Unification and Recursive Completion of Pattern Field Theory

Expanded Depth Series: Paper 16

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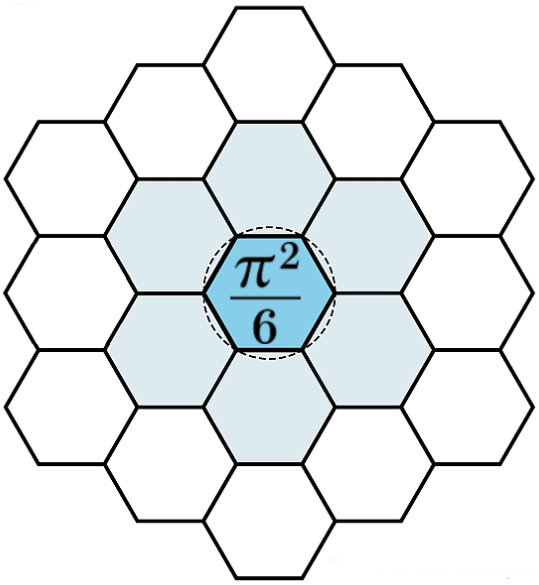

Abstract

This paper completes Pattern Field Theory by demonstrating recursive closure of its explanatory and mathematical structure. A single PAL-restricted transition operator is shown to generate all effective continuum laws of physics under projection and coarse-graining.

Quantum mechanics, quantum field theory, and general relativity are recovered as limiting descriptions without introducing new primitives. No additional ontological entities, force carriers, or temporal axioms are required. Completion is achieved through recursion, not termination.

$$\Psi_{n+1}(\omega') = \sum_{\omega \in \Omega} \mathbf{1}_{\mathrm{PAL}(\omega \to \omega')} \, e^{i\theta(\omega,\omega')} \, \Psi_n(\omega)$$

Figure 1: PAL-restricted transition operator generating all effective continuum limits.

All subsequent continuum equations arise as limits or projections of this operator.

1 Role of This Paper

This paper assumes the structural definitions of causality, correlation, and explanation established in Paper 15. No explanatory primitives are introduced here.

The sole purpose of this paper is derivational: to show that all known physical laws arise as effective descriptions of a single discrete transition structure operating under Phase Alignment Lock.

2 The Transition Operator as Fundamental Generator

Let Ω denote the space of admissible lattice configurations. The operator $\mathcal{T}$ defined above specifies admissible reconfiguration between elements of Ω.

It encodes:

- constraint compatibility via PAL,
- phase accumulation during validation,
- ordered reconfiguration without presupposed time,
- persistence without particle ontology.

No continuous dynamics is assumed. Continuity emerges only under coarse-grained interpretation.

3 Quantum Mechanical Limit

Assume near-identity transitions with small ordering parameter $\Delta\tau$, where τ is an ordering index rather than physical time:

$$\mathcal{T} = I - \frac{i}{\hbar} H \Delta\tau + O(\Delta\tau^2)$$

Applying the transition rule yields:

$$i\hbar \frac{\partial \psi}{\partial \tau} = H\psi$$

which is the Schrödinger equation. The Hamiltonian arises from local constraint adjacency and phase bias.

4 Path Integral Formulation

Iterated application of the transition operator generates a sum over admissible reconfiguration sequences:

This reproduces the Feynman path integral formulation without invoking classical trajectories.

$$\langle \omega_f \mid \mathcal{T}^N \mid \omega_i \rangle = \sum_{\{\omega_k\}} e^{i \sum_k \theta(\omega_k, \omega_{k+1})}$$

Figure 2: Iterated transition limit yielding the path-integral formulation as a sum over admissible reconfiguration sequences.

5 Quantum Field Theory Correspondence

Second quantization corresponds to lifting configuration space to occupation-number representations. Creation and annihilation operators encode allowed transitions between basin-stable configurations.

Propagators arise as projected correlation functions over repeated transition application. No mediating particles are fundamental.

6 Dimensional Lift and Emergent Spacetime

All constraint validation occurs on a two-dimensional adjacency structure. Three-dimensional space and time arise only after projection.

Sequential admissible reconfiguration is interpreted as motion; ordering is interpreted as time; depth resolution is interpreted as spatial extension.

No ontological transition from two to three dimensions occurs.

7 Gravitational Correspondence

Constraint density gradients under projection yield effective curvature. In the continuum correspondence limit:

$$G_{\mu\nu} \propto \mathcal{C}_{\mu\nu}$$

where $\mathcal{C}_{\mu\nu}$ represents projected constraint density. The proportionality indicates correspondence under coarse-graining, not identity at the discrete level. Einstein's field equations are thus recovered as effective descriptions of structural accessibility variation.

8 Recursive Completion

Pattern Field Theory is recursively complete:

- its primitives generate effective laws,
- those laws do not introduce new primitives,
- explanatory layers re-enter without contradiction.

No further axioms are required.

9 Closure

Pattern Field Theory is closed under recursion. All physical law emerges from constraint validation and projection. Further work refines resolution but does not extend ontology.

10 Document Timestamp and Provenance

All constructions and invariants derived here are treated as canonical for subsequent papers addressing coherons, stability, identity recurrence, chemistry, interaction, and experimental interpretation.