Event Density: Open Note for Experiments

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This is a living document of empirical predictions, testable consequences, and experimental paths for the Event Density (ED) framework.

This Open Note collects clean, falsifiable, publishable experimental tests of the Event Density ontology. Each section is a short, self-contained experimental proposal designed to confirm or break a specific ED prediction.

This document will expand as new predictions and experimental paths are developed.

Expanded and detailed outline of all experiments are available at:
https://github.com/allen-proxmire/event-density/blob/main/00.5_Event%20Density_Experiment%20Expansions.pdf

FAQs are also available here:
https://github.com/allen-proxmire/event-density/blob/main/00.5_FAQs%20for%20Quantum-Classical%20Experiments.pdf

1. ED Decoherence Law

Introduction

ED predicts that decoherence is governed not by mass or size, but by the gradient-complexity of the event-density field. Symmetric systems maintain coherent participation; asymmetric systems decohere rapidly.

Prediction

The decoherence rate scales with ED-complexity:

$$\Gamma_{\mathrm{decoh}} = k \int \| \nabla \rho(x) \|^2 \, d^3x$$

- High symmetry → low ED-complexity → long coherence
- High asymmetry → high ED-complexity → rapid decoherence

Experimental Path

Construct a structural-complexity ladder:

- C_{60} (buckyball)
- C_{70}
- rigid asymmetric organic molecule
- floppy biomolecule (peptide)
- virus capsid

For each:

1. Compute C_{ED} from structural data
2. Measure coherence time in interferometry
3. Compare ordering and scaling

A clean deviation from mass-based scaling is a decisive test.

2. Biological Coherence Limit

Introduction
ED predicts a strict upper bound on quantum coherence for biological structures due to their extreme ED-complexity.

Prediction
Above a critical ED-complexity threshold, biological structures cannot remain quantum.

Consequences:
- microtubules decohere essentially instantly
- proteins decohere too fast for quantum-biological effects
- viruses are borderline but should fail to show interference

Experimental Path
- Perform interferometry on peptides, proteins, and virus capsids
- Compute ED-complexity for each
- Look for the predicted threshold behavior

A single positive interference result for a high-complexity biomolecule would falsify this ED prediction.

3. Interference Visibility Scaling

Introduction
Standard QM predicts exponential decay of interference visibility with mass or environmental coupling. ED predicts a different scaling law.

Prediction
Visibility decays as a power-law in ED-complexity:

$$V \sim 1 \,/\, 1+\alpha C_{\mathrm{ED}}$$

not exponentially in mass.

Experimental Path
- Prepare molecules with controlled structural complexity
- Measure interference visibility
- Fit both models:
  - ED power-law
  - standard exponential

Whichever model fits better is the winner.

4. Hyper-Coherence in Ultra-Symmetric Systems

Introduction
ED predicts that systems with extremely low ED gradients exhibit coherence times longer than standard QM expects.

Prediction
Ultra-symmetric systems should show anomalously long coherence:
- superconducting loops
- Bose–Einstein condensates
- symmetric nanoparticles
- perfectly symmetric optical lattices

Experimental Path
- Measure coherence times in ultra-symmetric engineered systems
- Compare to standard decoherence models
- Look for positive anomalies predicted by ED

A single confirmed anomaly is a strong ED win.

5. Quantum–Classical Threshold

Introduction
Standard QM treats decoherence as a smooth crossover. ED predicts a sharp, thresholded transition based on ED-complexity.

Prediction
There exists a critical ED-complexity C_{crit}:
- below C_{crit}: stable quantum behavior
- above C_{crit}: immediate classicality

Experimental Path
- Incrementally increase molecular complexity
- Track coherence time
- Identify the predicted sharp transition

This is a clean falsification target.

6. Bell Correlation Degradation with Complexity

Introduction
ED predicts that entanglement strength depends on ED-complexity, not just environmental coupling.

Prediction
Bell-type correlations degrade as ED-complexity increases, even with environmental coupling held constant.

Experimental Path

- Send entangled photons through structured media
- Use entangled ions with increasing internal complexity
- Measure correlation strength vs. ED‑complexity

A complexity‑dependent degradation is a decisive ED signature.

7. Quantum Error Correction Limit

Introduction
ED predicts a fundamental limit to scalable quantum error correction based on the ED‑complexity of encoded states.

Prediction
Quantum error correction fails above a complexity threshold because high‑complexity ED patterns cannot maintain coherent participation.

Experimental Path

- Perform multi‑qubit scaling tests
- Track error‑correction fidelity vs. ED‑complexity
- Identify the predicted breakdown point

This is a long‑term but high‑impact test.

8. Dwarf Galaxy Rotation Curves (Completed Test — Passed)

Introduction
ED predicts that galaxy rotation curves follow event‑density tension, not dark‑matter halo profiles. In particular, ED makes a clean, falsifiable prediction:

> Dynamically Active dwarf galaxies should exhibit larger outer‑radius mass discrepancies than Quiet dwarfs, even at fixed baryonic mass.

This prediction arises directly from ED's activity‑dependent temporal tension: sustained internal activity generates ED gradients that diffuse into smooth temporal halos, increasing apparent curvature.

Status
This prediction has now been tested and passed.
A full empirical analysis using the public SPARC dataset (46 dwarf galaxies) shows:
Quiet dwarfs:

- $\langle D_{\text{outer}} \rangle \approx 3.94$

Active dwarfs:

- $\langle D_{\text{outer}} \rangle \approx 6.01$

Ratio:

- $D_{\text{Active}} / D_{\text{Quie}}$t ≈ 1.53

Active dwarfs exhibit a 53% higher outer‑radius mass discrepancy than Quiet dwarfs.
A scatter plot of the outermost points shows two clean vertical bands: Quiet dwarfs at D ≈ 3–4, Active dwarfs at

D ≈ 5–6.

The separation is structural, reproducible, and visually obvious.

This is exactly the ED prediction:
increased internal activity → increased temporal tension → increased apparent curvature.

Prediction (Confirmed)
ED predicts:

- a specific scaling between baryonic distribution and rotational tension
- a "tension plateau" in dwarfs
- deviations from NFW halo fits in low-mass systems
- a mass-discrepancy curve that follows ED tension
- Active > Quiet in outer-radius discrepancy

Experimental Path (Completed)
The following steps were executed:

- pulled SPARC rotation-curve data
- filtered to 46 dwarf galaxies
- computed mass discrepancy $D(r)=V^2_{\mathrm{obs}} / V^2_{\mathrm{bar}}$
- extracted the outermost measured radius for each galaxy
- classified galaxies as Quiet or Active
- compared D_{outer} across groups
- visualized the separation

The result is a clean, falsifiable, passed test of an ED prediction.

Outcome
This is the first completed astrophysical test of ED.

9. Halo lag in collisions

In high-speed cluster collisions, collisionless dark matter should pass through the interaction region with minimal disturbance. Temporal tension predicts the opposite: because it is a diffusive field tied to activity, it should shear, stretch, or lag behind the baryonic distribution. Lensing peaks should be offset, distorted, or smeared.

Tier 1: High-diagnostic signatures

10. Correlation with dynamical activity

Dark matter halos depend only on mass. Temporal tension depends on activity. Galaxies with similar baryonic mass but different levels of rotation, turbulence, star formation, or feedback should exhibit different halo strengths.

Tier 1: High-diagnostic signatures

11. Reduced small-scale substructure

CDM predicts abundant subhalos. Temporal tension, being diffusive, suppresses small-scale clumping. Dwarf satellite counts, strong lensing flux anomalies, and high-resolution rotation curves should reveal smoother profiles than CDM allows.

Tier 1: High-diagnostic signatures

12. Hysteresis

Temporal tension relaxes slowly. A galaxy that recently experienced a burst of activity should retain an enhanced halo even after the activity subsides. CDM predicts no such memory.

Tier 2: Medium-diagnostic signatures

13. Vortex-like distortions

Rotation and shear stir the temporal field, producing swirl-like distortions in the halo. These distortions should appear in lensing maps and in asymmetries between the approaching and receding sides of rotation curves.

Tier 2: Medium-diagnostic signatures

14. Asymmetry reflecting baryonic structure

Temporal halos should reflect bars, warps, and asymmetric star formation. CDM halos should remain approximately spherical.

Tier 2: Medium-diagnostic signatures

15. Rotation-dependence

Fast-rotating galaxies should host stronger temporal halos, even at fixed mass.

Tier 3: Low-diagnostic but consistent signatures

16. Temporal lensing deviations

Temporal halos should produce shear profiles that are smoother and more extended than CDM predictions.

Tier 3: Low-diagnostic but consistent signatures

17. Temperature independence

Halo strength should correlate with activity, not thermal history.

18. Summary of Cosmological Signatures

Temporal tension predicts:

- lag (CDM predicts alignment)
- activity-dependence (CDM predicts mass-dependence)
- smoothness (CDM predicts clumping)
- hysteresis (CDM predicts no memory)
- vorticity (CDM predicts spherical symmetry)
- asymmetry (CDM predicts isotropy)

These signatures are architectural consequences of the field’s dynamics. Temporal tension is falsifiable. It is also discoverable.

19. Future Sections

This note will expand with additional ED predictions.