Ω_s,Ω_t. Write K_U=δU−Ω_tU+UΩ_s for the link change relative to those frames. Direct differentiation gives

$$\delta J - \Omega_t J = \delta D_J + \kappa(x_t - K_U\rho_s - Ux_s) \quad \text{(C1)}$$

The transverse relative ray tangent is Π times the right-hand side divided by ||J||, where Π=I−uu† and u=J/||J||. The identity is evaluated at vanishing background defect; it does not constrain δD_J to vanish. For D_J≠0, replace δD_J on the right by δD_J−$\Omega_t D_J$. This supplies an attachment of variables, not their probability law.

On the inherited real diagnostic slice, z contains 100 real current components and twelve matter-frame parameters. At ||J||=1 its relative tangent map and two-state exposure matrix are

$$w = Bz, \;\; B = \Pi[I, iI, -iT_1u, \dots, -iT_{12}u] \quad \text{(C2a)}$$

$$R = Re[B^\dagger(M_d + M_e)B] = V_{vis}\Lambda {V_{vis}}^T, \;\; rank\, R = 22 \quad \text{(C2b)}$$

Here M_d and M_e are Eq. (B9), V_{vis} has orthonormal real columns and Λ contains the positive eigenvalues. For a real second moment S=E[zz^T], including any mean contribution, the leading summed exposure consumes only

$$Tr(RS) = Tr(\Lambda {V_{vis}}^T S V_{vis}) \quad \text{(C3)}$$

This is a projection for one initial quadratic observable. Hidden variables can feed back under evolution, so no closed 22-variable stochastic process follows. When a positive Gaussian precision is supplied, the projected covariance requires the Schur complement of its hidden block; freezing that block changes the answer. Neither the supplied metric nor its identification with the physical energetic response is selected by this algebra [35,36].

C2 Current retention and the momentum identity

Let V(j) stack all $P_r C_a$(j), including a=0, and retain its current coordinate as in QCA. Equation (A1), completeness and cyclicity of the trace imply

$$Tr\ \rho_{out}(j,j) = Tr\ \rho_{in}(j,j) \quad \text{(C4)}$$

This is exact even for correlated current–matter inputs. It does not make the off-diagonal current kernel or conjugate observables invariant. In a smooth local chart q, write p_i=−iħ∂_i, D_i=∂_iV and A_i=−iV†D_i. Completeness makes A_i Hermitian. On a common smooth domain, with X∘Y=(XY+YX)/2, the dual channel obeys

$$\mathcal{E}*(p_i) = p_i + \hbar A_i \quad \text{(C5a)}$$

$$\mathcal{E}*(p_i \circ p_j) = (p_i + \hbar A_i) \circ (p_j + \hbar A_j) + \hbar^2 N_{ij} \quad \text{(C5b)}$$

$$N_{ij} = \frac{D_i^\dagger(I-VV^\dagger)D_j + D_j^\dagger(I-VV^\dagger)D_i}{2} \quad \text{(C6)}$$

For every real direction z, the operator N(z,z) is positive. It is the added operator noise beyond the square of the transformed first moment, not the entire variance change for an arbitrary incoming state. On the original QCA orbit, the same calculation uses its invariant generator fields and symmetrized moments; non-Abelian finite impulses are not assumed to commute.

C3 Exact noise identity on the protected preparation

At the inherited current, either v=d or e satisfies C_av=0 for a>0 and C_0v=v. For a transverse tangent w, Eq. (B9) follows from the excited derivative E_a(w)v=i[T_au(w†v)−u(w†T_av)]/√s. Put E_0(w)v=($\partial_w C_0$)v. Differentiating ${C_0}^2$=I−$\Sigma_{a>0}{C_a}^\dagger C_a$ gives

$$(I + C_0)E_0(w)v = -\Sigma_{a>0}{C_a}^\dagger E_a(w)v, \quad A(w)v = iE_0(w)v \quad \text{(C7)}$$

I+C_0 is invertible, including when C_0 itself has a zero eigenvalue. The no-excitation derivative therefore cancels from Eq. (C6) on v, leaving the real Gram matrix of excited derivatives. For any real-parameter current tangent map L, the equal mixture ρ_C=(|d⟩⟨d|+|e⟩⟨e|)/2 has

$$N^C = \frac{1}{2}Re[L^\dagger(M_d + M_e)L] \quad \text{(C8)}$$

The factor one half converts the sum of two exposure tests into a normalized mixed preparation. For L=BV_{vis}, Eq. (C8) is Λ/2. This is a local current-only chart with d,e held fixed, rather than a quantization of all 112 original joint coordinates; a changing matter frame can have additional momentum terms. Quantization beyond the single QCA orbit also needs an admitted configuration measure.

To distinguish the full local fixed-preparation second moment, define ${Q^v}_{ij}$=Re⟨D_iv,D_jv⟩ and average over d,e. At the dark background ⟨v|A_i|v⟩=0, but A_iv need not vanish. Thus

$$Q^C = N^C + \frac{1}{2}\Sigma_{v=d,e}Re\langle E_0(\cdot)v, E_0(\cdot)v\rangle \quad \text{(C9)}$$

For a narrow real current wavepacket with fixed internal preparation, Q^C gives the leading local symmetrized momentum-covariance increase in $\hbar^2$ units. General states require the full expectation of Eq. (C5), including mean shifts and cross correlations. In particular N^C alone cannot be used as the total variance change or recording work. Fixed terminal projectors preserve these inner products when summed; they remain part of the operation.

C4 Evaluation on the original orbit and the larger chart

The background is u=(1,…,1)/√50, with s=1.3192, and d,e are the archived protected Q-sector vectors of Appendix B. Table 24 uses $\hbar$=1. Its traces are in the stated coordinate conventions and cannot be compared as physical force strengths. The orbit tangents are L_a=ΠiT_au; the larger chart uses L=BV_{vis}. Only the former stays within QCA's original current orbit.

Table 24. Native momentum tensors on the equal mixture of the two protected states.

Current directions	Rank N	Tr N	Tr Q
Original orbit in 12 generator labels	6	0.011957723962	0.012760834757
Declared 22-direction relative chart	22	5.470293625082	7.537581377668

The orbit noise has positive eigenvalues 0.000172589911142, 0.002816841079403 and 0.002989430990545, each with multiplicity two. On the larger chart the eigenvalues range from 0.001660433153689 to 0.855172110800953; each is half the corresponding summed-exposure eigenvalue. The larger-chart connection contribution $\mathrm{Tr}(Q^C - N^C)$=2.067287752586316 is substantial and must not be omitted when the full local second moment is required.

Table 25. Selected normalized entries of the original-orbit added-noise tensor.

Generator pair	Normalized entry
C2 and C4	0.954503721833
C5 and C7	−0.989571661867

These entries are $N_{ab}/\sqrt{(N_{aa}N_{bb})}$ in the archived colour-generator basis. They describe the symmetrized noise tensor for this preparation, not a joint classical probability law for all noncommuting generators. The zero W1 and Y directions are likewise preparation-specific. No vacuum average, force-sector correlation or physical time rate is inferred.

The exact identity is checked against the previous exposure arrays, and every chart derivative is checked against independent nonlinear instrument evaluations. The derivative of the square-root complement is retained by solving its fixed-rank Sylvester equation. A separate overlap of the outputs at opposite nearby currents verifies Q^C. Section 17 records the numerical tolerances; complete tensors and checks are in [37].

C5 The remaining propagation requirement

Suppose, as a separately justified local approximation, the physical kinetic Hamiltonian were H_{kin}=p$^{\mathrm{T}}K_{kin}$ p/2 with constant positive K_{kin}. Free propagation would give q(t)=q+tK_{kin} p. Applying the native operation before that propagation carries its positive added operator noise into

$$N_q(t) = \hbar^2 t^2 K_{kin} N^C {K_{kin}}^T \quad \text{(C10)}$$

Equation (C10) is the added-noise contribution, not the full output variance. In the narrow real-wavepacket, frozen-local-coefficient approximation, with negligible change in the position–momentum cross covariance, the corresponding total local disturbance uses Q^C in place of N^C. Neither approximation selects K_{kin}, the physical interval, the incoming state or the repeated-event law. A stationary covariance additionally requires the actual restoring dynamics and correlations.

The complete propagator must retain current, link, matter, record and completion cross terms from the same admitted parent, with the selected population writer and oriented history. PCN does not set K_{kin}=I or identify static stiffness with kinetic response. The new identity supplies a conditional disturbance source. Its physical joint fluctuation law and energetic gauge response remain to be derived.

Appendix D From recording disturbance to coupled action response

This appendix attaches the native momentum disturbance of Appendix C to the constrained endpoint/current variables of an existing master-action restriction and follows the resulting response [39–43]. It derives a conditional conversion mechanism. The canonical quantum attachment and Euclidean variational evolution are kept distinct from the physically selected matter–record process. No particle displacement, physical current-increment law or force coefficient is obtained.

D1 The current constraint and the endpoint momentum

Here x denotes the 100 real components of a complex fifty-address substrate amplitude at each vertex, not the compact link phase of Section 2. Let D be the 12-by-7 edge-difference matrix of the wheel, with hub 0 and rim vertices 1,…,6. Write $L=D^{T}D$, $\Pi=\mathrm{diag}(7,4,4,4,4,4,4)/31$ and $\kappa=1/31$. In this appendix Π is the endpoint-weight matrix, not the ray projector of Appendix C. The inherited unit J/T restriction is

$$\mathcal{L}_E = V(x) + \frac{1}{2}\|j - \kappa D x\|^2 + \frac{1}{2}\|\Pi\dot{x} + D^T j\|^2 \quad \text{(D1)}$$

The potential is $V=\lambda\Sigma_v(\|x_v\|^2-1)^2/4$, with $\lambda=1$ in the run. Links and record transport are held at identity. These unit coefficients are diagnostic source conventions. The current is independently varied, but has no velocity in Eq. (D1). Its primary momentum and stationary reduction are

$$p_j = 0, \;\; p = \Pi(\Pi\dot{x} + D^T j), \;\; j_* = \kappa D x - D\Pi^{-1}p \quad \text{(D2)}$$

Equivalently the reduced velocity metric is $M=\Pi(I+L)^{-1}\Pi$, which is positive. Its minimum eigenvalue is 0.002774887270, reproducing [40,41]. Equation (D2) is a stationary/constraint reduction, not the imposed relation $j=\kappa Dx$ on every history. In the Gaussian path formulation a conditional auxiliary remainder retains contact covariance $(I+DD^{T})^{-1}\delta(\sigma-\sigma')$ in the unit convention [43]. This remainder is not an independent smooth current oscillator. Full metric cross terms and other dynamical fields are omitted here and remain part of the physical completion.

D2 A canonical attachment that respects the constraint

As an additional construction, canonically quantize the reduced real endpoint variables and admit the native isometry as a function of the reduced current observable. The current components then commute. Suppressing the internal identity factor, the phase-space current map and canonical symplectic matrix give

$$R_J = (\kappa D, -D\Pi^{-1}), \;\; R_J \Omega {R_J}^T = 0 \quad \text{(D3)}$$

The cancellation follows because $D\Pi^{-1}D^{T}$ is symmetric. The shift $P=p-\kappa\Pi x$ is canonical and gives $j^*=-D\Pi^{-1}P$. Thus the current can be used in the joint spectral calculus of this reduced construction. Its six independent edge combinations per real component are gradients; this is not a general exclusion of cycle currents from the full theory.

For one selected edge, let d be its incidence row and $q=j_e$ its 100 Cartesian real components. With z=(x,p), define the current readout R_e and attachment B_e by

$$R_e = (\kappa d, -d\Pi^{-1}) \otimes I_{100}, \;\; B_e = -\Omega {R_e}^T \quad \text{(D4)}$$

The upper block of B_e is $\Pi^{-1}d^{T}\otimes I_{100}$ and its lower block is $\kappa d^{T}\otimes I_{100}$. Admitting V(q) on this reduced Hilbert space extends QCA's single-orbit construction. It does not derive a physical configuration measure, permanent Fact or local Gauss/Fock attachment. The native internal state remains a distinct fifty-address factor; it is not identified with the substrate field by dimension. Directly treating its earlier current-conjugate momentum as a new independent p_j would overlook the constraint in Eq. (D2).

D3 The noise pullback and initial cancellation

Retain A_i and N_{ij} from Eqs. (C5)–(C6), now in Cartesian current coordinates. Since Eq. (D4) is linear, the dual-channel identities on a common regular domain become

$$\mathcal{E} * (z) = z + \hbar B_e A \quad \text{(D5a)}$$

$$\mathcal{E} * (z_a \circ z_b) - \mathcal{E} * (z_a) \circ \mathcal{E} * (z_b) = \hbar^2 (B_e N B_e{}^T)_{ab} \quad \text{(D5b)}$$

N is operator-valued in this identity. The calculation evaluates its expectation at the inherited unit current and equal protected-state mixture. The resulting Cartesian tensor has rank 22, Tr N_{cart}=5.458335901119 and Tr Q_{cart}=7.524820542911. Pullback to both earlier current charts reproduces Appendix C. Different traces reflect different coordinates, not extra physical noise. Q includes the connection contribution; N alone is not the total variance change.

Writing η as a factorization of the positive second moment $\hbar^2 N_{cart}$ gives the disturbance directions

$$\delta x = \Pi^{-1} d^T \eta, \;\; \delta p = \kappa d^T \eta = \kappa \Pi \delta x \quad \text{(D6a)}$$

$$\delta j = \kappa D \delta x - D \Pi^{-1} \delta p = 0, \;\; \Sigma_v \pi_v \delta x_v = 0 \quad \text{(D6b)}$$

This factorization does not specify a classical kick distribution or joint probabilities for noncommuting observables. It shows how the added endpoint and momentum contributions cancel in every reduced current, consistently with Eq. (C4). It does not require the endpoint-coordinate distribution to remain fixed.

$$\delta x_{hub} = -\tfrac{31}{7}\eta, \;\; \delta x_{rim\,1} = \tfrac{31}{4}\eta \quad \text{(D7)}$$

For a hub-to-rim-1 event, Eq. (D7) gives added-noise correlation −1 in any common internal projection with nonzero variance, and hub-to-rim variance ratio 16/49. The weighted total amplitude is unchanged. These statements concern this added one-edge contribution; incoming fluctuations and other events can change the total correlations.

D4 Propagation through the existing action equations

The ADE equations retain the Euclidean potential sign [40]:

$$\dot{x} = \Pi^{-1}[(I + L)\Pi^{-1} p - \kappa L x], \;\; \dot{p} = \kappa L \Pi^{-1} p + \nabla V(x) \quad \text{(D8)}$$

Let $S_E(\sigma, 0)$ be their variational propagator along a chosen background, and let C_y read out endpoints or currents. The propagated positive response tensor is

$$\Sigma_y{}^{add}(\sigma) = \hbar^2 C_y S_E B_e N_{cart} B_e{}^T S_E{}^T C_y{}^T \quad \text{(D9)}$$

Equation (D9) transports an initial tensor through classical variational equations; it does not make Euclidean stationary flow a physical quantum channel. A separately selected real-time Hamiltonian would require its own propagator, with all constraints and coupled variables retained. For the local total Q contribution, the same linear map applies under the fixed-preparation approximation of Appendix C. Arbitrary incoming cross covariances and finite-width nonlinear evolution require the full state.

The diagnostic initial state is x_v=u and p_v=π_v(κ−χ_v)u, with χ_1=1 and all other χ_v=0. The selected spoke has j=u and ||u||=1. This is neither a vacuum selection nor a claim that the fixed links solve the full variational problem. Internal isotropy keeps the background aligned with u. The disturbance directions are transverse to u, so at linear order they factor as δx_v=a_vη and δp_v=b_vη, with δj_e=c_eη. Their equations are

$$\dot{a} = \Pi^{-1}[(I + L)\Pi^{-1} b - \kappa L a], \;\; \dot{b} = \kappa L \Pi^{-1} b + \lambda \, diag(r_v{}^2 - 1) a \quad \text{(D10a)}$$

$$c = \kappa Da - D\Pi^{-1}b, \;\; a(0) = \Pi^{-1}d^T, \;\; b(0) = \kappa d^T \quad \text{(D10b)}$$

Here x_v=r_vu on the evolving background. The radial Hessian term does not act on these transverse directions. Initially c=0, but direct differentiation gives

$$\dot{c}(0) = \kappa^2 D\Pi^{-1}(I - L)\Pi^{-1}d^T \quad \text{(D10c)}$$

The selected-spoke component is −0.298469387755. The initial current response is therefore nonzero at first order in σ, and its added second moment begins at order σ^2. Later coefficients depend on the evolving background and can change sign. Table 26 uses the full integrated response, rather than extrapolating this initial slope.

Table 26. Euclidean response gains multiplying the Cartesian recording tensor.

Parameter σ	Endpoint gain Σ a_v^2	Current gain Σ c_e^2
0.000	79.674744898	0.000000000000
0.001	79.710155379	0.000007753780
0.003	79.774252733	0.000699911885
0.010	79.754647891	0.078417195998
0.020	78.348140446	0.993762277660

The gains multiply N_{cart} in the summed diagonal endpoint or current block, with the overall $\hbar^2$ factor retained. They are coordinate response coefficients, not measured variances or SI displacements. At σ=0.01, the hub coefficient is −4.4335797437 and the selected-current coefficient is 0.1541818582; their cross block is −0.6835775635 $\hbar^2 N_{cart}$. Generally,

$$\Sigma_{x_v,jf}{}^{add} = \hbar^2 a_v c_f N_{cart}, \;\; \Sigma_{je,jf}{}^{add} = \hbar^2 c_e c_f N_{cart} \quad \text{(D11)}$$

The common internal tensor persists because this is a one-event linear response about an internally aligned background. Other preparations, further events or additional couplings need not preserve that factorization. Interpreting the local coefficients as an actual finite stochastic trajectory additionally requires a controlled weak-disturbance or semiclassical regime.

D5 The remaining physical identification

The canonical construction of D2 must be identified with the physically admitted current representation and measure. Its substrate variables and native internal state must then be attached to the physical matter carrier, and the same parent must supply the real-time temporal generator. The selected P_+ population writer [22] and the inherited spatial fermion normalization [44] remain valid at their stated grades; neither alone performs this coherent attachment. A conserved scalar likewise does not select the required generator without its boundary-flux identification [45].

There is a concrete reason not to copy Eq. (D8) into physical time. The reduced Euclidean action contains the velocity one-form $\dot{x}^T$Bx, where

$$B = \kappa\Pi(I + L)^{-1}L, \;\; \|B - B^T\|_F = 0.001351756614 \quad \text{(D12)}$$

Its nonzero curl prevents discarding it as an endpoint term in these coordinates. A naive continuation that keeps every field unchanged produces an imaginary real-time coefficient. A valid continuation or temporal transfer must specify the current/temporal transformation and measure. This is a required

identification, not a proof that physical continuation is impossible. It also prevents automatically equating the reduced canonical current with a Euclidean current insertion, whose contact term has a separate role.

The result is an explicit conditional connection between native recording disturbance and subsequent coupled action response. Its analytic identities, full instrument differentiation and independent nonlinear trajectory controls are recorded in Section 17 and [39]. Physical current–matter motion, the joint fluctuation law entering the gauge response and any additional force-gap closure remain unresolved. Appendix E tests the BCB action and physical-selection claims directly. It preserves these conditional identities while ruling out the specified direct current and clock identifications.

Appendix E Physical selection and the BCB evolution comparison

This appendix tests whether the conditional motion in Appendix D is selected as physical evolution by BCB, admissibility or the explicit BCB action [47–54]. We derive the relevant action equations and exhibit exact failures of specified direct mappings. The tests do not establish a no-go for the full VERSF theory. A changed carrier, additional matter–record coupling, dynamical geometry or a reduction with memory requires its own derivation.

E1 What the selection principles establish

The BCB and Hamiltonian admissibility results supply unitary form under their stated assumptions and a unique generator for a given strongly continuous unitary group [48,53]. They do not identify that group with Eq. (D8). Physical Admissibility explicitly distinguishes constraint completeness from dynamical completeness [52]. The observable-closure claim concerns the representation of all accessible outcomes and correlations through the Fold [54]; a shared observable algebra alone does not fix a history law. If a fixed law is included in the meaning of the Fold, that additional content must be supplied to this calculation. HMGBC Section 56A gives a more concrete route through one operational heat transfer on the full matter and unresolved-record carrier. It also states that sealing a calculation does not derive its remaining conventions [7].

The prior audit [47] gives two precise cautions for the Appendix D slice. Directly reading its Euclidean Hamiltonian as physical energy makes the intended unit-amplitude background a radial saddle, with seven positive and seven negative real growth eigenvalues. On the untruncated uniform-amplitude ray its energy is unbounded below. These are stability and source-admission issues, not a claim that unboundedness alone prevents self-adjointness or unitarity. Its natural real midpoint kernel also fails scalar-measure detailed balance: a hub/rim rectangle of side 1/10 gives log of the forward/reverse cycle-product ratio $-3/384400$ at $\hbar$=1. Endpoint density or scalar Doob factors telescope around that cycle. This excludes the stated same-carrier self-adjoint scalar-transfer identification, not every nonreversible process or full memory completion.

E2 The physical current velocity required for noise propagation

Let the unital completely positive dual $\mathcal{E}^*$ preserve each self-adjoint current J_a and its square. Such currents lie in its multiplicative domain. With $X \circ Y = (XY+YX)/2$, define the symmetric channel-noise operator and the current velocity generated by an admitted physical Hamiltonian:

$$\mathcal{N}_{\mathcal{E}}(X,Y) = \mathcal{E}*(X\circ Y) - \mathcal{E}*(X)\circ\mathcal{E}*(Y), \quad v_a = \frac{i}{\hbar}[H_{phys}, J_a] \quad \text{(E1)}$$

Multiplicative-domain preservation makes this noise operator vanish whenever either argument is a preserved current. Expanding the Heisenberg current gives

$$\mathcal{N}_{\mathcal{E}}(J_a(t), J_b(t)) = t^2\mathcal{N}_{\mathcal{E}}(v_a, v_b) + O(t^3) \quad \text{(E2)}$$

For bounded finite-regulator operators the remainder is norm controlled. Unbounded versions require a common regular domain and sufficient time differentiability. State expectation gives an added-noise contribution, not the full covariance change: the covariance of the dual images changes as well. If the Hamiltonian acts on retained records, the channel must be defined on that full output algebra. A four-level calculation verifies Eq. (E2) [47]; its chosen Hamiltonian is a mathematical control, not a physical VERSF prediction.

The zero-noise characterization used here is Choi's multiplicative-domain theorem [56], alongside the Stinespring dilation [55]. For self-adjoint X, vanishing channel noise is equivalent to membership in that

domain; for a general X both adjoint-product conditions are required. Proposition E1 applies this standard characterization to the Hamiltonian orbit and derives the onset order and finite derivative test.

Proposition E1 Hamiltonian orbit and onset of recording noise

Assume a fixed finite-dimensional output space, a time-independent self-adjoint Hamiltonian H and a fixed unital completely positive channel $\Phi = \mathcal{E}^*$. Let J be a self-adjoint current with zero initial channel noise. The Stinespring representation [55] gives an isometry V and a unital representation π. Define the projection Q and the linear map ℓ by

$$\Phi(X) = V^\dagger \pi(X) V, \quad Q = I - VV^\dagger, \quad \ell(X) = Q\pi(X)V \quad \text{(E2a)}$$

Set $\delta_H(X) = \frac{i}{\hbar}[H, X]$ and $\ell_n = \ell({\delta_H}^n J)$, where $\ell_0 = 0$ by initial preservation. For self-adjoint X the exact factorization is

$$\mathcal{N}_\Phi(X, X) = \ell(X)^\dagger \ell(X) \quad \text{(E2b)}$$

If r≥1 is the first index for which ℓ_r is nonzero, then

$$\mathcal{N}_\Phi(J(t), J(t)) = \frac{t^{2r}}{(r!)^2} {\ell_r}^\dagger \ell_r + O(t^{2r+1}) \quad \text{(E2c)}$$

Proof. Inserting $\Phi(X) = V^\dagger \pi(X) V$ in the noise difference gives $V^\dagger \pi(X) Q \pi(X) V$, which equals Eq. (E2b). The finite-dimensional Heisenberg orbit $J(t) = exp(t\delta_H)J$ has a norm-convergent Taylor series. Apply the linear map ℓ to that series. Its first nonzero term is $\frac{t^r \ell_r}{r!}$; multiplying by its adjoint proves Eq. (E2c). The same factorization proves that added noise vanishes for all t precisely when every ℓ_n vanishes. Equivalently, the entire Hamiltonian orbit lies in the multiplicative domain of Φ. These statements concern operator noise, independently of the chosen state.

For a d-dimensional output space it is sufficient to check $n = 0, \ldots, d^2 - 1$ for each relevant current: δ_H acts on a space of dimension d^2, and Cayley–Hamilton expresses all higher powers in these. A smaller test is valid if the span of the computed derivatives is proved invariant under δ_H. For a state ρ, the leading diagonal coefficient is $\frac{Tr(\rho {\ell_r}^\dagger \ell_r)}{(r!)^2}$. A faithful state detects every nonzero positive coefficient; a rank-deficient preparation can miss it. For several currents, applying the construction to every real linear combination gives the positive semidefinite symmetric added-noise matrix.

Thus zero velocity noise removes the t^2 term but need not remove later noise. Absence of added noise at all times is also weaker than preservation of the complete current statistics: the dual images of the evolved currents can change. When input and output observables are identified, fixing the current orbit as well as its products supplies the stronger statement. The invariant subsystem in Section E5 meets that stronger requirement under its literal attachment. The finite derivative bound above is not a continuum theorem; unbounded fields, time-dependent generators and regulator removal need separate control.

Exact control with delayed onset

Take three levels, $\hbar$=1, P=diag(1,1,0), and the pinching channel Φ(X)=PXP+(I−P)X(I−P). Choose

$$H = |0\rangle\langle 1| + |1\rangle\langle 0| + |1\rangle\langle 2| + |2\rangle\langle 1|, \quad J = diag(0,1,1) \quad \text{(E2d)}$$

The channel fixes J and J^2. Direct commutation gives a velocity confined to the first two levels, but an acceleration with a 0↔2 component. Consequently,

$$\mathcal{N}_\Phi(\delta_H J, \delta_H J) = 0, \quad \mathcal{N}_\Phi({\delta_H}^2 J, {\delta_H}^2 J) = diag(1,0,1) \quad \text{(E2e)}$$

Equation (E2c) therefore starts at order t^4. In the state I/3 its leading expectation is $\frac{t^4}{6}$. This control demonstrates why a zero value in Eq. (E2) cannot alone rule out recording-to-current propagation. It introduces no physical VERSF parameter and does not change any force-matching result.

E3 Direct variation of the BCB tick sector

The constraint action [50] separates the spacetime tick current J^{μ} from the remaining fields. In signature (+−−−), collect the remaining terms, taken independent of J, λ and χ, in $\mathcal{L}_0$:

$$\mathcal{L} = \mathcal{L}_0 + \lambda_\mu (J^\mu - F(s)\nabla^\mu s) - (\nabla_\mu \chi) J^\mu \quad \text{(E3)}$$

$$J^\mu = F(s)\nabla^\mu s, \;\; \nabla_\mu J^\mu = 0, \;\; \lambda_\mu = \nabla_\mu \chi \quad \text{(E4)}$$

These follow respectively from variations of λ, χ and J. The last sign corrects the intermediate minus sign printed in [50, Section 5.1] for its displayed negative conservation term. The correction leaves the two current constraints unchanged. For the stated modulation $F(s)=R\bigstar/(1-s/s_{max})$, define the scalar entropy potential q, distinct from the current-coordinate q of Appendices C–D:

$$q(s) = -R_{\square} s_{max} log(1 - s/s_{max}), \;\; J^\mu = \nabla^\mu q, \;\; \square_g q = 0 \quad \text{(E5)}$$

Equation (E5) is exact locally below saturation. On a fixed flat Lorentzian background it gives $J^0=\dot{q}$, spatial current $-\nabla q$ and $\ddot{q}-\nabla^2 q=0$. The fixed geometry and admissible entropy range are explicit restrictions; a dynamical metric remains coupled through □g. Eliminating J and λ yields $\mathcal{L}red=\mathcal{L}_0-\nabla\chi\cdot\nabla q$. In the potential-only entropy subcase $\mathcal{L}_0=-V(s(q))$, the constrained Hamiltonian is

$$p_\chi = -\dot{q}, \;\; p_q = -\dot{\chi}, \;\; \mathcal{H}_{tick} = -p_\chi p_q - \nabla\chi \cdot \nabla q + V(s(q)) \quad \text{(E6)}$$

This is a multiplier-sector Hamiltonian, not an admitted positive-energy quantum matter generator. A potential or gradient completion and the physical constraint quotient cannot be inferred from the q equation alone. For example, in this subcase the remaining entropy variation gives $F(s)\square\chi - V'(s)=0$. Constant s and $\chi=0$ obey the two current constraints but fail this equation when $V'(s)$ is nonzero. Thus the claim in [50] that entropy stationarity is automatic requires qualification. Its printed bare □s likewise needs a specified kinetic term in $\mathcal{L}_0$.

E4 Testing the previous current trajectory

Use the wheel, Π, κ and unchanged aligned initial data of D4. This section compares the background current trajectory itself, rather than the added current covariance calculated in D4. First, identifying Πx with tick charge and j with spatial tick flux would require $\Pi\dot{x}+D^T j=0$ on the closed cell. At the initial state, Eq. (D8) instead gives

$$\Pi\dot{x} + D^T j = \Pi^{-1} p = \frac{1}{31}(1, -30, 1, 1, 1, 1, 1)^T \quad \text{(E7)}$$

The putative total charge derivative is −24/31. This rejects that literal identification; it does not require substrate amplitude to be conserved tick charge. The soft quadratic continuity cost in D1 is not the hard conservation constraint in E4. A more favourable map does match the spatial current at an instant:

$$q_A = \Pi^{-1} p - \kappa x, \;\; j = -D q_A, \;\; q_A(0) = -e_1 \quad \text{(E8)}$$

Its first derivative is $(-1/217, 15/62, -1/124, -1/124, -1/124, -1/124, -1/124)^T$ in the prior diagnostic parameter. An additive constant in q can place the entropy in its allowed local range without changing currents. The initial transformed acceleration follows exactly from D8, using the radial potential Hessian 2I at $x_v=u$:

$$\Pi\ddot{q}_A = -\kappa\dot{q}_A + [\kappa^2(L - I) + 2I]\dot{x} \quad \text{(E9)}$$

On the rim edge 3→4, the initial current and its first derivative vanish; both $(LqA)_3$ and $(LqA)_4$ also vanish. The fixed-background BCB wave discretization $W\ddot{q}+Lq=0$ therefore gives zero second current derivative for any positive diagonal W. Equation (E9) instead gives $(\ddot{q}A)_4-(\ddot{q}A)_3=1/16$ and hence $\dddot{j}_{34}=-1/16$. For the declared comparison $W=\Pi$, the BCB third derivative also vanishes and its fourth derivative is $-961/16$.

Table 27. Current on rim edge 3→4 from identical mapped initial potential and velocity. Parameters and coefficients are diagnostic, not physical force units.

Evolution	j at zero	First derivative	Second derivative	Leading term
ADE Euclidean flow	0	0	−1/16	$-\sigma^2/32 + O(\sigma^3)$
BCB wave test $W=\Pi$	0	0	0	$-961t^4/384 + O(t^5)$

A regular common clock reparameterization multiplies the second derivative by a nonzero squared factor when the first derivative vanishes. It cannot remove this mismatch or change the leading order. The two equal local entropy values and velocities also exclude an explanation based solely on their identical local entropy-clock factors at that instant. This is a direct fixed-background matching test, not a proof about every possible geometry or memory reduction. Allowing an arbitrary scalar coefficient in $\Pi\ddot{q}+c^2Lq=0$ does not repair it: the unconstrained best coefficient is negative and leaves a nonzero residual [51]. The exact remote-edge result already suffices.

E5 The recording attachment in the constrained tick Hamiltonian

The graph version of E6, with a potential V(q), has an autonomous pair:

$$H_{tick} = -p_\chi{}^T W^{-1} p_q - \chi^T L q + V(q) \quad \text{(E10a)}$$

$$\dot{q} = -W^{-1} p_\chi, \;\; \dot{p}_\chi = Lq, \;\; W\ddot{q} + Lq = 0 \quad \text{(E10b)}$$

A recording isometry depending only on $j=-Dq$, and acting trivially on χ, commutes with q and p_χ. It can disturb pq, but that disturbance has zero projection into the closed pair in Eq. (E10b). The future tick current therefore stays in the preserved algebra and receives no added recording noise under this literal attachment. The exact matrix implementation verifies both subsystem closure and the zero projection. This is not a theorem that full BCB matter has no recording backreaction: the fixed geometry, potential-only multiplier sector and q-dependent recording map are explicit premises. Its scalar carrier has not been identified with the full native internal instrument. Replacing E10a by a positive free-q Hamiltonian would change the canonical dynamics and needs a separate physical derivation. In the language of Proposition E1, the current orbit remains in a fixed algebra of the recording channel. Its zero added-noise result follows from that invariant structure, rather than from one vanishing short-time coefficient.

E6 Matter stability and continuation

The leading BCB Higgs term [49] gives, on the fixed flat scalar restriction $H=(0,h/\sqrt{2})$ with gauge and fermion sources omitted,

$$\mathcal{H}_h = \frac{p_h{}^2}{2} + \frac{|\nabla h|^2}{2} + \lambda_H\left(\frac{h^2}{2} - v^2\right)^2 \quad \text{(E11)}$$

At $h=\sqrt{2}v$ its radial mass squared is $4\lambda Hv^2>0$ for $\lambda H>0$. Positive-weight graph discretizations of this leading stable sector have imaginary linear mode eigenvalues, whereas the direct Euclidean radial flow in Section E1 has real pairs. Smooth real invertible state coordinates and a finite nonzero real clock factor preserve this distinction at an equilibrium. This excludes that direct vacuum-flow identification; it does

not identify the substrate field x with the physical Higgs or exclude projection from a different full background.

Nor does a potential sign change alone complete a Wick rotation. A real Lorentzian velocity coupling $\dot{x}^T A(x)$ contributes $-i\, x'^T A(x)$ to the conventional Euclidean action. Appendix D instead contains the real coupling $x'^T Bx$ with nonzero antisymmetric part. Its symmetric part is an endpoint derivative, but $\mathrm{rank}(B-B^T)=2$ and $B_{10}-B_{01}=3/7688$. Keeping the variables unchanged would require an imaginary Lorentzian coefficient for that part. Additional fields, a specified continuation and the physical measure may change the construction; simply renaming σ as physical time does not.

E7 Consequence for the force strength calculation

The explicit BCB action yields the tick wave law, the constrained Hamiltonian and the leading matter equations evaluated here. The tested maps do not recover the Appendix D trajectory or its recording-to-current conversion. A physical reduction must identify the measured matter current, the disturbed conjugate variable, the Hamiltonian coupling and the retained records on one admitted carrier. Proposition E1 then distinguishes nonzero added-noise transfer, delayed onset and all-time absence of added channel noise. Physical preparation and the joint history law remain necessary, followed by the bulk response and observable matching of Section 12. These tests introduce no measured force input and establish no additional gap-closure percentage.