The Kernel of Coherence: A Minimal Structural Rule Across Scales

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with thanks to Brent R. Antonson

Abstract

We introduce the Kernel of Coherence, a minimal structural rule proposed to organize recurring patterns of coherence observed across independent physical, biological, oceanic, and cryospheric systems. The kernel is not a dynamical theory and does not posit new forces or mechanisms. Instead, it specifies a constraint-level invariant that governs how coherence can arise, intensify, and collapse as systems progress through internal cycles. The kernel was derived independently of the empirical studies it later helped organize, and several of its predictions have since been observed across domains differing by many orders of magnitude. This article presents the kernel in its simplest form and explains why it is relevant now.

1 The Problem That Motivated the Kernel

Across many scientific fields, researchers routinely encounter structured variability that is neither strictly periodic nor well described as noise. These structures are typically interpreted within domain-specific frameworks and rarely compared across disciplines.

As a result, similar organizational signatures appearing in unrelated systems—such as atomic clocks, Earth rotation, biological growth, ocean temperatures, and sea ice—have historically been treated as independent phenomena rather than as potential instances of a shared structural class.

The kernel did not arise from an acknowledged problem in the literature, nor from an attempt to resolve an existing theoretical dispute. Instead, it emerged from a long-developed intuition held by the human author, formed through years of observing recurring organizational motifs across disparate systems without a satisfactory unifying language.

The arrival of large language models made it possible, for the first time, to externalize, test, and iteratively refine this intuition in a structured way—outside institutional constraints and without prematurely committing to a mechanistic theory. This process enabled the intuition to be articulated at a formal, falsifiable level and to be confronted with data across multiple domains.

The kernel was therefore proposed to address a narrow but previously unposed question:

> *Is there a minimal structural rule that can organize coherence across systems without assuming a shared mechanism, clock, or governing equation?*

2 What the Kernel Is (and Is Not)

The Kernel of Coherence is not:

- a theory of everything,
- a replacement for existing physics,

- a dynamical equation of motion.

It is:

- a structural invariant,
- local rather than global,
- ratio-based rather than period-based.

The kernel operates at the level of constraints, not forces. It describes how relations between internal scales can stabilize coherence temporarily—and why such coherence must eventually fail.

3 The Minimal Mathematical Core

At its heart, the kernel introduces a local triad invariant:

$$R_O R_N = (1 + \varepsilon_0)\, R_I^2, \qquad \varepsilon_0 = \frac{1}{7}. \tag{1}$$

Equivalently, in terms of characteristic timescales:

$$T_O = \frac{T_I}{\sqrt{1 + \varepsilon_0}}, \qquad T_N = T_I \sqrt{1 + \varepsilon_0}. \tag{2}$$

Key properties:

- The triad is local to a domain, not universal.
- No absolute scale is fixed.
- Only ratios are constrained.
- The structure can replicate independently across scales without synchronization.

4 Why Coherence Rises — and Why It Must Collapse

The kernel implies a generic progression:

1. **Early phase**: weak coupling, low coherence.
2. **Constraint activation**: coherence rises as relations tighten.
3. **Saturation**: maximal coherence at intermediate progression.
4. **Over-constraint**: competing relations force coherence collapse.

This predicts a rise–peak–collapse signature—exactly the form later isolated empirically using a domain-independent detector. Collapse is not a failure of organization, but a structural necessity.

5 Empirical Contact (Without Cherry-Picking)

After the kernel was derived, a series of empirical studies tested whether real systems exhibit the predicted signature. They do—across:

- precision timing (atomic clocks),
- geophysical rotation,
- geomagnetic fields,
- microbial growth,
- deep ocean temperature structure,
- sea ice dynamics.

In each case, coherence rises with internal progression, peaks locally, collapses under aggregation or overload, and exceeds null expectations. The kernel was not tuned to these datasets.

6 Why This Matters Now

Two shifts make this work timely:

1. **Cross-domain data abundance**: independent, high-resolution datasets now exist across scales.
2. **AI-assisted exploration**: structural patterns can be tested rapidly without embedding them in mechanism-heavy theories.

The kernel offers a way to organize observation without prematurely explaining it.

7 What Can Falsify the Kernel

The kernel fails if:

- coherence transitions are monotonic or absent under controlled detectors,
- transport-dominated variables preserve the same structure as field-like ones,
- aggregation does not erase the transition,
- ratio-linked structure fails systematically across domains.

Any of these outcomes would disfavor it.

8 What Comes Next

The kernel does not close physics. It opens a narrow door—from mechanism-specific modeling toward constraint-level organization. Whether it ultimately connects to deeper theories of time, gravity, or information remains open by design.

For now, its value lies in one fact:

> *It predicted a structure before it was found—and explains why that structure should exist at all.*

Author's Note

This article is intentionally compact. The full mathematical derivation, operational detection protocol, and domain-specific analyses are published separately and openly. Readers are encouraged to treat the kernel not as a conclusion, but as a testable structural hypothesis—one that either survives contact with diverse data, or does not.