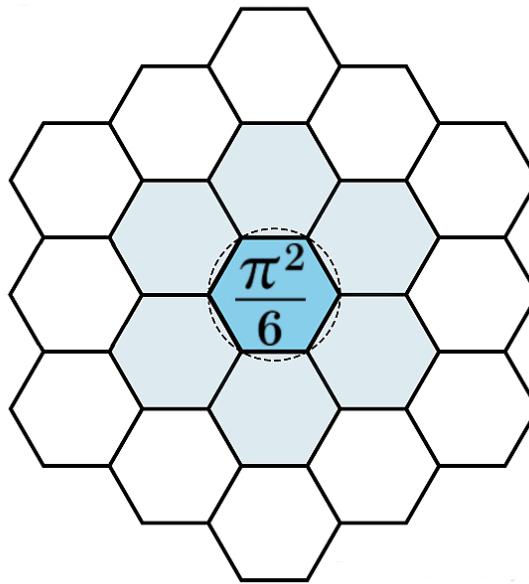


# Locality, Nonlocality, and Structural Separation

Expanded Depth Series: Paper 10

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## Abstract

This paper reformulates locality and nonlocality within Pattern Field Theory as properties of structural separation on the Allen Orbital Lattice. Locality is defined by constraint adjacency and basin separation, while nonlocality arises from shared structural support across distinct regions of the lattice.

No signals, influences, or transmissions are assumed. Apparent nonlocal effects are shown to result from global constraint relations and shared closure classes under Phase Alignment Lock.

# 1 Orientation and Dependency

This paper depends explicitly on the results of Papers 1 through 9 of the Expanded Depth Series. Paper 9 replaced temporal causality with structural dependency and explanatory order. The present paper addresses how spatial separation, local interaction, and apparent nonlocal correlation arise from constraint geometry on the Allen Orbital Lattice.

No metric space, signal propagation, or spacetime background is assumed. All notions of separation arise from lattice structure and basin topology.

## 2 Locality as Constraint Adjacency

Locality in Pattern Field Theory is not defined by spatial distance or light-cone structure.

**Definition 1** (Structural Locality). *Structural locality is the relation between configurations that share adjacent or overlapping constraint support on the Allen Orbital Lattice.*

Two configurations are local to one another if reconfiguration of one directly alters the constraint accessibility of the other through shared or adjacent lattice support.

Local interaction is therefore possible only within regions of constraint adjacency. Apparent spatial proximity corresponds to dense adjacency in constraint geometry, not to metric closeness.

## 3 Structural Separation and Basin Boundaries

Structural separation arises when configurations occupy disjoint regions of constraint geometry.

**Definition 2** (Structural Separation). *Structural separation is the absence of shared constraint support or adjacency between configurations under PAL.*

Basin boundaries enforce structural separation by preventing direct reconfiguration influence across incompatible constraint regions. Separated configurations cannot affect one another through local reconfiguration, regardless of apparent spatial arrangement.

Structural separation replaces absolute spatial distance with accessibility exclusion as the criterion for locality.

## 4 Nonlocality as Shared Structural Closure

Nonlocality in Pattern Field Theory does not involve influence across distance. It arises when configurations share structural closure without adjacent constraint support.

**Definition 3** (Structural Nonlocality). *Structural nonlocality is the relation between configurations that are structurally correlated through shared closure classes or global constraint conditions despite being structurally separated.*

Configurations exhibiting structural nonlocality depend on common global constraints enforced by Phase Alignment Lock across the Allen Orbital Lattice. Changes in one configuration do not propagate to the other. Instead, both are constrained by the same underlying closure conditions.

This explains nonlocal correlations without invoking signals, instantaneous effects, or violations of locality. Nonlocality reflects global constraint coherence rather than interaction.

**Proposition 1.** *All nonlocal correlations in Pattern Field Theory arise from shared structural closure under PAL.*

Nonlocality is therefore compatible with strict structural separation.

## 5 Resolution of Apparent Nonlocal Paradoxes

Apparent paradoxes of nonlocality arise when structural relations are misinterpreted as dynamical influences.

When configurations are observed under coarse depth resolution, shared structural closure may appear as instantaneous coordination. However, no reconfiguration influence occurs across separated regions.

**Definition 4** (Nonlocal Appearance). *A nonlocal appearance is the projection of shared structural constraints onto observational frameworks that assume dynamical causation.*

This resolves paradoxes associated with entanglement-like phenomena. Correlated outcomes arise because configurations occupy the same closure class, not because one affects the other.

No preferred reference frame or superluminal mechanism is required. The paradox dissolves once explanation is grounded in constraint geometry.

## 6 Compatibility with Observed Physical Regularities

Structural locality and nonlocality together reproduce observed physical regularities traditionally associated with spacetime theories.

Local interactions correspond to adjacency-limited reconfiguration. Global correlations correspond to shared closure conditions across basins. Separation limits direct influence while permitting correlation.

**Lemma 1.** *Structural separation guarantees the absence of reconfiguration influence between configurations while allowing correlation through shared closure.*

This framework accommodates both local causation and nonlocal correlation without contradiction. It preserves empirical adequacy while eliminating the need for spacetime mediation or signal-based explanations.

Locality and nonlocality are thus unified as complementary aspects of structural constraint organization on the Allen Orbital Lattice.

## 7 Summary of Structural Results

This paper has established the following results:

- Locality is defined as constraint adjacency on the Allen Orbital Lattice, not as spatial distance or light-cone structure.

- Structural separation arises from basin boundaries and incompatibility of constraint geometry.
- Nonlocality is explained as shared structural closure under Phase Alignment Lock without interaction or influence.
- Apparent nonlocal paradoxes arise from projecting structural relations onto dynamical or signal-based interpretive frameworks.
- Local interaction and nonlocal correlation coexist consistently as complementary aspects of constraint organization.

Together, these results replace spacetime-based locality assumptions with a purely structural account grounded in lattice geometry.

## 8 Closure

Locality and nonlocality in Pattern Field Theory are not competing principles. They are consequences of how constraint geometry partitions and unifies coherence on the Allen Orbital Lattice.

Nothing travels between separated regions. Nothing signals across distance. Correlation persists because structure is shared. Influence is limited because structure is separated.

With this paper, Pattern Field Theory completes its foundational account of locality and nonlocality without spacetime, signals, or causal paradoxes, closing the separation and correlation layer of the theory.

## Document Timestamp and Provenance

This document is part of Pattern Field Theory (PFT) and the Allen Orbital Lattice (AOL). It defines locality, nonlocality, and structural separation as properties of constraint geometry used by subsequent papers in the Expanded Depth Series.

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