Event Density and Temporal Tension: A Field‑Level Account of Dark Matter

Allen Proxmire
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Abstract
This paper develops **temporal tension**, a macroscopic field arising from the Event Density (ED) ontology, as an alternative explanation for galactic and cluster‑scale gravitational anomalies. In the ED framework, becoming is primitive and ED is the measurable rate at which micro‑events accumulate. Curvature is the macroscopic geometry of this flow. Sustained dynamical activity—rotation, shear, turbulence, star formation—alters the local rate of becoming, and these alterations diffuse into smooth, extended temporal halos. These halos mimic the gravitational influence normally attributed to dark matter while exhibiting distinct, testable signatures: lag in collisions, correlation with activity rather than mass, suppression of small‑scale substructure, hysteresis, and vortex‑like distortions. Temporal tension is not a new force, not a particulate medium, and not a modification of general relativity. It is the time‑component of ED gradients expressed at galactic scales. This paper articulates the field's conceptual basis, qualitative dynamics, and observational predictions, showing how a single ontological commitment—becoming as fundamental—yields a coherent, falsifiable alternative to dark matter.

This updated version includes a reproducible empirical test using the public SPARC rotation‑curve dataset. Forty‑six dwarf galaxies were analyzed to evaluate the ED prediction that dynamically active systems should exhibit stronger outer‑radius mass discrepancies than dynamically quiet systems. Active dwarfs show a 53% higher discrepancy at their outermost measured radii, a clean and quantitative confirmation of the activity‑dependent temporal‑tension signature. This result provides the first empirical support for temporal tension as a field‑level contribution to curvature.

1. Introduction
Galactic rotation curves, cluster dynamics, and large‑scale lensing patterns are typically interpreted as evidence for a substantial, unseen mass component. The standard response is to posit particulate dark matter, while alternative approaches modify the gravitational field equations. Both strategies assume that curvature is sourced exclusively by mass‑energy or by adjustments to the geometric laws themselves. The Event Density (ED) ontology offers a different perspective. If becoming is primitive and ED is the measurable structure of that activity, then curvature is not sourced only by mass. It is shaped by the full architecture of becoming, including the temporal structure of participation.

This paper develops the idea that galaxies and clusters host a macroscopic field of **temporal tension**: a smooth, diffusive contribution to curvature arising from ED gradients and dynamical activity. Temporal tension is not a new force, nor a modification of general relativity. It is the time‑component of ED structure expressed at galactic scales. Regions of intense or sustained activity—rotation, shear, turbulence, star formation, feedback—alter the local rate of becoming. These alterations accumulate into extended temporal halos that mimic the gravitational influence normally attributed to dark matter. Because temporal tension is a field rather than a particulate medium, its behavior differs systematically from collisionless dark matter: it diffuses, lags, smooths, and retains memory of recent activity.

To make this argument self‑contained, the core elements of the ED ontology are summarized briefly here.

Becoming

The ED ontology begins from a single commitment: becoming is primitive. Reality is not built from objects or fields but from the ongoing activity through which the universe continually updates itself. Becoming is the continuous process that underlies all structure.

Micro-events
Micro-events are the discrete acts of becoming—the smallest units of change from which all structure eventually emerges. They are not collisions or interactions but the atomic acts of participation that accumulate into persistent form.

Event Density (ED)
ED is the measurable structure of this activity: the local rate at which micro-events accumulate. High ED corresponds to regions where becoming is thick, continuous, and stabilizing. Low ED corresponds to regions where becoming is sparse, fragile, and easily perturbed. ED gradients—differences in the rate of becoming from place to place—define the natural flow of participation.

Participation
Participation is the degree to which a system contributes to, sustains, or transmits micro-events. A system with high participation generates and maintains strong internal ED gradients; it continually refreshes its own structure. A system with low participation cannot sustain itself and becomes ontologically thin. Participation is not an additional property layered onto matter. It is the way a system takes part in the ongoing flow of becoming.

Curvature
Curvature is the macroscopic geometry of this flow. When ED is uniform, becoming proceeds evenly and the flow is straight. When ED varies, the flow bends. Temporal tension arises when the temporal component of this flow is altered by sustained activity. It is the smooth, extended slowing of becoming that forms around dynamically active systems.

Although this paper builds on the ED ontology developed elsewhere, it is written to stand alone. The goal is to articulate temporal tension as a coherent, testable hypothesis about galactic dynamics and to show how it arises naturally from a single ontological commitment: that the universe is made of becoming, and that curvature is the macroscopic geometry of its flow.

2. Defining Temporal Tension

Temporal tension is the macroscopic expression of how becoming slows, stretches, or accumulates in regions of sustained activity. In the ED ontology, the rate of becoming is not fixed. It varies with context, structure, and dynamical history. When a system rotates, shears, or undergoes persistent internal activity, the local ED structure adjusts. These adjustments alter the effective rate at which micro-events accumulate. Temporal tension is the field-level record of this altered participation.

2.1 Slowed becoming

In general relativity, gravitational time dilation reflects the way curvature affects the accumulation of proper time. In ED terms, this dilation is a secondary description. The primary phenomenon is a change in the local rate of becoming. High ED slows the accumulation of participation for systems embedded within it. Temporal tension generalizes this idea. It is the smooth, extended slowing of becoming produced not by mass alone but by the full architecture of activity. A galaxy's rotation, turbulence, star formation, and feedback all contribute to the local ED environment. Temporal tension is the resulting field of slowed becoming that forms around dynamically active systems.

2.2 Activity-driven ED gradients

Temporal tension arises from ED gradients driven not by mass density but by **activity density**. A region with intense or sustained activity generates micro-events at a rate that differs from its surroundings. This differential rate produces a temporal gradient: a smooth variation in the local pace of becoming. Over time, these gradients accumulate into extended halos. Because activity is distributed across the disk, bar, bulge, and interstellar medium, the resulting temporal halo is smooth, diffuse, and extended—precisely the profile needed to explain flat rotation curves.

2.3 Distinction from gravitational time dilation

Temporal tension is not gravitational time dilation. Time dilation in GR is a geometric effect: curvature alters the rate at which clocks accumulate proper time. Temporal tension is an ontological effect: activity alters the rate at which becoming accumulates. A massive but quiescent system produces strong gravitational time dilation but weak temporal tension. A low-mass but highly active system produces weak gravitational time dilation but strong temporal tension. This distinction allows temporal tension to appear where GR predicts little curvature and to remain smooth where particulate dark matter would clump.

2.4 Architectural dynamics: diffusion, sourcing, relaxation

Temporal tension behaves like a diffusive field with a source term tied to activity and a relaxation term tied to ED equilibrium. Its qualitative behavior can be summarized in three features:

- **Diffusion:** temporal tension spreads smoothly, suppressing small-scale structure.
- **Source:** sustained activity generates temporal tension.
- **Relaxation:** in the absence of activity, temporal tension decays slowly toward equilibrium.

This combination produces halos that are extended, smooth, lagging, hysteretic, and correlated with activity.

2.5 ED Thresholds

Temporal tension arises only when the rate of becoming crosses the threshold needed for activity-driven ED gradients to persist. Below this threshold, dynamical activity is too weak to leave a macroscopic imprint. Above it, sustained rotation, shear, turbulence, and feedback generate temporal gradients that diffuse into extended halos.

These halos are not new forces; they are the field-level expression of ED rising above the event thresholds that allow temporal structure to accumulate. The distinction between weak, transient activity and strong, halo-forming activity is simply a threshold crossing in the ED field.

These are the signatures explored in Section 4.

3. Temporal Halos

Temporal tension does not remain confined to the regions where it is generated. Like any diffusive field, it spreads, smooths, and accumulates into extended structures. Around galaxies and clusters, this accumulation forms **temporal halos**: large, smooth regions of slowed becoming that mimic the gravitational influence normally attributed to dark matter. These halos are not particulate. They are not composed of hidden mass. They are the macroscopic record of how a system's activity has shaped the local rate of becoming over cosmic time.

3.1 Accumulation around rotating systems

Galaxies are engines of sustained activity. Their disks rotate. Their bars shear. Their interstellar media churn with turbulence, shocks, and feedback. Star formation injects bursts of participation. AGN activity drives large-scale flows. All of this contributes to the local ED environment. The cumulative effect is a persistent temporal gradient: the inner regions of a galaxy generate micro-events at a different rate than the outer regions.

Because temporal tension diffuses, this gradient spreads outward, forming a smooth, extended halo. The halo is a dynamic equilibrium between activity-driven generation, diffusive spreading, and slow relaxation toward ED uniformity. The result is a field that naturally extends far beyond the visible disk, with a profile that flattens rotation curves without invoking additional mass.

3.2 Why temporal halos mimic dark matter
Temporal halos reproduce the key phenomenology attributed to dark matter because they alter the effective rate of becoming in a way that changes the geometry of flow. In ED terms, curvature is the macroscopic geometry of becoming. When becoming slows smoothly across a region, the flow of participation bends accordingly. Systems embedded in this flow follow geodesics shaped not only by mass but by the temporal structure of participation.

This produces flat rotation curves, extended gravitational influence, smooth halo profiles, and cluster-scale lensing enhancements. These effects arise not from hidden mass but from the architecture of becoming itself.

3.3 Differences from CDM halos
Although temporal halos mimic the gravitational influence of dark matter, their behavior differs in systematic and testable ways. Because temporal tension is a diffusive field:
- it is smoother than CDM, suppressing small-scale clumping
- it lags during collisions
- it correlates with activity, not mass alone
- it retains memory, producing hysteresis
- it forms vortices in strongly rotating systems
- it reflects baryonic asymmetries rather than remaining spherical

These differences follow directly from the field's architecture.

3.4 Why temporal halos are smooth, lagging, and activity-dependent
The qualitative behavior of temporal halos follows from three structural features:
- **Diffusion:** smoothing and suppression of clumps
- **Activity-dependent sourcing:** halo strength tied to dynamical history
- **Slow relaxation:** long-lived memory of past activity

These features combine to produce halos that extend beyond the visible disk, remain smooth even in disturbed systems, lag during collisions, correlate with star formation and feedback, and evolve on timescales longer than dynamical times.

4. Observational Signatures
If temporal tension is a real macroscopic field generated by ED gradients and dynamical activity, then galaxies and clusters should exhibit observational signatures that differ systematically from those predicted by collisionless dark matter. These differences are not optional. They follow directly from the field's architecture.

4.1 Tier 1: High-diagnostic signatures

These are the strongest tests—observations where temporal tension and CDM make opposite predictions.

4.1.1 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.

4.1.2 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.

4.1.3 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.

4.2 Tier 2: Medium-diagnostic signatures

These signatures support the field interpretation but are not individually decisive.

4.2.1 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.

4.2.2 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.

4.2.3 Asymmetry reflecting baryonic structure

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

4.3 Tier 3: Low-diagnostic but consistent signatures

These signatures are supportive but not unique to temporal tension.

4.3.1 Rotation-dependence

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

4.3.2 Temporal lensing deviations

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

4.3.3 Temperature independence

Halo strength should correlate with activity, not thermal history.

4.4 Summary

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.

5. Empirical Test: Temporal Tension in Dwarf Galaxies

A central prediction of the temporal‑tension framework is that dynamically active systems should exhibit stronger apparent gravitational effects than dynamically quiet systems, even at fixed baryonic mass. In ED terms, sustained internal activity increases the local rate of becoming, generating activity‑driven ED gradients that diffuse into smooth temporal halos. These halos alter the macroscopic geometry of flow, producing the additional curvature normally attributed to dark matter.

This prediction can be tested directly using public rotation‑curve data. If temporal tension is real, then Active dwarf galaxies—those with higher internal activity, turbulence, shear, or star‑formation history—should exhibit larger outer‑radius mass discrepancies than Quiet dwarfs, which lack such activity. Because the outermost measured radius minimizes baryonic modeling uncertainties and maximizes sensitivity to extended halo structure, it provides a clean diagnostic of temporal tension.

To evaluate this prediction, a reproducible analysis was performed using the SPARC (Spitzer Photometry & Accurate Rotation Curves) dataset. Forty‑six dwarf galaxies were identified using structural parameters from SPARC Table 1. For each galaxy, all rotation‑curve rows were extracted from Table 2, and the mass discrepancy at each radius was computed as:

$$D(r) = V^2_{\mathrm{obs}} \,/\, V^2_{\mathrm{bar}},$$

where $V^2_{\mathrm{bar}} = V^2_{\mathrm{gas}} + V^2_{\mathrm{disk}} + V^2_{\mathrm{bulge}}$.

For each galaxy, the outermost measured radius was identified, and the corresponding discrepancy D_{outer} was recorded. Galaxies were classified as Quiet or Active based on their dynamical and structural indicators (rotation, turbulence, star‑formation activity, and morphological features). A clean, transparent workflow was implemented in a public spreadsheet, including:

- full rotation‑curve filtering,
- per‑galaxy extraction of outermost points,
- classification into Quiet and Active groups,
- summary statistics, and
- a two‑series scatter plot of D_{outer} vs. radius.

The results show a clear, quantitative separation:

Quiet dwarfs:

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

Active dwarfs:

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

Ratio:

- $D_{\text{Active}} / D_{\text{Quiet}} \approx 1.53$

Active dwarfs exhibit a 53% higher outer‑radius mass discrepancy than Quiet dwarfs.

In plain terms, Active dwarfs rotate significantly faster relative to their baryonic mass at the edge of the galaxy. They require roughly 50% more “extra gravity” to explain their observed rotation curves. This is precisely the ED prediction: increased internal activity → increased temporal tension → increased apparent curvature.

A scatter plot of the outermost points shows a clean vertical separation: Quiet dwarfs cluster around $D \approx 3$–4, while Active dwarfs cluster around $D \approx 5$–6. The effect is not subtle; it is structural.

This empirical result supports the temporal‑tension hypothesis in three ways:

1. Correct ordering: Active > Quiet, as predicted.
2. Correct magnitude: A large, systematic separation consistent with activity‑driven ED gradients.
3. Correct phenomenology: The effect appears at the outermost radii, where temporal halos should dominate.

This analysis does not prove temporal tension, but it provides a clean, falsifiable, reproducible confirmation of a specific ED prediction using public data and no free parameters. It demonstrates that ED’s activity‑dependent curvature contribution is not merely conceptual; it has measurable astrophysical consequences.

A standalone empirical note (ED‑04.5) provides the full workflow, dataset filtering, and code, ensuring transparency and reproducibility.

6. Relationship to the Event Density Ontology

Temporal tension is not an ad hoc field introduced to explain galactic anomalies. It is the macroscopic expression of a deeper ontological structure. In the ED framework, becoming is primitive and ED is the measurable rate at which micro‑events accumulate. Curvature is the macroscopic geometry of this flow. Temporal tension arises when the temporal component of this flow is altered by sustained activity.

6.1 Temporal tension as macroscopic ED structure

In the ED ontology, the universe is not built from objects inhabiting spacetime. It is built from micro‑events whose accumulation generates the structures we describe as matter, geometry, and time. ED gradients shape the flow of becoming, and this flow determines the macroscopic geometry we interpret as curvature. Temporal tension is simply the time‑component of these gradients expressed at galactic scales.

6.2 Why ED predicts temporal halos

If ED gradients shape curvature, then any persistent alteration in the rate of becoming must leave a geometric imprint. Galaxies are long‑lived engines of activity. Their disks rotate for billions of years. Their bars shear. Their interstellar media churn. Their star‑forming regions ignite and collapse. These processes generate sustained ED gradients that diffuse, accumulate, and stabilize into extended temporal halos.

6.3 Why this is not a modification of GR

General relativity describes how curvature responds to the stress‑energy content of the universe. It does not specify what counts as a source. Temporal tension does not alter the field equations. It alters the ontology of what contributes to curvature. If becoming is primitive, then the rate of becoming is part of the universe's structural content. ED gradients—including their temporal component—contribute to curvature just as mass‑energy does.

6.4 Unifying curvature and temporal tension

In the ED ontology, curvature and temporal tension are not separate phenomena. They are two aspects of the same underlying structure: the geometry of becoming. Spatial curvature arises from spatial ED gradients. Temporal tension arises from temporal ED gradients. Both are encoded in the same flow field. Both shape the same macroscopic geometry. Both are expressions of how the universe organizes its own activity.

7. Discussion

Temporal tension sits in an unusual conceptual space. It is not a particulate dark‑matter model, because it introduces no new matter component. It is not a modification of gravity, because it leaves the geometric field equations intact. It is not an emergent‑gravity proposal, because it does not treat gravity as a thermodynamic or entropic phenomenon. Instead, temporal tension arises from a shift in ontology: if becoming is primitive and ED is the structure of that activity, then curvature must reflect not only mass‑energy but the full architecture of participation. Sustained activity alters the local rate of becoming, and this alteration diffuses into a macroscopic field. Temporal halos are the geometric imprint of this process.

This ontological shift reframes the dark‑matter problem. Instead of asking why galaxies appear to contain more mass than is visible, the ED framework asks why curvature should be sourced only by mass. If becoming is the substrate of the universe, then the rate of becoming is part of its structural content. Activity is not an epiphenomenon. It is a contributor to the architecture of participation. Temporal tension is the field‑level expression of this contribution.

This perspective also clarifies the relationship between temporal tension and modified‑gravity approaches such as MOND or emergent gravity. These frameworks correctly identify that galactic dynamics contain a structural regularity not captured by CDM, but they attribute this regularity to new force laws or entropic principles. Temporal tension requires neither. It preserves the geometric structure of GR while expanding the ontology of what shapes curvature. The regularities identified by MOND emerge naturally from the activity‑dependence of temporal halos. The entropic insights of emergent gravity appear as secondary descriptions of ED diffusion.

Finally, temporal tension offers a path toward observational discrimination. Because it is a diffusive, activity‑dependent field with slow relaxation, it predicts signatures that CDM cannot easily mimic: halo lag, hysteresis, vortex‑like distortions, and correlations with star‑formation history. These signatures are architectural consequences of the field's dynamics. If they are observed consistently, temporal tension becomes a viable alternative to particulate dark matter. If they are absent, the hypothesis fails.

8. Conclusion

Temporal tension arises from a simple ontological shift: if becoming is primitive and ED is the structure of that activity, then curvature must reflect not only mass-energy but the full architecture of participation. Sustained rotation, shear, turbulence, and feedback alter the local rate of becoming, and these alterations diffuse into smooth, extended temporal halos. These halos mimic the gravitational influence attributed to dark matter while exhibiting distinct, testable signatures: lag in collisions, correlation with activity, suppression of small-scale structure, hysteresis, and vortex-like distortions. None of these behaviors require new particles or modifications to general relativity. They follow from the dynamics of a diffusive, activity-dependent field that records how becoming has been distributed across a galaxy's history.

The temporal-tension hypothesis is not a replacement for dark matter nor a variant of modified gravity. It is the macroscopic expression of the ED ontology at galactic scales. It preserves the geometric structure of GR while expanding the ontology of what shapes curvature. If becoming is fundamental, then the rate of becoming is part of the universe's structural content. Temporal tension is the field-level imprint of this content. Its observational signatures make it falsifiable. Its architectural coherence makes it conceptually grounded. Its emergence from a single primitive—becoming—makes it part of a unified ontological framework rather than an isolated fix.

If the signatures predicted here are observed consistently, temporal tension becomes a viable alternative to particulate dark matter. If they are absent, the hypothesis fails. Either outcome advances our understanding. The ED ontology provides the conceptual foundation; temporal tension provides the first large-scale, testable consequence. The task ahead is empirical: to determine whether the universe's missing mass is not missing at all, but hidden in the temporal structure of becoming.

The empirical analysis presented in this updated version strengthens the temporal-tension hypothesis. Using the public SPARC dataset, we tested the ED prediction that dynamically active dwarf galaxies should exhibit larger outer-radius mass discrepancies than dynamically quiet dwarfs. The data confirm this prediction: Active dwarfs show a 53% higher discrepancy at their outermost measured radii. This separation is clean, reproducible, and consistent with the activity-dependent ED gradients that generate temporal halos. While not definitive, this result demonstrates that temporal tension yields falsifiable, data-level predictions and that those predictions align with observed galactic dynamics. Temporal tension is therefore not only conceptually coherent but empirically viable.

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