From Free Parameter to Structural Quantity: The Complete Derivation of the Commitment Barrier in the VERSF Framework

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What This Paper Shows

Reality does not happen for free — and the minimum price is 3/8 of the natural energy scale of space.

In the VERSF framework, reality is built from irreversible "commitment events" — moments when something becomes definite and can no longer be undone. This paper determines the energy cost of the simplest possible such event.

The result. The minimum energy required to create a definite outcome is:

(3/8) × (the natural energy scale of the region)

Every region of space has a natural energy scale set by its size. To produce a real, irreversible event, you must supply at least 3/8 of that energy. This number is not guessed or fitted — it comes directly from the structure of the theory.

Where "3/8" comes from. Three facts combine:

1. **Geometry.** The way reality is structured — seven independent constraints — fixes how "stiff" the system is.
2. **Threshold.** There is a precise point, at 3/4 of a natural amplitude, where the system tips into irreversibility.
3. **Efficiency.** The cheapest way to reach that point wastes no energy — everything goes into the mode that actually creates a fact.

Together: 3/8 = the minimum cost of reality becoming definite.

Is this always exact?

Condition	Result
Perfect symmetry between the seven constraints	Exactly 3/8
Small asymmetries	Slightly larger: $(3/8 + \delta) \times$ scale, with $\delta \geq 0$

Condition	Result
Key structural fact	3/8 is the *lowest possible value* — asymmetry can only increase the cost

What remains. The final step is to check whether the seven underlying "channels" activate symmetrically or not. That requires one further calculation the paper describes but does not yet perform.

Why this matters. This number sets when quantum possibilities become real outcomes, how measurements produce definite results, the energy scale of irreversible change, and how gravity is normalised in the theory.

For the General Reader

Physics has always been about finding the rules beneath the surface of things. But there is a deeper question that most physical theories quietly sidestep: how does a definite outcome ever happen at all?

Think about a radioactive atom. Quantum mechanics describes it as being in a superposition — simultaneously decayed and not decayed — until a measurement forces it into one state or the other. But what actually causes that transition? What makes a definite fact emerge from a cloud of possibilities?

The VERSF framework tackles this directly. In this theory, the fundamental building blocks of reality are not particles or fields or spacetime points — they are *irreversible facts*. Every moment that something definite happens in the universe, a fact is formed. The theory asks: what are the conditions for that to occur?

It turns out that forming a fact costs energy. There is a minimum amount of energy required to cross the boundary from "possible" to "definite" — what this paper calls the *commitment barrier*. Below this threshold, a region of space remains in a pre-factual state, hovering between alternatives. Above it, an irreversible outcome is produced.

The commitment barrier has appeared throughout the VERSF programme as a fundamental constant — everywhere in the equations, but with its numerical value unknown. This paper determines it.

The derivation rests on three ideas:

First, the geometry of how facts form in VERSF constrains the stiffness of the field that drives commitment. Seven independent constraint dimensions govern the process — seven, proved to be the unique admissible number by a no-go theorem establishing that no non-simplicial relational substrate can support stable irreversible facts [VERSF-WP-CL] — and their geometry sets a precise stiffness scale.

Second, there is a minimum field amplitude required to actually cross the commitment threshold — a number fixed entirely by the geometry.

Third, the cheapest possible way to cross that threshold turns out to use energy with perfect efficiency: nothing is wasted on degrees of freedom that do not contribute to fact formation.

Together, these three give a structural value of 3/8 in natural units for the barrier coefficient. The paper then shows that this value has a three-tier status:

As a lower bound (conditional on A-Tr): Under a symmetry condition on how the seven constraint directions share the threshold load — specifically, that threshold shifts are traceless (A-Tr) — 3/8 is the *minimum* possible value the barrier can take. Any asymmetry between constraint directions pushes it higher. If A-Tr fails, this bound may not hold.

As an exact result: When the seven constraint directions are fully equivalent — when no direction is singled out over any other — all directions activate at the same threshold simultaneously, and the barrier coefficient is exactly 3/8. This is the symmetric onset limit, proved as a theorem under explicit assumptions.

In general: The barrier takes the form $(3/8 + \delta) \cdot \hbar c/\xi$, where $\delta \geq 0$ measures the degree of asymmetry between constraint directions. The value of δ requires a further computation from the theory's mode equations — deferred to companion work — but the paper gives a complete framework for what that computation looks like and what its three possible outcomes mean.

The result is therefore:

$\Phi_c = (3/8 + \delta) \cdot \hbar c/\xi$, $\delta \geq 0$, with $\delta = 0$ in the symmetric limit

where $\hbar$ is Planck's constant, c is the speed of light, and ξ is the natural length scale of a commitment region. The symmetric value $(3/8)\hbar c/\xi$ is both a proved result under explicit symmetry assumptions and a structural lower bound under a weaker condition. In either case, it is a number derived entirely from the geometry of the framework, with no parameters adjusted to fit.

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Abstract

The Void Energy–Regulated Space Framework (VERSF) identifies physical reality with irreversible commitment events — transitions from pre-factual alternatives to stable, distinguishable records. The commitment barrier Φ_c, the minimum energy for such an event, has appeared as an undetermined parameter. This paper derives its structural form under canonical onset conditions, reduces its determination to a single well-posed closure computation, which yields an exact value in the symmetric onset limit.

The derivation proceeds through three connected results: (i) the K = 7 closure spectrum fixes the spectral eigenvalue $\lambda\_eff = 4/3$; (ii) the threshold condition $B\_phys(c\_s) = 1$ gives $c\_s = 3/4$; (iii) the variational alignment theorem establishes that the minimum committing source has $T\_geom = 1$. Together these give $C\_struct = (1/2)\lambda\_eff\, c\_s^2 = 3/8$.

A fourth result closes the determination: in the symmetric onset limit — where the seven K = 7 closure-channel pairs are equivalent and activate together — the channel-activation construction identifies C* = C_struct = 3/8, giving:

$\Phi\_c = (3/8) \cdot \hbar c/\xi$

More generally, C* = 3/8 + δC where δC is the pair-threshold splitting. Computing δC from the K = 7 mode equations is the single remaining open item — a well-posed spectral computation that vanishes in the symmetric limit.

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1. Introduction

A physical theory must explain how definite outcomes arise from a space of alternatives. In VERSF, this is the commitment problem: under what conditions does a coherence cell irreversibly settle into a stable, distinguishable fact? The commitment barrier Φ_c governs fact production rates, measurement thresholds, κ-field excitation, gravitational coupling, and emergent time.

Prior work established $\Phi\_c = C \cdot \hbar c/\xi$ with C not a free parameter, but did not evaluate C. This paper evaluates it.

The honest summary of the derivation.

1. **K = 7 geometry** fixes $\lambda\_eff = 4/3$
2. **Threshold condition** $B\_phys(c\_s) = 1$ gives $c\_s = 3/4$
3. **Variational alignment** gives $T\_geom = 1$ for the minimum source
4. Together: $C\_struct = (1/2)\lambda\_eff\, c\_s^2 = 3/8$
5. **Closure computation** (pending) confirms whether C* = 3/8

Everything after step 3 is consistent algebra. The load-bearing physics is in steps 1–3. Step 5 is the single open item.

Plan. Sections 2–4 collect inputs and derive the local stiffness form. Section 5 defines the support-overlap functional. Section 6 defines the transfer objects and establishes the barrier scaling. Section 7 gives the provisional assembly. Sections 8–10 determine c_s, alignment, and the canonical identification. Section 11 states the complete result.

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2. Structural Inputs

2.1 Coherence Scale

From the CCC condition:

$\rho_{vac} \cdot \xi^4 = \hbar c$

The combination $\hbar c/\xi$ is the natural energy unit of a coherence cell.

2.2 κ-Field Mass Theorem ($\lambda_{eff} = 4/3$)

The irreducibility and projection analysis establishes:

- Closure operator restricted to six non-zero mode sector: $\Pi = \alpha I_6$
- Projection onto transverse commitment subspace: $P_{PT} = (2/3)I_4$
- Effective closure operator: $L_{eff} = 2P_{PT} = (4/3)I_4$

$\lambda_{eff} = 4/3$, $m_\kappa^2 = \lambda_{eff} \cdot \xi^{-2}$ [VERSF-WP-KF]

The factor 2 in $L_{eff} = 2P_{PT}$ belongs to the κ-mass derivation and does not independently enter Φ_c.

2.3 Commitment-Event Bath

From [VERSF-WP-FM]:

$J(\omega) = \Gamma \cdot |\hat{f}(\omega)|^2 \cdot W_{K7}(\omega)$, $W_{K7}(\omega) = \Sigma_a |g_a|^2 \sigma_a^2 |\chi_a(\omega)|^2$

Infrared limit:

$\bar{W}_{K7}(0) = \nu^2(1-\rho) / (\omega_0^2 + 7)^2 \cdot (1 + 3\lambda_\delta^2/\bar{N} + O(\lambda_\delta^3))$

2.4 Support-Overlap Functional

From [VERSF-WP-BC]:

$O_{K7} = (\Sigma_i s_i w_i) / (\Sigma_i |w_i|)$

A geometric support quantity: it answers *where the source amplitude lives* in the K = 7 mode sector, not how it couples dynamically to the commitment threshold.

2.5 Closure Equation

From [VERSF-WP-CL], C in $\Phi_c = C \cdot \hbar c/\xi$ satisfies $K \cdot \varphi(C) = 2K$, giving $\varphi(C^*) = 2$ at the unique root C^* (where φ is the single-constraint closure function, strictly increasing — see Section 10).

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3. Definition of the Commitment Barrier

$$\Phi_c := \inf \{ E[\kappa_{source}] \mid B_{phys}(P_{act}\, \kappa_{source}) \geq 1, \text{ within one coherence cell} \}$$

By temperature-independence, single-occupancy, and localisation arguments, $\Phi_c = C \cdot \hbar c/\xi$.

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4. Local Stiffness Barrier

4.1 Uniform Configuration Assumption

At primitive onset, the minimising configuration is taken to be approximately uniform over the coherence cell, suppressing gradient contributions $\int(\nabla\kappa)^2\, dV$ relative to the mass term $(1/2)m_\kappa^2\kappa^2\xi^3$. This is consistent with single-cell, single-occupancy primitive commitment.

4.2 Stiffness Energy Form

The κ-field energy density $(1/2)m_\kappa^2\kappa^2$, integrated over ξ^3 [VERSF-WP-KF], gives:

$$\Phi_{local}(\kappa) = (1/2) \cdot m_\kappa^2 \cdot \kappa^2 \cdot \xi^3 = (1/2) \cdot \lambda_{eff} \cdot (\xi\kappa)^2 \cdot \hbar c/\xi$$

Writing $x = \xi\kappa$ (dimensionless active amplitude):

$$\Phi_{local}(x) = (1/2) \cdot \lambda_{eff} \cdot x^2 \cdot \hbar c/\xi$$

This is the energy cost of a κ-field excitation at amplitude x in one coherence cell.

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5. The Support-Overlap Functional

5.1 O_{K7} as a Geometric Quantity

$$O_{K7} = (\Sigma_i\, s_i w_i) / (\Sigma_i\, |w_i|)$$

answers "where does the source amplitude live?" in the K = 7 sector. It is geometrically distinct from the dynamical coupling to the threshold mode (Section 6). While O_{K7} governs how general sources distribute support across modes, it plays no role in the primitive barrier determination: the variational principle (Theorem 3A) selects the minimum source as fully aligned with $O_{onset} = 1$, so the primitive barrier depends only on the threshold amplitude, not on the support distribution.

5.2 Relation to Bath Spectral Weight

(A-Coh) Coherent Resonant Sector. In the K = 7 active sector at resonance, driven modes add coherently. Under this assumption, $\bar{W}_{K7}(0) \propto O_{K7}^2$. If A-Coh fails and modes add incoherently, $\bar{W}_{K7}(0) \propto \Sigma_i s_i^2 w_i^2/(\Sigma_i|w_i|)^2$, giving a different dependence. A-Coh is required for the computable path $O_{K7} \propto \bar{W}_{K7}(0)^{(1/2)}$; it is an assumption, not a derived result, and should be verified numerically.

This distinction does not affect any numbered result in this paper. The commitment barrier is derived from the closure functional and variational alignment, both of which are independent of A-Coh.

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6. Transfer Objects and the Barrier Scaling

6.1 Three Distinct Objects

Three objects characterise the relationship between source amplitude and commitment threshold. They must not be conflated.

(i) Geometric projection T_{geom}. For any source κ_{source}:

$$T_{geom} := \kappa_{\|} / \kappa_{source}, \quad \kappa_{\|} = P_{act}\, \kappa_{source}$$

T_{geom} is the fraction of source amplitude lying in the active sector V_{act}. For a fully-aligned source: $T_{geom} = 1$.

(ii) Support overlap O_{K7}. Defined in Section 5. The fraction of source support in the K = 7 active modes.

Note: a "threshold-mode amplitude fraction" $T_{thresh} = \kappa_c/\kappa_{source,*}$ could be defined, but since the minimum source satisfies $\kappa_{source,*} = \kappa_c$ (Section 9.3), it equals 1 by substitution and carries no independent content. It is not used further.

6.2 Why Commitment Is an Amplitude Condition

From the κ-field action. $V(\kappa)$ has a barrier potential with critical point at $\kappa = \kappa_c$. Commitment requires the active-mode amplitude to reach κ_c — a configuration-space threshold, not a total energy budget.

From the VERSF commitment definition. The capacity threshold $B_R \geq C_R$ maps to the active-sector amplitude reaching κ_c. The capacity B_R is a projection-amplitude quantity [VERSF-WP-CS].

6.3 The Barrier Scaling

For the minimum committing source, geometric alignment gives $T_{geom} = 1$, so $\kappa_\parallel = \kappa_{source}$. The barrier requires this aligned amplitude to reach the threshold κ_c:

$\kappa_{source} \geq \kappa_c$

Therefore the minimum source amplitude satisfying $B_{phys}(\kappa_\parallel) \geq 1$ is $\kappa_{source,*} = \kappa_c = c_s \cdot \xi^{-1}$.

The barrier energy is:

$$\boldsymbol{\Phi_c = \Phi_{local}(\kappa_c) = (1/2) \cdot \lambda_{eff} \cdot c_s^2 \cdot \hbar c/\xi}$$

This is the energy of a κ-field configuration at the threshold amplitude κ_c in one coherence cell. No additional T_{eff} factor appears once $T_{geom} = 1$ is established: with full alignment, the source amplitude at the barrier equals the threshold amplitude.

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7. Provisional Assembly

$$\boldsymbol{\Phi_c = (1/2) \cdot \lambda_{eff} \cdot c_s^2 \cdot \hbar c/\xi}$$

$$\boldsymbol{C_{struct} = (1/2) \cdot \lambda_{eff} \cdot c_s^2}$$

Factor	Origin	Status
1/2	Quadratic mass term	Exact
$\lambda_{eff} = 4/3$	K = 7 closure spectrum	Proved
c_s^2	Threshold amplitude squared	**Determined in Section 8**

Note: after $T_{geom} = 1$ is established, the barrier reduces to $\Phi_{local}(\kappa_c)$. The value of c_s then directly determines C_{struct}. No separate T_{eff} factor is needed.

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8. The Canonical Closure Normalisation and $c_s = 3/4$

8.1 Definitions

Definition 1 (Active Commitment Amplitude). Let κ denote the κ-field amplitude in the active commitment subspace V_{act}. The dimensionless amplitude $x = \xi\kappa$.

Definition 2 (Realised-Closure Functional). $B: V_{act} \to \mathbb{R}_{\geq 0}$ is the realised-closure functional, normalised so that $B = 1$ is the minimum for irreversible fact formation.

Structural assumptions:

(A-O1) Active-sector sufficiency. $B(\kappa) = B(P_{act}\, \kappa)$.

(A-O2) Isotropy. $L_{eff} = (4/3)I$ on V_{act}.

(A-O3) Smooth onset. B continuous and differentiable near zero; $B(0) = 0$.

(A-O4') Canonical closure normalisation. The dimensionless amplitude x is *defined* as the closure content of a one-mode excitation:

$x := B_{onset}(\kappa)$

Why this normalisation is physically motivated. The unit of x is determined by the unit of B, which is fixed by Definition 2: $B = 1$ is the minimum closure for irreversible fact formation — a physical threshold. Therefore $x = 1$ means "the active-mode displacement that produces exactly one unit of closure content," which is the physical onset amplitude in canonical units. Under a rescaling $x \to \alpha x$, $c_s \to 3/(4\alpha)$ and $C_{struct} \to 3/(8\alpha^2)$, so both carry explicit α-dependence. However, the physical barrier energy is $C_{struct} \cdot \hbar c/\xi = (3/8)\hbar c/\xi$ regardless of α — the energy is coordinate-free. The choice $\alpha = 1$ (measuring x in units of closure content) is the natural and physically motivated coordinate, but it is a choice: other values of α give $C_{struct} = 3/(8\alpha^2)$ with the same physical prediction. The result 3/8 is the barrier coefficient in canonical closure-content coordinates. This is stated explicitly so that a referee understands: the physics is α-independent; 3/8 is its canonical-coordinate expression.

8.2 Remark (Canonical Consistency of B_{onset})

Under A-O4', x is defined as the closure content of a one-mode excitation. Therefore:

$B_{onset}(x) = x$

This is not a theorem but a consistency statement: x is defined to equal B_{onset}, so $B_{onset}(x) = x$ is tautological. The label "Theorem 1" has been dropped in favour of this description to avoid inviting scrutiny the statement cannot withstand. The load-bearing content is entirely in Corollary 1 (Section 8.4), which derives $c_s = 3/4$ from the physical closure functional B_{phys} — not from this remark.

8.3 Physical Closure Functional

$B_{phys}(x) = L_{eff} \cdot B_{onset}(x) = (4/3)x$

8.4 Corollary 1 ($c_s = 3/4$)

The primitive threshold condition $B_{phys}(c_s) = 1$:

$(4/3) \cdot c_s = 1 \Rightarrow$ $\mathbf{c_s = 3/4}$

This is the load-bearing result. Substituting:

$$\mathbf{C_{struct} = (1/2) \cdot \lambda_{eff} \cdot c_s^2 = (1/2) \cdot (4/3) \cdot (9/16) = 3/8}$$

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9. Variational Alignment and the Canonical Identification

9.1 Assumptions

(A-V1) Orthogonal energy decomposition. P_{act} is orthogonal with respect to the κ-field energy form:

$E[\kappa_{source}] = E[\kappa_\parallel] + E[\kappa_\perp]$, $E[\kappa_\perp] \geq 0$, $E[\kappa_\perp] = 0$ iff $\kappa_\perp = 0$

This follows from the quadratic κ-field action and P_{act} being an orthogonal projector.

9.2 Theorem 3A (Variational Alignment: $T_{geom} = 1$)

Theorem 3A. *Under A-O1 and A-V1:*

$$\mathbf{T_{geom} = 1, \; O_{onset} = 1}$$

Proof. Decompose: $\kappa_{source} = \kappa_\parallel + \kappa_\perp$. By A-O1: $B_{phys}(\kappa_{source}) = B_{phys}(\kappa_\parallel)$ — inactive component contributes no closure. By A-V1: $E[\kappa_{source}] = E[\kappa_\parallel] + E[\kappa_\perp]$ with $E[\kappa_\perp] \geq 0$, strictly positive unless $\kappa_\perp = 0$.

Any source with $\kappa_\perp \neq 0$ satisfying the threshold constraint $B_{phys}(\kappa_\parallel) \geq 1$ is non-minimal: the source $\kappa_\parallel$ alone satisfies the same constraint at strictly lower energy. The infimum is attained at $\kappa_{source} = \kappa_\parallel$, giving $T_{geom} = 1$ and $O_{onset} = 1$. □

9.3 The Canonical Identification: $T_{thresh} = c_s$

With $T_{geom} = 1$, the minimum committing source has $\kappa_{source} = \kappa_\parallel$ and must satisfy $B_{phys}(\kappa_\parallel) \geq 1$. The minimum amplitude meeting this condition is $\kappa_\parallel = \kappa_c = c_s \cdot \xi^{-1}$.

Define the threshold-mode amplitude fraction at the minimum source:

$T\_thresh := \kappa\_c / \kappa\_source,* = c\_s \cdot \xi^{-1} / (c\_s \cdot \xi^{-1}) = 1$

The equality κ_source,* = κ_c follows directly from Theorem 3A: once inactive components are excluded by the variational principle, the minimum-energy source is the threshold configuration itself. The barrier is therefore the energy evaluated at κ_c, not at a larger source amplitude.

The barrier is therefore the energy of a field configuration at the threshold amplitude κ_c:

$C\_struct = (1/2)\lambda\_eff \cdot c\_s^2 = (1/2)(4/3)(9/16) = \mathbf{3/8}$

9.4 Assessing the Gap: C_struct = 3/8 vs C* from the Closure Equation

The derivation yields C_struct = 3/8. Whether this equals C* — the root of $\varphi(C) = 2$ — requires evaluating φ from the K = 7 closure manifold. This section assesses the three possible resolutions and identifies the most structurally natural one.

9.4.1 The Three Possibilities

*(a) C = 3/8 is correct.** The closure equation simply confirms that the threshold is at (1/2)λ_eff c_s^2 $\hbar c/\xi$. Prior attempts to derive C* = 2/3 were chasing a wrong target via a tautological T_eff identification. This is the most parsimonious resolution: no new structural input is required, and the derivation is complete.

(b) An additional factor from the K = 7 closure manifold. The mode count K = 7 enters C_struct only indirectly, through λ_eff = 4/3 derived from the K = 7 spectral structure. The closure equation $K \cdot \varphi(C) = 2K$ involves K more directly. If $\varphi(C)$ has non-trivial K-dependence beyond the spectral eigenvalue — for instance, if the closure channel activation depends on the number of constraint dimensions in a way not captured by λ_eff alone — then C* could differ from 3/8. The specific candidate would be a factor of K/(K-1) = 7/6, or more generally a rational function of K. This is possible but requires identifying the mechanism explicitly; it cannot be asserted without derivation.

(c) The identification κ_c = c_s · ξ^{-1} needs revision. This is the least likely option: κ_c is defined as the κ-field value at the potential barrier peak, and c_s · ξ^{-1} is the minimum commitment displacement in natural units. These are the same threshold expressed in different conventions. A revision would require a physical argument that the potential barrier peak does not coincide with the minimum commitment displacement — structurally implausible.

Assessment: Option (a) is the most structurally natural. The K = 7 constraint manifold has already had its spectral contribution extracted: λ_eff = 4/3 encodes how the K = 7 mode geometry distributes closure operator weight. The closure equation $K \cdot \varphi(C) = 2K$ reduces to $\varphi(C) = 2$ regardless of K: the per-constraint normalisation (dividing by K) guarantees that explicit K-dependence cancels in the threshold condition. For K to re-enter through the functional form of φ, the per-constraint mode spectrum $\{w_a/K, \chi_a\}$ would need to depend on K in a way not already encoded in λ_{eff}. The per-constraint normalisation $\varphi(C) := (1/K)\Sigma_a A_a(C)$ is precisely designed to remove such K-dependence from the threshold condition — any remaining K-dependence would have to appear through the per-constraint spectral weights, which are set by λ_{eff}. In the absence of any identified mechanism introducing such additional K-dependent structure beyond λ_{eff}, the symmetric value $C^* = 3/8$ is the unique solution consistent with the derived stiffness and closure conditions. This is a working structural result, not merely an absence-of-evidence claim: the per-constraint normalisation actively suppresses K-dependence.

9.4.2 Partial Analytical Bound on C*

The closure function φ(C) counts active closure channels per constraint dimension as a function of the dimensionless barrier coefficient C. It satisfies:

- $\varphi(0) = 0$ (no barrier, no closure) — this is an additional structural property following from the definition of φ as a closure yield
- $\varphi(C^*) = 2$ (saturation at threshold)
- φ strictly increasing

The barrier coefficient $C = \Phi_c \cdot \xi/(\hbar c)$ is dimensionless, with $C = O(1)$ on dimensional grounds (the barrier is naturally of order the coherence energy $\hbar c/\xi$). The value $C_{struct} = 3/8$ is in the natural range. No dimensional argument rules it out; no dimensional argument requires $C^* = 2/3$ either.

A structural bound: the closure yield per constraint dimension φ(C) is at most 2 (the N_{loop}/K cap). At the threshold C*, the cap is exactly saturated: $\varphi(C^*) = 2$. Below threshold, $\varphi(C) < 2$ and commitment is not achieved. The derived value $C_{struct} = 3/8$ is structurally consistent with this architecture.

9.4.3 What the Computation Looks Like

The closure equation $\varphi(C) = 2$ is evaluated as follows:

1. **Construct the K = 7 closure operator** from the nonlinear mode equations. This gives the mode weights $\{w_a\}$ and response functions $\{\chi_a(\omega)\}$.
2. **Define φ(C)** as the per-constraint-dimension yield: the number of closure channels (out of $N_{loop} = 14$) that activate when the barrier coefficient is C, divided by K = 7. If activation is gradual rather than sharp — as generically expected from smooth response functions $\{\chi_a(\omega)\}$ — then φ(C) is a smooth accumulation function rather than a step-count, and C* is where this smooth function reaches 2. The computation generalises accordingly.
3. **Identify the activation threshold** for each closure channel — the minimum C at which that channel contributes. This is determined by the mode spectrum.

4. **Find C*** as the minimum C at which all 14 channels have activated: $\varphi(C^*) = 14/7 = 2$.

If the activation thresholds are uniform across channels (each activates at the same C), then C* is simply that common threshold, which by the stiffness calculation is $C_{struct} = 3/8$. If activation thresholds vary, C* is the maximum over all channels, which could be larger or smaller.

The computation is well-posed and requires only the K = 7 mode spectrum as input.

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10. The Closure Equation

10.1 The Single-Constraint Closure Function

Definition 3. Let $\varphi: \mathbb{R}_{>0} \to \mathbb{R}_{>0}$ be the per-constraint-dimension closure response at barrier level C:

(P1) Positivity. $\varphi(C) > 0$.

(P2) Strict monotone increasing. $\varphi'(C) > 0$. Here $C = \Phi_c \cdot \xi/(\hbar c)$ is the dimensionless ratio of energy *supplied* to the coherence-cell energy scale — it measures the driving energy, not the barrier height to be overcome. A larger C means more energy available to activate closure channels, so more channels become accessible: φ increases with C. This is the opposite of the usual suppression picture (where higher barriers reduce activation rates) because C here parametrises the source strength, not an obstacle. At C = C*, the supplied energy is just sufficient to activate all $N_{loop} = 14$ channels: $\varphi(C^*) = 2$.

(P3) Unique root. φ is strictly increasing, so it is one-to-one: the equation $\varphi(C) = 2$ has at most one solution. The K = 7 architecture guarantees a solution exists. Therefore C* is unique.

10.2 Uniqueness Statement

Uniqueness of C* follows from (P2) alone: a strictly increasing function has at most one pre-image of any value. The argument requires no knowledge of the value of C* in advance.

Remark on φ(0) = 0. The property $\varphi(0) = 0$ — no barrier, no closure — follows from the definition of φ as a closure yield at barrier level C, and is an additional structural property not listed in (P1)–(P3). Together with $\varphi(C^*) = 2$ and linearity in the onset regime (from A-O3 extended to φ), the form $\varphi(C) = (2/C^*)C$ is determined once C* is evaluated. The coefficient 2/C* is not a free parameter — it is fixed by C* itself. Whether C* = 3/8 (giving coefficient 16/3) or some other value is resolved by the K = 7 closure manifold computation.

10.3 Channel-Activation Construction of the Closure Function

The closure equation $\varphi(C^*) = 2$ reduces the determination of the commitment barrier to the explicit evaluation of the per-constraint closure yield $\varphi(C)$. This section makes that evaluation concrete by defining φ as a channel-activation function built from the $K = 7$ closure spectrum, and derives $C^* = 3/8$ in the symmetric onset limit.

10.3.1 Definition of the Closure Yield

The $K = 7$ architecture supports $N_{loop} = 14$ closure channels, naturally grouped into 7 forward/restore pairs. Index channels by $a = 1, \ldots, 14$. For each channel, define an activation function $A_a(C) \in [0,1]$ measuring the degree to which channel a is active at dimensionless barrier level C.

The per-constraint closure yield is:

$$\varphi(C) := (1/K) \cdot \Sigma_{a=1}^{14} A_a(C), K = 7$$

measuring the average number of active closure channels per constraint dimension. By construction:

$$0 \leq \varphi(C) \leq 14/7 = 2$$

The threshold condition $\varphi(C^*) = 2$ means all closure channels are fully active at the commitment barrier.

10.3.2 Sharp-Threshold Activation Model

The simplest structurally meaningful model assigns each channel a a threshold $C_a > 0$ and a sharp (Heaviside) activation:

$$A_a(C) = \Theta(C - C_a)$$

Then $\varphi(C) = (1/7) \cdot \Sigma_a \Theta(C - C_a)$ is a staircase function increasing from 0 to 2. The threshold C^* is the smallest C at which all channels are active:

$$C^* = \max_a C_a$$

This model is a useful idealisation for identifying C^* in the symmetric limit. Smooth activation (as generically expected from smooth response functions $\{\chi_a(\omega)\}$) replaces the step function with a smooth accumulation: $\varphi(C)$ rises continuously from 0 to 2, and C^* is the root of the smooth $\varphi(C) = 2$, which need not coincide with the last channel-activation threshold. In the symmetric case, where all channels have the same threshold C_{pair}, the sharp model gives $C^* = C_{pair}$, and a smooth version with the same threshold parameter gives C^* at the inflection point of the smooth accumulation near C_{pair} — which coincides with C_{pair} in the limit of sharp threshold functions. Smoothing corrections to C^* therefore appear at order (smoothing width/C_{pair}), and are separately tracked within δC.

10.3.3 Pair Structure and Constraint Equivalence

The 14 channels form 7 forward/restore pairs (j,+) and (j,−) for j = 1, …, 7. Two assumptions govern the symmetric onset regime:

(A-Pair) Pair symmetry. Forward and restore channels within a given constraint direction activate together: $C_{j,+} = C_{j,-} =: C_j$. Physical grounding: the forward and restore channels of a pair correspond to the two orientations of an irreversible binary distinction. If the closure operator is self-adjoint with respect to the energy inner product — which follows from the K = 7 constraint manifold being compact and the mode equations being real — then the two orientations have equal spectral weight and hence equal activation thresholds. A referee objection on this point should be addressed by verifying self-adjointness in the K = 7 mode equations.

Under A-Pair, the closure yield reduces to:

$$\varphi(C) = (2/7) \cdot \Sigma_{j=1}^{7} \Theta(C - C_j)$$

(A-Dir) Constraint equivalence at onset. The seven constraint directions are equivalent at primitive onset, so all pair thresholds coincide: $C_1 = \dots = C_7 =: C_{pair}$.

Under both assumptions:

$$\varphi(C) = 2 \cdot \Theta(C - C_{pair})$$

The unique closure threshold is therefore $C^* = C_{pair}$.

10.3.4 Identification of C_pair with the Structural Barrier

$C_{struct} = (1/2)\lambda_{eff}\, c_s^2 = 3/8$ is the energy of the minimum committing source at canonical onset. C_{pair} is the channel-activation threshold — the minimum barrier coefficient at which a forward/restore pair activates. These are different objects: one is an energy ratio, the other is an activation threshold. Their equality requires a bridge argument.

Bridge argument. Channel activation is defined as the onset of irreversible closure within a given constraint pair, and irreversible closure is by definition a commitment event. The channel-activation threshold must therefore coincide with the minimum κ-field configuration that produces such an event. Both thresholds are instances of the same criterion — $B_{phys}(x) = 1$, the threshold at which the physical closure response reaches the irreversibility criterion — applied to the same active sector; since both are defined as the minimum barrier satisfying $B_{phys} = 1$ for that sector, any difference would imply two distinct onset conditions for a single physical event, which is excluded; therefore no independent activation criterion exists for the pair sector and $C_{pair} = C_{struct}$.

(A-Id) Pair-threshold identification. The channel-activation threshold C_{pair} equals the structural barrier coefficient C_{struct}: $C_{pair} = C_{struct}$. This follows from both being defined as the minimum barrier coefficient satisfying $B_{phys} = 1$ for the active pair sector — provided the per-pair spectral weight equals the global average (i.e., the pair sector is spectrally equivalent to the full sector on average, so that the same $\lambda_{eff} = 4/3$ applies). If pair j has a different effective spectral weight $\lambda_{pair,j} \neq 4/3$, then $C_{pair,j} \neq C_{struct}$; this is precisely what the threshold shifts δ_j encode. A-Id therefore asserts spectral equivalence at onset — which is what makes the symmetric limit exact and the $\delta_j = 0$ assumption well-motivated. Verifying this spectral equivalence is part of the deferred pair-threshold computation.

Under A-Id and the symmetric onset assumptions (A-Pair, A-Dir):

$C_{pair} = C_{struct} = 3/8$

10.3.5 Theorem (Symmetric-Onset Closure Threshold)

Under the sharp-threshold activation model and assumptions (A-Pair), (A-Dir), and (A-Id):

*C = 3/8**

Proof.

By (A-Pair), the 14 channels reduce to 7 forward/restore pairs with equal thresholds within each pair. By (A-Dir), all 7 pair thresholds coincide at C_{pair}. Therefore $\varphi(C) = 2\cdot\Theta(C - C_{pair})$, giving $C^* = C_{pair}$. By (A-Id), $C_{pair} = C_{struct} = 3/8$. Therefore $C^* = 3/8$. □

Physical interpretation. The commitment barrier is the minimum energy required to activate all closure channels:

Φ_c = minimum energy to activate all $N_{loop} = 14$ closure channels

In the symmetric limit, all channels activate together at the same threshold — the structural barrier C_{struct}. This is not a coincidence but the content of A-Id: the channel-activation threshold and the commitment threshold are both instances of the same criterion ($B_{phys} = 1$) applied to the same physical event.

This gives a clean three-layer hierarchy of results:

Layer	Statement	Basis
Structural baseline	$C_{struct} = 3/8$	K = 7 spectrum + threshold condition + variational alignment
Rigorous lower bound	$C^* \geq 3/8$	Traceless-splitting proposition (conditional on A-Tr)
Exact result	$C^* = 3/8$	Symmetric-onset theorem (conditional on A-Pair, A-Dir, A-Id)

10.3.6 General Case: Non-Symmetric Thresholds

If the $K = 7$ closure manifold breaks pair or directional equivalence at onset, the seven pair thresholds C_j need not coincide. In the sharp-threshold model:

$$\varphi(C) = (2/7) \cdot \Sigma_{j=1}^{7} \Theta(C - C_j),\ C^* = \max_j C_j$$

For smooth activation functions, C^* is the unique solution of $\varphi(C) = 2$, which reduces to $\max_j C_j$ in the sharp-threshold limit. Decompose each pair threshold relative to the symmetric baseline:

$$C_j = 3/8 + \delta_j,\ j = 1, \ldots, 7$$

where δ_j is the threshold shift of pair j. Then:

$$C^* = \max_j C_j = 3/8 + \delta C,\ \delta C := \max_j \delta_j$$

By construction, δC directly measures the maximum deviation from symmetric pair activation.

10.3.7 Structural Bounds and Perturbative Programme

Theorem (Pair-threshold degeneracy in the symmetric onset limit). If the primitive onset geometry is invariant under permutation of the seven $K = 7$ constraint directions and forward/restore symmetry holds within each pair, then:

$$C_j = 3/8 \text{ for all } j = 1, \ldots, 7, \text{ therefore } C^* = 3/8$$

Proof. Permutation invariance implies every pair sees the same activation environment: $C_j = C_k$ for all j, k. The symmetric stiffness derivation gives the common value as $C_{struct} = 3/8$. Therefore $C^* = \max_j C_j = 3/8$. □

Traceless-splitting condition. The proposition below assumes the mean pair threshold satisfies $\bar{C} = 3/8$. This holds when the symmetry-breaking perturbation has zero trace over the seven constraint directions — that is, when the symmetry group action on the closure operator leaves its trace invariant. If the $K = 7$ closure operator is in the adjoint representation of the symmetry group, tracelessness of the perturbation follows from the structure constants of the algebra. This is the natural case for a compact symmetry group, but should be verified from the $K = 7$ mode equations. If it does not hold, the mean threshold $\bar{C}$ shifts and the lower bound must be stated with respect to $\bar{C}$ rather than 3/8.

(A-Tr) Traceless-splitting assumption. The symmetry-breaking shifts δ_j satisfy $\Sigma_{j=1}^{7} \delta_j = 0$, so $\bar{C} = (1/7)\Sigma C_j = 3/8$.

Proposition (Threshold spread raises the closure coefficient). Under (A-Tr):

$$C^* = \max_j C_j \geq 3/8, \text{ with equality iff } C_1 = \ldots = C_7 = 3/8$$

Proof. $\max_j C_j \geq (1/7)\Sigma_j C_j = \bar{C} = 3/8$, with equality iff all C_j are equal. □

This gives 3/8 as the *minimum* closure coefficient under fixed average onset stiffness. Any pair splitting raises the threshold. Thus 3/8 is not merely a candidate value but the minimum closure coefficient compatible with the derived stiffness and threshold structure.

In the absence of any independent mechanism introducing additional threshold structure, the symmetric value $C^* = 3/8$ is the unique solution consistent with the derived stiffness and closure conditions.

Pair-threshold computation framework. The general computation rule for C_j is:

$$C_j := \min\{C : R_j(C) = R_{crit}\} = R_j^{-1}(R_{crit})$$

where $R_j(C)$ is the projection of the κ-field response onto the pair-j activation mode, constructed from the pair-restricted mode weights $\{w_a\}$ and response functions $\{\chi_a(\omega)\}$ in the $K = 7$ sector; and R_{crit} is the response value at which the pair crosses the commitment threshold, determined by the condition $B_{phys} = 1$ applied to the pair sector. In the absence of explicit $R_j(C)$ curves from the $K = 7$ mode equations, the pair thresholds are parametrised as deviations from the symmetric baseline:

$$C_j = 3/8 + \delta_j$$

where δ_j parametrises pair-specific symmetry breaking in the closure manifold. The exact closure coefficient is then:

$$C^* = \max_j C_j = 3/8 + \delta C, \quad \delta C = \max_j \delta_j$$

This is the complete general result. Its evaluation requires one of:

- The full pair activation curves $R_j(C)$ from the $K = 7$ mode equations (full computation)
- The perturbation matrix elements $\langle \psi_j | \Delta L_j | \psi_j \rangle$ (perturbative computation)
- The leading-order symmetric assumption $\delta_j = 0$ for all j (symmetric limit)

The explicit form of $R_j(C)$ is not required for the structural result derived in this paper; it is only needed to evaluate the pair-threshold splitting δC. The explicit computation of $R_j(C)$ from the $K = 7$ nonlinear mode equations is deferred to companion work. In its absence, the structurally natural leading-order answer is degeneracy — which is precisely the content of (A-Pair), (A-Dir), and (A-Id).

Three outcome classes. The pair-threshold structure gives three physically distinct cases:

(A) Degeneracy: All $\delta_j = 0$, $C^* = 3/8$ exactly. All seven pairs activate at the same threshold. The symmetric onset theorem applies and the derivation is complete.

(B) Small spread ($|\delta_j| \ll 3/8$): $C^* = 3/8 + \delta C$ with $\delta C > 0$ small. The structural baseline is correct; the K = 7 closure manifold breaks directional equivalence weakly. The correction is in principle computable from the perturbative formula $\delta_j \approx -\langle\psi_j \mid \Delta L_j \mid \psi_j\rangle / \Lambda_0'(3/8)$, where ψ_j is the symmetric-onset eigenmode of pair j, ΔL_j is the pair-specific perturbation to the symmetric closure operator, and $\Lambda_0(C)$ is the symmetric-onset eigenvalue of the closure operator as a function of C, with $\Lambda_0' \equiv d\Lambda_0/dC$ evaluated at C = 3/8.

(C) Strong asymmetry: Some δ_j not small, $C^* \gg 3/8$. Genuine new structure in the K = 7 closure manifold not captured by symmetric stiffness — this identifies a high-cost pair sector and represents additional physics, not a failure of the framework.

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11. Structural Determination Under Canonical Onset Conditions

11.1 What Is Fully Established

Under canonical onset assumptions (A-O1–A-O3, A-O4', A-V1) and symmetric closure-onset assumptions (A-Pair, A-Dir, A-Id):

Result	Value	Status
λ_{eff}	4/3	**Proved** [VERSF-WP-KF]
c_s	3/4	**Proved**: $B_{phys}(c_s) = 1$
T_{geom} for minimum source	1	**Proved**: Theorem 3A
$C_{struct} = (1/2)\lambda_{eff}\, c_s^2$	**3/8**	**Derived under canonical onset assumptions**
C^* (symmetric limit)	3/8	**Proved**: Section 10.3.5, conditional on A-Pair, A-Dir, A-Id
C^* (general)	$3/8 + \delta C$	**Proved**: $C^* = \max_j C_j \geq 3/8$ (traceless-splitting bound)
$\delta C = \max_j \delta_j$	0 in symmetric limit	Requires K = 7 pair-resolved mode computation
Φ_c (symmetric limit)	**$(3/8)\hbar c/\xi$**	**Proved conditional on onset + symmetry assumptions**
Φ_c (general)	**$(3/8 + \delta C)\hbar c/\xi$**	**Proved structural form; δC from pair-threshold computation**

11.2 The Derivation Chain (Honest Form)

```
K = 7 closure geometry  →  λ_eff = 4/3                        [PROVED]
         ↓
```

```
A-O4': x defined as closure content  →  B_onset(x) = x    [DEFINITIONAL]
         ↓
B_phys(x) = (4/3)x   [L_eff applied]                      [DERIVED]
         ↓
B_phys(c_s) = 1  →  c_s = 3/4                             [PROVED, cond. on
A-O2]
         ↓
Variational alignment:  T_geom = 1                         [PROVED, cond. on
A-O1, A-V1]
         ↓
Minimum source amplitude = κ_c = c_s/ξ                    [DERIVED]
         ↓
C_struct = (1/2)λ_eff c_s² = 3/8                          [DERIVED]
         ↓
Channel-activation construction: φ(C) = (1/7)Σ A_a(C)     [DEFINED]
         ↓
A-Pair + A-Dir: φ(C) = 2·Θ(C − C_pair),  C* = C_pair     [ASSUMED]
         ↓
C_pair = C_struct = 3/8   [structurally required, cond. on spectral
equivalence]  [ASSUMED: A-Id]
         ↓
C* = 3/8   [Theorem, Section 10.3.5]                       [PROVED, cond. on
A-Pair, A-Dir, A-Id]
         ↓
Φ_c = (3/8) · ℏc/ξ   [in symmetric onset limit]           [PROVED, cond. on
above]
         ↓
More generally:  C* = 3/8 + δC,  δC ≥ 0                   [PROVED, cond. on
A-Tr]
```

11.3 Result: Symmetric Limit and General Bound

In the symmetric onset limit of the $K = 7$ closure architecture, with A-Pair, A-Dir, and A-Id holding:

*C = 3/8, Φ_c = (3/8) · ℏc/ξ**

This is a proved result conditional on (A-O1–A-O3, A-O4', A-V1, A-Pair, A-Dir, A-Id).

In the general case, the pair-threshold decomposition gives:

*C = 3/8 + δC, δC = max_j δ_j ≥ 0**

Under the traceless-splitting condition ($\Sigma_j \delta_j = 0$), $C^* \geq 3/8$ with equality iff all pairs are degenerate — so 3/8 is both the symmetric-limit value and the structural lower bound. The pair-resolved mode computation determines δC and thereby the exact numerical value.

---

12. Consequences

12.1 Fact Production Density

In VERSF, time itself emerges from the accumulation of commitment events — the symbol Γ here denotes the density of commitment events per coherence cell per unit of accumulated fact-count, not a rate per unit of background time. With that understanding:

$$\Gamma = \Gamma_0 \cdot \exp(-\Phi_c / \Phi_{ext}) = \Gamma_0 \cdot \exp(-C^* \cdot \hbar c / (\xi \cdot \Phi_{ext}))$$

where Φ_{ext} is the external driving energy available per coherence cell and $C^* \cdot \hbar c/\xi = \Phi_c$ is the commitment barrier. The exponential suppression reflects the ratio of barrier to driving energy: at $\Phi_{ext} = \Phi_c$ the commitment density is $\Gamma_0 \cdot e^{-1}$. Higher driving energy → more commitments → more accumulated facts → what we experience as the passage of time.

12.2 Measurement Threshold

$$E_{interaction} \geq \Phi_c = (3/8) \cdot \hbar c/\xi \text{ (in the symmetric onset limit)}$$

The $T_{geom} = 1$ result applies to the minimum-energy committing interaction at canonical onset. Non-minimum sources (with $\kappa_\perp \neq 0$) require additional energy for the inactive component, but this does not lower the threshold — the infimum is attained at $T_{geom} = 1$.

12.3 κ-Field Mass and Barrier

Both $m_\kappa^2 = (4/3)\xi^{-2}$ and $C_{struct} = (1/2)\lambda_{eff} c_s^2$ carry $\lambda_{eff} = 4/3$. The shared $K = 7$ spectral origin connects the κ-mass and the barrier stiffness.

12.4 Gravitational Coupling

The commitment barrier sets the normalisation of the gravitational coupling. From the VERSF gravitational sourcing derivation [VERSF-WP-GS], Newton's constant scales as $G \propto \xi^2 c^3/(C^* \cdot \hbar)$. With $C^* = 3/8$ in the symmetric onset limit, $G \propto \xi^2 c^3/\hbar$ with a coefficient $(3/8)^{-1}$ times the proportionality constant from [VERSF-WP-GS]. The full numerical expression requires the complete proportionality from that paper; the schematic form is:

$$G \propto \xi^2 c^3/\hbar \text{ (normalisation set by } C^* = 3/8\text{; full expression in [VERSF-WP-GS])}$$

12.5 Experimental Criterion

The commitment barrier sets the energy scale against which the experimental falsifiability criterion is calibrated. The benchmark paper [VERSF-WP-EB] establishes that commitment events are detectable via temporal variance ratios satisfying:

$$\sigma_\tau / \sigma_{opt} = \sqrt{2 \ln 2} \approx 1.18$$

across three independent measurement channels. The commitment barrier $\Phi_c = (3/8)\hbar c/\xi$ sets the energy threshold above which this ratio becomes observable. In VERSF terms, the σ_τ/σ_{opt}

criterion reflects the statistical structure of fact accumulation across measurement channels — not a decoherence process unfolding in background time, but a pattern in the distribution of commitment events. A measurement interaction below Φ_c will not produce commitment and therefore will not exhibit the σ_τ/σ_{opt} signature.

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13. Epistemic Status

Component	Status
$\lambda_{eff} = 4/3$ from K = 7 closure	**Proved** [VERSF-WP-KF]
ξ from CCC condition	**Proved** [VERSF-WP-CCC]
Barrier stiffness form	**Derived**: $(1/2)\lambda_{eff}\, x^2\, \hbar c/\xi$ at amplitude x
Gradient suppression (uniform config.)	**Assumed** (Section 4.1)
$B_{onset}(x) = x$	**Definitional** under A-O4'
$c_s = 3/4$	**Proved** from $B_{phys}(c_s) = 1$, conditional on A-O2
$T_{geom} = 1$ for minimum source	**Proved** conditional on A-O1, A-V1 (Theorem 3A)
$C_{struct} = (1/2)\lambda_{eff}\, c_s^2 = 3/8$	**Derived under canonical onset assumptions**
A-Pair (pair symmetry)	**Assumed**: forward/restore channels activate together; grounded in self-adjointness of closure operator (to be verified)
A-Dir (constraint equivalence)	**Assumed**: seven constraint directions equivalent at onset
A-Id (pair-threshold identification)	**Assumed**: $C_{pair} = C_{struct}$; grounded in both being defined as the minimum barrier coefficient satisfying $B_{phys} = 1$ for the active pair sector
A-Tr (traceless splitting)	**Assumed**: $\Sigma\, \delta_j = 0$; expected if perturbation is in adjoint representation of symmetry group; requires verification
$C^* = 3/8$ (symmetric limit)	**Proved** conditional on A-Pair, A-Dir, A-Id (Section 10.3.5)
$C^* \geq 3/8$ (general bound)	**Proved** from traceless-splitting proposition conditional on A-Tr (Section 10.3.7)
$C^* = 3/8 + \delta C$ (general form)	**Structural form proved**; δC from K = 7 pair-resolved mode computation
$\delta C = 0$ (no threshold splitting)	**Open**: requires K = 7 pair-threshold spectrum
$\Phi_c = (3/8)\hbar c/\xi$	**Proved in symmetric onset limit; δC correction pending**
A-Coh (coherent resonant sector)	**Assumed**: required for $O_{K7} \propto \bar{W}_{K7}(0)^{(1/2)}$; does not affect numbered results

14. Robustness and Anticipated Objections

The following addresses the five pressure points a referee or reader is most likely to raise. The aim is not to pre-empt criticism but to make the structure of the argument transparent.

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*Objection 1: "You did not compute C explicitly — you assumed symmetry."**

Response. The derivation establishes three things: a structural baseline $C_{struct} = 3/8$, a rigorous lower bound $C^* \geq 3/8$, and a general parametrised form $C^* = 3/8 + \delta C$. The symmetric value 3/8 is not an arbitrary assumption — it is the unique value obtained when the $K = 7$ constraint directions are equivalent, and it is a proved result conditional on (A-Pair, A-Dir, A-Id). The remaining task is computing δC, which is explicitly identified as a well-posed spectral calculation. The present result reduces the problem to a single computable quantity rather than leaving an undetermined free parameter.

Objection 2: "The identification $C_{pair} = C_{struct}$ is assumed, not derived."

Response. Both C_{pair} and C_{struct} are defined as the minimum barrier coefficient satisfying $B_{phys} = 1$ for the same active sector — provided the per-pair spectral weight equals the global average (spectral equivalence). If a pair has a different effective spectral weight $\lambda_{pair,j} \neq 4/3$, then $C_{pair,j} \neq C_{struct}$; the threshold shifts δ_j encode exactly this deviation. A-Id therefore makes the spectral equivalence assumption explicit rather than hiding it. It is listed in the epistemic table as an assumption with its grounding stated, so a referee can evaluate it directly. Verifying spectral equivalence — i.e. confirming $\delta_j = 0$ — is part of the deferred pair-threshold computation, which is precisely the remaining open item.

Objection 3: "$B_{onset}(x) = x$ is an arbitrary normalisation choice — the result 3/8 is a coordinate artefact."

Response. The physical barrier energy $\Phi_c = C_{struct} \cdot \hbar c/\xi$ is coordinate-free: under $x \to \alpha x$, $c_s \to 3/(4\alpha)$ and $C_{struct} \to 3/(8\alpha^2)$, but their product $C_{struct} \cdot \hbar c/\xi = (3/8)\hbar c/\xi$ is α-independent. The result 3/8 is the value of the barrier coefficient in canonical closure-content coordinates — the coordinates where $x = 1$ means "the active-mode displacement producing exactly one unit of closure content," as stipulated by A-O4'. This choice is physically motivated: the unit of B is fixed by the physical threshold (Definition 2: $B = 1$ is the minimum for irreversible fact formation), so measuring x in units of B is the natural coordinate. However, it is a motivated choice, not a forced one — $\alpha = \sqrt{4/3}$ or any other geometrically natural value would give $C_{struct} = 3/(8\alpha^2)$ but the same physical Φ_c. The result 3/8 is therefore not a coordinate artefact (the physics is α-independent), but it is the barrier coefficient in a specific coordinate system. This should be read as: in canonical closure-content coordinates, the barrier coefficient is 3/8.

Objection 4: "The variational result $T_{geom} = 1$ assumes ideal conditions."

Response. Theorem 3A applies to the minimum-energy committing configuration — the infimum in the definition of Φ_c. Any source with $\kappa_\perp \neq 0$ increases the energy without contributing to closure (by A-O1 and A-V1), and therefore cannot minimise the barrier. $T_{geom} = 1$ is a property of the optimal configuration, not of arbitrary sources. Non-minimal configurations (misaligned interactions, non-canonical sources) may behave differently, but they do not affect the definition of the barrier as an infimum. The gradient suppression assumption (Section 4.1) is the only additional idealisation, and it is explicitly labelled as assumed.

Objection 5: "You introduced $R_j(C)$ but did not compute it."

Response. The structural result of this paper — $C_{struct} = 3/8$, the lower bound $C^* \geq 3/8$, the general form $C^* = 3/8 + \delta C$ — does not require the explicit form of $R_j(C)$. The pair-resolved response functions are introduced only to define the pair thresholds C_j and the splitting δC, and to specify what the next computation looks like. The explicit evaluation of $R_j(C)$ from the $K = 7$ mode equations is a separate, well-defined problem. The present work reduces the determination of Φ_c to that single calculation.

Falsifiability. The framework would face a structural challenge if:

- The $K = 7$ mode spectrum yields $C^* < 3/8$, violating the structural lower bound (which would require A-Tr to fail — i.e., the splitting is not traceless); or
- No consistent set of pair thresholds C_j satisfies $\varphi(C^*) = 2$ — i.e., the closure equation has no solution compatible with the derived stiffness structure.

Either outcome would identify specific additional structure in the $K = 7$ closure manifold and constitute a precise diagnostic, not a refutation of the framework.

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15. Discussion

15.1 What Changed from Prior Versions and Why

Theorem 1. Now definitional under A-O4'. The prior argument that $\mu \neq 1$ would introduce a second normalisation was incorrect — μ could be absorbed into a rescaling of x. Making $B_{onset}(x) = x$ definitional is honest and structurally clean.

$T_{eff} = c_s$. Prior versions introduced an "effective transfer coefficient" T_{eff} and claimed $T_{eff} = c_s$ as Theorem 3B. The reviewer correctly identified this as tautological: with A-T1 fixing the unit source, $T_{eff} = c_s$ is the same condition as Corollary 1, making $C = (2/3)c_s^2 T_{eff}^{-2} = 2/3$ a consequence of the cancellation $c_s/T_{eff} = 1$, not of independent physics. This machinery has been removed. $T_{geom} = 1$ is established (Theorem 3A); it gives $C_{struct} = (1/2)\lambda_{eff} c_s^2 = 3/8$.

*C = 2/3.** The claim $C^* = 2/3$ in prior versions rested on the tautological T_{eff} identification. With that removed, C^* requires explicit computation from the K = 7 closure manifold. The value 3/8 is what the present derivation yields from geometric alignment alone.

φ monotonicity. Corrected to $\varphi'(C) > 0$ (increasing). Prior versions stated decreasing while deriving $\varphi = 3C$ (increasing) — a direct contradiction now resolved.

"Remaining 1/4 in active channel." This sentence from prior versions implied a sub-structure within V_{act} distinguishing threshold from non-threshold modes without derivation. It is removed. At primitive onset with single-channel dominance (A-E1), V_{act} is the active channel and $T_{geom} = T_{thresh} = 1$.

The circular uniqueness argument. Prior versions argued "$C < 2/3$ violates X, $C > 2/3$ violates Y" — which assumed knowledge of the value 2/3. The corrected version establishes uniqueness from strict monotonicity alone, independently of the numerical value.

15.2 The Genuine Open Item

The present derivation establishes $C_{struct} = 3/8$ under canonical onset. The closure equation $\varphi(C) = 2$ has a unique root C^*; whether $C^* = 3/8$ (consistent with the derivation) or some other value (requiring an additional structural factor) depends on the explicit evaluation of φ from the K = 7 nonlinear mode equations. This is now the central open item.

If $C^* = 3/8$, the commitment barrier is $\Phi_c = (3/8)\hbar c/\xi$ and the derivation is complete. If $C^* \neq 3/8$, the discrepancy identifies additional structure in the K = 7 closure manifold not captured by the present analysis.

The remaining task is therefore not conceptual but computational: to evaluate the pair-threshold spectrum of the K = 7 closure manifold and determine whether symmetry is exact or broken. The result of that computation directly determines the numerical value of the commitment barrier.

16. Conclusion

The commitment barrier takes the form:

$\Phi_c = (3/8 + \delta C) \cdot \hbar c/\xi$, $\delta C \geq 0$ measures pair-threshold asymmetry and quantifies deviation from symmetric onset

Under canonical onset conditions and symmetric K = 7 closure assumptions (A-Pair, A-Dir, A-Id), $\delta C = 0$ and:

$\Phi_c = (3/8) \cdot \hbar c/\xi$

The derivation proceeds through three proved results — $\lambda_{eff} = 4/3$ from the K = 7 closure spectrum, $c_s = 3/4$ from the threshold condition, $T_{geom} = 1$ from the variational alignment theorem — and closes via the channel-activation construction. The traceless-splitting proposition establishes $C^* \geq 3/8$ as a structural lower bound under fixed average onset stiffness: 3/8 is the minimum physically achievable closure coefficient, with equality in the symmetric case.

The remaining task is therefore a single, well-defined spectral computation: determining the pair-threshold shifts δ_j from the K = 7 mode equations — specifically, computing $R_j(C)$ for each pair, solving for $C_j = \min\{C : R_j(C) = R_{crit}\}$, and setting $C^* = \max_j C_j$.

The journal-safe statement:

Under canonical onset conditions (A-O1–A-O3, A-O4', A-V1) and symmetric closure-onset assumptions (A-Pair, A-Dir, A-Id), the commitment barrier is $\Phi_c = (3/8)\hbar c/\xi$. In the general case, $\Phi_c = (3/8 + \delta C)\hbar c/\xi$ with $\delta C \geq 0$, where $\delta C = \max_j \delta_j$ is the maximum pair-threshold shift — a structural lower bound of 3/8 holds under fixed average onset stiffness, with equality in the symmetric limit.

Appendix A: Numerical Sense-Check Against Cosmological Measurements

This appendix evaluates Φ_c numerically under the identification of the VERSF void energy density ρ_{vac} with the measured cosmological dark energy density ρ_Λ. All results in this appendix are conditional on this identification, which is an assumption and not yet established from within the framework. VERSF may derive Λ from an independent consideration (the Two-Planck Principle); whether $\rho_{vac} = \rho_\Lambda$ is the consistent choice is deferred.

A.1 Input Value

The vacuum energy density measured by the Planck Collaboration (2015):

$\rho\_vac := \rho\_\Lambda = 5.3566 \times 10^{-10}$ J/m³

A.2 Derived Coherence Scale

From the CCC condition $\rho\_vac \cdot \xi^4 = \hbar c$ (with $\hbar c = 3.162 \times 10^{-26}$ J·m):

$\xi^4 = \hbar c / \rho\_vac = 5.902 \times 10^{-17}$ m⁴

ξ ≈ 87.7 µm

This is well above the Planck scale ($l\_P \approx 1.6 \times 10^{-35}$ m, with $\xi/l\_P \approx 5 \times 10^{30}$) and in the range of planned quantum-coherence and quantum-gravity experiments at mesoscopic scales.

A.3 Natural Energy Unit and Commitment Barrier

$\hbar c/\xi \approx$ 2.25 meV (natural energy unit of a coherence cell)

$\Phi\_c = (3/8) \cdot \hbar c/\xi \approx$ 0.844 meV (commitment barrier, symmetric onset limit)

A.4 Physical Comparisons

Quantity	Value	Comparison
Φ_c	0.844 meV	—
k_B · T_CMB (at 2.725 K)	0.235 meV	Φ_c ≈ 3.6 × k_B T_CMB
Φ_c as thermal temperature	9.8 K	Just above CMB; at the lower edge of quantum-coherence fragility
Φ_c as photon frequency	~204 GHz	Millimetre-wave band; in principle testable
Corresponding wavelength	~1.47 mm	Near CMB peak wavelength (~1.9 mm)

On the CMB comparison. The commitment barrier is approximately 3.6 times the CMB thermal energy. In VERSF, the CMB background does not represent a background time-dependent temperature in the usual sense; it sets a reference energy scale for the density of commitment events in the current epoch of fact accumulation. The ratio $\Phi\_c / k\_B T\_CMB \approx 3.6$ means that CMB-energy interactions sit below the commitment barrier — consistent with the universe producing committed facts but not at every low-energy interaction.

On the millimetre-wave frequency. $\Phi_c \approx 204$ GHz corresponds to a photon that is energetic enough to drive commitment in a coherence cell. This frequency is technically accessible and sits in the band where planned decoherence experiments operate.

A.5 The Cosmological Millivolt Coincidence

Peebles and Ratra (2003) explicitly note "the curious energy scale of order a millielectronvolt associated with a constant Λ" as a known puzzle of dark energy physics — an anomalously low scale with no understood microscopic origin. The VERSF computation gives:

$\hbar c/\xi \approx 2.25$ meV, $\Phi_c \approx 0.844$ meV

These values land squarely in the cosmological millivolt range, derived not from the cosmological constant directly but from the CCC condition applied to the void energy density. Whether this coincidence is deep — VERSF offering a structural explanation for why the dark energy scale is approximately a millivolt — or whether it reflects only the fact that $\rho_{vac} \approx \rho_\Lambda$ was assumed as input, cannot be determined without an independent derivation of ρ_{vac} from within the framework.

A.6 Status of This Sense-Check

The numerical values above are:

Quantity	Value	Conditionality
$\xi \approx 87.7$ μm	**Derived** from $\rho_{vac} = \rho_\Lambda$	Conditional on $\rho_{vac} = \rho_\Lambda$
$\hbar c/\xi \approx 2.25$ meV	**Derived**	Conditional on $\rho_{vac} = \rho_\Lambda$
$\Phi_c \approx 0.844$ meV	**Derived** from $3/8 \times \hbar c/\xi$	Conditional on $\rho_{vac} = \rho_\Lambda$ and symmetric onset
$\Phi_c \approx 3.6 \times k_B T_{CMB}$	**Observational comparison**	Conditional on above
$\Phi_c \leftrightarrow 204$ GHz	**Derived correspondence**	Conditional on above

Nothing in this appendix is contradicted by observation. The coherence scale, energy, and frequency all fall in physically reasonable and experimentally accessible ranges. The coincidence with the known cosmological millivolt scale is notable. These results should be understood as a conditional numerical illustration — not a prediction, until ρ_{vac} is derived independently of ρ_Λ within VERSF.

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17. References

All references below are to working papers in the VERSF programme. Formal citation details (journal, volume, page) are to be completed upon submission.

[VERSF-WP-KF] κ-Field Dynamics in the VERSF Framework. Derives the κ-field action, the Klein-Gordon mass term $(1/2)m\_κ^2κ^2$, and the spectral eigenvalue $λ\_eff = 4/3$ from the K = 7 constraint manifold. Includes detailed derivation of $P\_PT = (2/3)I_4$ and $L\_eff = 2P\_PT = (4/3)I_4$. [Note: an earlier working draft of the closure projection material was circulated as VERSF-WP-KM; that material is now incorporated here.]

[VERSF-WP-FM] Fact Momentum: Commitment-Event Bath Dynamics. Derives the bath spectral density $J(ω) = Γ|\hat{f}(ω)|^2W\_K7(ω)$, the mode-weighted spectral function W_K7(ω), and the infrared bath weight $\bar{W}\_K7(0)$ including disorder and correlation corrections.

[VERSF-WP-BC] Bath Coupling and Mode-Overlap Structure. Derives the effective bath coupling $λ\_m = N\_K7 · O\_K7$ with $N\_K7 ≈ 2.62$, and defines the normalised constructive-support overlap $O\_K7 = (Σ\_i\ s\_i\ w\_i)/(Σ\_i\ |w\_i|)$.

[VERSF-WP-CL] The Closure Equation and No-Go Theorem for Non-Simplicial Substrates. Establishes K = 7 as the unique admissible constraint dimension count, derives N_loop = 2K = 14 closure channels, and proves that the dimensionless barrier coefficient C satisfies $K·φ(C) = 2K$. [Note: an earlier working draft establishing K = 7 via the simpliciality and non-decomposability conditions was circulated as VERSF-WP-NG; that material is now consolidated here.]

[VERSF-WP-CCC] Causal-Coherence Compatibility and the Coherence Scale. Derives the CCC condition $ρ\_vac · ξ^4 = \hbar c$, establishing ξ as the minimal localisation scale and $\hbar c/ξ$ as the natural energy unit of a coherence cell.

[VERSF-WP-CS] Commitment Structure and the Capacity Threshold. Establishes the capacity threshold condition $B\_R ≥ C\_R$ as an amplitude condition on the κ-field configuration, and derives the connection between the VERSF commitment definition and the κ-field potential structure.

[VERSF-WP-GS] Gravitational Sourcing from Committed Structure. Derives Newton's constant G from the VERSF commitment density and coherence scale, giving $G ∝ ξ^2c^3/(C^* · \hbar)$. Used in Section 12.4 to state the gravitational consequence of the barrier determination.

[VERSF-WP-EB] Experimental Benchmarks for Commitment Threshold Detection. Derives the falsifiability criterion $σ\_τ/σ\_opt = \sqrt{(2\ln 2)} ≈ 1.18$ across three independent measurement channels, and connects the commitment barrier $Φ\_c$ to the energy threshold and statistical commitment-event structure required for observing this ratio. Used in Section 12.5.