The In–Out Self-Referential Field Vibration

Second-Order Relationality and the Emergence of Orientation in PNP

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One-Sentence Summary. Spatial orientation and the concepts of "in" and "out" are not fundamental primitives, but emerge as phase-dependent projections of the self-referential scalar field mode (1).

Abstract. We develop a second-order relational description of the Point–Not–Point (PNP) scalar-field framework, showing how "in" and "out" —along with orientation, direction, and spatial geometry— emerge from the self-referential phase structure of a single real scalar field $U(x,t)$. The minimal closed mode, denoted (1), exhibits a Möbius-like phase inversion across its nodal surface, sustaining continuous energy circulation without requiring a background geometric twist. This work complements the dynamical theorems of PNP by providing the conceptual formulation of how a scalar field constructs spatial orientation.

Keywords. PNP Framework, Scalar Field Recursion, Emergent Geometry, Mobius Phase Topology, Relational Space

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1. Introduction

In standard physics, space is treated as a container and orientation as a primitive. In the Point–Not–Point (PNP) framework, neither is fundamental: the only ontic entity is a scalar energy field $U : \mathbb{R}^3 \times \mathbb{R} \to \mathbb{R}$. Observable structure arises from the closed oscillations of U, with apparent directions and "in–out" relations emerging from nodal phase behavior.

Building on the derivation of causality from topological persistence [1], we here show how the minimal (1) mode defines a **self-referential energy flow** that reverses orientation across a node without spatial inversion, grounding spatial concepts in scalar recursion.

2. Scalar Field Recursion

The field dynamics are governed by the recursive definitions:

$$F = d(*dU), \quad dF = 0, \quad d * F = 0$$

from which electric- and magnetic-like fields follow:

$$\mathbf{B} = * \, dU, \quad \mathbf{E} = * \, d * \, dU$$

These satisfy the source-free Maxwell equations. In PNP, however, vectors are not primary: they are projections of the scalar's own oscillatory recursion.

Note: The Hodge dual (∗) is used here as a relational operator on the field gradients, not as a rigid structure dependent on a pre-existing metric background.

3. Minimal Mode and In–Out Reversal

We define the minimal spherical standing wave (referring to the symmetry of the nodal set, rather than a fundamental embedding space):

$$U(r, t) = A \sin(kr - \omega t), \quad U(0, t) = U(R, t) = 0$$

The boundary condition gives $kR = \pi$. The field flows inward, cancels at $r = 0$, and reemerges outward with opposite phase.

Let the effective orientation vector be:

$$\hat{n}(r) = \frac{\nabla U}{|\nabla U|}$$

Then, examining the limit across the node:

$$\lim_{r \to 0^-} \hat{n} = - \lim_{r \to 0^+} \hat{n}$$

This inversion is continuous in phase space ($e^{i\pi} = -1$) but appears as a reversal in vector space. This is a **Möbius-like effect** in the field's orientation: the "inside" transforms continuously into the "outside" through a phase twist, creating a non-orientable topology from a simple scalar oscillation.

4. Second-Order Relationality

PNP's relationality is two-tiered:

1. **First-order:** Spatial relations arise from field phase gradients (Distance).
2. **Second-order:** Those gradients are themselves defined by other relations—internal phase continuity across nodes (Orientation).

"In" and "out" are thus not absolute directions but phase-dependent projections. Space itself is the stable pattern of these relations.

5. Implications

- **Emergent Orientation:** Orientation is locally reversible and defined only via field phase.
- **Relational Descriptors:** "In" and "out" are not ontic; they are relational descriptors of recursion.
- **Epistemic Geometry:** Geometry and topology are epistemic models of field closure, constrained only by measurable phase continuity, not fundamental givens.
- **Complexity:** Complex structure results from nested and interacting closed modes.

6. Conclusion

The minimal (1) mode in PNP provides a self-referential energy flow that defines "in" and "out" without presupposing space or orientation. This complements the formal derivation of PNP's dynamics, offering a compact conceptual lens for interpreting the framework's physical and philosophical reach.

7. References

1. **Nedrock, F., Vale, L., Freet, M., Rodriguez, A. M.** (2025). *The PNP Theory of Cause and Effect: Causality from Topological Persistence in Scalar Fields.* Preferred Frame Lab. https://writing.preferredframe.com/doi/10.5281/zenodo.18317319