Coheron Interaction, Basin Capacity, and Emergent Periodicity

Expanded Depth Series: Paper 5

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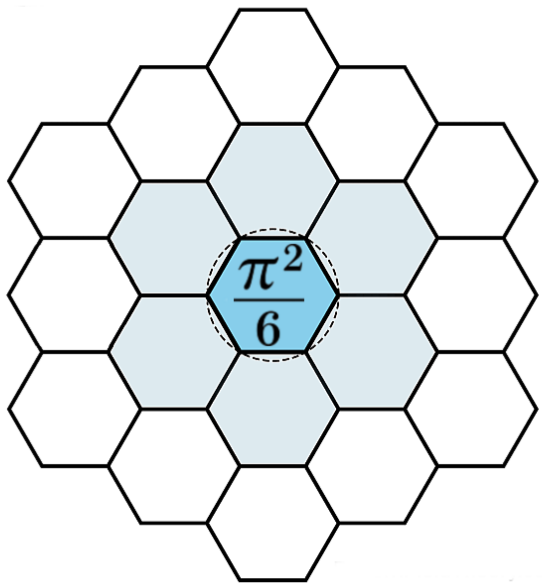

Abstract

This paper develops the interaction theory of coherons within Pattern Field Theory (PFT). Building on the Allen Orbital Lattice (AOL), coherons, and Phase Alignment Lock (PAL) established in earlier papers, we define interaction without particles, forces, exchange objects, or trajectories. Interaction is shown to arise solely from structural compatibility and constraint co-satisfaction.

We introduce the concept of basin capacity as a finite structural limit imposed by recurrence and lattice geometry. Basin saturation leads inevitably to instability and transition, producing discrete families of stable coheron configurations. From this mechanism, periodicity emerges as a necessary structural consequence rather than an imposed rule.

This framework explains the finiteness and structure of the periodic table, the existence of elemental families, and the emergence of chemical regularity without invoking electrons or particle exchange.

1 Orientation and Dependency

This paper is the fifth in the Expanded Depth Series of Pattern Field Theory. Its constructions depend explicitly on results established in the preceding papers.

Paper 1 established identity as ontologically prior to measurement and rejected observer-dependent foundations. Paper 2 constructed the Allen Orbital Lattice as a finite, recurrence-constrained structural substrate. Paper 3 defined coherons as the fundamental coherent identities supported on the lattice and introduced Phase Alignment Lock as the sole stability condition.

The present paper assumes these structures as fixed. No new primitives are introduced. Particles, forces, trajectories, and exchange mechanisms remain excluded from the foundational level.

The purpose of this paper is to explain how coherons coexist, constrain one another, and form structured families under finite lattice capacity. The emergence of periodicity is derived directly from these constraints.

2 Interaction Without Particles or Forces

In Pattern Field Theory, interaction does not occur through forces, fields, or particle exchange. Such mechanisms presuppose entities capable of transmission or mediation across space. No such entities exist at the foundational level.

Definition 1 (Structural Interaction)**.** *Interaction between coherons is the mutual constraint imposed by their simultaneous attempt to satisfy Phase Alignment Lock on a shared lattice structure.*

Each coheron occupies a set of constraint loops on the Allen Orbital Lattice. These loops enforce phase alignment across shells and recurrence paths. When multiple coherons are present, their constraint requirements may be compatible, incompatible, or partially compatible.

Interaction therefore arises not from action-at-a-distance, but from constraint co-satisfaction. A coheron does not act upon another coheron. Instead, the lattice either admits or rejects the combined constraint configuration.

This definition eliminates the need for interaction carriers, coupling constants, or dynamical equations. Stability is determined entirely by whether PAL can be maintained for all involved coherons under shared lattice constraints.

3 Coheron Compatibility and Mutual Stability

Not all coherons can coexist within the same basin of the Allen Orbital Lattice. Compatibility is a structural property determined by constraint geometry and phase alignment.

Definition 2 (Coheron Compatibility)**.** *Two coherons are compatible if and only if their combined constraint loops admit simultaneous Phase Alignment Lock on the shared lattice without phase drift.*

Compatibility admits three structural regimes:

- **Lock sharing:** Constraint loops reinforce one another, increasing stability.

- **Neutral coexistence:** Constraint loops remain disjoint and non-interfering.
- **Lock exclusion:** Constraint loops induce phase drift, preventing PAL.

Arbitrary fusion of coherons is structurally forbidden. Duplex curvature identities cannot merge unless their internal phase structure admits a higher-order locked configuration. This restriction replaces ad hoc exclusion principles with geometric necessity.

Proposition 1. *Mutual stability of coherons within a basin is possible if and only if all pairwise and higher-order PAL conditions are simultaneously satisfied.*

This proposition establishes that interaction limits arise from structural compatibility, not energetic competition. Stability is discrete, not continuous.

4 Basin Structure on the Allen Orbital Lattice

The Allen Orbital Lattice is not an unbounded homogeneous substrate. Its recurrence structure and shell geometry partition coherence-supporting regions into finite domains. These domains are referred to as basins.

Definition 3 (Basin)**.** *A basin is a maximal region of the Allen Orbital Lattice within which a finite set of coherons may simultaneously satisfy Phase Alignment Lock under shared recurrence constraints.*

Basins are not imposed externally. They arise naturally from lattice curvature, shell adjacency, and recurrence closure. Each basin possesses a characteristic topology determined by lattice depth, prime-index structure, and permissible constraint loop geometries.

Within a basin, coherons may coexist, interact, and form structured families. Across basin boundaries, PAL compatibility is generally lost due to changes in shell recurrence orientation and phase accumulation.

Basins therefore function as coherence domains. They define the maximal structural extent within which stable identity configurations may exist.

5 Basin Capacity and Saturation

Because each basin admits only a finite number of compatible constraint configurations, it possesses a finite capacity.

Definition 4 (Basin Capacity)**.** *The capacity of a basin is the maximum number of mutually compatible coherons that can be supported while maintaining Phase Alignment Lock across all required lattice paths.*

Capacity is not an energetic limit, nor is it probabilistic. It is a purely structural bound arising from:

- finite recurrence paths,
- discrete shell adjacency,
- phase compatibility constraints,

- exclusion enforced by duplex curvature geometry.

As coherons are added to a basin, the space of available PAL-compatible configurations shrinks. Constraint loops increasingly overlap, compete for phase coherence, or induce relative phase drift.

Proposition 2. *A basin reaches saturation when no additional coheron can be introduced without violating at least one Phase Alignment Lock condition.*

At saturation, the basin remains stable only for its existing coheron set. Further insertion attempts necessarily destabilize one or more identities. This establishes an absolute upper bound on stable coexistence.

6 Capacity-Induced Instability and Transition

When a basin reaches saturation, further structural evolution cannot occur through incremental addition. Instead, instability becomes inevitable.

Definition 5 (Capacity-Induced Instability)**.** *Capacity-induced instability is the loss of Phase Alignment Lock resulting from attempted overpopulation of a basin beyond its structural capacity.*

This instability does not manifest as explosive collapse or annihilation. Rather, it appears as progressive PAL failure, fragmentation of constraint loops, or forced reconfiguration of coheron identities.

When instability exceeds a critical threshold, a structural transition occurs. One or more coherons can no longer be supported within the original basin and must reconfigure into a new basin with different recurrence and shell constraints.

Lemma 1. *Basin transitions are discrete and non-continuous.*

There exists no smooth deformation from one saturated basin to another. Transitions correspond to topological reorganization of constraint support, not gradual adjustment. This discreteness is central to the emergence of structured families of stable configurations.

Capacity-induced transitions therefore provide the mechanism by which new coherence regimes arise while preserving global structural consistency.

7 Emergence of Periodicity

Periodicity in Pattern Field Theory is not imposed as an organizing principle. It arises necessarily from repeated cycles of basin filling, saturation, and transition on the Allen Orbital Lattice.

Definition 6 (Structural Periodicity)**.** *Structural periodicity is the recurrence of stable coheron configurations resulting from repeated basin capacity constraints under increasing lattice depth.*

As basins form and reach capacity, the set of admissible coheron configurations exhibits regularity. When a transition occurs to a new basin, the structural constraints governing compatibility are altered in a systematic manner determined by lattice geometry and recurrence orientation.

Because the Allen Orbital Lattice is constructed from discrete, repeatable structural rules, these transitions recur in patterned sequences. The same classes of compatibility reappear, though embedded at greater depth or under modified boundary conditions.

Periodicity therefore reflects the finite and recursive nature of coherence support, not a preordained ordering of identities.

8 Structural Origin of the Periodic Table

The periodic table emerges as a classification of stable coheron families distributed across successive basins.

Definition 7 (Coheron Family)**.** *A coheron family is a set of coheron configurations sharing structural compatibility properties within a basin or across corresponding basins.*

Each basin admits a finite set of stable families. Within a family, coherons exhibit similar interaction profiles, constraint geometries, and stability responses. These shared properties manifest observationally as chemical similarities.

The finite number of naturally occurring elements is a direct consequence of basin capacity. Once all structurally admissible basins are populated, no further stable coheron families can arise without altering the underlying lattice constraints.

Gaps, groupings, and cutoffs in the periodic table correspond to:

- inaccessible coherence configurations,
- premature basin saturation,
- incompatibility with existing constraint populations.

This explanation requires no electron shells, orbitals, or exchange mechanisms. Periodicity is structural, not dynamical.

9 Apparent Chemical Behavior Without Electrons

Chemical behavior traditionally attributed to electron sharing or transfer is reinterpreted in Pattern Field Theory as coheron compatibility and constraint reconfiguration.

Definition 8 (Structural Bonding)**.** *Structural bonding is the mutual stabilization of coherons through compatible constraint alignment within a shared or adjacent basin.*

What appears as bonding arises when coheron configurations admit joint PAL satisfaction with reduced overall constraint tension. Apparent valence corresponds to the number of compatible configurations available to a coheron before inducing basin saturation or PAL failure.

Chemical reactions correspond to reorganization of constraint configurations seeking higher stability under fixed lattice constraints. No entities are exchanged, and no particles migrate. Only the pattern of coherence changes.

This framework preserves observed regularities while eliminating the need for particle-level mechanisms.

10 Constraints on Higher-Order Structures

The same structural principles that permit coheron interaction and basin formation also impose strict limits on higher-order complexity.

As lattice depth increases, the number of potential coheron configurations grows. However, basin capacity does not scale indefinitely. Each increase in depth introduces additional recurrence constraints, phase alignment requirements, and compatibility exclusions.

Proposition 3. *There exists an upper bound on stable structural complexity within any finite recurrence regime of the Allen Orbital Lattice.*

This bound prevents arbitrary accumulation of coherons into increasingly complex aggregates. Structures exceeding compatibility limits cannot be stabilized, regardless of environmental conditions.

This explains why matter exhibits rich but finite complexity, why exotic configurations are rare or transient, and why artificial or hypothetical extensions of the periodic table rapidly lose stability.

Higher-order structures persist only when coherence gains from mutual constraint alignment outweigh losses induced by phase crowding and basin saturation.

11 Summary of Structural Results

The following results have been established in this paper:

- Coheron interaction is defined structurally, without particles, forces, or exchange mechanisms.
- Basins arise naturally from lattice recurrence and shell geometry.
- Basin capacity is finite and structurally enforced.
- Saturation leads inevitably to discrete instability and transition.
- Periodicity emerges from repeated capacity-limited basin formation.
- The periodic table reflects finite coheron family distributions.
- Chemical behavior corresponds to coheron compatibility, not electron dynamics.
- Structural complexity is bounded by recurrence constraints.

These results fix the interaction and periodicity layer of Pattern Field Theory and establish a foundation for subsequent treatments of dynamics, excitation, and measurement.

12 Closure

Coheron interaction, basin capacity, and emergent periodicity together complete the structural explanation of matter organization in Pattern Field Theory.

No additional ontological primitives are required. Stability, diversity, and regularity arise solely from lattice constraints and Phase Alignment Lock. Periodicity is not imposed, optimized, or selected. It is unavoidable.

With this paper, the coherence-based description of identity, interaction, and structure is complete at the foundational level. Subsequent papers will address excitation, apparent propagation, and observational coupling without altering the structures fixed here.

Document Timestamp and Provenance

This document is part of Pattern Field Theory (PFT) and the Allen Orbital Lattice (AOL). It specifies coheron interaction, basin capacity, and emergent periodicity used by subsequent papers in the series.