Realised Readout and Charge-Sector Maintenance: a Two-Part Account of Yukawa Structure in VERSF

Keith Taylor *VERSF Theoretical Physics Programme — Standard Model Readout Series*

This is a two-part paper. **Part I** ("A Realised-Readout Channel for Yukawa Structure") builds the realised-readout mechanism: it rules out a standing-symmetric source for the fermion mass asymmetry, constructs the unique access-visible conditioned readout that survives, and drives the quark question down to a single inner-product test. **Part II** ("Charge-Sector Maintenance and the Quark Yukawa Projection") closes that test under one named premise package — *maintenance-conjugacy*, comprising the existence of a signed maintenance coordinate, a differential up/down reading of that coordinate, and conjugate record coupling to it (with a stable positive closure Hessian): it shows that, once this package holds, the quark readout contrast is forced strictly nonzero and cannot vanish by accidental cancellation, leaving one sharply-named first-principles target — derive that maintenance functional from closure geometry.

Part I — A Realised-Readout Channel for Yukawa Structure in VERSF

From Committed Records to Fermion Mass Contrasts

Companion to "The Reflection-Scope Verdict: Do the Carrier, Generation, and Realization Theorems Force S R S = R?" This part promotes the conditioned-readout construction of that paper's §12 to a standalone result at its own grain. It carries forward, rather than re-derives, the scope verdict's qualifiers: the access-visibility condition on uniqueness, the exact-versus-leading-order distinction between a binary record and a locked order parameter, and the open question of whether the readout coupling is independent of the carrier coupling or already fixed by it.

Summary for the General Reader

The fundamental matter particles — the electron, the quarks, and their heavier relatives — each have a mass, and in the Standard Model, our best theory of particles, each of those masses is set by a number that physicists simply measure and write down by hand. (Force-carrying particles like the photon are massless and are not at issue here; the puzzle is the matter particles.) There are about a dozen of these mass-setting numbers. They range wildly: the heaviest particle's is enormous, the lightest's is tiny, and they span twelve powers of ten. The theory gives no reason for any of them. They go in as inputs; nothing explains them. "Why do these particles have the masses they do?" is one of the biggest unanswered questions in physics — and part of why it stays unanswered is that it is *vague*. It is not even clear what kind of answer would count as an answer.

This paper's first move is to rule one tempting answer out. Take two closely related particles, the up quark and the down quark. They are almost identical twins, but they have different masses. Could that difference come from some perfectly balanced, mirror-symmetric structure underneath? The paper shows it cannot — and this is a hard result, not a hunch. If the underlying structure treats the two sides as exact mirror images, then by definition the two sides read out equal, and the two particles would come out with the *same* mass. A perfect mirror can only swap the two sides; it can never make them differ. So whatever creates the mass difference, it is not mirror symmetry by itself.

What survives is a more interesting idea, and it is one physicists already know well from other settings: the *rules* of a system can be perfectly balanced while the *outcome* is lopsided — once the system has actually committed to one option. Think of a pencil balanced on its tip. The laws acting on it are completely symmetric, with no preferred direction, but the pencil still has to fall *some* way, and once it falls, the result is one-sided. The rules stay symmetric; the realised outcome does not. The proposal here is that nature lays down a *record* of which way things actually fell, and that record can tip the mass one way rather than the other — without the underlying laws ever being lopsided.

The paper's real contribution is what it does to the vague question. Instead of trying to compute the dozen mystery numbers directly, it turns the whole problem into a single, sharp, yes-or-no question. The idea is that the underlying medium has to *read* the committed record in order to turn it into a mass difference, and at the simplest level there are two relevant ways it can read it — one that shows up in the mass and one that does not. It can read it as a real difference in *weight* between the two sides — and that kind of reading does show up as a mass difference. Or it can read it as a kind of hidden internal *twist* — really there, but of a kind the mass simply cannot feel, so it produces no difference at all. So the foggy "why these dozen numbers?" sharpens to one clean question: **does the medium read the record as a real weight-difference, or as an invisible twist?** That is a proper scientific question — it has a definite answer that can be calculated, and the answer could come out either way. If it comes out "invisible twist," the whole approach fails. That is exactly what a good question should do.

The paper is honest that this question has been *answered* in one place and is *still owed* in another. For one family of particles — the electron and its two heavier cousins, the muon and the tau — companion papers have already worked out the relevant numbers, and they are not fudge factors tuned to fit. The amount by which the tau is heavier than the muon comes out two independent ways that agree to about one and a half percent, and it is tied to the same underlying count that explains why there are exactly three families of matter and not four. So for these particles the relevant "dial" is fixed by the structure of the theory, not adjusted by hand. Two honest cautions come with this, and the paper states both: matching that result up with the general mechanism this paper is built around is a further step that has been spelled out but not yet proved, and — importantly — the same result does *not* automatically carry over to the quarks.

The quarks are where the paper started, with the up/down difference, and there the answer is still owed. The paper says so plainly instead of overclaiming. What it *can* now do is pin down exactly what would have to be true for the quark case to work: the record nature lays down would have to be of a specific kind — one that the up and down sides genuinely read differently rather than identically. The paper proves that *if* the record is of that kind, the mass difference follows cleanly, with no wiggle room. What it cannot yet do is show, from the underlying theory alone, that the record really is of that kind. And it flags the trap to avoid: you are not allowed to simply read off the needed answer from the masses you are trying to explain — that would be circular. The honest target it hands to the next paper is precise: derive that one missing ingredient from the underlying structure, on its own terms.

None of this replaces the Higgs — the famous mechanism that actually turns these numbers into masses still works exactly as before. This proposal is only about *where the numbers come from* in the first place. And the paper does not compute any actual mass. What it does is earlier in the chain and, arguably, more useful: it takes a fuzzy, possibly unanswerable question and turns it into a sharp one that can be tested and could fail — answered for one family of particles, and openly unfinished for the quarks. That is the move that turns a mystery into a research problem.

The message:

A particle's mass may not be a fixed label stamped on it, but a *reading* of a record that nature lays down when events become settled. If so, the long-standing mystery of these dozen numbers turns into a single testable question about how those records are read — a question already answered for one family of particles, and clearly marked as unfinished business for the quarks.

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Abstract

The Standard Model describes the allowed gauge interactions of fermions but does not derive the Yukawa couplings that fix fermion masses and hierarchies. Within VERSF, prior work derived or constrained several structural features of the Standard Model — generation count, class-grain refinement, carrier structure, and the W_7 fold-access obstruction. The Reflection-Scope Verdict established that the inherited Carrier, Generation, and Realization theorems do not force the W_7 access state into the reflection-fixed subspace, and proved a sharper bound alongside it: the fold *reflection* cannot source the up/down asymmetry, and no fully symmetric standing linear field splits the irreducible E_1 fold doublet — any such field is Schur-trivial and gives no P_+/P_- contrast.

This paper shifts the problem from standing symmetry to *realised readout*. It asks whether a committed substrate record can condition the physical access state that enters the effective Yukawa response. The proposal is not that a standing invariant field splits the doublet, but that a realised commitment record supplies a branch-conditioned pointer variable m that couples to the fold-access contrast observable $\Delta P = P_+ - P_-$. The minimal positive, trace-one, reflection-covariant conditioned access state is

$R\_m = ½(I + \zeta\, m\, \Delta P)$, $|\zeta m| \le 1$,

giving

$\chi(m) = \ln[\, Tr(P_+ R\_m) / Tr(P_- R\_m)\,]$.

Under the §7 Gibbs construction the exact conditioned state is $R\_m = ½[I + \tanh(\beta hm)\Delta P]$, for which the access contrast is **exactly linear**, $\chi(m) = 2\beta hm$, at every m. The constant-gain form $R\_m = ½(I + \zeta m\Delta P)$ with $\chi = 2\,\text{artanh}(\zeta m)$ is a re-parametrization that is exact for a binary record ($\zeta = \tanh \beta h$, $m = \pm1$) and a small-m linearisation otherwise; the artanh nonlinearity is an artifact of holding ζ frozen, not a feature of the dynamics (§4.3, §9).

This evades the Schur obstruction because the *law* is reflection-covariant ($R_{-m} = S\, R\_m\, S$) while the *realised* state is not reflection-fixed. The unconditioned ensemble stays symmetric and gives $\chi = 0$; individual committed histories carry $\chi \neq 0$.

Three qualifiers travel with the construction and are stated as part of the result, not buried. **(i) Access-visibility.** ΔP is not the only reflection-odd direction on E_1; the off-diagonal σ_y-like direction is equally covariant under m, but produces reflection-odd *coherence* the diagonal access functional $Tr(P\pm\cdot)$ does not detect. So the construction is the unique lowest-order covariant readout **among those the χ functional can read** — the access-visibility qualifier is the substantive content of "minimal," not a footnote. **(ii) What is exact.** The Gibbs state $½[I + \tanh(\beta hm)\Delta P]$ is exact for every m, giving the linear contrast $\chi = 2\beta hm$; it is the *constant-ζ rewriting* $½(I + \zeta m\Delta P)$ that is exact only for a binary record ($\zeta = \tanh \beta h$) and a small-m linearisation otherwise ($\zeta\_lin = \beta h$), the two constants coinciding only as $\beta h \to 0$. The single symbol ζ must not be allowed to carry both jobs, and no nonlinear (artanh) departure is a feature of the construction's own dynamics — under continuous m the contrast is linear. **(iii) The gain is a coupling — and now a structurally valued one.** Writing $\zeta = \tanh(\beta h)$ for a pointer coupling h is a reparametrisation, not a derivation; but in the charged-lepton realisation the gain is no longer a free scalar. A companion paper (*Structural Origin of Yukawa Operators*, with its Role-4/BCB companions) derives the depth-decay exponent as an inherited closure-architecture quantity, $\kappa\_clos \approx \ln(14) = \ln(\dim \Gamma\_min)$ — the same integer that fixes the generation count — so the *charged-lepton analogue* of the gain inherits a structural value, while its identification with the general E_1 projection h_Δ used in this paper is stated as a bridge and its extension to quarks remains open. The remaining freedom in the lepton analogue is contracted to a named, bounded ~3% residual (whether the fundamental scale is the integer 14 or the convergent focusing value e^(8/3), companion problem #8). The honest grade is therefore "charged-lepton analogue structurally valued up to a bounded residual; general projection via a stated bridge; quark projection open," materially stronger than "free open scalar" without claiming the general object is already proven.

This paper also *inherits* a second structural input. The charge-blindness of the mass-generating coordinate — $[\hat{Y}, \chi] = 0$ (companion *Yukawa Hierarchy Theorem*, Theorem 5.1) — is exactly the separation the realised readout requires: the conditioning variable is charge-blind, so the readout disturbs no charge eigenvalue, and charge universality across generations follows as a structural consequence. The construction stands on its own (Theorem 1 and the Schur evasion need no companion); these two inheritances strengthen the *charge-blindness* leg to a cited theorem and the *gain* leg, in the charged-lepton sector, to a structurally valued quantity — with its identification to the general E_1 projection a stated bridge and the quark projection open.

The Standard Model claim runs through a **second, named pillar**: a proportional-readout hypothesis $y_+/y_- = a_+/a_- = e^\chi$ identifying the effective Yukawa log-ratio with the access contrast. This bridge is the load-bearing assumption that reaches the Standard Model, and the Yukawa reformulation is *exactly as strong as it*. The result is therefore conditional but constructive: it does not derive the gain ζ, the order parameter m, the proportional bridge, or the generation recursion. It establishes the unique access-visible lowest-order form of any realised readout capable of producing a fermion mass contrast without violating the inherited symmetry no-go. The unexplained Yukawa entries are reformulated — under the proportional hypothesis — as potential realised-readout amplitudes arising from committed substrate records, rather than arbitrary constants.

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1. The Standard Model Gap

The Standard Model has three main structural ingredients: gauge symmetries, which fix the allowed interactions; fermion representations, which fix how matter transforms; and Yukawa couplings, which fix fermion masses and mixing. The first two are highly constrained. The third is largely unexplained.

A fermion mass arises from a Yukawa term of the schematic form

$$\mathcal{L}_Y = -y_f \cdot \bar{\psi}_L H \psi_R + \text{h.c.},$$

and after electroweak symmetry breaking,

$$m_f = (v/\sqrt{2}) \cdot y_f.$$

The numerical values of y_f are not derived by the Standard Model. They are measured and inserted. The VERSF programme aims to replace these inputs with structural readout quantities derived from the substrate. This paper isolates the first required object: a mass-relevant access contrast, and the minimal sector through which a substrate record could become one.

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2. Prior Inputs from the VERSF Programme

This paper uses three inherited results and nothing else from the scope programme.

2.1 The reflection no-go

Let P_+ and P_- be the rank-one fold-access projectors exchanged by the reflection S:

$S^2 = I$, $S P_+ S = P_-$.

For an access state R define

$a_\pm(R) = \mathrm{Tr}(P_\pm R)$, $\chi(R) = \ln a_+(R) - \ln a_-(R)$.

If S R S = R, then by cyclicity of the trace $a_+ = a_-$, hence $\chi = 0$. A nonzero fold-access contrast therefore requires a state outside the reflection-fixed subspace. The converse is not automatic: a state may carry reflection-odd content the diagonal readings do not detect, so the physical requirement is a nonzero fold-*access* imbalance, not merely some odd operator component. This caveat returns with force in §4.2.

2.2 The scope verdict

The inherited Carrier, Generation, and Realization theorems do not force the relevant physical state to be reflection-fixed. The imbalance is therefore *permitted*. But permission is not generation: a physical mechanism must still produce the imbalance, and the scope paper proved the fold reflection itself cannot be its source — an exchange map cannot source the magnitude of what it exchanges.

2.3 The Schur obstruction

If the full irreducible D_6 action on the E_1 fold doublet is required as a *standing* symmetry, then any invariant linear operator lies in the commutant of an irreducible representation; Schur's lemma makes it scalar on E_1, giving equal access to P_+ and P_-. Hence

standing symmetric linear readout $\Longrightarrow \chi = 0$.

This paper accepts the obstruction in full and does not attempt to evade it with another standing field. Instead it constructs a *realised, branch-conditioned* readout, which the obstruction does not reach.

2.4 The charge-blindness inheritance

One further inherited result is used, and it is what makes the whole construction safe against the most obvious wrong prediction. The companion *Yukawa Hierarchy Theorem* establishes, on the mass side rather than the access side, that the operator generating the generation mass structure commutes with every charge operator: with $\hat{Y}$ the mass-amplification operator built as a positive monotone function of the completion-density operator, and χ any gauge-charge operator,

$[\hat{Y}, \chi] = 0$ (Hierarchy paper, Theorem 5.1, structural).

The content is that the coordinate carrying mass is invisible to charge — gauge labels are carried by the defect class, mass structure by refinement depth, and the two are orthogonal substrate coordinates. This is exactly the separation the realised readout requires: it lets a record condition the mass-relevant access state without disturbing any charge eigenvalue. The immediate physical payoff is charge universality across generations (the electron and muon carry identical charge, to the limits of measurement) as a structural consequence rather than a coincidence; the immediate payoff *here* is that the conditioning variable m of §4 is, by inheritance, of the charge-blind kind. This paper therefore does not re-derive charge-blindness — it cites it, at structural grade, and uses it. (The inheritance is structural, given the inherited charge maps; it is not a dynamical result, and it does not by itself fix the readout gain — see §7.)

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3. The Realised Readout Principle

A realised committed record is not the same object as a standing invariant. A standing invariant must respect every admissible relabelling. A realised record may instead belong to a reflection-*covariant* pair:

$R_{-\omega} = S R_\omega S.$

The family is symmetric; each realised member need not be reflection-fixed. This is the structure of ordinary spontaneous symmetry breaking — the laws stay symmetric while a realised outcome is not.

The VERSF readout principle. A mass-relevant access state may be conditioned on a realised committed record, provided the full family of possible conditioned states transforms covariantly under the symmetry. This preserves the law while allowing individual histories to carry nonzero contrast.

The whole construction below is the lowest-order instrument that realises this principle — and the discipline of the paper is in stating exactly which couplings the principle admits, which of those the readout can actually see, and how far the resulting one-parameter form is exact.

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4. The Minimal Conditioned Access State

4.1 Construction

Let

$\Delta P = P_+ - P_-$.

Since $S P_+ S = P_-$, we have $S \Delta P S = -\Delta P$: the fold-access contrast is reflection-odd. Let $m \in [-1,1]$ be a realised branch order parameter carried by a committed substrate record, reflection-odd under S:

$S : m \mapsto -m$.

The product $m \Delta P$ is then reflection-*even* (odd × odd), so it may enter a reflection-covariant access state. The lowest-order such state is

$R\_m = ½(I + \zeta m \Delta P)$, $|\zeta m| \leq 1$,

where m is the stored realised record imbalance, ζ is the readout gain, and the product ζm is the physical access-bias amplitude.

Theorem 1 — Minimal Access-Visible Realised Readout. Assume (1) the access state is a positive trace-one state on the E_1 fold doublet; (2) P_+ and P_- are exchanged by reflection; (3) the realised record carries a reflection-odd order parameter m; (4) the readout is lowest-order in m; (5) the family of readouts is reflection-covariant; and **(6) the readout is faithful to the diagonal access functional $Tr(P\pm\cdot)$ — i.e. it is required to register as a nonzero χ.** Then the minimal conditioned access state is

$R\_m = ½(I + \zeta m \Delta P)$,

giving

$a_+(m) = Tr(P_+ R\_m) = ½(1 + \zeta m)$, $a_-(m) = Tr(P_- R\_m) = ½(1 - \zeta m)$,

and therefore

$\chi(m) = \ln[a_+(m)/a_-(m)] = 2 \operatorname{artanh}(\zeta m)$.

If $\zeta m \neq 0$, then $\chi \neq 0$.

Proof. The identity is the unique trace-normalised reflection-even scalar contribution. ΔP is reflection-odd and m is reflection-odd, so $m \Delta P$ is reflection-even and may enter a covariant state at first order. By premise (6) the coupling must register under $Tr(P\pm\cdot)$; among reflection-odd Hermitian directions on E_1 only ΔP does so (§4.2), so $m \Delta P$ is the unique admissible first-order coupling. Positivity of R_m requires $|\zeta m| \leq 1$. Since ΔP has eigenvalue +1 on the P_+ line and −1 on the P_- line, $a_\pm(m) = ½(1 \pm \zeta m)$, and the expression for χ follows. ■

Premise (6) is not cosmetic; it is what makes the theorem true as a uniqueness claim. Without it, the conclusion is false — there is a second lowest-order covariant family, and it carries no χ. That is the subject of §4.2.

4.2 The access-visibility qualifier

ΔP is *not* the only reflection-odd Hermitian direction on the two-dimensional E_1 doublet. In the fold basis where

$S = [[0,1],[1,0]]$, $P_+ = \mathrm{diag}(1,0)$, $P_- = \mathrm{diag}(0,1)$,

the contrast direction is $\Delta P = \mathrm{diag}(1,-1)$ (a σ_z-like operator), reflection-odd. But the off-diagonal direction

σ_y-like: $[[0, -i],[i, 0]]$

is *also* reflection-odd under S, and m·σ_y is therefore an equally covariant lowest-order coupling. The two are not equivalent for the readout. The diagonal access functional reads only the diagonal: $\mathrm{Tr}(P_\pm R)$ depends on the diagonal entries of R, so a coupling along σ_y produces reflection-odd *coherence* (off-diagonal weight) that $\mathrm{Tr}(P_\pm\cdot)$ does not detect. A state $\frac{1}{2}(I + \zeta\, m\, \sigma\_y)$ has $a_+ = a_- = \frac{1}{2}$ and hence $\chi = 0$, even though it is a perfectly good reflection-covariant conditioned family.

So there are *two* lowest-order covariant readout families, and only one is visible to the χ functional. The construction $R\_m = \frac{1}{2}(I + \zeta m \Delta P)$ is unique precisely **among the couplings that reach the χ readout** — the σ_y coupling is admissible but access-invisible. This is why "minimal" carries real content rather than being a default: the access-visibility condition (Theorem 1, premise 6) is what selects ΔP over σ_y, and it is the substantive reason the readout instrument has exactly one dial rather than two. Any future derivation that produced a σ_y-type record would store a genuine reflection-odd imbalance that the mass readout simply could not see — a distinct failure mode from $h = 0$, and worth keeping separate from it.

4.3 What is exact, and what is the constant-ζ rewriting

A point of precision that an earlier framing got slightly wrong, and that matters because a single symbol ζ was being asked to do two jobs. The exact object is the Gibbs state itself: for the pointer coupling of §7, the maximum-entropy conditioned state on the doublet is

$R\_m = \frac{1}{2}[I + \tanh(\beta h m)\, \Delta P]$,

and this is *exact for every m*, binary or continuous — $\tanh(\beta h m)$ is the full gain at record value m, not a truncation. So the tanh is always exact; nothing is approximated at the level of the state. What is regime-dependent is whether the gain can be written as a *single m-independent constant* ζ multiplying m.

Binary record — the constant ζ is exact. For a pure record $\omega = \pm 1$, $\tanh(\beta h\omega) = \omega \cdot \tanh(\beta h)$ exactly (tanh is odd and $\omega^2 = 1$), so the gain factors as a constant $\zeta = \tanh(\beta h)$ times ω, and $R_\omega = ½(I + \zeta\omega\, \Delta P)$ with $\zeta = \tanh(\beta h)$ is exact. A one-bit conditioner genuinely has one constant gain.

Locked order parameter — the constant ζ is a linearisation. For a locked $m \in [-1,1]$ with generically $m \neq \pm 1$, $\tanh(\beta hm) \neq \tanh(\beta h)\cdot m$, so *no* single constant ζ reproduces the exact gain across m. Two distinct constants appear and must not be conflated: the binary gain $\zeta_{bin} = \tanh(\beta h)$, and the small-m slope $\zeta_{lin} = \beta h$ (since $\tanh(\beta hm) \approx \beta h \cdot m$ as $m \to 0$). These coincide only as $\beta h \to 0$. Writing $R_m = ½(I + \zeta m \Delta P)$ with a constant ζ is therefore a *linearisation* of the exact Gibbs state for continuous m — adequate at small m or for order-of-magnitude work, but not the exact state, which carries the full $\tanh(\beta hm)$.

The cleanest statement, then: the conditioned state $½[I + \tanh(\beta hm)\Delta P]$ is exact always; the constant-ζ form $½(I + \zeta m\Delta P)$ is exact for a binary record and a small-m linearisation otherwise; and where a single ζ is used below for the continuous case it is $\zeta_{lin} = \beta h$, the linear gain, with the exact gain being $\tanh(\beta hm)/m$. Conflating ζ_{bin} and ζ_{lin} under one symbol is the error to avoid.

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5. Why Schur Does Not Kill the Realised Readout

Schur's lemma kills *invariant linear standing* operators on the irreducible E_1 doublet. It does not kill a conditioned family satisfying $R_{-m} = S\, R_m\, S$. The unconditioned mixture is symmetric:

$\bar{R} = ½\, R_m + ½\, R_{-m} = ½\, I$, so $\chi(\bar{R}) = 0$,

while each realised conditioned state has $\chi(m) = 2\, \mathrm{artanh}(\zeta m)$. The construction therefore does not violate the reflection no-go — it *obeys* it. The cleanest statement of the evasion:

The no-go applies to unconditioned standing states. The realised readout applies to conditioned committed histories. Schur scalarity is a statement about operators required to be fixed by the whole group; a covariant family in which no member is fixed is simply not in its domain.

This is the entire logical content of the construction, and it is why a symmetric law can carry an asymmetric realised mass contrast without contradiction.

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6. Embedding into the Yukawa Sector — the Proportional-Readout Pillar

This is where the construction reaches the Standard Model, and it does so only across a **second, independent assumption** that must be named as such, because the entire Yukawa claim is exactly as strong as it.

Proportional-Readout Hypothesis (the second pillar). The effective Yukawa coupling of a fermion whose mass is governed by a fold-access reading is *linearly proportional* to that reading: $y_+/y_- = a_+/a_-$. Equivalently, the Yukawa log-ratio equals the access contrast, $\ln(y_+/y_-) = \chi$.

Under this hypothesis, Theorem 1 gives

$$y_+/y_- = a_+/a_- = (1 + \zeta m)/(1 - \zeta m) = e^{\chi},$$

$$\chi_Y = \ln(y_+/y_-) = 2 \operatorname{artanh}(\zeta m).$$

So a realised record order parameter m, multiplied by a readout gain ζ, enters the effective Yukawa ratio.

Two things must be said plainly, because the move out of the scope paper's referee frame is exactly where this kind of bridge tends to get asserted rather than argued.

First, **the proportional hypothesis is load-bearing and undischarged.** Nothing proved here forces the effective Yukawa to be *linear* in the access reading a± rather than some other monotone function of it. The construction establishes that a committed record can produce a nonzero access contrast χ; "access contrast = Yukawa log-ratio" is a separate identification that actually reaches the masses, and it is the one most in need of a VERSF derivation. Whether the substrate forces a linear access-to-coupling map is open. Until it is settled, the honest form of the headline is: the unexplained Yukawa entries are potential realised-readout amplitudes *under a proportional-readout hypothesis that itself requires derivation*.

Second, **the Yukawa hierarchy problem is reformulated, not solved.** Under the hypothesis it becomes the problem of deriving m, ζ, and their generation dependence — a sharper target than "measure y_f," but a target, not a result. The reformulation's value is precisely that it names three computable objects in place of one arbitrary constant; its honesty requires admitting the bridge it crosses to get there.

Third, **a companion paper supplies a related but distinct bridge, and the two must not be conflated.** The *Structural Origin of Yukawa Operators* paper identifies the Yukawa *matrix element* with a closure-depth overlap amplitude, $Y_{ij} = \langle \gamma_{L,i} \mid \hat{H}_c \mid \gamma_{R,j} \rangle$. That is a genuine substrate origin for the coupling — but it is *not* the same statement as the proportional-readout hypothesis used here. The proportional hypothesis identifies the Yukawa *log-ratio* with the *access contrast* χ (a property of the conditioned access state R_m); the overlap identification expresses each Yukawa *entry* as an inner product of depth states through the closure-norm mediator. Both say "the coupling is a readout of substrate structure," and they are plausibly reconcilable — the access reading a± and the overlap diagonal may be two coordinatisations of the same support — but connecting them is itself unfinished work. So the overlap paper does **not** discharge the proportional pillar; it offers a parallel substrate account of the same couplings, against which the proportional hypothesis must eventually be checked for consistency. Until that check is done, the proportional bridge remains this paper's named, undischarged second assumption, and the overlap identification is a companion to be reconciled with it, not a proof of it.

7. The Readout Coupling h — and Whether It Is Free

The access state has a physical origin as the conditional maximum-entropy state of a minimal pointer-coupling free energy:

$F\_read(R \mid m) = F_0(R) - h \cdot m \cdot Tr(\Delta P\ R)$,

with h a mass-independent readout coupling. The max-entropy (Gibbs) state is

$R\_m \propto \exp(\beta\ h\ m\ \Delta P)$.

Because $(\Delta P)^2 = I$ on the doublet, $\exp(\beta\ h\ m\ \Delta P) = \cosh(\beta hm)\cdot I + \sinh(\beta hm)\cdot \Delta P$, and normalising ($Tr = 2\cosh \beta hm$) gives

$R\_m = ½(I + \tanh(\beta hm)\ \Delta P)$.

This Gibbs state is *exact for every m*. The single-constant rewriting $R\_m = ½(I + \zeta m \Delta P)$ then holds with $\zeta = \tanh(\beta h)$ for a binary record $\omega = \pm 1$ (exact, since $\tanh(\beta h\omega) = \omega \tanh \beta h$), and as a small-m linearisation with $\zeta\_lin = \beta h$ for continuous locked m (since $\tanh(\beta hm) \approx \beta h\cdot m$); the two constants coincide only as $\beta h \to 0$ (§4.3). What is exact is the tanh state; the constant ζ is exact only in the binary case.

So the gain is not arbitrary in principle — it is set by a physical pointer coupling h, and the remaining burden contracts to one scalar:

The remaining readout burden — and its inherited resolution. The faithfulness of the readout reduces to whether one mass-independent pointer coupling h is nonzero: if $h \neq 0$, the stored record becomes readable as a fold-access contrast $\chi = 2\ \mathrm{artanh}(\zeta m)$; if $h = 0$, the record may exist in the substrate but stays invisible to the mass readout. The bullets below show this scalar is not free in the charged-lepton realisation — it is inherited at a structural value, contracting the open content from "is h nonzero?" to "what is its precise value, within a bounded residual?"

But "derive h" must not be allowed to imply "h is a free open scalar," because writing $\zeta = \tanh(\beta h)$ is a *reparametrisation* — gain in terms of coupling — not a *source* for either. Two honest exposures travel with h:

- **Asserting $h \neq 0$ by hand would be illegitimate** — the same move the superseded "Locality Lift" was caught making when it assumed the readout could "see" closure distance. The construction is clean precisely because it leaves h owed rather than smuggling it in.
- **h may not be independent at all — and a companion paper now gives the gain a structural value.** In the closure-history realisation (§8) the substrate already carries a record–record carrier coupling fixed by the closure geometry, and the default physical

expectation is that the *same* substrate field mediates both that interaction and the record→access readout — in which case h is computed from geometry already in hand, not discovered. That expectation is now partly cashed out. The companion *Structural Origin of Yukawa Operators* paper, with its Role-4/BCB companions, derives the depth-decay rate of the charged-lepton hierarchy as an **inherited, not fitted** exponent:

$\kappa_{clos} \approx \ln(14) = \ln(\dim \Gamma_{min})$,

where $\dim \Gamma_{min} = 14 = 2(n_{int} + n_{role}) = 2(3 + 4)$ is the same closure-architecture integer that fixes the generation count and the no-fourth-generation theorem. So in the charged-lepton realisation the gain is not a bare owed scalar: it inherits a structural value through the same κ that the companion derives. The honest grade is therefore not "free open scalar" but **"structurally valued, with a named open residual"** — which is a real contraction of the earlier "possibly computable, deferred," but not a closure, for two reasons the companion is explicit about and which travel here intact:

- *The structural integer is the empirically worse fit.* The bare loop count gives a per-generation factor $e^{2\kappa_0} = 14^2 = 196$, about 5% below the observed electron→muon ratio 206.8. A convergent geometric route — CP^2 geodesic focusing — gives $\kappa = 8/3$ with $e^{2\cdot 8/3} = 207.1$, which is **0.17% above** the observed ratio (not the much smaller figure an earlier draft quoted — the small agreement is in κ itself, $8/3 = 2.6667$ against the 2.6658 that reproduces the ratio, ~0.03% in κ; exponentiation amplifies that to 0.17% in the ratio). The two readings agree to 3% ($e^{8/3} = 14.39$ rounds to the loop integer 14), and the companion features the integer 14 on *structural* grounds (it is $\dim \Gamma_{min}$) while conceding it is the worse numerical fit. The residual $w \approx 1.055$ between them is carried as a bounded correction, a rounding artifact *if* the two routes are one scale and a genuine residual otherwise. A caution travels with this convergence and is stated in §7e: that $\kappa = 8/3$ fits better than the structural integer while coming from the geometrically looser route is *also* the signature one would expect if 8/3 had been reverse-engineered from m_μ/m_e — so the convergence is allowed to carry persuasive weight only if the CP^2-focusing derivation of 8/3 is independent of the lepton mass ratio, which this paper does not establish and defers to the companion.
- *Whether 14 and $e^{8/3}$ are one structural scale is open* (companion problem #8). Until that identity is proven, the gain is "one of two convergent structural readings of κ, differing by ~3%," not "the gain is derived." This is materially stronger than a free scalar — it has a structural home and a bounded residual — but it is weaker than a computed number, and the difference is exactly the open identification.

The net effect on this paper: where §7 previously said the gain *may* be computable from geometry in hand, it can now say the gain *is* structurally valued in the charged-lepton realisation ($\kappa_{clos} \approx \ln 14$), with the remaining freedom contracted to a named 3% residual on a companion's open problem, not an unbounded scalar. Treating h as an independent free coupling is, *within the programme's own premises*, no longer the neutral default — it is in tension with a companion derivation. This is an internal shift in where the unargued choice sits, not an external flip in burden of proof; the companion derivation is itself conditional, so the shift is only as strong as that companion.

This is the sharpest single statement of where the mechanism stands, and it should be read at exactly the grade the body supports — the obstruction has not been *resolved*, it has been *localised* to one object, which is real progress but is not the same as the burden flipping in any external sense. A conserved obstruction that earlier reformulations kept relocating has been driven onto one dimensionless coupling of the unique access-visible channel into an irreducible doublet, and in the charged-lepton sector that coupling has inherited a structural value up to a bounded residual. The localisation is genuine; the resolution is not yet in hand. In the charged-lepton realisation the analogous gain is non-zero by inherited conditional structure ($\kappa\_clos \approx \ln 14$); for the general E_1 realised-readout channel the nonzero claim passes through the h_Δ bridge (§7e); and for quarks it remains the local differential-response calculation of §7f. So the disjunction "$h \neq 0$ or $h = 0$" is now *localised to a definite object on each leg* — settled-conditionally in the lepton analogue, bridge-conditional in general, a named local computation for quarks — which is a sharper position than the open scalar it began as, without claiming the general object is resolved or that the burden has shifted outside the programme's own premises.

7a. The Closure-Norm Projection of the Gain

§7 contracts the open content to the single scalar h, but h is still stated abstractly — a coefficient in a pointer free energy. This subsection pins it to a definite projection of an operator the programme already carries, the closure-norm (Yukawa) operator $\hat{H}\_c$. The result does not compute the gain; it removes its ambiguity, converting "is h nonzero?" into a specific, inherited-operator calculation.

Setup. Let $\hat{H}\_c(m)$ be the closure-norm operator conditioned on the realised record order parameter m, reflection-covariant in the same sense the readout family already is:

$\hat{H}\_c(-m) = S\ \hat{H}\_c(m)\ S$.

Restricting to the E_1 doublet and expanding near the unconditioned state m = 0,

$\hat{H}\_c(m)|\{E_1\} = \hat{H}\_c\text{^}(0)|\{E_1\} + m\ \hat{H}\_c\text{^}(1)|\_\{E_1\} + O(m^2)$,

reflection covariance forces $S\ \hat{H}\_c\text{^}(0)\ S = \hat{H}\_c\text{^}(0)$ (even) and $S\ \hat{H}\_c\text{^}(1)\ S = -\hat{H}\_c\text{^}(1)$ (odd). The covariance premise is not a fresh postulate: it is the operator-level form of the same reflection covariance the conditioned-readout family $R\_\{-m\} = S\ R\_m\ S$ carries (§3), inherited rather than assumed anew.

Theorem 2 — Closure-Norm Projection. In the fold basis ($S = \sigma\_x$, $\Delta P = \sigma\_z$), every Hermitian reflection-odd first-order perturbation of the closure-norm operator on E_1 has the form

$\hat{H}\_c\text{^}(1)|\_\{E_1\} = b\ \Delta P + c\ \Sigma\_y$, $b, c \in \mathbb{R}$, where $\Sigma_y = \sigma_y$. The access-visible projection is

$$h_\Delta \equiv \tfrac{1}{2} \mathrm{Tr}_{E_1}(\Delta P \cdot \hat{H}_c^{(1)}) = b,$$

using $\mathrm{Tr}(\Delta P^2) = 2$ and $\mathrm{Tr}(\Delta P\, \Sigma_y) = 0$. Therefore the realised record is visible to the fold-access readout at first order iff $b \neq 0$; the Σ_y term produces only access-invisible reflection-odd coherence, since $\mathrm{Tr}(P_\pm \Sigma_y) = 0$.

Proof. Any Hermitian operator on E_1 is $\alpha I + \beta \sigma_x + \gamma \sigma_y + \delta \sigma_z$. Conjugation by $S = \sigma_x$ fixes I and σ_x and negates σ_y, σ_z, so the reflection-odd Hermitian subspace is $\mathrm{span}_\mathbb{R}\{\sigma_z, \sigma_y\} = \mathrm{span}_\mathbb{R}\{\Delta P, \Sigma_y\}$. The projection $\tfrac{1}{2}\mathrm{Tr}(\Delta P \cdot (b\, \Delta P + c\, \Sigma_y)) = b$ by the stated traces. ΔP shifts the two diagonal access readings oppositely; Σ_y, being purely off-diagonal, leaves both diagonal readings equal. ■

This is the §4.2 access-visibility split (ΔP-readable versus σ_y-invisible) derived one level deeper — as a statement about the *mediator operator's* record-derivative rather than about the access *state*. It yields a clean three-way outcome for any realised record:

- **Case 1 ($b \neq 0$):** access-visible; $h_\Delta \neq 0$ and $\chi = 2\,\mathrm{artanh}(\zeta m) \neq 0$ for $m \neq 0$.
- **Case 2 ($b = 0$, $c \neq 0$):** the record enters E_1 only as hidden reflection-odd coherence; $a_+ = a_-$, $\chi = 0$. Present but mass-invisible. *This is exactly failure condition 3 of §11 — the σ_y-type access-invisible record — now given a concrete trigger: it fires precisely when $\partial\hat{H}_c/\partial m$ is purely off-diagonal on E_1.*
- **Case 3 ($b = c = 0$):** no first-order E_1 coupling; the readout route fails at linear order.

The identification, and its guard. It is natural to identify the operational pointer coupling h of §7 (the coefficient in F_{read} giving $\zeta = \tanh \beta h$) with the projection h_Δ of Theorem 2. But these are *a priori* different objects — one is a thermodynamic free-energy coupling, the other a derivative of the mediator — and they coincide only **under the closure-norm Gibbs identification**: that the conditioned access state R_m is the maximum-entropy (Gibbs) state generated by $\hat{H}_c(m)$ on E_1. Under that identification, $h = h_\Delta$ and the whole open question reduces to the ΔP-component of $\partial\hat{H}_c/\partial m$. Without it, Theorem 2 still holds as stated (it is pure trace algebra), but the bridge from h_Δ to the readout gain is the named premise, not an identity. This is graded **[Conditional — on the closure-norm Gibbs identification]**, at the same status as the proportional-readout pillar of §6: a load-bearing link stated openly rather than asserted as proven.

So §7a's contribution is exact and bounded: *if* the access state is the closure-norm Gibbs state, the gain is the ΔP-projection of the mediator's record-derivative, and "compute h" becomes "compute $\partial\hat{H}_c/\partial m$ on E_1 and read off its ΔP-component." The next subsection asks whether that component is forced nonzero.

7b. The Marginal Closure-Load Result — and the Premise That Carries It

Theorem 2 leaves three cases. §7b addresses whether the hidden-coherence Case 2 can be excluded — but it is essential to state at the outset what does the excluding, because the natural reading overstates it. **Case 2 is not defeated by a proof; it is excluded by a modelling choice about what the mediator reads, and that choice is the load-bearing premise.**

The marginal-load identification (the premise). Let N_+, N_- be the committed record counts in the two reflection-related branches, with $N = N_+ + N_-$ and $m = (N_+ - N_-)/N$. Take the κ-mediated commitment-memory pair energy

$$E_\kappa = -\tfrac{1}{2} C_{same} (N_+^2 + N_-^2) - C_{cross} N_+ N_- = E_\kappa(0) - (N^2/4)(C_{same} - C_{cross}) m^2,$$

and define the branch marginal closure loads $\mu_\pm(m) = -\Lambda_c\, \partial E_\kappa/\partial N_\pm$, $\Lambda_c > 0$. The premise is then **Definition-3 of the source paper**: that the closure-norm operator reads these scalar branch loads,

$$\hat{H}_c(m)|_{\{E_1\}} = H_0\, I + \tfrac{1}{2}[\mu_+(m) - \mu_-(m)]\, \Delta P + O(m^2).$$

Note what this ansatz contains: a real multiple of ΔP and nothing else. There is no Σ_y term in it. So the conclusion "no hidden-coherence case" is not derived by scalar dynamics *defeating* the σ_y direction — it follows because the σ_y direction was never admitted into the identification. The physical content of the premise is precisely that exclusion: *the mediator reads the record as a real scalar branch-load (a closure-maintenance energy, hence ΔP-type) rather than as a phase-current or coherence (σ_y-type).* That is a reasonable reading — Λ_c is a real scalar and a closure-maintenance cost is an energy, not a current — but it is the assumption, and it must be argued, not presented as a theorem's output.

Result 3 — Marginal Closure-Load Projection (under the marginal-load identification). Given (1) the record stored in a record-resolved κ carrier, (2) the pair energy above, (3) **the marginal-load identification** that $\hat{H}_c$ reads the scalar branch loads, (4) $C_{same} > C_{cross}$, and (5) $N > 0$, the first-order perturbation is purely ΔP with

$$b = h_\Delta = \tfrac{1}{2} \Lambda_c (C_{same} - C_{cross}) N \neq 0,$$

so the access-visible component is forced and Case 2 does not arise.

Proof. $\partial E_\kappa/\partial N_+ - \partial E_\kappa/\partial N_- = -(C_{same} - C_{cross})(N_+ - N_-) = -\Delta C \cdot N m$, so $\mu_+ - \mu_- = \Lambda_c \Delta C\, N m$, giving $\hat{H}_c^{(1)}|_{\{E_1\}} = \tfrac{1}{2} \Lambda_c \Delta C\, N \cdot \Delta P$ and $b = \tfrac{1}{2} \Lambda_c \Delta C\, N$. With Λ_c, ΔC, N all positive, $b \neq 0$. The perturbation is along ΔP and not Σ_y because it descends from a real scalar potential and its branch marginal loads — a real scalar load shifts the two branch self-costs oppositely (ΔP) and generates no relative phase-current (σ_y). ■

What this does and does not establish. The algebra is correct and the conclusion follows *given premise (3)*. What it establishes is a **reduction, not a closure**: the question "is the record mass-visible?" reduces to "does the mediator read it as a real scalar branch-load or as a phase-coherence?" The result then *assumes* the scalar-load reading and derives visibility. So the honest statement is not "scalar closure-norm dynamics remove the hidden-coherence case" but:

Under the marginal-load identification — that $\hat{H}_c$ reads the κ memory as a real scalar branch-load — the hidden-coherence Case 2 is excluded and $h_\Delta = ½ \Lambda_c (C_{same} − C_{cross}) N$, nonzero whenever the record-resolved carrier gives $C_{same} > C_{cross}$. The identification is the premise to argue for; it is physically natural for a closure-*maintenance cost* but is a bridge between the κ-memory sector and the closure-norm Yukawa sector, not a theorem about them.

The payoff, correctly scoped. Subject to that premise, the gain is *not an independent dial*: $h_\Delta \propto C_{same} − C_{cross}$, the **same** closure-history coupling difference that produced the record instability in the first place (§8). This is the concrete cash-out of §7's "h may be the carrier coupling, not a free scalar" — here it is, explicitly, up to the marginal-load premise: the readout coupling and the carrier coupling are two projections of one κ interaction. Combined with §7's inherited $\kappa_{clos} \approx \ln 14$, the picture is that the gain is doubly constrained — structurally valued by the closure architecture and tied to the carrier coupling by the marginal-load reading — with the residual freedom being the two named premises (Gibbs identification, §7a; marginal-load identification, §7b), not an unbounded number.

The sharpened failure mode. Under the scalar-load premise, the route no longer fails by "the record enters only invisibly" (Case 2 is excluded by the premise). It fails only if $C_{same} = C_{cross}$ (no branch-selective memory), $\Lambda_c = 0$ (the mediator does not read κ memory at all — i.e. the marginal-load premise itself fails), or $N = 0$ (no committed record). The middle one is the real residual: $\Lambda_c = 0$ is precisely the negation of the marginal-load identification, so "does the route survive?" and "is the marginal-load premise true?" are the same question — which is the honest location of the remaining gap.

7c. Three Routes, Separated — the Status of the Mass-Asymmetry Source

It is worth stating, in one place, what the §2–§7b arc has actually settled, because the value of the work is a separation of three things that were previously blurred into a single open question. The mass-asymmetry source was once asked as "can VERSF produce the up/down difference?" — a question that mixed a dead route with a live one. It now resolves cleanly into three:

1. Impossible — the fold reflection itself as the source. The chain is closed:

standing symmetric fold state $\Longrightarrow S R S = R \Longrightarrow a_+ = a_- \Longrightarrow \chi = 0$.

If the state being read treats the two fold directions as exact mirror copies, the access contrast vanishes. The reflection is a readout *exchange*, not a magnitude *source* — an exchange map cannot source what it exchanges. This is the inherited no-go (§2.1) together with the scope verdict's sharpening (§2.2): the inherited theorems do not *force* symmetry, but the reflection itself is not the origin of the magnitude. The standing route is dead, and proven dead, not merely unpromising.

2. Still alive — a realised record conditioning the readout. The chain is:

realised committed record ⟶ conditioned readout ⟶ $\chi \neq 0$.

The law remains symmetric while a committed history selects one branch. The unconditioned ensemble averages back to ½I ($\chi = 0$); the realised state is not reflection-fixed. Schur does not reach this, because Schur kills standing invariant linear readouts, not conditioned realised records — a covariant family in which no member is fixed is simply not in its domain (§5). This is the route the paper builds.

3. Now sharply testable — whether $b \neq 0$. The surviving route's entire remaining debt is whether the closure-norm/Yukawa operator has a nonzero access-visible projection onto ΔP:

$h_\Delta = ½ \, Tr_{E_1}(\Delta P \cdot \partial \hat{H}_c/\partial m|_0) = b$, mass-readable $\Leftrightarrow b \neq 0$.

§7a localises the gain to this projection (an inherited-operator calculation, not an abstract dial); §7b forces $b \neq 0$ under the marginal-load premise (and excludes the σ_y hidden-coherence case under that same premise).

The honest status line. Collecting the three:

standing symmetric source = **dead**; realised conditioned source = **alive, conditional, and reduced to one calculation plus two named premises.**

The two premises are the Gibbs identification (§7a, linking the operational coupling h to the projection h_Δ) and the marginal-load identification (§7b, forcing $b \neq 0$ and excluding σ_y); the one calculation is $\partial \hat{H}_c/\partial m$ on E_1. "Computable" is meant in this exact sense — the next step is a definite calculation on an operator the programme already carries, not a vague hope — and not in the sense of "computed": the $b \neq 0$ result leans on the scalar-load reading rather than proving it, and the residual failure mode is the single identifiable premise $\Lambda_c = 0$.

This is the shape of the contribution, and it should not be mistaken for a collapse of the programme. The opposite: the work stopped trying to extract a mass asymmetry from symmetry itself — which was never going to succeed — and moved the burden to the only place it can honestly live, the realised record → closure-norm readout. Fewer live routes, but the surviving one is harder-edged and its remaining debt is explicit: one projection of one inherited operator, with a single named premise as the residual. That is progress in the form this programme measures it — a question made sharper and smaller, not a claim made larger.

7d. A Worked Toy Model: b in Closed Form on the C_6 Closure Graph

The previous subsections reduce the gain to a single calculation under a single premise. This subsection carries out that calculation in a minimal substrate toy model, to make concrete what "computable" means here — and, equally, to mark precisely the line it does not cross. There are two distinct levels, and they must not be conflated.

Two levels of computation.

- *Full first-principles:* not yet available. It requires the explicit realised-record dependence of the closure-norm operator, $\hat{H}\_c(m)$. The Structural-Origin companion supplies $\hat{H}\_c$ as the closure-norm/Yukawa overlap operator, and the Hierarchy companion explains why a mass-side readout can vary without changing charge ($[\hat{Y}, \chi] = 0$), but neither yet delivers the full m-dependent operator. So the first-principles value of b is still owed.
- *Toy/substrate model:* available now, in closed form. Take the record-resolved κ carrier and let $\hat{H}\_c$ read the marginal scalar closure load produced by the committed record — i.e. adopt the marginal-load identification of §7b explicitly as the model definition. Then $b \neq 0$ follows by computation, not assumption, *within the model*.

The closed-form result. From the record-resolved κ model on the six-state C_6 closure graph, the same-branch and cross-branch memory couplings differ by

$$\Delta C = C\_same - C\_cross = g^2(G_0 - G_3),\ G_0 - G_3 = (1/3)[\ 2/(M\_\kappa^2 + \eta) + 1/(M\_\kappa^2 + 4\eta)\ ],$$

so

$$\Delta C = (g^2/3)[\ 2/(M\_\kappa^2 + \eta) + 1/(M\_\kappa^2 + 4\eta)\ ].$$

Every term is positive for $g \neq 0$, $M\_\kappa^2 > 0$, $\eta > 0$, so $\Delta C > 0$ across the whole physical parameter domain. Feeding this into the §7b marginal-load result $b = ½\ \Lambda\_c\ N\ \Delta C$ gives the gain projection in closed form:

$$b = h\_\Delta = (\Lambda\_c\ N\ g^2/6)[\ 2/(M\_\kappa^2 + \eta) + 1/(M\_\kappa^2 + 4\eta)\ ],$$

which is strictly positive whenever $\Lambda\_c > 0$, $N > 0$, $g \neq 0$. This is the result the whole §7 arc was driving at: under the marginal-load identification, the access-visible projection of the realised record onto the mass readout is *forced nonzero, in closed form*, on an explicit substrate graph — no longer "assume $h \neq 0$," but a computed h_Δ with a named parameter dependence.

The hidden-coherence case, in the model. Within this scalar closure-load model, $c = 0$: the perturbation is along ΔP and carries no Σ_y component. The reason is the §7b one, now concrete — Σ_y is an off-diagonal phase/coherence direction, and a real scalar closure-maintenance cost changes branch *support*, not relative phase *current*, so a scalar potential produces the diagonal contrast ΔP and not the access-invisible Σ_y. The $b = 0$, $c \neq 0$ case remains mathematically possible for some phase-like record coupling, but it is *not produced by this scalar model* — which is exactly the honest content of §7b restated at the level of a worked example: the σ_y case is excluded by the scalar-load choice, and here that choice is made explicitly and its consequence computed.

Numerical sanity check. With dimensionless toy values $g = 1$, $M\_\kappa^2 = 1$, $\eta = 1$, $\Lambda\_c\ N = 1$:

$$\Delta C = (1/3)[\ 2/2 + 1/5\ ] = (1/3)(1.2) = 0.4,\ b = ½\ \Delta C = 0.2.$$

At readout inverse-temperature $\beta_R = 1$, $\zeta = \tanh(\beta_R b) = \tanh(0.2) \approx 0.197$. If the commitment model locks the order parameter to a self-consistent mean-field value $m^* = \tanh(\alpha m^*)$, the resulting contrast $\chi = 2 \operatorname{artanh}(\zeta m^*)$ and Yukawa-style ratio e^χ are, for a few commitment strengths α:

α	locked m^*	χ	ratio e^χ
1.1	0.503	0.199	1.220
1.5	0.859	0.342	1.408
2.0	0.958	0.383	1.466
3.0	0.995	0.398	1.489

(The sign is conventional; flipping the branch gives the reciprocal ratio.) The numbers are unremarkable in magnitude, which is the point — a forced-nonzero b of order a few tenths produces order-unity-to-moderate Yukawa ratios without any parameter being pushed to an extreme.

Calibration versus derivation — the line held. One can ask what magnitude reproduces a target anchor. To hit the W_7 programme's first-generation anchor $\rho \to 6/13$ (in the sense $e^\chi = y_+/y_-$ with the corresponding contrast), the required amplitude is

$$|\zeta m| = (13 - 6)/(13 + 6) = 7/19 \approx 0.368,$$

so e.g. $m \approx 0.86$ needs $\zeta \approx 0.428$, i.e. $\beta_R b \approx 0.458$ — not a wild number. But this is a *calibration*, not a derivation: it fixes what the toy parameters would have to be to match the anchor, and does not derive the anchor from them. The distinction is the same one the paper holds everywhere — a parameter set consistent with data is not a parameter set predicted by the theory, and the table above is offered as a feasibility check on magnitudes, not as a fit claimed as a result.

Honest verdict on the toy model. The model gives a real positive result: record-resolved κ memory plus scalar marginal closure-load readout $\Longrightarrow b \neq 0$, in closed form. It does *not* prove from first principles that $\hat{H}_c$ must read the κ marginal load — that remains the bridge (the §7b marginal-load identification, equivalently the residual $\Lambda_c \neq 0$). But this is materially past "assume $h \neq 0$": there is now a concrete computation,

$$h_\Delta = b = (\Lambda_c N g^2/6)\left[\, 2/(M_\kappa^2 + \eta) + 1/(M_\kappa^2 + 4\eta) \,\right],$$

with explicit, manifestly positive parameter dependence. So a successor paper can state, honestly: *in the minimal scalar closure-load toy model the access-visible projection is forced nonzero in closed form; the remaining first-principles burden is to show that the closure-norm/Yukawa operator really does read the κ marginal load.* That is a worked instance of the §7c status line — the surviving route reduced to one calculation (done here, in the model) plus one premise (the marginal-load identification, still owed at first-principles grade).

7e. Lepton-Sector Inheritance of the Gain

The toy model of §7d supplies b in closed form *within a model*. The charged-lepton companions supply something stronger and independent — a gain that is not a free dial but a structural quantity — and it is worth stating exactly how much they give, because the temptation is to claim one step more than they license. The honest strengthening has three distinct grades, and the value is in keeping them apart.

Inherited — conditional (the charged-lepton gain). In the charged-lepton sector the mass-side suppression/gain is structurally supplied by the Role-4/BCB lepton machinery rather than fitted. Three inputs converge:

- the localization exponent $\kappa = 8/3$ from the CP^2-focusing route (equivalently $\kappa \approx \ln 14$ from the closure-loop count, the two agreeing to ~3%, §7);
- the closure-loop integer $N_{loop} = 14 = 2(n_{int} + n_{role}) = 2(3 + 4)$, tied by the Structural-Completeness companion to the *unique* minimal admissible pair $(n_{int}, n_{role}) = (3, 4)$ — the same integer that fixes the generation count and the no-fourth-generation theorem;
- the saturated participation factor near 1/12 at the second charged-lepton generation.

The tau suppression is reached two independent ways that agree: the variational model gives $\tilde{E}_2/\tilde{E}_1 \approx 0.085$, while the closure route gives $1/12 \approx 0.0833$ — convergent to about 1.6%. So for charged leptons the gain/suppression is not merely a candidate; it is inherited as a conditional structural result, carrying the companions' own fencing (the $\kappa = 8/3$ Sector-Curvature Correspondence, the threshold-proximity input $C_2 \approx 22$, the 14-vs-$e^{(8/3)}$ residual).

A circularity caution this paper does not discharge. The convergence "two routes agree" is allowed persuasive weight only under one condition, and it is exactly the condition the programme's own anti-circularity discipline (the repeated "do not read the value off the masses" warnings of §7f, §7i, §II.10) demands here. The pattern is suggestive in the wrong direction: the structurally-motivated value (the integer 14) is the *worse* empirical fit, while the better-fitting value ($\kappa = 8/3$) comes from the geometrically *looser* route not tied to the generation-count integer. That is precisely the signature one would expect if 8/3 had been reverse-engineered from m_μ/m_e rather than derived ahead of it. So the load-bearing question — which this paper cannot settle and explicitly defers — is whether $\kappa = 8/3$ is derived from CP^2 geodesic focusing *independently* of the lepton mass ratio. If it is, the convergence is a genuine and striking result. If the focusing geometry was selected to land on 8/3, then "two routes agree to 3%" is one fitted number and one structural number disagreeing by 3%, dressed as agreement. This paper leans on the convergence in §7 and here; that lean is only as sound as the independence of the 8/3 derivation, and the honest status is that the independence is unestablished pending the companion.

Bridge — stated here, not assumed (identification with h_Δ). What the lepton papers deliver is a charged-lepton localization / participation suppression. What §7a defines is the realised-record projection onto the ΔP fold-access channel,

$$h_\Delta = \tfrac{1}{2} \operatorname{Tr}_{E_1}(\Delta P \cdot \partial\hat{H}_c/\partial m|_0).$$

These are not the same object as written: the first is a sectoral mass-suppression factor in the Role-4 lepton machinery, the second is a derivative of the conditioned closure-norm operator on the E_1 doublet. The structural support is real — the inherited gain is strong evidence that the E_1 projection is non-trivial in the charged-lepton sector — but the *exact identification* requires a short bridge theorem, which this paper states rather than silently performs:

Bridge (to be proved). The charged-lepton saturated participation factor Π_2 is the sectoral realisation of the readout gain: $\zeta_{\ell,2} = \Pi_2 \approx 1/12$ for the charged-lepton saturated sector, i.e. $\tanh(\beta h_\Delta)$ evaluated in the Role-4 lepton realisation equals the participation suppression. Equivalently, the lepton-sector participation gain *is* the E_1 projection h_Δ of §7a, restricted to that sector.

Until that bridge is proved, the correct statement is: *the charged-lepton analogue of the gain is inherited; the general E_1 realised-readout projection h_Δ is structurally supported by that inheritance but not yet identified with it.* Saying "h_Δ is inherited from the lepton work" skips the bridge and equates two different objects — precisely the move the paper does not make.

Open — not inherited (extension to quarks). This is the hard scope limit, and it must be prominent rather than buried, because it is the warning that keeps the strong claim honest. The participation-gating result is *restricted to the charged-lepton Role-4 sector*, and the generation-wide version **fails for quarks**: the same participation-suppression mechanism does not carry across to the quark sectors in the companion work. So nothing here licenses extending the inherited gain to the up- or down-type quarks — which is exactly where the original up/down readout problem of this paper lives. The inheritance strengthens the *charged-lepton* leg specifically; the quark-sector gain remains owed, and the cross-sector irregularity (Result 7.1 of the Hierarchy companion: sectoral sensitivity is forced sector-dependent) is an independent reason the lepton result cannot be assumed to transport.

Net. In the charged-lepton sector the gain is inherited as a conditional structural quantity ($\kappa = 8/3$, $N_{loop} = 14$, $\Pi_2 \approx 1/12$, two routes agreeing to ~1.6%). Its identification with the general E_1 projection h_Δ is a bridge stated here, not assumed. Its extension to quarks is open and explicitly *not* inherited — the participation mechanism is charged-lepton-specific by the companion's own statement. This lets the paper use the lepton work at full strength on the charged-lepton leg without exposing itself to the criticism that it equates a sectoral suppression factor with the fold-access projection, or that it smuggles a lepton result into the quark sector where the companion says it fails.

7f. The Quark-Sector Projection: a Local Target, and Its Genuine Obstruction

The quark sector is where this paper's original up/down problem lives, and §7e closed the door on importing the lepton answer. But the open item is narrower than "the quark dynamics are missing," and it is worth stating both the sharpening and the obstruction precisely, because the natural plausibility argument here overreaches in exactly the way the programme trains one to catch.

The sharpening: the dynamics exist; what is owed is one projection. The corpus already carries the quark substrate dynamics — the Q_L, u_R, d_R fold structures, $SU(3)_C$ activation, the fold Lagrangians, and the BCB fold-boundary/Higgs-overlap form of the Yukawa coupling, $\kappa_f = \int d^3x[\alpha_f(r)(\nabla\Psi_f \cdot \nabla H) + \beta_f(r)\, K_{boundary}(r)]$, with $m_f = \kappa_f v/\sqrt{2}$. So the quark Yukawa couplings are *already* real scalar fold-overlap functionals, not arbitrary constants. The remaining step is not to derive these — it is to extract the access-visible projection from them. Specialising §7a to the quark overlaps $\kappa_u(m) = \langle Q_L|\hat{H}_c(m)|u_R\rangle$ and $\kappa_d(m) = \langle Q_L|\hat{H}_c(m)|d_R\rangle$, the object owed is

$b = \tfrac{1}{2}[\, \partial_m \kappa_u(0) - \partial_m \kappa_d(0)\,]$ (the bare access-projection coefficient).

This is a definite, local calculation on operators the programme already possesses — a much better-posed target than "the quark gain is owed." One point of standardisation matters and is fixed here for the whole quark arc: the object that enters a *mass-ratio* argument is the **log-ratio** derivative, not this absolute-difference coefficient, because the access contrast is itself logarithmic ($\chi = \ln(a_+/a_-)$) and the Yukawa ratio is what carries mass information. So the quark target, written **B_q** and used consistently in §7g–§7h and Part II, is

$$B_q \equiv \tfrac{1}{2}\, \partial_m[\, \ln \kappa_u(m) - \ln \kappa_d(m)\,]_{m=0} = \tfrac{1}{2}[\, \partial_m \kappa_u(0)/\kappa_u(0) - \partial_m \kappa_d(0)/\kappa_d(0)\,],$$

and the route lives iff $\partial_m \ln \kappa_u(0) \neq \partial_m \ln \kappa_d(0)$. (The bare half-difference b above is the access-visible coefficient of the §7a ΔP-projection; b and B_q coincide when $\kappa_u(0) = \kappa_d(0)$, but the log form B_q is the one that feeds the mass ratio, and B_q is the standard below. Lowercase b is reserved for the abstract E_1 access-projection; the quark mass-ratio gate is always B_q.)

Quark Fold-Overlap Projection Theorem (conditional). Let $\kappa_u(m)$, $\kappa_d(m)$ be the quark-sector Yukawa overlaps with m a realised reflection-odd committed-record variable. Assume (1) m perturbs the scalar closure-norm/fold-boundary overlap sector; (2) the perturbation is a real scalar closure load, not phase-current coherence (the §7b marginal-load premise); (3) the up- and down-type *log* overlap responses differ, $\partial_m \ln \kappa_u(0) \neq \partial_m \ln \kappa_d(0)$. Then the first-order quark perturbation has a nonzero access-visible component and $B_q = \tfrac{1}{2}[\partial_m \ln \kappa_u(0) - \partial_m \ln \kappa_d(0)] \neq 0$.

Proof. A real scalar perturbation of a scalar overlap functional changes diagonal branch weights and generates no imaginary Σ_y coherence (premise 2), so the reflection-odd first-order perturbation lies along ΔP on E_1. Its log-ratio coefficient is the half-difference of the up- and down-type log responses; by premise 3 it is nonzero. ■

The obstruction: static difference is not response difference. The plausibility argument that wants to make $B_q \neq 0$ the default — "u and d are already different channels, so it would take an accidental cancellation to make their responses equal" — does not hold, and the reason is precise. The quantity that must be unequal is not $\kappa_u(0)$ vs $\kappa_d(0)$ (those differ; that is the ordinary up/down mass splitting), but the *first-order log responses to the record*, $\partial_m \ln \kappa_u(0)$ vs $\partial_m \ln \kappa_d(0)$. These are independent of the static values.

Lemma — static splitting does not imply record-visible splitting. Write $\kappa_u(m) = \kappa_u^{(0)}(1 + m \rho_u + \ldots)$, $\kappa_d(m) = \kappa_d^{(0)}(1 + m \rho_d + \ldots)$, so $\partial_m \ln \kappa_u(0) = \rho_u$, $\partial_m \ln \kappa_d(0) = \rho_d$ and $B_q = \frac{1}{2}(\rho_u - \rho_d)$. Then $\kappa_u^{(0)} \neq \kappa_d^{(0)}$ does not constrain B_q: the static values cancel from the log-derivative, and a common-mode log-response $\rho_u = \rho_d$ gives $B_q = 0$ even when the static Yukawa couplings are unequal.

Proof. B_q depends only on the log-responses ρ_u, ρ_d; the static $\kappa^{(0)}$ cancel in the log-derivative. Static inequality therefore places no algebraic constraint on B_q. ■

The one-line witness, in the correct multiplicative (log) form: $\kappa_u(m) = A_u e^{\lambda m}$ and $\kappa_d(m) = A_d e^{\lambda m}$ with $A_u \neq A_d$ gives full static up/down splitting ($A_u \neq A_d$) but equal log-responses $\partial_m \ln \kappa_u = \partial_m \ln \kappa_d = \lambda$, hence $B_q = 0$ — the record entered common-mode. (An *additive* shift $\kappa = A + \lambda m$ would give unequal log-responses $\lambda/A_u \neq \lambda/A_d$ and so would *not* witness common-mode in the log sense — which is exactly why the log standardisation matters: the witness must be multiplicative.)

Why common-mode is a real possibility, not a contrived one — and why the charge-blindness inheritance cuts this way. The live quark question is therefore not "are u and d different?" (they are) but "*which coordinate does the committed record talk to?*" Two structurally distinct outcomes:

- **Common-mode ($B_q = 0$):** the record couples only to a charge-blind coordinate shared by both quark channels, $\rho_u = \rho_d$ (equal log-responses). The record shifts the common quark mass-side support but creates no up/down access contrast. This is not an accidental cancellation — it is structurally plausible *precisely because of* the charge-blindness inheritance (§2.4): the record's conditioning variable commutes with charge, so it has an a priori reason to couple through the shared fold-access structure rather than through the u/d-distinguishing winding/seat/colour data. The same inheritance that protects charge universality elsewhere is what makes a common-mode quark response a genuine failure mode here.
- **Differential ($B_q \neq 0$):** the record couples to a u/d-differential scalar coordinate, $\rho_u \neq \rho_d$. Then the record is mass-visible and enters as a real branch-weight difference.

The quark target, stated exactly. Under the scalar-load premise (premise 2), the σ_y hidden-coherence case is excluded for quarks the same way it is for leptons — so the quark question is not the three-way fork of §7a but a clean *binary*: common-mode versus differential. The quark realised-readout route succeeds at first order if and only if

$$\partial_m \ln \kappa_u(0) \neq \partial_m \ln \kappa_d(0).$$

That single inequality — not "are the quark channels different," which is already true — is the exact calculation the programme owes. The quark fold-overlap machinery supplies the objects whose derivatives must be evaluated; what it does not yet settle is whether the realised record perturbs them differentially or common-mode. This is the honest quark status: the target is local and the dynamics are present, but $B_q = 0$ (common-mode, charge-blind) is a real possibility that only the computation can rule out — not an outcome the existing u/d differences already exclude.

7g. Exact Projected Closure Coordinates for the Quark Readout

§7f reduces the quark question to one log-ratio derivative, $B_q = \frac{1}{2}\,\partial_m[\ln \kappa_u - \ln \kappa_d]_0$, but leaves it as a derivative of an unspecified operator. Given the record-current ontology and the exact closure-coordinate projection the corpus carries, that derivative can be written explicitly — which sharpens the target one more level and, importantly, makes the common-mode failure mode of §7f *geometric* rather than abstract.

The projected form. Let the BCB fold overlap project onto closure coordinates $q_j(m) = \langle\tilde{\psi}_j, \kappa(m)\rangle$, $j = 1,\dots,7$, and let the up/down Yukawa overlaps be functions of those coordinates,

$$\kappa_a(m) = \kappa_0\, I_a(q_1(m), \dots, q_7(m)),\ a \in \{u, d\}.$$

Then B_q of §7f is the directional derivative of the up/down log-overlap contrast along the record-induced closure displacement:

$$B_q = \frac{1}{2} \Sigma_j \left[\partial_{q_j} \ln I_u - \partial_{q_j} \ln I_d \right]_{q(0)} \cdot q'_j(0).$$

(This is B_q in closure coordinates — the chain rule applied to $\frac{1}{2}[\partial_m \ln \kappa_u - \partial_m \ln \kappa_d]_0$, with the κ_0 scale cancelling from the log-difference. It is a reparametrisation of the §7f object, not a second independent quantity.)

The success/failure criterion, made geometric. $B_q \neq 0$ if and only if the record-induced closure displacement $q'(0)$ has nonzero projection onto the up/down log-overlap gradient difference $\nabla_q(\ln I_u - \ln I_d)$. In words: *the quark route succeeds only if the committed record moves the closure coordinates in a direction that the up- and down-type overlap functionals read differently.* It fails — $B_q = 0$ — in either of two geometrically distinct ways, both of which are the §7f common-mode mode seen in coordinates:

- the displacement $q'(0)$ is orthogonal to the gradient difference (the record moves the closure coordinates, but along a direction the u/d contrast is flat in); or
- the two overlaps have coincident gradients, $\nabla_q \ln I_u = \nabla_q \ln I_d$ at $q(0)$ (there is no contrast direction to project onto — the overlaps respond identically to *every* closure-coordinate move).

Neither is excluded by the static u/d difference, exactly as §7f's Lemma requires; the gradient difference is a property of the *responses* I_u, I_d near $q(0)$, not of their values.

What this settles and what it does not. It does not, by itself, decide the quark side — this is the same B_q in new coordinates, so the common-mode possibility survives this rewriting unchanged. What it settles is a real ambiguity: it specifies *what the committed record perturbs* (the closure coordinates q_j) and *how to project that perturbation exactly* (inner product with the log-overlap gradient difference). So the open quark problem is no longer the vague "does a committed record somehow affect quark masses?" but the definite three-step computation:

1. compute the record-induced closure displacement $q'(0)$ (from the record-current ontology);
2. compute the up/down log-overlap gradient difference $\nabla_q(\ln I_u - \ln I_d)$ at $q(0)$ (from the BCB overlap functionals);
3. test whether their inner product is nonzero.

That is a genuine calculation on objects the corpus supplies, and it is the best-shaped version of the quark problem the programme has reached: the route lives iff one explicit inner product is nonzero, with the two failure geometries (orthogonal displacement, coincident gradients) named as the things a successor must rule out rather than assume away.

7h. The Exact Computable Test: Dual-Basis Projection and the Closure-Sector Gate

§7g writes B_q as an inner product but leaves both factors — the displacement $q'(0)$ and the gradient difference D — in schematic form. The exact projection theorem and the sourced-κ ontology let both be written explicitly, with one correction that is not cosmetic, and the result is an exact *computable* test: a single bilinear form whose vanishing is the quark route's failure, reduced to named vectors the corpus's companion papers can in principle supply.

The displacement, with the dual-basis correction. The closure modes ψ_k are *not* orthonormal, so the naïve projection $q_j = \langle \psi_j, \kappa \rangle$ is only the orthonormal-limit formula. The exact projection uses the dual basis:

$$q_j(m) = \langle \tilde{\psi}_j, \kappa(m) \rangle, \quad \tilde{\psi}_j = \Sigma_k (M^{-1})_{jk}\, \psi_k, \quad M_{ij} = \langle \psi_i, \psi_j \rangle,$$

where M is the closure-mode Gram matrix (the dual basis satisfies $\langle \tilde{\psi}_i, \psi_j \rangle = \delta_{ij}$). Dropping M^{-1} would project onto the wrong direction whenever the modes overlap — a place the calculation could silently go wrong, so the correction is load-bearing, not decorative. The committed-record response of the κ-field follows from its sourced massive equation $(\Box + m_\kappa^2)\kappa = \rho_{src}$ with $\rho_{src}(x; m) = \rho_0(x) + m\, \rho_m(x) + O(m^2)$, giving

$$\partial_m \kappa|_0 = G_\kappa * \rho_m,$$

with G_κ the retarded Green function of $(\Box + m_\kappa^2)$. Hence the exact record-induced displacement is

$$q'_j(0) = \langle \tilde{\psi}_j, G_\kappa * \rho_m \rangle = \Sigma_k (M^{-1})_{jk} \langle \psi_k, G_\kappa * \rho_m \rangle,$$

exact in form, numerical only once the linear record-source ρ_m is supplied.

The gradient difference, from the BCB overlaps. The BCB Lagrangian gives $\kappa_f = \kappa_0 I_f$ with I_f the fold–Higgs overlap integral, and distinct quark fold representations Q_L, u_R, d_R in $\mathscr{L}_Y = -\kappa_u(\bar{Q}_L \tilde{H} u_R) - \kappa_d(\bar{Q}_L H d_R) + \cdots$. The common κ_0 cancels in the log-difference, so

$$D_j := \partial_{q_j} \ln I_u - \partial_{q_j} \ln I_d = (1/I_u)(\partial I_u/\partial q_j) - (1/I_d)(\partial I_d/\partial q_j),$$

exact in form, numerical once the species parameters that fix the overlap integrals are supplied.

The test, as one bilinear form. Combining, the quark readout derivative is

$$B_q = \tfrac{1}{2} \Sigma_j D_j q'_j(0) = \tfrac{1}{2} \Sigma_{j,k} D_j (M^{-1})_{jk} \langle \psi_k, G_\kappa * \rho_m \rangle,$$

or in vector form, with $(b_m)_k := \langle \psi_k, G_\kappa * \rho_m \rangle$,

$$B_q = \tfrac{1}{2} D^T M^{-1} b_m.$$

So the entire quark question reduces to the non-vanishing of one bilinear form:

$$B_q \neq 0 \Leftrightarrow D^T M^{-1} b_m \neq 0.$$

In words: the committed record changes the up/down quark mass readout iff the record-induced κ-field displacement has nonzero projection — *in the closure-mode metric M^{-1}* — onto the up/down log-overlap gradient difference.

The three failure geometries, made explicit. $B_q = 0$ — the §7f/§7g common-mode mode, now in fully explicit linear algebra — occurs in exactly three ways:

- **$b_m = 0$:** the record does not perturb the closure coordinates at all (no source response);
- **$D = 0$:** up and down read every closure-coordinate shift identically (no contrast direction exists);
- **$M^{-1} b_m \perp D$:** the record perturbs the closure coordinates, but in a direction the metric makes invisible to the up/down difference.

None is excluded by the static u/d inequality — D and b_m are properties of *responses*, not of the zeroth-order overlap values — so this is the §7f Lemma restated at the level of named vectors, not a softening of it.

What is settled, and the exact remaining gate. This does not evaluate B_q: the companion papers supply the *form* of $q'(0)$ (dual-projected sourced-κ response) and of D (BCB overlap gradients) but not yet the numbers — ρ_m is not given explicitly, and the overlap integrals await their species parameters. What is settled is that the quark problem is now a definite linear-algebra gate rather than an open-ended question. The next proof target is correspondingly sharp, and it is the honest terminus of the quark line in this paper:

Show that the record-induced source ρ_m has nonzero projection onto the same closure sector that differentiates I_u from I_d — i.e. that $M^{-1} b_m$ is not orthogonal to D.

That single statement is the quark route's survival condition, reduced from "does a committed record affect quark masses?" to a named inner product between a sourced-κ response and an overlap-gradient difference, both expressible in objects the corpus already carries. Whether that inner product is nonzero — and the route lives — or zero — and it fails common-mode — is the calculation the next paper owes; this paper's contribution is to have made it exactly that calculation and no longer anything vaguer.

7i. A Sufficient Condition for the Gate to Open

With §7h, Part I's core construction is complete: the quark route is reduced to one exact gate, $B_q = \frac{1}{2} D^T M^{-1} b_m$. The two subsections that follow (§7i, §7j) are the bridge into Part II — they sketch, in the three-premise form, the sufficient condition that Part II then proves cleanly in its single maintenance-conjugacy form. A reader who wants the sharp version may read §7i/§7j as motivation and take the finished result from Part II §II.6.

§7h leaves the quark route as the non-vanishing of $B_q = \frac{1}{2} D^T M^{-1} b_m$. This subsection gives a clean *sufficient* condition for $B_q \neq 0$ — a genuine proof that the gate opens — but it is conditional on three premises, and the honesty of the result depends on all three being visible rather than two stated and one buried in the algebra. For the quark-relevant committed record the proof is clean; for a generic record the statement is false, because a record can perturb only a common-mode closure coordinate and then the contrast still vanishes. The premises are what separate those cases. (Part II §II.5 collapses these three premises into the single maintenance-conjugacy premise, which is the cleaner statement; this subsection is the three-premise precursor.)

The charge-sector direction. The up/down distinction cannot be sourced by closure class alone (up- and down-type quarks of a fixed generation are both partial closures) nor by generation depth alone (the contrast is same-generation). It requires a variable that distinguishes the charge sectors and enters with *opposite sign* on up- and down-type partial closures — call its closure-coordinate direction e_χ, the up/down-odd direction. The two structural inputs the proof needs are then statements about how e_χ enters the overlap gradient and the record source.

Proposition — nonzero same-sector projection. Suppose: **(P1)** the up/down log-overlap gradient difference lies in the charge-sector direction, $D = d \cdot e_\chi$ with $d = \partial_{e_\chi} \ln I_u - \partial_{e_\chi} \ln I_d \neq 0$ (the up and down overlaps read the charge-sector coordinate differentially); **(P2)** the record-induced source has a nonzero charge-sector-odd component, $\rho_m = r \cdot \rho_\chi + \rho_{even}$ with $r \neq 0$, so after the massive-κ response and exact projection $b_m = r \cdot e_\chi + b_{even}$; **(P3)** the odd/even decomposition is orthogonal in the closure-mode metric, $e_\chi^T M^{-1} b_{even} = 0$ (the common-mode part has no M^{-1}-overlap with the charge-sector direction). Then

$$B_q = \tfrac{1}{2} D^T M^{-1} b_m = \tfrac{1}{2} d\, r \cdot e_\chi^T M^{-1} e_\chi \neq 0,$$

since M is positive-definite, so M^{-1} is positive-definite and $e_\chi^T M^{-1} e_\chi > 0$.

Proof. Substituting $D = d\cdot e_\chi$ and $b_m = r\cdot e_\chi + b_{even}$ gives $D^T M^{-1} b_m = d\, r\cdot e_\chi^T M^{-1} e_\chi + d\cdot e_\chi^T M^{-1} b_{even}$. The second term vanishes by (P3). The first is strictly positive by positive-definiteness of M^{-1}, and nonzero d, r by (P1), (P2). ■

The positive-definiteness step is the substantive part: it upgrades "the two odd components overlap" to "they overlap *strictly*," ruling out an accidental-cancellation zero. There is no fine-tuning escape — given the three premises, B_q cannot vanish.

The three premises, at honest grade. None of (P1)–(P3) is supplied by the algebra; each is a structural claim the corpus must discharge.

- **(P1) $d \neq 0$** is §7f's differential-response condition localized to e_χ. It is supported by the BCB structure — the Yukawa couplings are $\kappa_f = \kappa_0 I_f$ with I_f a dimensionless fold-geometry overlap and Q_L, u_R, d_R distinct fold representations, so the up/down log-ratio depends on the difference of geometry-overlap responses, not the common scale κ_0 — but the corpus still marks the charge-sector dependence of the surviving substrate-stiffness candidates as *open*. Plausible, not established.
- **(P2) $r \neq 0$** rests on the maintenance paper's *conjectural* sign identification: up-type partial closures couple constructively to the shared bath, down-type screening-wise — an up/down-odd source. This leg inherits a conjecture's grade, and explicitly so.
- **(P3) M^{-1}-orthogonality** is the premise most easily lost: the factorization needs e_χ and the even sector orthogonal *in the M^{-1} metric*, not merely "odd vs even" abstractly. It holds if the exchange-sector decomposition is a genuine symmetry decomposition that M respects (M block-diagonal across odd/even), but that is a property of the closure-mode Gram matrix to be verified, not assumed. With a generic common-mode component the cross term $d\cdot e_\chi^T M^{-1} b_{even}$ does *not* drop, and B_q is no longer the clean product — so (P3) is doing real work and is stated here as a hypothesis rather than folded silently into "the common-mode part does not contribute."

What is shown, and the circularity to avoid. The result is therefore: *if the realised record is the signed partial-closure maintenance record (P2), if the up/down overlaps read that charge-sector coordinate differentially (P1), and if the sector decomposition is metric-orthogonal (P3), then ρ_m has nonzero projection onto the same closure sector that differentiates I_u from I_d, and $B_q \neq 0$ — the quark route lives.* This is the exact proof route, and it is a real advance: it identifies *which* record (the signed maintenance record) and *which* overlap property (charge-sector-differential reading) make the gate open, and shows that once those hold the positive-definite metric forbids cancellation.

The remaining first-principles burden is correspondingly sharp — and carries one specific danger the paper must name. The burden is to *derive* the signed maintenance record from closure geometry, i.e. establish (P2)'s $r \neq 0$ (and the (P1) sign of d) from substrate dynamics, **rather than infer it from the observed up/down mass pattern.** The latter would be circular: reading the sign that produces the right answer off the answer itself. So the honest claim is the conditional one — the gate opens *given* the signed maintenance record — with the derivation of that record from geometry, not from the mass data, flagged as the open and circularity-sensitive step. The corpus marks exactly this open: persistent-distinguishability load and interface-transport complexity remain live candidates only if they vary across charge sectors with opposite sign, which is (P1)–(P2) restated as the thing not yet derived.

7j. Programme-Level Consolidation and the Quark-Side Grade

Stepping back from the projection algebra, the §7f–§7i arc does something for the wider VERSF programme beyond settling one paper's open item: it ties four previously separate strands into one coordinate system. Worth stating plainly, with the honest verb — the strands are now *expressed in shared machinery*, with the cross-links proven where they are kinematic and conditional where they are dynamical.

The four strands, and the grade of each link.

1. *Fold/record ontology* — what carries committed facts — connects to
2. *κ-closure dynamics* — how records perturb closure structure — through the sourced massive equation $(\square + m_\kappa^2)\kappa = \rho_{src}$ with its linear record-response $\partial_m \kappa|_0 = G_\kappa * \rho_m$. **Kinematic, solid.**
3. *Exact projection coordinates* — how the perturbation is read in the closure basis — connect to (2) through the dual-basis projection theorem $q'(0) = M^{-1} b_m$. **Exact (§7h), solid.**
4. *BCB/Yukawa overlap geometry* — how fermion masses read closure geometry — connects to (3) only through the gradient direction $D = d\cdot e_\chi$, which is premise (P1). **Conditional, corpus-open.**

So the consolidation is real but correctly graded: the quark mass problem is no longer floating outside the rest of VERSF — it is tied into the same closure-coordinate machinery that supports the commitment-threshold and closure-spectrum papers — with three of the four links kinematic and the fourth (the one reaching the actual mass geometry) conditional on the charge-sector-differential overlap. The machinery is shared; the physics is closed only where the links are proven.

The substrate-stiffness localization — the sharpest payoff. The substrate-stiffness hierarchy paper writes fermion mass as $m_D = \mathcal{D}_{\gamma_D} S(D) v$ with $S(D) = S_H S_L S_P S_I$. The quark result localizes *where the up/down split can live*: under the conditional theorem of §7i, the split is carried by the charge-sector dependence of S_P and/or S_I — and *not* by the generation operator $\mathcal{D}_{\gamma_D}$ (the contrast is same-generation), not by closure class (both are partial closures), and not by a free Yukawa parameter (there is none; $\kappa_f = \kappa_0 I_f$). This is a genuine narrowing — it excludes three of the four candidate sources — but it inherits its grade from (P1)–(P2): it is where the split *must* live *if* it lives in the signed maintenance record at all. The "most likely S_P and/or S_I" carries exactly the conjectural weight of the (P2) sign identification, and is stated as a consequence of the conditional theorem, not as an independent finding.

The quark-side grade, exactly. Collecting the arc at honest grade:

- **Proven / exact:** the projected closure-coordinate test, $B_q = \frac{1}{2} D^T M^{-1} b_m$, with its three explicit failure geometries (§7h).
- **Conditional theorem:** if the realised record is the signed partial-closure maintenance record and the up/down overlaps read that charge-sector coordinate differentially (with the metric-orthogonal decomposition), then the quark readout contrast is nonzero, with no cancellation escape by positive-definiteness (§7i).
- **Open:** derive the signed admissibility-maintenance functional from closure geometry, rather than reading its sign from the observed quark mass pattern (§7i, the circularity-sensitive step).

That last item is now the programme's central quark-side task — and it is sharp in a way it was not before this arc: not "explain the quark masses" but "derive one signed functional (the charge-sector dependence of S_P and/or S_I) from substrate dynamics, independently of the masses it is meant to produce."

What this does not mean. The boundary is worth stating as flatly as the achievement. It does *not* mean the programme has derived the quark masses: m_u/m_d, m_c/m_s, m_t/m_b are not computed from first principles. It does not discharge the proportional-readout bridge (§6), still the load-bearing assumption reaching the Standard Model. It does not prove the admissibility-maintenance hypothesis — that is (P2), conjectural. The arc's contribution is to convert the quark mass-asymmetry problem from an open-ended question into one exact test plus one conditional theorem plus one sharply-named open functional — a better-posed problem, not a solved one.

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8. Relation to Closure-History Memory

The companion scope paper isolated one candidate source for m: a realised closure-history record stored in a record-resolved κ memory carrier, with the U/D orientation retained as a committed record (conditional on W_7 closure being ordered-irreversible commitment). This paper does not need that derivation. It uses only the abstract output:

$m \in [-1,1]$, $S : m \mapsto -m$.

Closure-history memory is therefore *one* candidate source of m, not the defining subject here. Any realised substrate record could supply m, provided it is (1) reflection-odd, (2) mass-independent, (3) persistent enough to govern the access state, and (4) faithfully coupled to ΔP — where condition (4) is exactly the access-visibility requirement of §4.2 and the $h \neq 0$ requirement of §7, now seen as the same demand from two sides.

One caveat must be carried forward from the companion paper rather than left to die in the abstraction: in the closure-history realisation, the readout coupling h of §7 is *plausibly the same κ physics* that fixes the carrier coupling, in which case "derive h" is "compute h from the C_6 closure geometry," not "discover a free parameter." Abstracting away from the source (as this paper does) is a legitimate scoping choice, but it is also the move that can quietly re-open a question the companion paper had sharpened to near-closure. Stated once, here, so it is not lost: the gain may already be determined.

8a. What is not yet bridged

Two companion papers now supply structural inputs this one leans on — the *Hierarchy Theorem* (the $[\hat{Y}, \chi] = 0$ charge-blindness of §2.4) and the *Structural Origin* paper (the $\kappa_{clos} \approx \ln 14$ gain of §7). Honesty requires marking where those inputs are *not* yet seamlessly connected to the readout construction, because two gaps remain across the papers and neither should be papered over by the fact that the numbers are encouraging.

The vocabulary gap (completion density versus closure spectrum). The two companion papers grade the *same* charged-lepton hierarchy through two different substrate quantities. The Hierarchy paper runs the mass ordinal through *completion density* $C = p_v/K_c$, with the named bridges ECB (efficiency → completion density) and ANCH-COMP (completion density → mass). The Structural Origin paper runs the hierarchy through the *closure-mode spectrum* $\{\lambda_n\}$ of the overlap operator, with depth-decay exponent κ_{clos}. These land near the same observed ratios, but whether completion density C and the closure spectrum $\{\lambda_n\}$ are the same object under two names, related by a stated map, or genuinely distinct mechanisms that happen to converge, is **not established in either paper**. (The Hierarchy paper flags an internal version of this — its anchoring and coherence companions "do not yet agree on the functional form," exponential-of-a-power versus pure power law.) This readout paper inherits its *gain* from the closure-spectrum vocabulary (κ_{clos}, §7) and its *order parameter* m from the closure-history/completion-density vocabulary (§8). It does not need the two unified to state its own construction — but it must not present them as a single settled mechanism, and a successor that wires m and ζ together from first principles will have to supply the $C \leftrightarrow \{\lambda_n\}$ map that the companions currently leave open.

The proportional-bridge gap (already named, restated for completeness). The proportional-readout hypothesis of §6 (access contrast = Yukawa log-ratio) and the overlap identification of the Structural Origin paper (Yukawa entry = depth-state overlap) are two distinct bridges into the Standard Model, plausibly consistent but not yet shown equivalent. Neither companion discharges the proportional pillar; it remains this paper's load-bearing second assumption.

The shape of the honest claim is therefore: the construction *stands on its own* (Theorem 1 and the Schur evasion need no companion), and it now *inherits* two structural inputs at honest grade (charge-blindness, proven; gain, structurally valued up to a bounded residual) — but the full first-principles wiring of m, ζ, and the proportional bridge into one mechanism requires two cross-paper identifications that are named here and open.

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9. Generation Dependence and the Halving Law

The W_7 quark programme introduced a halving law $\rho = \frac{1}{2}$ for generation-to-generation contrasts. This paper does not derive it, and — following the corrected §4.3 — it must be careful about which regime the recursion lives in, because the two regimes give *different* recursions and only one is the construction's own dynamics.

Under the Gibbs dynamics (the physical case), halving is linear. The §7 Gibbs readout gives the exact access contrast

$$\chi_g = 2\, \beta_g\, h_g\, m_g$$

— linear in m_g for every m_g, not just at the binary endpoints (§4.3, §10 item 4). The exact halving condition $\chi_{g+1} = \frac{1}{2} \chi_g$ is therefore simply

$$\beta_{g+1}\, h_{g+1}\, m_{g+1} = \tfrac{1}{2}\, \beta_g\, h_g\, m_g,$$

a linear relation with no tanh and no nonlinear departure. So within the construction's own dynamics, halving in χ is linear halving in the product $\beta_g h_g m_g$, and there is no "calculable deviation at larger amplitude" — the contrast is linear at all amplitudes.

The tanh recursion lives only in the binary-per-generation regime. If instead one holds the gain frozen at a generation-constant $\zeta_g = \tanh(\beta_g h_g)$ and writes $\chi_g = 2\, \mathrm{artanh}(\zeta_g m_g)$, then $\chi_{g+1} = \frac{1}{2} \chi_g$ gives the nonlinear recursion

$$\zeta_{g+1}\, m_{g+1} = \tanh[\, \tfrac{1}{2}\, \mathrm{artanh}(\zeta_g\, m_g)\,],$$

reducing to $\zeta_{g+1} m_{g+1} \approx \frac{1}{2} \zeta_g m_g$ only for small argument. But by §4.3 the constant-ζ artanh form is exact *only when each generation's record is genuinely binary* ($m_g = \pm 1$); off the endpoints it is a frozen-ζ re-parametrization, not the Gibbs-exact contrast. So the nonlinear recursion — and the "testable departure as the amplitude grows" earlier drafts advertised — is an artifact of the constant-ζ parametrization, not a prediction of the construction's dynamics. It would be the right recursion only in the non-physical binary-per-generation reading, and must not be presented as an empirical signature of the linear Gibbs theory.

The honest target. What is owed is a generation-recursion theorem for the model parameters (β_g, h_g) and the order parameter m_g, whose leading behaviour reproduces $\rho = \frac{1}{2}$:

Derive the recursion of the realised record-readout product $\beta_g h_g m_g$ across generations, reproducing $\rho = \frac{1}{2}$ as the linear halving $\beta_{g+1} h_{g+1} m_{g+1} = \frac{1}{2} \beta_g h_g m_g$ of the Gibbs contrast.

No nonlinear departure should be claimed as a falsifiable signature unless the per-generation record is independently shown to be binary; under the construction's own (continuous-m) dynamics the contrast is linear, and §9 is a consistency target for the linear recursion, not a source of an empirical handle.

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10. What Is Proved, What Is Conditional, What Is Open

Proved here (unconditional within the inherited inputs):

1. A standing reflection-fixed access state gives no fold contrast (the no-go).
2. A realised conditioned access state can give a fold contrast without violating reflection covariance.
3. The minimal *access-visible* conditioned state is $R_m = \frac{1}{2}(I + \zeta m \Delta P)$, unique among couplings the χ functional can read (Theorem 1 with premise 6; the σ_y coupling is the covariant-but-invisible alternative, §4.2).
4. The conditioned Gibbs state $R_m = \frac{1}{2}(I + \tanh(\beta h m)\Delta P)$ is *exact for every m*, giving $\chi = 2\,\mathrm{artanh}(\tanh(\beta h m)) = 2\beta h m$ exactly for the Gibbs gain; the single-constant form $\chi = 2\,\mathrm{artanh}(\zeta m)$ is exact for a binary record ($\zeta = \tanh \beta h$) and a small-m linearisation otherwise ($\zeta_{lin} = \beta h$), the two constants coinciding only as $\beta h \to 0$ (§4.3).
5. The unconditioned ensemble stays symmetric, $\chi(\bar{R}) = 0$.
6. The reflection-odd first-order perturbation of the closure-norm operator on E_1 decomposes as $b\,\Delta P + c\,\Sigma_y$, with access-visible projection $h_\Delta = \frac{1}{2}\mathrm{Tr}(\Delta P \cdot \hat{H}_c^{(1)}) = b$; the record is mass-visible iff $b \neq 0$, the σ_y term being access-invisible (Theorem 2, §7a — pure trace algebra). This is a localisation of the gain, not a computation of it.

Inherited at structural grade (proven in companion papers, used here):

1. Charge-blindness of the mass-generating coordinate, $[\hat{Y}, \chi] = 0$ (Hierarchy paper, Theorem 5.1) — so the conditioning variable m is charge-blind and the readout disturbs no charge eigenvalue; charge universality across generations follows (§2.4).
2. A structural value for the gain in the charged-lepton realisation, $\kappa_{clos} \approx \ln 14 = \ln(\dim \Gamma_{min})$ (Structural Origin paper + Role-4/BCB companions) — so the gain is structurally valued, not a free scalar, up to the named 14-vs-$e^{(8/3)}$ residual (§7).
3. The charged-lepton gain as a conditional structural quantity (§7e): $\kappa = 8/3$, $N_{loop} = 14 = 2(3+4)$, saturated participation $\Pi_2 \approx 1/12$, with the tau suppression reached two convergent ways (variational $\tilde{E}_2/\tilde{E}_1 \approx 0.085$ and closure $1/12 \approx 0.0833$, agreeing to ~1.6%). **[Inherited — conditional]**, charged-lepton sector only.

Bridges stated here (not assumed, not yet proved):

1. Identification of the charged-lepton participation gain with the general E_1 projection: $\zeta_{\{\ell,2\}} = \Pi_2 \approx 1/12 = \tanh(\beta\, h_\Delta)$ in the Role-4 lepton realisation (§7e). **[Bridge — stated here]**; the sectoral suppression factor and the fold-access projection h_Δ are not equated without it.

Conditional here (true given a named, unproved premise):

1. The Yukawa ratio equals the access ratio — the proportional-readout pillar (§6), undischarged and load-bearing; the companion overlap identification is a parallel bridge to be reconciled with it, not a proof of it.
2. A committed substrate record supplies a persistent m (§8).
3. The readout gain ζ is nonzero — now *doubly constrained*: inherited as structurally valued ($\kappa_{clos} \approx \ln 14$, §7), and forced nonzero by the marginal closure-load result (§7b), which

is carried out explicitly in closed form on the C_6 closure graph (§7d: $b = (\Lambda_c N g^2/6)[2/(M_\kappa^2+\eta) + 1/(M_\kappa^2+4\eta)] > 0$). But this holds only under two named premises, the **closure-norm Gibbs identification** (§7a: that the access state is the Gibbs state generated by $\hat{H}_c$, which is what makes $h = h_\Delta$ rather than two distinct couplings) and the **marginal-load identification** (§7b/§7d: that $\hat{H}_c$ reads the κ memory as a real scalar branch-load, which is what excludes the σ_y hidden-coherence case). These two premises are the load-bearing content; the σ_y case is excluded by the second, not defeated by a proof. The toy model computes b *given* the second premise; it does not establish the premise.

Open (named targets for successor papers):

1. Resolve the precise value of the gain: prove whether the structural integer 14 or the focusing value $e^{(8/3)}$ is fundamental (companion problem #8), closing the ~3% residual.
2. Argue the two gain premises from below: the closure-norm Gibbs identification (§7a) and — the sharper one — the marginal-load identification (§7b/§7d), whose negation ($\Lambda_c = 0$, the mediator not reading κ memory as a scalar load) is the real residual failure mode now that the σ_y case is otherwise excluded. The toy model (§7d) computes b in closed form *given* the marginal-load identification; what remains is the first-principles realised-record dependence of $\hat{H}_c(m)$ — the explicit m-dependent closure-norm/Yukawa operator that the companion papers supply at $m = 0$ but not yet as a function of m — which would replace the toy computation with a derived one.
3. Derive m from a concrete substrate mechanism.
4. Prove the realised conditioned state governs *persistent* fermion mass, not just an instantaneous reading.
5. Derive or refute the proportional-readout hypothesis from substrate structure, and reconcile it with the companion overlap identification (§6).
6. Supply the $C \leftrightarrow \{\lambda_n\}$ map relating the completion-density and closure-spectrum vocabularies of the two companion papers (§8a).
7. Derive the generation recursion of $\zeta_g m_g$, recovering $\rho = ½$ at leading order.
8. Extend from one two-branch contrast to the full Yukawa matrices and mixing. **Specifically not inherited:** the charged-lepton gain of §7e does *not* transport to the quark sectors — the participation-gating mechanism is Role-4-charged-lepton-specific and fails for quarks in the companion work, and the forced sector-dependence of the sensitivity (Hierarchy companion Result 7.1) is an independent reason the lepton result cannot be assumed to carry. The quark-sector gain — where this paper's own up/down problem lives — remains owed, but is now a *local target* (§7f): the BCB quark fold-overlap dynamics already exist, so what is owed is one log-ratio derivative, $B_q = ½[\partial m \ln \kappa_u(0) - \partial m \ln \kappa_d(0)]$ *(the log form, since the access contrast and Yukawa ratio are logarithmic). Under the scalar-load premise the quark question reduces to a clean binary — differential log-response ($B_q \neq 0$, route lives) versus common-mode log-response ($B_q = 0$, route fails; witnessed by the multiplicative $\kappa_a = A_a e^{\lambda m}$, unequal static masses but equal log-response). The conditional Quark Fold-Overlap Projection Theorem is proved; the open part is whether the record couples differentially or common-mode, and* ***a common-mode charge-blind response is a real failure mode, not excluded by the existing u/d static differences*** *— the charge-blindness inheritance (§2.4)*

actually makes common-mode structurally plausible. §7g sharpens this to an explicit projected form: $B_q = \frac{1}{2} \Sigma_j [\partial_{q_j} \ln I_u - \partial_{q_j} \ln I_d]_0 \, q'_j(0)$, an inner product of the record-induced closure displacement $q'(0)$ with the up/down log-overlap gradient difference. §7h reduces it to one exact bilinear gate, $B_q = \frac{1}{2} D^T M^{-1} b_m$ (with M the closure-mode Gram matrix, the dual-basis M^{-1} being a load-bearing correction since the modes are non-orthonormal): the route lives iff $D^T M^{-1} b_m \neq 0$, with three named failure geometries ($b_m = 0$, $D = 0$, or $M^{-1}b_m \perp D$). The exact remaining gate is to show the record source ρ_m projects onto the closure sector that differentiates I_u from I_d. Form supplied by the corpus (dual-projected sourced-κ response, BCB overlap gradients); numbers (ρ_m explicit, overlap species parameters) owed. §7i then gives a *sufficient condition* for the gate to open: under (P1) charge-sector-differential overlaps $d \neq 0$, (P2) charge-sector-odd record source $r \neq 0$, and (P3) M^{-1}-orthogonal odd/even decomposition, $B_q = \frac{1}{2} d \, r \, e_\chi^T M^{-1} e_\chi \neq 0$ by positive-definiteness — no cancellation escape. The three premises are the honest content: (P1) plausible but the charge-sector stiffness dependence is corpus-open, (P2) rests on the maintenance paper's *conjectural* sign identification, (P3) is a property of the closure Gram matrix to verify. The remaining burden is to derive the signed maintenance record from closure geometry **rather than infer its sign from the observed up/down mass pattern** (the circularity to avoid).

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11. Failure and Fork Conditions

The realised-readout mechanism fails, cleanly and identifiably, if any of the following holds:

1. every admissible mass readout must be standing and reflection-fixed (no realised readout permitted);
2. every conditioned readout reduces to a D_6-equivariant linear map on E_1 (covariance loophole closed);
3. the only access-faithful record is σ_y-type, i.e. every available realised record is reflection-odd but produces coherence the diagonal functional cannot read (access-invisibility, §4.2) — a failure distinct from $h = 0$, now with a *concrete trigger* (§7a, Case 2): it fires precisely when $\partial\hat{H}_c/\partial m$ is purely off-diagonal on E_1 ($b = 0$, $c \neq 0$). §7b shows this case is excluded *under the marginal-load identification* — a real scalar closure-load cannot produce σ_y coherence — so this failure mode survives only if that identification is wrong, i.e. if the mediator reads the record as a phase-current rather than a scalar branch-load;
4. the pointer coupling vanishes, $h = 0$ — the channel is built but carries no current (§7); note this is now *constrained against* from two sides: by inheritance, $\kappa_{clos} \approx \ln 14$ fixes a structural value in the charged-lepton realisation (§7), and by the marginal closure-load result $h_\Delta = \frac{1}{2}\Lambda_c(C_{same} - C_{cross})N \neq 0$ *under the marginal-load premise* (§7b). The residual form of this failure mode is therefore the negation of that premise: $\Lambda_c = 0$ (the closure-norm operator does not read κ memory as a scalar load at all), with $C_{same} = C_{cross}$ (no branch-selective memory) and $N = 0$ (no committed record) the other two degenerate cases;

5. realised records cannot persist long enough to govern mass;
6. the proportional-readout hypothesis is false — the access ratio does not enter the effective Yukawa ratio (§6);
7. in the quark sector, the realised record couples *common-mode* to the shared quark fold-access coordinate, so that $\partial_m \ln \kappa_u(0) = \partial_m \ln \kappa_d(0)$ and hence $B_q = 0$, even though $\kappa_u(0) \neq \kappa_d(0)$ (§7f) — a quark-specific failure mode with no single-channel analogue, structurally plausible because the charge-blind record (§2.4) has reason to couple through the shared access structure rather than the u/d-distinguishing data;
8. the mechanism cannot be extended beyond a single up/down contrast.

These are clean failure modes with distinct diagnostics. Listing access-invisibility (3) separately from $h = 0$ (4), the proportional-hypothesis failure (6), and the quark common-mode failure (7) is deliberate: each closes the route at a different point, and a successor paper must know which one it is testing.

What these conditions are, and are not. In candour, these are *internal-consistency forks*, not experimental falsifications against an unmeasured quantity. Each says "the construction stops working if such-and-such internal structure fails to hold" — the proportional hypothesis is false, the record is common-mode, M_χ has the wrong sign — and a successor would discover the failure by computation within the programme, not by a measurement disagreeing with a prediction. The one place the work touches data, the tau suppression $1/12 \approx 0.0833$ against the variational 0.085, is a *postdiction* of an already-known ratio, and $\rho = ½$ is imposed on χ as a consistency target rather than derived (§9 is bookkeeping, as noted there). So the present contact with experiment is postdictive, and the "falsification conditions" are internal forks. Stated plainly: the VERSF mass programme is at the stage of *reproducing* known Standard Model structure through routes that contain structural choices, and the live question — the one that would convert this from an internally rigorous formal system into physics making contact with nature — is whether any part of it *predicts* a number not already used to build it. The single most decisive such test, identified in §7e, is whether $\kappa = 8/3$ is derived independently of the lepton mass ratio it reproduces; that, not another internal sharpening, is the next load-bearing move, and this paper does not perform it.

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12. Conclusion

The Standard Model does not explain the numerical Yukawa couplings that set fermion masses. VERSF cannot solve this by assigning unequal *standing* labels inside an indistinguishable class — the inherited realization and symmetry constraints forbid that route — nor by a fully symmetric linear field splitting the E_1 fold doublet, which Schur's lemma makes scalar.

The surviving route is realised readout. A committed substrate record may condition the access state without breaking the symmetry of the law. Under the Gibbs construction the exact conditioned state is $R_m = ½[I + \tanh(\beta h m)\Delta P]$, producing the access contrast

$\chi = 2\beta h m$,

linear in the record at every amplitude. (The constant-gain form $\frac{1}{2}(I + \zeta m\Delta P)$ with $\chi = 2 \operatorname{artanh}(\zeta m)$ is a re-parametrization, exact at the binary endpoints and a small-m linearisation otherwise; the artanh nonlinearity is a frozen-ζ artifact, not a feature of the dynamics, and carries no falsificatory weight — §4.3, §9.) This is a precise VERSF candidate for the *channel* through which a Yukawa contrast could arise: not a standing asymmetry, but a realised readout amplitude.

The result is not a mass derivation, and its title says "channel," not "origin," for a reason. What is built is the unique access-visible readout sector any such derivation must use; what it now *inherits* from companion work is two structural inputs — charge-blindness as a cited theorem ($[\hat{Y}, \chi] = 0$), and a structural value for the gain in the charged-lepton realisation ($\kappa_{clos} \approx \ln 14$), contracting the gain from a free scalar to a structurally valued quantity with a bounded ~3% residual. What remains owed is the order parameter m, the proportional bridge that carries the access contrast into the Yukawa ratio (and its reconciliation with the companion overlap identification), the $C \leftrightarrow \{\lambda_n\}$ map relating the two companions' vocabularies, the persistence of the realised reading, and the generation recursion that would reproduce $\rho = \frac{1}{2}$. The mechanism is now sharply testable: each is a named target with a clean failure-or-fork condition, and the single readout coupling that once stood as a free *terminus* is now sharper on every leg — the charged-lepton analogue of the readout gain is inherited as a nonzero conditional structural quantity, while the identification of that sectoral gain with the general E_1 projection h_Δ, and the quark-sector differential response B_q, remain explicit live targets. If the remaining steps complete, Yukawa structure becomes a consequence of committed-record readout rather than an arbitrary Standard Model input. If they cannot, the VERSF mass programme fails at a clearly identified point — and the paper has marked exactly which one. The one place Part I leaves furthest open — whether the quark gate B_q is forced nonzero — is the subject of Part II.

Part II — Charge-Sector Maintenance and the Quark Yukawa Projection

Exact Projected Closure Coordinates, Signed Bath Coupling, and the Nonzero Up/Down Readout

Part II takes up exactly where Part I §7h–§7j stop. Part I reduced the quark question to one inner product, $B_q = \frac{1}{2} D^T M^{-1} b_m$, and showed a sufficient condition for it to be nonzero but rested that on three separate premises. Part II tightens this: a single named premise package — maintenance-conjugacy, that the committed record couples to the same signed maintenance functional that distinguishes up-type from down-type quarks (existence of that coordinate, its differential up/down reading, and conjugate record coupling to it, on a stable positive closure subspace) — collapses those three into one structure and forces the contrast strictly positive, with no cancellation escape. What remains is one first-principles target, named at the end.

Summary for the General Reader

Part I ended by reducing the whole quark mass-difference problem to a single yes-or-no test: does the record nature lays down move the underlying system in a direction that the up and down quarks read *differently*? If yes, the mass difference is real; if the record moves things in a direction both quarks read the same way, the difference vanishes and the idea fails for quarks.

This part answers that test under one clearly-stated assumption. Suppose the record couples to the very same quantity that already tells up-type and down-type quarks apart — the "maintenance" cost the underlying medium pays differently for the two charge types. Then the answer is forced: the up and down quarks must read the record differently, because the record is, by assumption, pushing on exactly the thing that distinguishes them. The mathematics makes this clean and leaves no loophole: the contrast comes out strictly nonzero, never accidentally cancelling to zero.

What this does *not* do is compute the actual quark masses, or prove that the record really does couple to that maintenance quantity. That coupling is the assumption doing the work — and it is worth being exact about what is proved versus assumed. The paper does not prove the record reaches the up/down sector; that is the assumption. What it proves is the *no-loophole* part: once that coupling is supplied, the resulting difference cannot accidentally cancel to zero. So the result converts "does the record affect quark masses?" into the single sharp task of showing, from the underlying geometry alone, that this maintenance quantity exists and pushes oppositely on up versus down — and that it must be derived from the theory, not read backwards off the masses it is supposed to explain.

In one line: *if the record couples to the thing that already distinguishes up from down, the quark mass difference follows with no loophole — and the one remaining job is to derive that thing from first principles rather than from the answer.*

Abstract

Part I reduced quark-sector Yukawa visibility to the non-vanishing of an exact projected closure inner product, $B_q = \frac{1}{2} D^T M^{-1} b_m$, where $D_j = \partial_{q_j} \ln I_u - \partial_{q_j} \ln I_d$ is the up/down log-overlap gradient difference, b_m is the record-induced κ-field projection onto the closure modes, and M is the Gram matrix of the non-orthonormal closure basis. The exact projection theorem fixes the closure coordinates as $q_j = \langle \tilde{\psi}_j, \kappa \rangle$ with $\tilde{\psi}_j = \Sigma_k (M^{-1})_{jk} \psi_k$, so the M^{-1} insertion is the exact coordinate correction, not a modelling choice.

Part II supplies a first conditional closure of the quark projection. The admissibility-maintenance programme has shown the up/down residual cannot arise from closure class alone — up- and down-type quarks of a fixed generation are both partial closures — so the sign reversal must be carried by a charge-sector variable within the partial-closure class, the surviving candidates being charge-sector-resolving persistent-distinguishability load and/or interface-transport complexity. We define a signed charge-sector maintenance coordinate $M_\chi(q)$ on the exact closure-coordinate space and impose the **maintenance-conjugacy premise**: $F(q|m) = F_0(q) - m M_\chi(q) + O(m^2)$, i.e. the realised record m couples as the conjugate source to the same

maintenance functional that distinguishes up-type from down-type partial closures. With $\ln I_u = \ln I_u^0 + M_\chi$ and $\ln I_d = \ln I_d^0 - M_\chi$, the log-overlap gradient difference is $D = 2g_\chi$ with $g_\chi = \nabla q\, M_\chi|\{q_0\}$; linear response gives $q'(0) = H^{-1} g_\chi$ with $H = \nabla^2\_q\, F_0|\_\{q_0\}$ the positive closure Hessian. Therefore $B_q = ½ D^T q'(0) = g_\chi^T H^{-1} g_\chi$, strictly positive whenever $g_\chi \neq 0$, since H^{-1} is positive-definite on the stable subspace. Equivalently $D^T M^{-1} b_m = 2 g_\chi^T H^{-1} g_\chi \neq 0$. The result is conditional, not a quark-mass derivation; its value is to isolate the remaining first-principles burden — derive M_χ from closure geometry and show it changes sign between up-type constructive bath coupling and down-type screening bath coupling. The honest grade, set out in full in §II.5, is that the conjugacy premise is *most of the conclusion*: it assumes the record couples to the up/down-distinguishing coordinate, after which $B_q > 0$ is near-immediate by construction. What the theorem adds is narrow — it identifies conjugacy as the single premise that would close the quark route and shows that premise has no internal loophole (the positivity removes the orthogonality escape that existed in Part I only because D and b_m were a priori independent). It is a contribution to problem-shaping, not a step toward the masses; §II.5 and §II.8 set out this discipline in full.

II.1 The quark projection problem

Part I reduced the quark-side problem to the derivative $B_q = ½\, \partial m[\ln \kappa_u(m) - \ln \kappa_d(m)]\{m=0\}$. In the BCB/Yukawa overlap picture $\kappa_f = \kappa_0 I_f$, with κ_0 a universal scale and I_f a dimensionless fold-geometry overlap integral, the universal κ_0 cancels in the up/down log-ratio, leaving $B_q = ½\, \partial m[\ln I_u(m) - \ln I_d(m)]\{m=0\}$. With q_j the exact projected closure coordinates, the chain rule gives $B_q = ½ \Sigma_j [\partial\{q_j\} \ln I_u - \partial\{q_j\} \ln I_d]\_\{q_0\}\, q'_j(0) = ½ D^T q'(0)$. Because the closure modes are non-orthonormal, $q'(0) = M^{-1} b_m$ with $(b_m)_j = \langle\psi_j, \partial_m \kappa|_0\rangle$, so $B_q = ½ D^T M^{-1} b_m$. The route succeeds iff $D^T M^{-1} b_m \neq 0$. This part gives a controlled condition under which that inner product is forced nonzero.

II.2 Inherited inputs

Record-current ontology. The record-current programme identifies the substrate carrier of J^μ with persistent, topologically protected commitment-loop transport; in the hydrodynamic single-species regime $J^\mu = \rho_{pers} u^\mu$. So the record-induced source is not an arbitrary scalar perturbation but a projected, persistent, fold-supported commitment source. The species decomposition remains open; the existence of a physical record source is inherited.

Exact projected closure coordinates. The closure amplitudes are exactly $q_j = \langle\tilde\psi_j, \kappa\rangle$ with $\tilde\psi_j = \Sigma_k (M^{-1})\{jk\}\, \psi_k$, $M\{ij\} = \langle\psi_i, \psi_j\rangle$. The dual basis is mandatory because the closure modes are substantially non-orthonormal; the naïve $q_j = \langle\psi_j, \kappa\rangle$ is only the orthonormal limit.

Yukawa overlaps as fold geometry. The BCB Fold Lagrangian replaces independent Yukawa couplings with $\kappa_f = \kappa_0 I_f$, I_f a dimensionless fold-overlap integral; the quark terms involve distinct fold representations Q_L, u_R, d_R, so the up/down contrast is a contrast between I_u and I_d, not between free constants.

The admissibility-maintenance constraint. Up- and down-type quarks at fixed generation share partial-closure class, so neither closure class nor generation depth can carry the up/down sign reversal; it must be carried by a charge-sector variable inside the partial-closure class, with persistent-distinguishability load and interface-transport complexity the surviving candidates (live only if they vary across charge sectors with opposite sign). This part takes that as its target.

II.3 Exact projected closure coordinates

Let $S = \mathrm{span}\{\psi_0,\dots,\psi_6\}$ be the projected $K = 7$ closure subspace, $\kappa(x,t) = \Sigma_j\, q_j(t)\, \psi_j(x) + \kappa_\perp$ with $\kappa_\perp \perp S$. With $b_i = \langle\psi_i, \kappa\rangle$ and $M_{ij} = \langle\psi_i, \psi_j\rangle$, $b = Mq$ so $q = M^{-1}b$, and $q_j = \langle\tilde{\psi}_j, \kappa\rangle$. For a realised record m, the induced displacement is $q'_j(0) = \langle\tilde{\psi}_j, \partial_m \kappa|_0\rangle$, i.e. $q'(0) = M^{-1} b_m$ with $(b_m)_i = \langle\psi_i, \partial_m \kappa|_0\rangle$. Positive-definiteness of M (linear independence of the modes) makes M^{-1} positive-definite on the closure subspace.

II.4 The signed maintenance coordinate

Introduce a scalar maintenance coordinate $M_\chi(q)$ on exact closure-coordinate space; the subscript χ marks the up/down-odd component — the part of the admissibility-maintenance functional that changes sign between up- and down-type partial closures, not the whole mass functional. Define the leading charge-sector form

$\ln I_u(q) = A_u(q) + M_\chi(q)$, $\ln I_d(q) = A_d(q) - M_\chi(q)$,

with A_u, A_d the common-mode, generation, localization, and sector-anchor structure not odd under the up/down sign. At the readout point, $g_\chi = \nabla_q M_\chi(q_0)$, so the odd part of the gradient difference is $D = 2g_\chi$ provided the even terms carry no up/down-odd derivative; in general $D = 2g_\chi + D_{residual}$. This part focuses on the clean case $D = 2g_\chi$ — the sharp expression of the claim that the up/down log-overlap contrast is read through the signed maintenance coordinate.

II.5 The maintenance-conjugacy premise

Maintenance-Conjugacy Premise. The realised record parameter m couples as the conjugate source to the same signed maintenance coordinate $M_\chi(q)$ that differentiates up- from down-type partial-closure overlaps:

$F(q|m) = F_0(q) - m\, M_\chi(q) + O(m^2)$,

with $F_0(q)$ the unconditioned closure free energy. Let $H = \nabla^2_q F_0(q_0)$; assuming q_0 is a stable closure point after gauge, trace, and redundant directions are removed, H is positive-definite on the physical projected subspace. Stationarity $\nabla_q F(q(m)|m) = 0$ differentiated at $m = 0$ gives $H\, q'(0) - g_\chi = 0$, so $q'(0) = H^{-1} g_\chi$. The record-induced displacement is exactly the closure response to the signed maintenance gradient.

A word on the status of this premise, in keeping with the series' discipline — stated flatly, because the clarity of the grading should not function as an anesthetic for how much the premise carries. It is strong, and it is most of the conclusion. It posits that the record couples to *precisely* the functional that already splits up from down; given that, the displacement $H^{-1}g_\chi$ and the gradient $2g_\chi$ are built from the same vector g_χ, and $B_q = g_\chi^T H^{-1} g_\chi > 0$ follows almost immediately. The positivity step — that a positive-definite quadratic form is positive on nonzero vectors — is true but addresses a *weak* worry. The real structure is: in Part I the contrast could vanish because D and b_m were a priori independent vectors that might be orthogonal; the conjugacy premise removes that escape by *assuming the two are collinear*; the positivity then observes that collinear vectors do not cancel. So the non-circular content of the theorem is not "the record reaches the up/down sector" (that is the premise, and it is the whole physical claim) and not even mainly the positivity (that is one sentence) — it is the *identification* of conjugacy as the single condition that closes the route, together with the demonstration that this one condition leaves no internal loophole. The existence of the coupling is assumed; what is shown is that nothing else is needed and nothing internal can defeat it. The two must be kept apart, and §II.8/II.10 do so.

II.6 Main theorem: nonzero quark projection

Theorem (Charge-Sector Maintenance Projection). Assume: (1) exact projected closure coordinates $q_j = \langle \tilde{\psi}_j, \kappa\rangle$; (2) a stable unconditioned closure Hessian $H = \nabla^2_q F_0(q_0) \succ 0$ on the physical projected subspace; (3) a signed maintenance coordinate $M_\chi(q)$ with $g_\chi = \nabla_q M_\chi(q_0) \neq 0$; (4) the up/down log-overlap contrast read through it, $D = 2g_\chi$; (5) the record conjugate to M_χ, $F(q|m) = F_0(q) - m\, M_\chi(q) + O(m^2)$. Then the quark readout derivative $B_q = \tfrac{1}{2}\, \partial m[\ln I_u - \ln I_d]\{m=0\}$ is strictly nonzero — in fact $B_q = g_\chi^T H^{-1} g_\chi > 0$.

Proof. $B_q = \tfrac{1}{2} D^T q'(0)$. By (4), $D = 2g_\chi$; by (5) and linear response, $q'(0) = H^{-1} g_\chi$. So $B_q = \tfrac{1}{2}(2g_\chi)^T H^{-1} g_\chi = g_\chi^T H^{-1} g_\chi$. Since $H \succ 0$, $H^{-1} \succ 0$, so $g_\chi^T H^{-1} g_\chi > 0$ whenever $g_\chi \neq 0$. ■

The strict positivity is purely algebraic: no numerical sampling is required. It follows from positive-definiteness of the stable closure Hessian — if $H \succ 0$ then $H^{-1} \succ 0$, so $g_\chi^T H^{-1} g_\chi > 0$ for any $g_\chi \neq 0$.

The residual case (so nothing is hidden in $D = 2g_\chi$). Premise (4) took the clean case $D = 2g_\chi$, but §II.4 noted the general form $D = 2g_\chi + D_{residual}$, with $D_{residual}$ any up/down gradient difference not carried by the maintenance coordinate. Without assuming it away, $B_q = \tfrac{1}{2} D^T q'(0) = \tfrac{1}{2}(2g_\chi + D_{residual})^T H^{-1} g_\chi$, i.e.

$$B_q = g_\chi^T H^{-1} g_\chi + \tfrac{1}{2} D_{residual}^T H^{-1} g_\chi.$$

The first term is the strictly positive maintenance contribution; the second is the residual cross-term. So the readout is nonzero unless the residual exactly cancels the maintenance term — that is, $B_q \neq 0$ whenever

$$|D_{residual}^T H^{-1} g_\chi| < 2\, g_\chi^T H^{-1} g_\chi,$$

and $B_q = 0$ requires an exact structural cancellation, $D_{residual}^T H^{-1} g_\chi = -2\, g_\chi^T H^{-1} g_\chi$. The honest statement is therefore stronger than the clean case alone: pure maintenance-conjugacy forces a nonzero readout, and residual non-maintenance terms do not kill it unless they are structurally tuned to cancel the positive maintenance contribution exactly. The clean case $D_{residual} = 0$ is the special point where positivity is unconditional.

II.7 Interpretation in κ-source language

With $(b_m)_j = \langle \psi_j, \partial_m \kappa|_0 \rangle$ and $q'(0) = M^{-1} b_m$, the theorem says $M^{-1} b_m = H^{-1} g_\chi$, i.e. $b_m = M H^{-1} g_\chi$. This is not an independent identity but a *constraint the maintenance-conjugacy premise imposes* — it links the source projection b_m to the Hessian response $H^{-1}g_\chi$ precisely by equating the two displacement expressions, and is a restatement of premise (5), not a derivation from it. Substituting, $D^T M^{-1} b_m = (2g_\chi)^T H^{-1} g_\chi = 2 g_\chi^T H^{-1} g_\chi \neq 0$ — precisely the Part I target condition. In source-field language, if $\partial_m \kappa|_0 = G_\kappa * \rho_m$ then $(b_m)_j = \langle \psi_j, G_\kappa * \rho_m \rangle$, and the conjugacy premise states ρ_m is the source conjugate to M_χ, so its projected displacement is automatically in the sector that differentiates I_u from I_d. This is the desired statement — ρ_m has nonzero projection onto the same closure sector that differentiates I_u from I_d — *provided* ρ_m is the maintenance-conjugate record source.

II.8 What is proved, conditional, and open

Proved here, given the named premises. $B_q = \frac{1}{2} D^T M^{-1} b_m$; if the record is conjugate to M_χ then $q'(0) = H^{-1}\nabla M_\chi$; if $D = 2\nabla M_\chi$ then $B_q = \nabla M_\chi^T H^{-1} \nabla M_\chi > 0$. So *under the maintenance-conjugacy premise, the common-mode failure does not occur* — stated precisely: common-mode is the negation of conjugacy, so conjugacy is exactly the condition under which common-mode is absent, not an independent fact that defeats it.

Inherited. The exact dual-basis projection (M^{-1}, not naïve orthogonal); the BCB replacement of free Yukawas by $\kappa_0 I_f$; the record-current ontology as the record-source carrier; the admissibility-maintenance requirement of a charge-sector variable inside the partial-closure class.

Conditional here. That M_χ exists as a closure-geometric functional; that up/down responses differ by opposite signs of M_χ; that the record couples conjugately to M_χ; that H is positive-definite on the physical subspace after redundant directions are removed.

Open. Derive $M_\chi(q)$ from closure geometry; show whether it lives in persistent-distinguishability load S_P, interface-transport complexity S_I, or a coupled $S_P S_I$ term; compute $g_\chi = \nabla M_\chi(q_0)$; insert explicit fold-Higgs overlaps I_u, I_d and evaluate D_j; compute the resulting numerical quark mass contrast.

II.9 Failure and fork conditions

The route fails if any of: **(1) no signed maintenance coordinate** — $M_\chi = 0$ or $\nabla M_\chi(q_0) = 0$, giving $B_q = 0$; **(2) record is common-mode** — the record couples to a common-mode M_{even} rather than M_χ, so the displacement is invisible to the up/down contrast (this is the negation of the conjugacy premise, and the real residual); **(3) overlap gradients are common-mode** — $\partial_{q_j} \ln I_u = \partial_{q_j} \ln I_d$ along the record-shifted direction, so $D = 0$ there; **(4) wrong maintenance sign** — closure geometry yields the same sign for up- and down-type bath maintenance, failing the quark sign test; **(5) Hessian instability** — H not positive on the relevant subspace, indicating q_0 is not stable or redundant directions are not properly quotiented; **(6) exact projection fails** — but within the exact-projection theorem this is a theorem of the closure subspace, not a physical assumption.

II.10 Conclusion

Part II reduces the quark Yukawa projection to a precise conditional theorem. The realised-readout problem began with $D^T M^{-1} b_m$; under the maintenance-conjugacy premise that inner product is forced strictly nonzero, $B_q = g_\chi^T H^{-1} g_\chi > 0$, with positive-definiteness ruling out any cancellation. The result does not derive quark masses, determine m_u/m_d, or compute CKM structure. It proves something prior and necessary, and only that: *given* that the record is the conjugate source to the signed maintenance functional, the maintenance record is mass-visible to the quark Yukawa projection.

The remaining quark-side task is therefore exact, and it is the programme's central one: **derive $M_\chi(q)$ from closure geometry** — show whether it is carried by S_P, S_I, or their coupled sector, and prove that $\ln I_u - \ln I_d$ reads it with opposite sign — *from the underlying geometry, not by reading the sign off the observed quark masses*, which would be circular. If that derivation succeeds, the quark realised-readout route is structurally alive in the strongest available sense: record source, projected closure displacement, and up/down Yukawa contrast all live in the same charge-sector maintenance direction. If it fails, the failure is clean and identified — common-mode record, absent maintenance functional, or non-differential overlap gradients. That is the progress the two parts together lock in: Part I builds the channel and isolates the inner product; Part II shows one premise forces it nonzero; and what is left is a single functional to derive, on its own terms.

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