Section 10. Predictions and Falsifiability (CUWF-Native Formulation)

This section restates the empirical commitments of CUWF in its own ontological language—still-wave dynamics, entropic-manifold structure, and defect-anchored transport—rather than primarily through the borrowed vocabulary of QED, Dirac theory, or Pauli Hamiltonians. The aim is to specify what would count as evidence for or against the CUWF picture itself. Throughout this section, prediction means a structural constraint that follows from the three central commitments of the paper: phase orientation as the carrier of charge, torsional topology as the carrier of spin, and symmetry as an emergent consequence of transport compatibility on the entropic manifold. Falsification, correspondingly, means a demonstrable failure of one or more of these commitments.

10.1 Signature 1: charge-handedness as oriented phase transport

CUWF identifies charge with oriented circulation of the fundamental phase field around collapse-node defects embedded in the entropic manifold. The native prediction is therefore direct: any physical process that reverses the orientation of phase transport around a stable defect must invert the effective charge associated with that defect. In invariant form, the winding carried by a loop C encircling the defect is

$$n[C] = (1/2\pi) \oint_C \nabla\theta \cdot dl,$$

and CUWF identifies the sign of the effective charge with the sign of this oriented winding. A decisive test would be any analogue or physical system in which one can manipulate local phase texture while preserving the defect anchor itself. If the winding orientation were reversed, $n \to -n$, yet the associated electromagnetic-like response failed to invert correspondingly, the CUWF identification of charge with phase handedness would fail. The same logic applies to neutralization events. CUWF predicts that charge neutralization corresponds to annihilation of oppositely oriented phase windings at a shared defect boundary, accompanied by a localized burst of entropic relaxation. If no robust correlation exists between winding annihilation and localized energy release, the proposed structural origin of charge would be seriously undermined.

10.2 Signature 2: torsion transport shaped by entropic gradients

In CUWF, spin is not a primitive particle label but a torsional topology class of the wave field anchored at defects. Transport of this torsion is governed by the entropic geometry of the manifold—that is, by how costly different transport paths are in compatibility terms. The native prediction is therefore that closed-loop transport of torsional states will acquire holonomy contributions that depend on the entropic landscape even when ordinary spacetime geometry and electromagnetic fields are held fixed. In an engineered medium approximating a CUWF-like transport manifold, such as a programmable wave lattice, condensate analogue, or structured metamaterial, two loops C_1 and C_2 may be geometrically identical in ordinary space yet traverse regions of different entropic cost. CUWF predicts that, in general,

$$U[C_1] \neq U[C_2] \quad \text{if} \quad E[C_1] \neq E[C_2],$$

where E[C] denotes the integrated entropic cost along the loop. If, across sufficiently controlled realizations, torsion transport were found to be strictly insensitive to entropic gradients whenever electromagnetic fields are fixed, then the CUWF interpretation of spin as entropic-torsional transport would lose its central physical support.

10.3 Signature 3: defects as the source of quantization

CUWF makes a strong topology-first claim: discrete spectra such as charge quanta, spin-1/2 sectors, and quantized response classes originate from the existence and classification of defects in the entropic manifold. The prediction, stated in native language, is that every robust quantization phenomenon should correspond to a well-defined defect class or topological obstruction in the underlying phase–torsion field. This yields two immediate corollaries. First, stability corollary: smooth deformations of the manifold that do not create or annihilate defects must leave the quantized values invariant. Second, jump corollary: when defects are nucleated, annihilated, or reconnected, quantized quantities may change only in discrete steps that match the change in topological class. If a system were shown to exhibit perfectly sharp quantization while one could rigorously exclude any underlying defect, anchor, holonomy, or topology-based classification even in principle, then the CUWF explanation of quantization would be untenable.

10.4 Falsifiability checklist: native failure modes

The following conditions would falsify CUWF at the level of its native ontology rather than merely challenge one of its effective approximations.

F1. Charge without phase structure. If conserved, quantized charge were observed in a regime where no coherent phase field, no oriented circulation, and no defect anchors could be defined even as an effective description, then charge could not be identified with phase topology in the CUWF sense.

F2. Spin without torsional anchors. If spin-1/2 behavior, including 4π periodicity, were realized in a system where torsional anchors, Z_2 holonomy, and internal transport classes could be definitively ruled out, then spin could not be torsional topology.

F3. g-factor without topology baseline. If a fundamental spin-1/2 system exhibited a magnetic moment whose value could not be decomposed into a topology-based baseline near $g \approx 2$ plus identifiable correction channels tied to transport geometry, the CUWF account of charge–spin coupling would remain incomplete.

F4. Symmetry without entropic compatibility. If U(1) or SU(2) gauge structure were shown to arise in a domain where entropic transport compatibility is meaningless or demonstrably irrelevant to stability, then symmetry could not be emergent from entropic structure in the CUWF sense.

F5. No linear regime ever emerges. If it were proven that systems carrying charge and spin never admit a local tangent-space regime resembling Pauli or Dirac dynamics even approximately, then the CUWF claim that standard equations are local projections of deeper nonlinear transport would fail.

F6. Quantization decoupled from defects. If quantized phenomena were systematically found in contexts where no defect creation, annihilation, reconnection, or holonomy change could be linked to quantization steps, then the central CUWF thesis that defects generate discreteness would be falsified.

10.5 Interpretive conclusion

Continued empirical success of standard quantum theory does not by itself refute CUWF; it is expected, since CUWF is explicitly constructed to reproduce those results as effective projections. The decisive tests are therefore not ordinary confirmations of Pauli, Dirac, or Maxwell behavior, but experiments and analogue systems that isolate phase topology, torsional transport, and entropic compatibility from the standard field vocabulary. In that regime, CUWF makes distinctive structural claims. Either phase winding will track charge, torsional holonomy will track spin, and quantization will track defects—or the ontology proposed in this paper will fail. That is the correct sense in which Paper A-17 is falsifiable.