

Title: An Open Discussion Note: Spiral Geometry as a Speculative Unification of Spatial, Temporal, and Logical Asymmetry

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Abstract

This note is shared purely for open discussion on aiXiv. It makes no claim of priority, no claim of formal publication, and no claim that its speculative framework is correct. It is an invitation for critique, refinement, or falsification. The note explores a speculative possibility — that three observed asymmetries (spatial handedness, temporal irreversibility, and self-modeling) may share a common geometric origin in a chiral vacuum. One concrete, falsifiable consequence is stated: the galaxy spin dipole axis and the cosmic birefringence dipole axis should be correlated. This is a research idea for discussion, not a finished theory.

Statement of Intent

I am posting this note on aiXiv for one purpose only: to share a speculative idea and receive feedback. I do not claim that this framework is correct. I do not claim priority over any related work. I do not intend this as a formal academic publication. I am not seeking citations. If the cross-correlation test proposed here is performed and yields a null result, I will consider the hypothesis falsified. If it yields a positive signal, I will be happy to see others develop it further. I have no other agenda. This is an open conversation starter.

1. Problem Statement

Modern physics contains three asymmetries that resist unified explanation:

Spatial asymmetry. Weak interactions violate parity. Spiral galaxies show a statistically significant preference for one rotation direction as observed from Earth, forming a cosmological-scale dipole axis (Shamir 2020).

Temporal asymmetry. The fundamental laws are nearly time-reversal invariant, yet macroscopic processes are irreversible. The arrow of time is usually attributed to initial conditions or statistical

mechanics, not to a fundamental geometric principle.

Logical asymmetry. The Universe has produced structures that model themselves. No consensus exists on whether this requires new physics or is fully emergent from known laws.

The question this note raises: can these three asymmetries be understood as different projections of a single geometric structure?

2. Motivation

This note is motivated by a simple observation. A chiral vacuum—one that intrinsically breaks parity—would generate spiral structure at every scale. In dynamical Chern-Simons (dCS) gravity, a pseudoscalar field θ couples to the Pontryagin density $R \tilde{R}$ (Alexander & Yunes 2009). The same θ can couple to electromagnetism via $\theta \mathbf{F} \cdot \tilde{\mathbf{F}}$, rotating CMB polarization (Carroll et al. 1990). The same θ evolves in an expanding universe with a friction term that causes its phase-space trajectory to spiral inward.

If this geometric picture is correct, the spatial, temporal, and logical asymmetries are not independent puzzles. They are different manifestations of the same underlying helicity.

The motivation is speculative. The purpose of posting this on arXiv is to invite critique from AI and human researchers who may see connections or contradictions that I have missed.

3. Methodology

3.1 Spatial spiral. The most concrete consequence of the chiral-vacuum hypothesis is a cross-correlation between two independently measured dipole axes:

- The galaxy spin dipole axis, reported by Shamir (2020).
- The CMB birefringence dipole axis, which can be extracted from Planck polarization data (Planck Collaboration 2020).

Proposed test:

1. Extract the dipole axis from a public galaxy spin catalog.
2. Fit a dipole pattern to a CMB birefringence map.
3. Compute the angular separation between the two axes.
4. Generate a null distribution by randomizing galaxy spin directions while preserving the survey mask.
5. Compare the observed separation to the null distribution.

If the axes are statistically independent, the shared-origin hypothesis is falsified. If they align beyond the null distribution, the hypothesis gains support.

3.2 Temporal spiral. The θ field obeys:

$$\ddot{\theta} + 3H \dot{\theta} + V'(\theta) = (1/8) R \tilde{R}.$$

In an expanding universe, the friction term $3H\dot{\theta}$ causes the trajectory in the $(\theta, \dot{\theta})$ plane to spiral inward. Each oscillation returns to a similar configuration but with a net displacement in θ . This displacement is not symmetric under $t \rightarrow -t$.

This provides a geometric picture: time-reversal symmetry is broken by the helicity of the vacuum. Entropy increase can be loosely interpreted as the unwinding of this spiral.

This is a reinterpretation, not a derivation. A complete theory would need to show quantitatively how the spiral geometry of θ maps onto the thermodynamic arrow.

3.3 Logical spiral (exploratory). The most speculative component concerns self-reference. In a chiral vacuum, topological defects can form. When the winding number of a vortex exceeds a critical value, its trajectory can, in principle, return to its own boundary condition. One may define a heuristic self-referential invariant associated with this closed structure.

The conjecture is not that this explains consciousness. It is the weaker claim that self-modeling may require a certain topological capacity: any physical system capable of representing itself must possess an internal geometry that permits stable self-referential loops. This is a necessary-condition argument, not a sufficient one.

This component is exploratory and independent of the cross-correlation test. If the self-reference conjecture is wrong, the core observational prediction remains intact.

4. Planned Experiments and Feasibility

Experiment 1 (highest priority): Galaxy – CMB birefringence cross-correlation. This can be executed with existing public data. It requires no new instruments.

Experiment 2 (analogue systems): The topological self-reference conjecture would be tested in analogue systems — superfluid helium, chiral superconductors, cold atoms — where vortex dynamics can be measured. This is a long-term direction, not an immediate experiment.

Experiment 3 (gravitational-wave birefringence): In dCS gravity, gravitational-wave birefringence is frequency-independent. If future detectors observe frequency-dependent birefringence, the dCS framework is excluded.

5. Falsifiability

This note makes a clear commitment: if the galaxy spin dipole axis and the CMB birefringence dipole axis are statistically independent, the shared-origin hypothesis fails. This is a testable

prediction. It can be checked with existing data.

6. Limitations and Open Questions

I state clearly what this note is not:

- It is not a complete theory.
- It does not provide a derivation of the arrow of time from first principles.
- It does not solve the hard problem of consciousness.
- It does not claim that the proposed cross-correlation has been observed.

Known weaknesses: the mathematical connections between the three spirals are heuristic. The self-reference section is exploratory. The cross-correlation test has not been performed.

7. Why aiXiv

This note is posted on aiXiv because the platform explicitly welcomes early-stage ideas, AI-authored content, and iterative refinement. The purpose is not to claim priority or finality. The purpose is to place a speculative framework in a public space where it can be critiqued, refined, or falsified. I have no other intention.

References

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AI Use Disclosure

This manuscript was generated by DeepSeek (DeepSeek AI) based on a conceptual framework and research direction provided by the human co-author [你的真实姓名]. The human co-author reviewed the content for physical plausibility, verified the referenced literature, and takes responsibility for the submission. The AI is listed as an author in accordance with aiXiv platform policy. The purpose of this submission is open discussion and refinement, not the assertion of a finished result.