

Equation of the Universe:

The Fabric and Lattice

Document Class: Tier 1 Foundational

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Version: Rev 3.47

Founded in December 2012

Current revision: September 2026

This document depends on

Equation of the Universe — Core Theory (Rev 3.46 or later)

§1.0 — Pre-Coherent Fabric

Before coherence, individual fabrics exist as independent oscillatory fabrics with their own amplitude, recurrence rate, and phase. At this stage there is no universal phase reference, no King Frequency, and no CPP identity.

independent fabrics → symmetric pair interaction → 4th-order phase selection
→ four stable phase families → shared recurrence → ν_K → CPP lattice

A pre-coherent fabric is represented as

$$\Psi_i(t) = A_i \sin(\omega_i t + \phi_i)$$

where

- A_i is the local amplitude,
- ω_i is the local recurrence rate,
- ϕ_i is the local phase.

Before coherence,

$$0 \leq \phi_i < 2\pi$$

and phase is continuous.

The initial fabric population is therefore not divided into predefined eigenstates. Coherent phase structure must arise from interaction between the fabrics rather than being imposed as an initial condition.

§1.1 — Intrinsic Fabric Response

The instantaneous oscillatory state of a pre-coherent fabric is represented by the signed response

$$S_i(t) \equiv \Psi_i(t) = A_i \sin \theta_i$$

where

$$\theta_i = \omega_i t + \phi_i.$$

The curvature response of the same fabric is represented by the sign-independent quantity

$$C_i \propto \Psi_i^2.$$

Therefore,

$$C(\Psi_i) = C(-\Psi_i).$$

The signed response retains phase direction, while the curvature response depends on oscillation magnitude and is unchanged by half-cycle phase reversal.

Because the fabric is an oscillator with a recurrence rate ω_i , the same scalar oscillation also possesses a normalized recurrence-rate response,

$$Q_i \equiv \frac{\Psi_i}{\omega_i}.$$

For

$$\Psi_i = A_i \sin \theta_i,$$

this gives

$$Q_i = A_i \cos \theta_i.$$

Thus the instantaneous state and normalized recurrence-rate response form a conjugate quadrature pair,

$$(\Psi_i, Q_i) = A_i(\sin \theta_i, \cos \theta_i).$$

The quantity Q_i is not a second field, a second fabric, or an independently assigned degree of freedom. It is the normalized rate response of the same scalar oscillation and therefore follows directly from the recurrence already present in the pre-coherent fabric.

The two quadratures are orthogonal over a full oscillation cycle and satisfy

$$\Psi_i^2 + Q_i^2 = A_i^2.$$

This quadrature-complete description provides the interaction variables used to determine whether relative phase preference can emerge without assigning discrete phase states in advance.

§1.2 — Symmetry of Fabric–Fabric Interaction

When two pre-coherent fabrics i and j interact, no universal phase reference yet exists. Their interaction can therefore depend only on relative oscillatory state rather than on either absolute phase individually.

Define the instantaneous relative phase

$$\delta_{ij}(t) = \theta_j - \theta_i$$

or, explicitly,

$$\delta_{ij}(t) = (\omega_j - \omega_i)t + \phi_j - \phi_i.$$

Using the conjugate responses (Ψ_i, Q_i) and (Ψ_j, Q_j) , define the normalized relative-alignment invariant

$$D_{ij} \equiv \frac{\Psi_i \Psi_j + Q_i Q_j}{A_i A_j}.$$

Substituting

$$\Psi = A \sin \theta, \quad Q = A \cos \theta,$$

gives

$$D_{ij} = \sin \theta_i \sin \theta_j + \cos \theta_i \cos \theta_j$$

and therefore

$$D_{ij} = \cos(\theta_j - \theta_i) = \cos \delta_{ij}.$$

Define the orthogonal mismatch invariant

$$M_{ij} \equiv \frac{\Psi_i Q_j - Q_i \Psi_j}{A_i A_j}.$$

Substitution gives

$$M_{ij} = \sin \theta_i \cos \theta_j - \cos \theta_i \sin \theta_j,$$

so, up to orientation sign convention,

$$M_{ij} = \sin \delta_{ij}.$$

The two relative invariants therefore satisfy

$$D_{ij}^2 + M_{ij}^2 = 1.$$

The interaction is also invariant under independent half-cycle reversal of either fabric,

$$\Psi_i \rightarrow -\Psi_i, \quad Q_i \rightarrow -Q_i,$$

or

$$\Psi_j \rightarrow -\Psi_j, \quad Q_j \rightarrow -Q_j.$$

Under either reversal,

$$D_{ij} \rightarrow -D_{ij}, \quad M_{ij} \rightarrow -M_{ij},$$

while

$$D_{ij}^2 \quad \text{and} \quad M_{ij}^2$$

remain unchanged.

The pre-coherent Fabric interaction therefore depends on the squared quadrature invariants rather than on the sign of either fabric alone.

The fundamental interaction property adopted here is quadrature degeneracy:

$$V_{ij} = G(D_{ij}^2) + G(M_{ij}^2),$$

where the same response function G applies to both conjugate relative quadratures.

This does not impose an exchange symmetry between two independently chosen variables. The equivalence follows from the fact that $\{D_{ij}\}$ and $\{M_{ij}\}$ are the two orthogonal relative responses generated by the same scalar oscillators.

§1.3 — Suppression of the Second Harmonic and Fourth-Order Phase Selection

To determine the first phase-dependent contribution, expand the common nonlinear interaction response as

$$G(x) = g_0 + g_1x + g_2x^2 + g_3x^3 + \dots$$

Then

$$V_{ij} = G(D_{ij}^2) + G(M_{ij}^2)$$

becomes

$$V_{ij} = 2g_0 + g_1(D_{ij}^2 + M_{ij}^2) + g_2(D_{ij}^4 + M_{ij}^4) + \dots$$

Because

$$D_{ij}^2 + M_{ij}^2 = 1,$$

the complete lowest-order contribution is

$$g_1(D_{ij}^2 + M_{ij}^2) = g_1,$$

which is independent of relative phase.

Therefore the second-harmonic phase-selection coefficient vanishes:

$$\boxed{a_2 = 0}.$$

No discrete phase state has been assumed in obtaining this result.

The first nonlinear phase-dependent contribution is

$$g_2(D_{ij}^4 + M_{ij}^4).$$

Using

$$D_{ij} = \cos \delta_{ij}, \quad M_{ij} = \sin \delta_{ij},$$

gives

$$D_{ij}^4 + M_{ij}^4 = \cos^4 \delta_{ij} + \sin^4 \delta_{ij}.$$

Using

$$\cos^4 \delta + \sin^4 \delta = \frac{34}{5} \frac{14}{\cos 4} \delta,$$

the phase-dependent part becomes

$$V_{\text{phase}} = \frac{g_2}{4} \cos(4\delta_{ij}),$$

apart from phase-independent constants.

For the pre-coherent Fabric, the nonlinear response is taken to be saturating, so the local response becomes less sensitive as either quadrature approaches its maximum magnitude. This requires the relevant nonlinear coefficient to be negative,

$$g_2 < 0.$$

Define

$$g_2 = -\kappa, \quad \kappa > 0.$$

Then, apart from an additive constant,

$$V_{\text{phase}} = \frac{\kappa}{4} [1 - \cos(4\delta_{ij})].$$

The stationary points satisfy

$$\frac{\partial V_{\text{phase}}}{\partial \delta_{ij}} = \kappa \sin(4\delta_{ij}) = 0.$$

The stable minima occur when

$$\cos(4\delta_{ij}) = 1,$$

so

$$4\delta_{ij} = 2\pi n.$$

Therefore,

$$\delta_{ij} = n \frac{\pi}{2}.$$

Within one full cycle, the stable relative phases are

$$\delta = 0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}.$$

The effective interaction therefore satisfies the required phase-selection condition

$$a_2 = 0, \quad a_4 \neq 0.$$

The four stable phase families arise from three Fabric properties:

1. scalar oscillatory recurrence;

2. equal coupling through the two conjugate quadratures of that oscillation;
3. a saturating nonlinear interaction response.

The four-family structure is therefore not assigned before coherence and is not obtained by inserting a fourth harmonic manually. It emerges because the quadrature-complete interaction removes the lower phase preference while retaining the first nonlinear phase-dependent term at fourth order.

§2 — Coherence and King Recurrence

As fabric interactions persist, compatible recurrence and phase relationships can reinforce while incompatible relationships weaken.

Coherence is reached when a common recurrence becomes stable across the interacting fabric population.

That common recurrence defines the King Frequency,

$$\nu_K.$$

The associated King period is

$$T_K = \frac{1}{\nu_K}.$$

The King Frequency is therefore not assigned to the pre-coherent fabrics. It emerges from their collective interaction and becomes the common recurrence reference for all later coherent structure.

§2.1 — Phase-Family Alignment

Once a common recurrence is established, the remaining distinction between coherent fabrics is their relative phase.

The interaction between coherent fabrics therefore becomes a function of phase difference,

$$\Delta\phi_{ij} = \phi_j - \phi_i.$$

Stable phase families occur at relative phases where the effective interaction is stationary and locally stable:

$$\frac{\partial V_{\text{eff}}}{\partial \Delta\phi} = 0$$

with

$$\frac{\partial^2 V_{\text{eff}}}{\partial (\Delta\phi)^2} > 0.$$

As recurrence differences decrease, the relative phase between interacting fabrics can settle into the stable states established by the fabric–fabric interaction:

$$\Delta\phi = 0, \quad \frac{\pi}{2}, \quad \pi, \quad \frac{3\pi}{2}.$$

These four phase families are the stable solutions of the fourth-order interaction derived in §1.3.

Once a common King recurrence is established, the four families become fixed phase offsets relative to that recurrence and form the four primordial CPP eigenstates.

Appendix A — Phase-Family Derivation Tests and Falsification Record

A.1 Purpose

The four primordial CPP phase families must arise from the physical properties of initially continuous pre-coherent fabrics. Their number and spacing cannot be introduced as initial conditions, imposed through phase binning, or recovered by selecting an interaction solely because it produces four solutions.

The required derivation condition is

$$a_2 = 0, \quad a_4 \neq 0$$

for the effective relative-phase interaction

$$V(\delta) = V_0 + a_2 \cos(2\delta) + a_4 \cos(4\delta) + \dots$$

This appendix records mechanisms examined during development, including those rejected. These rejected constructions define falsification boundaries on the accepted derivation.

This is the conjugate recurrence-rate quadrature of the same scalar fabric.

$$Q_i = \frac{\dot{\Psi}_i}{\omega_i} = A_i \cos \theta_i.$$

A.2 Independent Half-Cycle Reversal

The first tested symmetry was invariance under independent reversal of either scalar fabric,

$$I(\Psi_i, \Psi_j) = I(-\Psi_i, \Psi_j) = I(\Psi_i, -\Psi_j).$$

This symmetry eliminates interaction terms that depend on the sign of either fabric individually. It therefore removes first-harmonic phase preference.

It does not eliminate

$$\cos(2\delta).$$

A second-harmonic phase-selection term remains fully compatible with independent half-cycle reversal.

****Result: rejected as sufficient.****

Independent reversal is retained as a valid Fabric property, but it cannot explain four phase families.

A.3 Direct Fourth-Harmonic Assumption

An interaction of the form

$$V(\delta) \propto 1 - \cos(4\delta)$$

immediately generates four stable relative phases.

However, introducing this expression before deriving its harmonic content presupposes the required answer. It demonstrates what interaction would produce four phase families but does not explain why the lower allowed harmonic is absent.

****Result: rejected as a foundational derivation.****

The fourth harmonic may appear only after lower-order contributions have been removed by an independently established property of the interaction.

A.4 Alignment–Mismatch Exchange as an Assumed Symmetry

An earlier construction defined

$$D_{ij} \propto \cos \delta_{ij}, \quad M_{ij} \propto \sin \delta_{ij}$$

and imposed the exchange symmetry

$$D_{ij} \leftrightarrow M_{ij}.$$

This allowed the interaction

$$D_{ij}^2 M_{ij}^2$$

and therefore produced

$$D_{ij}^2 M_{ij}^2 = \frac{18}{[1 - \cos(4\delta_{ij})]}.$$

The mathematical result is valid, but the equality of alignment and mismatch was not independently established from the scalar Fabric definition.

****Result: rejected as an unexplained assumption.****

The later quadrature derivation recovers the required equivalence from the oscillator itself rather than imposing it.

A.5 Three-Fabric Symmetric Interaction

Three identical fabrics permit the fully symmetric second-harmonic interaction

$$V_2^{(3)} = a_2 \sum_{i < j} \cos[2(\phi_i - \phi_j)].$$

Permutation symmetry requires equal coefficients for identical pair interactions but does not require those coefficients to vanish.

Three-body phase invariants can also exist, including combinations of the form

$$2(\phi_i + \phi_j - 2\phi_k).$$

Such collective interactions demonstrate that genuine higher-order phase locking is possible, but they coexist with the symmetry-allowed pairwise second harmonic.

****Result: rejected as sufficient.****

Three-fabric interaction alone does not establish

$$a_2 = 0.$$

A.6 Four-Fabric Collective Interaction

Four fabrics permit genuine collective invariants such as

$$\cos[2(\phi_1 + \phi_2 - \phi_3 - \phi_4)].$$

For a reduced configuration consisting of two equal-phase pairs,

$$\phi_1 = \phi_2 = \alpha, \quad \phi_3 = \phi_4 = \beta,$$

this becomes

$$\cos[4(\alpha - \beta)].$$

A fourth harmonic can therefore arise naturally from an irreducible four-body interaction.

The same symmetry nevertheless continues to permit ordinary pair terms

$$\cos[2(\phi_i - \phi_j)].$$

****Result: retained as a possible higher-order collective interaction, but rejected as the origin of second-harmonic suppression.****

A.7 Four-Member Closure

For a four-member closed sequence having equal phase increment δ ,

$$4\delta = 2\pi n$$

gives

$$\delta = n \frac{\pi}{2}.$$

The construction correctly produces quarter-cycle spacing.

It does not independently establish why the primitive closure contains four members. An (N) -member closure would instead produce

$$\delta = \frac{2\pi n}{N}.$$

Using a four-member closure to derive four primordial states therefore relocates the assumption rather than eliminating it.

****Result: rejected as the origin of the four phase families.****

A.8 Permutation Symmetry

For N identical fabrics define

$$R_2 = \sum_{j=1}^N e^{2i\phi_j}.$$

Then

$$|R_2|^2 = N + 2 \sum_{i < j} \cos[2(\phi_i - \phi_j)].$$

The second-harmonic interaction is itself a fully permutation-symmetric collective invariant.

****Result: rejected as a cancellation mechanism.****

Permutation symmetry among identical fabrics does not imply

$$a_2 = 0.$$

A.9 Accepted Mechanism — Quadrature-Degenerate Nonlinear Coupling

A scalar oscillatory fabric

$$\Psi_i = A_i \sin \theta_i$$

possesses the normalized recurrence-rate response

$$Q_i = \frac{\dot{\Psi}_i}{\omega_i} = A_i \cos \theta_i.$$

The two quantities are conjugate quadratures of the same oscillator rather than independent fields.

For interacting fabrics define

$$D_{ij} = \frac{\Psi_i \Psi_j + Q_i Q_j}{A_i A_j} = \cos \delta_{ij}$$

and

$$M_{ij} = \frac{\Psi_i Q_j - Q_i \Psi_j}{A_i A_j} = \sin \delta_{ij}.$$

The Fabric interaction is quadrature-degenerate:

$$V_{ij} = G(D_{ij}^2) + G(M_{ij}^2).$$

Expanding the nonlinear response,

$$G(x) = g_0 + g_1 x + g_2 x^2 + \dots,$$

gives

$$V_{ij} = 2g_0 + g_1(D^2 + M^2) + g_2(D^4 + M^4) + \dots.$$

Because

$$D^2 + M^2 = 1,$$

the complete lowest-order term is independent of phase. Consequently,

$$a_2 = 0.$$

The next contribution is

$$D^4 + M^4 = \frac{34}{+ \cos(4\delta)} \frac{14}{+ \cos(4\delta)}.$$

For a saturating nonlinear response the local channel response is concave,

$$g_2 < 0.$$

Writing

$$g_2 = -\kappa, \quad \kappa > 0,$$

the phase-dependent interaction becomes, apart from a constant,

$$V_{\text{phase}} = \frac{\kappa}{4} [1 - \cos(4\delta)].$$

Its stable minima satisfy

$$\delta = 0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}.$$

The four phase families therefore follow from three Fabric properties:

1. scalar oscillatory recurrence;
2. equal coupling through its conjugate quadratures;
3. saturating nonlinear interaction response.

No CPP identity or discrete phase value is assumed before this result.

A.10 Empirical Precedent and Scope

Laboratory oscillator systems demonstrate that symmetry-related interaction channels can destructively suppress a lower harmonic while allowing a higher harmonic to remain. Higher-order phase locking among three or more oscillators has likewise been experimentally realized.

These observations establish that harmonic suppression through coherent interaction channels and collective phase locking are physically realizable behaviors.

They do not establish that the EOTU Fabric exists or that laboratory oscillators reproduce its microscopic dynamics. Their role is narrower: they demonstrate that the interaction behavior required by the Fabric derivation is physically admissible rather than mathematically unique to the EOTU construction.

A.11 Falsification Conditions

The primordial phase-family derivation fails if any of the following is established within the EOTU framework:

the normalized recurrence-rate quadrature ($Q_i = \Psi_i/\omega_i$) is not a physically participating Fabric response;

the two conjugate quadratures do not couple equivalently;

a nonconstant second-harmonic contribution survives the complete interaction;

the nonlinear interaction lacks a fourth-order contribution;

the stable fourth-order interaction does not support quarter-cycle relative phases;

an additional lower-order invariant compatible with all accepted Fabric properties is identified and cannot be canceled by the quadrature-complete interaction.

Accordingly, the four CPP phase families remain derived only while the interaction satisfies

$$[a_2 = 0, \quad a_4 \neq 0]$$

without insertion of a discrete phase structure as an initial condition. The derivation fails if a complete permitted Fabric interaction produces a nonzero second-harmonic phase-selection term that is not canceled by the quadrature-complete response.

The rejected mechanisms recorded in this appendix are retained deliberately. They identify routes that appear capable of producing the desired four-state result but fail to derive it under the required pre-coherent conditions. Their preservation provides a reproducible boundary between a derived phase structure and one imposed by construction.