

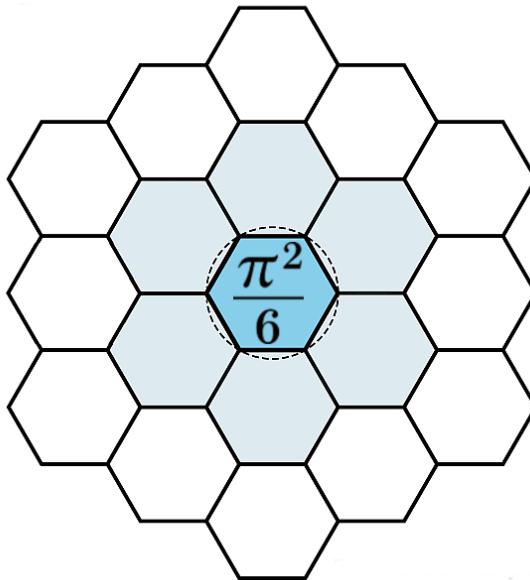
# Structural Regime Resolution

Unified Index, Diagnostics, and Cross-Domain Map

Structural Regime Resolution Series — Paper V

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## Abstract

This paper provides an index, diagnostic method, and cross-domain map for the Structural Regime Resolution (SRR) series. SRR is a description-control parameter in Pattern Field Theory (PFT) governing whether constraint transitions are represented as volumetric regions (high SRR) or collapsed into effective boundaries (low SRR). Papers I–IV established SRR across domains from dominion boundaries in plasmas to quantum criticality and quanta-scale regimes. This paper unifies the series into a single reference entry-point: it provides canonical definitions, a reusable SRR diagnostic procedure, standard notation, and a cross-domain mapping table covering heliopause transitions, shocks, reconnection and auroras, discharges, crystal defects, faults, reaction fronts, membranes, superconducting transitions, quantum criticality, and tunneling.

# Unified Index and Diagnostic Framework

## What SRR Is Used For

SRR is used to prevent a common modeling error: treating an effective boundary object as a primitive entity. In PFT, apparent boundaries are not primary. They are reduced representations of finite constraint transition zones.

SRR is the control that decides whether:

- a transition is modeled as a **volume** (high SRR), or
- the same transition is modeled as an **boundary** (low SRR).

## Canonical Definitions

**Definition 1** (Structural Regime Resolution (SRR)). *Structural Regime Resolution (SRR) is the resolution level at which internal structure is represented in a description. SRR determines whether a constraint transition is modeled as an extended volumetric region (high SRR) or collapsed into an effective boundary object (low SRR).*

**Definition 2** (Constraint transition zone). *A constraint transition zone is a finite region in which two or more constraint regimes overlap and cannot be simultaneously satisfied. It necessarily expresses tension and resolves it through excitation, reconfiguration, or both.*

**Definition 3** (Dominion). *A dominion is a region governed by a consistent ordering authority or constraint set.*

**Definition 4** (Tension (PFT)). *Tension is stored unsatisfied constraint resulting from incompatibility within an overlap region.*

**Definition 5** (Excitation). *Excitation is the set of dissipation channels through which unresolved constraints are expressed (heating, agitation, broadening, energetic distributions, wave activity).*

**Definition 6** (Reconfiguration). *Reconfiguration is a structural change that resolves constraint incompatibility (e.g., reconnection, slip, switching, fracture, discharge).*

## Standard Notation

This series uses the following minimal symbols:

- $L$  : characteristic modeling length (instrument scale or description scale)
- $\delta$  : physical thickness of a constraint transition zone
- $\xi$  : correlation length (when relevant, especially near criticality)

**Proposition 1** (Low-SRR boundary collapse criterion). *If  $\delta \ll L$ , then a low-SRR description may replace the transition zone by an effective boundary object without materially affecting bulk predictions.*

**Proposition 2** (High-SRR regime criterion). *If  $\delta \gtrsim L$  (or if internal layering is observable at the current  $L$ ), then boundary collapse fails and the transition must be represented as a finite volumetric region.*

## The SRR Diagnostic Procedure (Reusable)

For any boundary-like phenomenon, apply the SRR diagnostic procedure:

1. **Identify dominions:** What are the two ordering authorities on either side of the transition?
2. **Identify mismatch class:** What cannot be simultaneously satisfied? (topology, occupancy, flow, phase, chemical ordering, transport limits)
3. **Identify  $\delta$ :** What is the observed or inferred thickness of the transition region?
4. **Identify  $L$ :** What is the modeling scale or measurement scale used in the description?
5. **Locate excitation:** Where does heating, broadband activity, or energetic population enhancement occur?
6. **Locate reconfiguration:** Are there embedded thin layers or discrete events (slips, reconnection layers, discharge steps)?
7. **Assign SRR state:** Is the description operating in high SRR (volumetric) or low SRR (collapsed boundary)?
8. **Check hierarchy:** Does the system show nested layering (thick zone  $\rightarrow$  thin sublayer  $\rightarrow$  sharp crossing)?

This procedure produces a single consistent explanation language across domains.

## Series Map (Papers I–IV)

- **Paper I: Structural Regime Resolution** — formal definition, boundary emergence, cross-scale statement.
- **Paper II: Dominion Boundaries and Plasma Transitions** — heliopause structure, reconnection, auroras, shocks, heating.
- **Paper III: Quantum Criticality and Superconductivity** — QCP as volumetric transition, critical fans, pseudogap, strange metals.
- **Paper IV: SRR at the Quanta Scale** — orbitals, tunneling, barriers, boundary conditions, point particles as SRR artifacts.

## Cross-Domain SRR Map (Quick Reference Table)

Phenomenon	High SRR (volumetric)	Low SRR (collapsed)
Heliopause (Paper II)	Mixed dominion transition zone; distributed heating and energetic populations; nested layers	Effective surface separating heliosphere and VLISM
Collisionless shocks (Paper II)	Foreshock + ramp + overshoot + downstream relaxation as nested transition volumes	Single shock surface with jump conditions
Magnetic reconnection (Paper II)	Finite restructuring region with embedded thin layers and distributed excitation	Localized boundary event or idealized topology swap
Auroras (Paper II)	Volumetric excitation cascade from upstream mismatch to downstream deposition	Boundary-like emission feature
Lightning discharge (Paper I/II)	Volumetric stepped leader and streamer regions; distributed excitation and branching	Thin line discharge path
Crystal dislocations (Paper I)	Finite distortion zones with internal structure	Defect lines/planes
Fault zones (Paper I)	Fractured volumes, distributed damage and micro-slip	Single fault plane
Reaction fronts (Paper I)	Finite switching region of mixed constraints and transport limits	Thin front boundary
Membranes (Paper I)	Finite molecular machine region with internal gating and constraint management	Compartment boundary surface
Quantum criticality (Paper III)	Whole-system frustration volume; critical fan as extended transition region	Point or line in phase diagram
Superconducting transition (Paper III)	Fluctuation region; vortex matter; partial PAL locking	Sharp $T_c$ boundary
Tunneling (Paper IV)	Finite barrier region with decaying admissibility and continuous overlap	Wall crossing probability at an effective boundary

## Canonical Statement

**Remark 1** (Series canonical statement). *In Pattern Field Theory, apparent boundaries, interfaces, and discontinuities are emergent artifacts of reduced Structural Regime Resolution. At sufficiently high SRR, these objects resolve into finite constraint transition zones governed by mixed constraints, tension, excitation, and reconfiguration.*

## Immediate Use

This paper is intended to be used as:

- the entry point for the SRR series,
- the definition source for SRR citations,
- the diagnostic template for applying SRR to new domains,
- the cross-domain map for readers outside PFT.

## Glossary

**Structural Regime Resolution (SRR)** A description-control parameter deciding whether a constraint transition is represented as a volume (high SRR) or collapsed into an effective boundary (low SRR).

**Constraint transition zone** Finite overlap region of incompatible constraints; expresses tension, excitation, and reconfiguration pathways.

**Dominion** Region governed by a consistent ordering authority or constraint set.

**Tension** Stored unsatisfied constraint.

**Excitation** Dissipation channels of unresolved constraint mismatch.

**Reconfiguration** Structural change resolving incompatibility.

$\delta$  Physical thickness of a transition zone.

$L$  Modeling or observational scale.

$\xi$  Correlation length (especially near criticality).

## Document Timestamp and Provenance

This document is part of Pattern Field Theory (PFT) and the Allen Orbital Lattice (AOL). It provides the unified index, diagnostics, and cross-domain map for Structural Regime Resolution (SRR), serving as Paper V in the Structural Regime Resolution Series.

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