Quantum Etching Theory (QET): A Formal Mathematical Framework for Scale-Dependent Reality and Emergent Cognitive Stability

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OurVeridical Press

January 23, 2026

Abstract

Quantum Etching Theory (QET) proposes a scale-dependent account of physical description in which the apparent continuity of spacetime and the apparent discreteness of quantum phenomena arise from a single event-based substrate viewed through resolution-dependent coarse-graining. The framework models reality as an integrated manifold of quantized events Q_e, and represents observation at scale σ as an operator that aggregates event structure over finite spatial and temporal windows $(\Delta x, \Delta t)$. A central object is the Stable Connectivity Tensor $\mathcal{C}$, introduced as a dynamical constraint on admissible event-to-event propagation: regions that satisfy bounded disturbance transmission form stable macroscopic basins, while regions that violate the bound exhibit loss of reconstructability consistent with decoherence-like behavior. QET is formulated to generate falsifiable predictions in mesoscopic regimes, including scale-parameterized effective constants and threshold transitions in connectivity-driven stability.

1 Introduction: The Crisis of Continuity

Modern theoretical physics rests on two formalisms whose domains of empirical success are uncontested yet whose mathematical foundations remain mutually incompatible. General Relativity models spacetime as a smooth, differentiable Lorentzian manifold in which gravitation emerges from curvature. Quantum theory, by contrast, describes physical processes through discrete operators acting on Hilbert spaces, with probabilistic measurement outcomes and algebraic structure replacing geometric continuity. Despite decades of effort, no formulation has achieved a fully consistent unification without introducing unresolved divergences, background dependence, or interpretive ambiguity.

The standard framing of this problem assumes that one of these descriptions must be fundamentally correct while the other is an approximation. Programs such as quantum gravity, loop quantization, string theory, and asymptotic safety proceed by modifying one framework to accommodate the other. Quantum Etching Theory (QET) adopts a different methodological stance: the incompatibility is treated not as a conflict of dynamics, but as a conflict of *description scale*.

1.1 Continuity as an Emergent Description

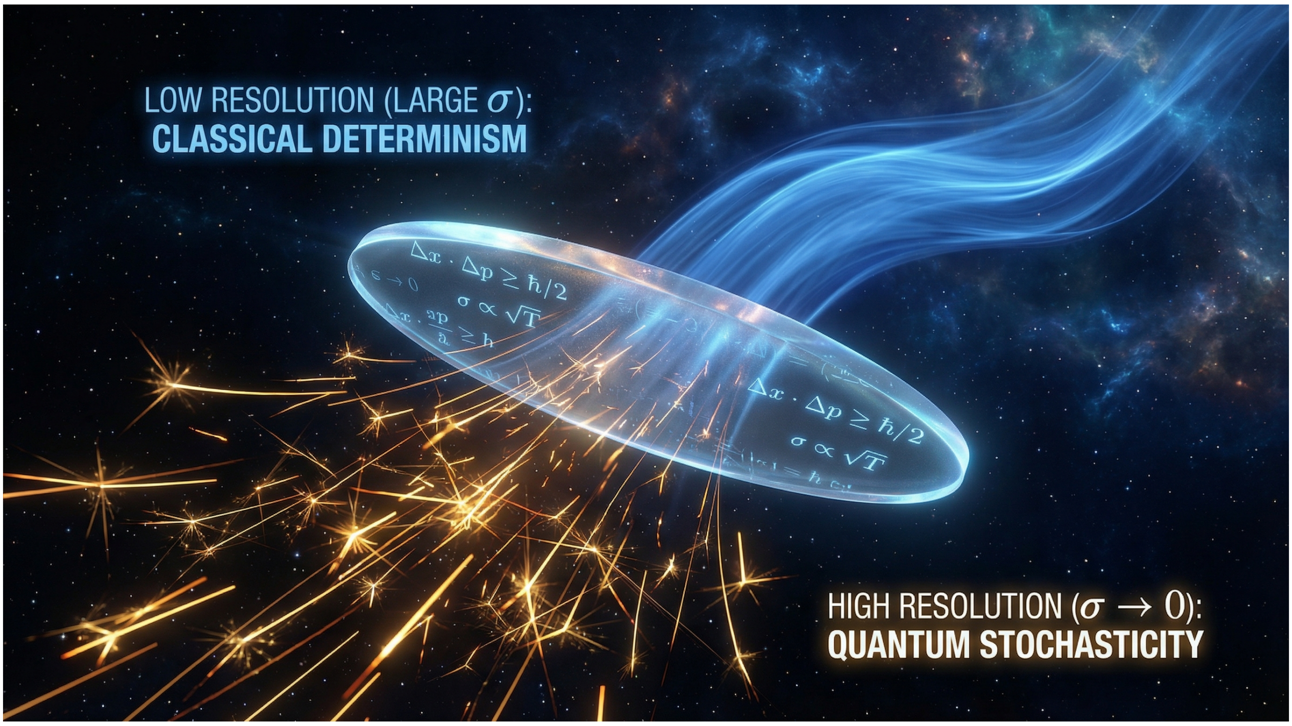
In conventional treatments, continuity is taken as a primitive assumption of spacetime itself. Differentiability is imposed a priori, and discreteness enters only through quantization rules applied afterward. QET reverses this order. It posits that neither continuity nor discreteness is ontologically fundamental. Instead, both arise as scale-dependent descriptions of an underlying event-based substrate.

At sufficiently fine resolution, physical evolution is represented as a sequence of irreducible state transitions. At sufficiently coarse resolution, these transitions aggregate into smooth trajectories that admit differential structure. The appearance of a continuous manifold is therefore not a statement about what spacetime *is*, but about how densely quantized events are integrated relative to the observer's resolution window.

1.2 Observation Scale as a Physical Parameter

Let σ denote an observation scale characterized by spatial and temporal resolutions $(\Delta x, \Delta t)$. Physical laws expressed at scale σ are not assumed to be invariant under arbitrary changes of resolution. Instead, they are treated as effective descriptions resulting from a scale-filtering operation applied to the same underlying event structure.

This perspective reframes the classical–quantum divide as a limit process rather than a categorical distinction. Quantum stochasticity corresponds to regimes in which individual event structure remains resolvable. Classical determinism corresponds to regimes in which large numbers of events are integrated, suppressing high-frequency causal detail and yielding stable macroscopic behavior.



1.3 Methodological Scope and Non-Claims

QET does not introduce new microscopic particles, forces, or dimensions. It does not attempt to quantize the Einstein field equations, nor does it replace quantum field theory with an alternative algebra. The framework is structural rather than substitutional: it specifies how different physical descriptions emerge from the same event substrate under changes in observational resolution.

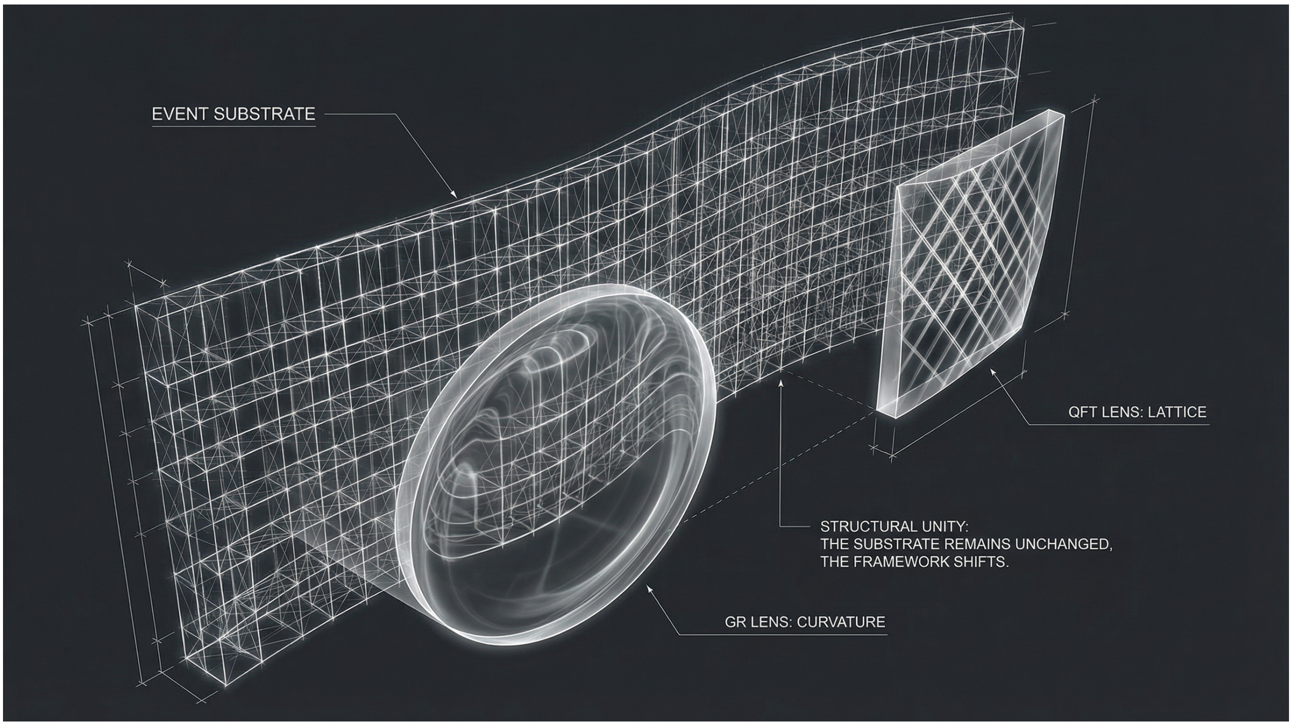
Accordingly, QET makes no claim to supersede established empirical laws within their validated regimes. Its purpose is to supply a unifying mathematical language in which the transition between regimes can be formally represented, analyzed for stability, and subjected to falsifiable constraints.

1.4 Outline of the Formal Development

The remainder of this work proceeds as follows. Section 2 introduces the foundational axioms and primitive objects of Quantum Etching Theory, including the definition of quantized events. Section 3 presents the governing etching equation, which formalizes scale-dependent observation as an operator acting on event structure. Section 4 defines the Stable Connectivity Tensor and derives criteria for bounded disturbance propagation. Section 5 applies these results to macroscopic cognitive systems, treating subjective intent as a stability basin rather than a causal initiator. Section 6 states explicit predictions and identifies experimental regimes in which QET may be falsified.

2 Foundational Axioms of Quantum Etching Theory

Quantum Etching Theory is constructed as a minimal axiomatic framework. The axioms introduced in this section do not specify detailed dynamics; instead, they constrain the admissible form of any physical description across observation scales. Each axiom defines a structural property of the event substrate and its relationship to scale-dependent observation.



2.1 Primitive Objects and Notation

Before stating the axioms, we introduce the primitive objects used throughout the theory.

Definition 1 (Quantized Event)**.** A *quantized event*, denoted Q_e, is an irreducible state transition between two distinguishable configurations of a physical system. Formally, it is represented as a transition

$$x_t \rightarrow x_{t+1},$$

where the transition satisfies the criterion of measurability at some observation scale σ.

Quantized events are not assumed to be spatially localized particles nor instantaneous occurrences in an external time parameter. They are primitive transitions that collectively define the structure from which both spacetime geometry and dynamical laws are inferred.

Definition 2 (Observation Scale)**.** An *observation scale* σ is defined by a pair $(\Delta x, \Delta t)$ specifying the spatial and temporal resolution of measurement. All physical descriptions are indexed by σ, and quantities expressed at different scales are related through explicit aggregation operators.

2.2 Axiom I: Irreducible Event Structure

Definition 3 (Axiom I)**.** Reality admits a decomposition into quantized events Q_e such that no event can be subdivided into smaller measurable transitions at the same observation scale.

This axiom establishes discreteness as a property of description rather than an intrinsic commitment to atomic spacetime. What counts as irreducible is always relative to σ; finer resolution may reveal substructure that was previously unobservable.

Remark 1. Axiom I does not assert a minimum length or time in an absolute sense. It asserts only that, at any fixed scale, there exists a smallest resolvable transition.

2.3 Axiom II: Scale-Dependent Aggregation

Definition 4 (Axiom II)**.** The apparent continuity or discreteness of physical law arises from the aggregation of quantized events over an observation scale σ.

At coarse scales, large collections of events are integrated, producing smooth trajectories and continuous fields. At fine scales, individual events remain distinguishable, and probabilistic or stochastic descriptions dominate.

Remark 2. Classical fields and spacetime metrics are therefore treated as emergent statistical summaries of underlying event structure, not as fundamental entities.

2.4 Axiom III: Etched Block Structure

Definition 5 (Axiom III)**.** All quantized events are embedded in a four-dimensional block structure in which the total set of events is fixed, while their interpretation depends on observation scale.

This axiom adopts a block-universe ontology without privileging any particular foliation or temporal ordering as fundamental. Dynamics arise from relational structure among events rather than from an external flow of time.

2.5 Axiom IV: Bounded Disturbance Propagation

Definition 6 (Axiom IV)**.** Physical stability at scale σ requires that disturbances between connected quantized events remain bounded under aggregation.

This axiom anticipates the introduction of a formal stability object that constrains admissible event connectivity. Regions that violate this bound cannot sustain coherent macroscopic structure.

Remark 3. Axiom IV functions as a selection principle: only regions of the block structure that satisfy bounded propagation give rise to persistent physical or cognitive systems.

2.6 Summary of the Axiomatic Layer

Together, these axioms define a theory in which:

- Discreteness and continuity are scale-relative descriptions.
- Events, not fields or particles, form the primitive substrate.
- Temporal evolution is an emergent ordering of etched transitions.
- Stability is a structural constraint rather than a dynamical add-on.

The next section introduces the governing mathematical expression that implements these axioms quantitatively.

3 The Governing Etching Equation

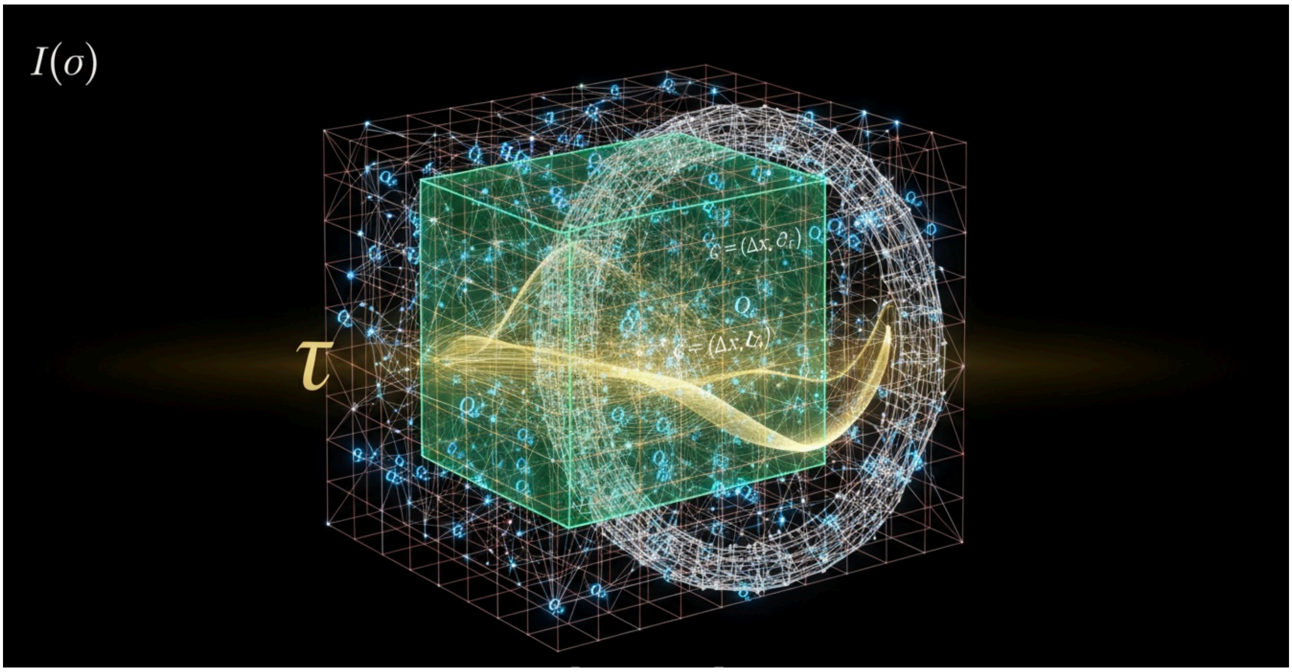
The axioms of Quantum Etching Theory are implemented through a single scale-indexed construction that maps irreducible event structure to observable physical description. This construction formalizes observation as an aggregation operator acting on quantized events, constrained by stability-preserving connectivity.

3.1 Observed Reality as a Scale-Indexed Functional

Let $I(\sigma)$ denote the observed physical description at observation scale $\sigma = (\Delta x, \Delta t)$. QET defines $I(\sigma)$ not as a fundamental state, but as the result of integrating quantized events over a finite resolution window. Formally,

$$I(\sigma) \;=\; \oint_{\Omega} \left[\sum_{i=1}^{N} Q_{ei}\, \delta(\tau - \tau_i) \right] \;\star\; \mathcal{F}(\Delta x, \Delta t) \;\otimes\; \boldsymbol{\mathcal{C}}. \tag{1}$$

Each component of Eq. (1) corresponds directly to one of the axioms introduced in Section 2.



3.2 Event Sum and Temporal Marking

The summation

$$\sum_{i=1}^{N} Q_{ei}\, \delta(\tau - \tau_i)$$

represents the full set of quantized events embedded in the block structure, indexed by an internal ordering parameter τ. The Dirac distribution does not introduce a flowing time variable; it serves only to label relational adjacency between events.

Remark 4. The parameter τ is not assumed to correspond to physical time as measured by clocks. It is an ordering index internal to the etched structure.

3.3 The Observation Kernel

The operator $\mathcal{F}(\Delta x, \Delta t)$ acts as a scale-dependent kernel that aggregates event structure. Its functional form depends on the resolution of observation.

- **High-resolution regime** ($\Delta x \to \ell_P,\ \Delta t \to t_P$): $\mathcal{F}$ approaches a delta-like kernel, isolating individual events. In this regime, stochastic or quantum descriptions dominate.
- **Low-resolution regime** ($\Delta x \gg \ell_P,\ \Delta t \gg t_P$): $\mathcal{F}$ behaves as a low-pass filter, suppressing high-frequency event structure and producing smooth effective fields and trajectories.

Thus, the apparent mathematical form of physical law depends explicitly on the choice of $\mathcal{F}$, and therefore on σ.

3.4 Stable Connectivity Tensor

The tensor $\mathcal{C}$ encodes admissible pathways of influence between events. It represents the structural constraint imposed by Axiom IV, ensuring bounded propagation of disturbances under aggregation.

We define stability at scale σ by the condition

$$\|\mathcal{C} \cdot Q_e\| < \epsilon_{\text{threshold}}(\sigma), \tag{2}$$

where $\epsilon_{\text{threshold}}$ is a scale-dependent bound.

Remark 5. Equation (2) is not a dynamical equation of motion. It is a constraint on admissible connectivity. Violations correspond to loss of reconstructability rather than energetic divergence.

3.5 Interpretation of the Etching

Equation (1) formalizes the central claim of QET: physical reality at any scale is an etched summary of event structure filtered by observation and constrained by connectivity. The block structure remains fixed, while the observed description varies with σ.

In this sense, laws of physics are not immutable priors but scale-indexed regularities that emerge from stable patterns of event aggregation.

3.6 Limiting Cases and Consistency

In appropriate limits, the governing equation reproduces standard descriptions:

- Classical field theory emerges when $\mathcal{F}$ strongly suppresses event-level detail and $\mathcal{C}$ enforces smooth connectivity.
- Quantum descriptions emerge when individual events remain resolvable and aggregation is minimal.

The theory is therefore consistent with established physics within validated regimes, while providing a unified formal language for transitions between them.

4 Stability, Connectivity, and Structural Persistence

This section formalizes the notion of stability introduced axiomatically and encoded in the Stable Connectivity Tensor $\mathcal{C}$. The objective is to distinguish structural persistence from dynamical evolution and to characterize failure modes in which physical descriptions cease to be reconstructable at a given observation scale.

4.1 Connectivity as a Structural Constraint

Connectivity in QET does not represent causal force propagation in the conventional sense. Instead, it specifies which sequences of quantized events may be jointly aggregated without unbounded amplification of disturbance. Formally, $\mathcal{C}$ acts on collections of events to constrain admissible relational paths within the etched block structure.

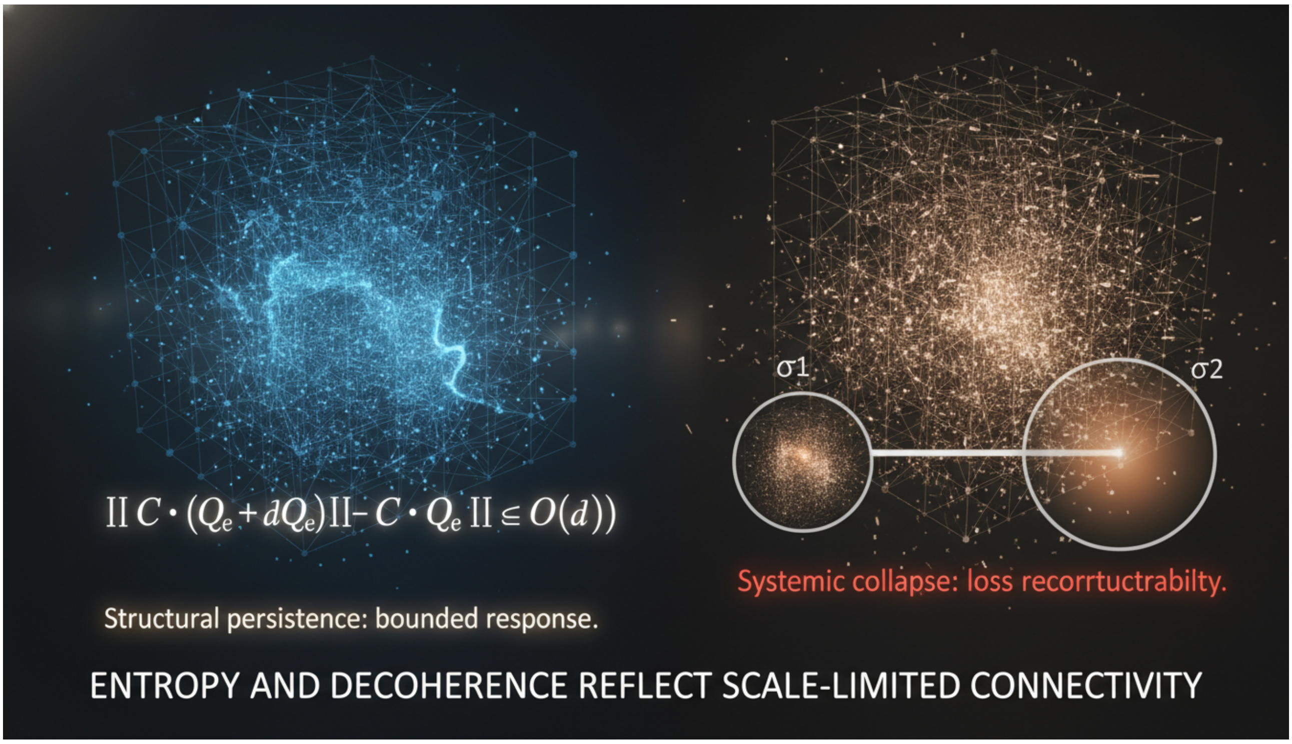
Definition 7 (Admissible Connectivity)**.** A set of quantized events $\{Q_{ei}\}$ is said to be *admissibly connected* at scale σ if there exists a connectivity tensor $\mathcal{C}(\sigma)$ such that

$$\left\| \mathcal{C}(\sigma) \cdot \sum_i Q_{ei} \right\| < \epsilon_{\text{threshold}}(\sigma).$$

Admissible connectivity ensures that aggregation over the observation kernel does not introduce uncontrolled deviation in the resulting description.

4.2 Structural Persistence

Structural persistence is defined as the capacity of an aggregated region to maintain a stable description under small perturbations to event structure.



Definition 8 (Structural Persistence)**.** A region of the event manifold exhibits *structural persistence* at scale σ if all admissible perturbations δQ_e satisfy

$$\|\boldsymbol{\mathcal{C}} \cdot (Q_e + \delta Q_e)\| - \|\boldsymbol{\mathcal{C}} \cdot Q_e\| \;\leq\; \mathcal{O}(\delta),$$

with $\mathcal{O}(\delta)$ vanishing as $\delta \to 0$.

Persistence is therefore a property of bounded response, not of energetic minimization or equilibrium.

4.3 Systemic Collapse

When connectivity constraints fail, aggregation ceases to produce a stable macroscopic description.

Definition 9 (Systemic Collapse)**.** Systemic collapse at scale σ occurs when no connectivity tensor exists that satisfies the bounded disturbance condition for a given region of events.

Collapse manifests observationally as decoherence, loss of classical trajectory structure, or effective erasure of information, depending on the regime and scale.

Remark 6. Systemic collapse does not imply destruction of underlying events. The etched structure remains intact; what fails is the ability of an observer at scale σ to reconstruct a coherent description.

4.4 Relation to Entropy and Decoherence

Within QET, entropy increase is interpreted as a measure of diminishing reconstructability rather than microscopic disorder. As aggregation proceeds, high-frequency correlations between events may fall outside admissible connectivity bounds, rendering them inaccessible at the observation scale.

Decoherence is thus recast as a connectivity failure: interference terms persist in the etched structure but no longer contribute to stable aggregated descriptions.

4.5 Scale Dependence of Stability Thresholds

The stability threshold $\epsilon_{\text{threshold}}(\sigma)$ is explicitly scale-dependent. Coarse observation tolerates larger absolute disturbances while suppressing fine structure; fine observation admits smaller disturbances but preserves detailed event relations.

This dependence predicts sharp transitions in observed behavior as σ varies, providing a natural boundary between quantum, mesoscopic, and classical regimes without invoking separate physical laws.

4.6 Summary

Stability in Quantum Etching Theory is a geometric and structural condition imposed on event connectivity. Persistent physical systems correspond to regions of the etched block structure that admit bounded aggregation at the observation scale. Failure of this condition leads to systemic collapse, redefining decoherence and entropy as observational phenomena rather than fundamental losses.

5 Emergent Cognition and Macroscopic Stability Basins

This section applies the structural machinery of Quantum Etching Theory to cognitive systems. No additional primitives are introduced. Cognition is treated as a special case of macroscopic structural persistence arising from dense, recurrent connectivity among quantized events.

5.1 Cognitive Systems as High-Density Event Regions

A cognitive system is defined here as a region of the event manifold characterized by exceptionally high event density and strong recurrent connectivity. Neural activity, biochemical signaling, and sensory transduction collectively instantiate large ensembles of quantized events whose aggregation produces stable macroscopic patterns.

Let $\{Q_{e_j}^{\text{neural}}\}$ denote the subset of events associated with a biological nervous system. At the relevant observation scale σ_{cog}, the aggregation window spans temporal intervals on the order of tens to hundreds of milliseconds and spatial regions encompassing large neural populations.

Remark 7. Nothing in this definition is specific to biological substrate. Any system that satisfies the same connectivity and stability conditions would qualify as cognitive under QET.

5.2 Macroscopic Stability Basins

We define a macroscopic cognitive state as a basin of attraction in the space of aggregated descriptions.

Definition 10 (Macroscopic Stability Basin)**.** A macroscopic stability basin is a region in the space of aggregated states $I(\sigma)$ such that trajectories entering the region remain bounded under admissible perturbations.

These basins correspond to persistent percepts, intentions, memories, or behavioral dispositions. Their stability is maintained by dense feedback encoded in $\mathcal{C}$, not by top-down control or initiating causes.

5.3 The Intentional Blur

Individual neural events are deterministic transitions within the etched block structure. However, when integrated over σ_{cog}, fine-grained causal detail is suppressed by the observation kernel $\mathcal{F}$.

This suppression produces what may be termed an *intentional blur*: a unified macroscopic state that masks the multiplicity of underlying event paths. The resulting description is low-frequency, coherent, and persistent, satisfying the stability condition of Section 4.

Remark 8. The intentional blur is not an epistemic failure. It is the necessary consequence of stability-preserving aggregation.

5.4 Subjective Agency as Structural Interpretation

Within QET, the experience of agency is identified with the persistence of a macroscopic stability basin across successive aggregation windows. The system continuously re-enters nearby regions of state space, giving rise to the appearance of continuity and authorship.

Formally, if $I_t(\sigma)$ and $I_{t+1}(\sigma)$ remain within the same basin under the action of $\mathcal{C}$, the system registers a single coherent trajectory despite underlying event turnover.

5.5 No Causal Privilege of the Self

Crucially, QET assigns no causal privilege to macroscopic cognitive states. Stability basins do not initiate events; they constrain which aggregated descriptions remain admissible. All causal structure resides at the level of quantized events and their connectivity.

This resolves apparent tensions between determinism and subjective experience without modifying physical law. The self is not a driver of the etched structure, but a stable interpretive pattern arising within it.

5.6 Summary

Cognition in Quantum Etching Theory is an emergent stability phenomenon. Conscious intent corresponds to a macroscopic basin maintained by dense, recurrent connectivity among events. The feeling of authorship arises from structural persistence across observation windows, not from indeterminacy or top-down causation.

6 Predictions, Experimental Access, and Falsifiability

Quantum Etching Theory is intended as a physically constrained framework rather than a purely interpretive reformulation. Accordingly, it yields concrete predictions that distinguish it from scale-invariant formulations of physics. These predictions arise from the explicit dependence of observable structure on the observation scale σ and from the existence of connectivity thresholds governing structural persistence.

6.1 Scale-Parameterized Effective Constants

In QET, quantities traditionally treated as fundamental constants appear as effective parameters derived from event aggregation. While their values remain invariant across wide observational regimes, the theory predicts measurable deviation near resolution boundaries where aggregation structure changes.

Proposition 1 (Scale Dependence of Effective Constants)**.** *Let k denote a physical constant inferred from observations at scale σ. QET predicts that*

$$k(\sigma) = k_0 \left[1 + \alpha \log\left(\frac{\sigma}{\sigma_0}\right) + \mathcal{O}(\alpha^2) \right],$$

for sufficiently small α, where σ_0 is a reference scale.

This behavior is expected to be negligible in everyday laboratory conditions but potentially detectable in precision experiments probing mesoscopic regimes between quantum coherence and classical stability.

6.2 Connectivity Threshold Transitions

The existence of a scale-dependent stability bound $\epsilon_{\text{threshold}}(\sigma)$ implies the presence of sharp transitions in observable behavior when event density or connectivity falls below critical values.

Proposition 2 (Connectivity Threshold)**.** *There exists a critical event density $\rho_c(\sigma)$ such that for $\rho < \rho_c$, no admissible connectivity tensor $\boldsymbol{\mathcal{C}}$ satisfies the bounded disturbance condition.*

Below this threshold, aggregated descriptions fail to persist, leading to rapid loss of reconstructability. Observationally, this may appear as abrupt decoherence, sudden loss of classical trajectories, or effective vacuum behavior despite preserved microscopic structure.

6.3 Mesoscopic Test Regimes

The most promising tests of QET lie in systems that straddle the boundary between quantum coherence and classical stability. Candidate regimes include:

- Large molecular interferometry, where coherence length and aggregation scale compete.
- Neural-scale electrophysiology, where dense event coupling produces stable macroscopic patterns.
- Engineered quantum systems with tunable connectivity, allowing controlled approach to stability thresholds.

In each case, QET predicts non-smooth transitions as aggregation scale or connectivity is varied, in contrast to gradual crossover expected from purely statistical models.

6.4 Distinguishing QET from Interpretive Frameworks

Unlike interpretations that modify only the semantics of quantum theory, QET makes structural commitments that can be falsified. Failure to observe scale-parameterized drift, threshold behavior, or bounded-reconstructability transitions in the relevant regimes would directly undermine the theory.

Remark 9. Agreement with existing data in established regimes is not sufficient validation. QET stands or falls on its ability to predict deviations where aggregation structure changes.

6.5 Summary

Quantum Etching Theory is empirically constrained by its scale dependence and stability criteria. Its predictions target mesoscopic domains where traditional descriptions are least secure, offering clear experimental pathways for confirmation or rejection.

7 Methodological Implications and Limits

Quantum Etching Theory occupies a methodological position that is deliberately constrained. It is neither a replacement for established dynamical laws nor an interpretive overlay detached from empirical consequence. Instead, QET functions as a scale-explicit structural framework: it specifies how descriptions valid at different resolutions relate to one another through aggregation and stability constraints.

7.1 Separation of Structure and Dynamics

A central methodological commitment of QET is the separation between structural admissibility and dynamical evolution. Traditional physical theories often conflate these roles by embedding stability requirements directly into equations of motion. QET instead treats stability as a prior constraint on which aggregated descriptions are physically meaningful at a given scale.

This separation allows multiple dynamical models to coexist within the same structural envelope, provided they respect bounded disturbance propagation. Consequently, disagreements between competing microscopic models do not immediately threaten the coherence of macroscopic descriptions, so long as connectivity conditions are satisfied.

7.2 Limits of Applicability

QET is not intended to describe phenomena outside the domain of scale-dependent aggregation. It does not address:

- The detailed microdynamics governing individual quantized events.
- The origin of specific interaction strengths or coupling constants at the event level.
- Cosmological initial conditions or ultimate boundary conditions of the block structure.

These omissions are not deficiencies but scope delimitations. QET constrains how descriptions relate across scales; it does not attempt to exhaustively specify the content of any one scale.

7.3 On Interpretation and Ontology

Ontologically, QET is minimal. It commits only to the existence of quantized events and their relational embedding. Concepts such as particles, fields, spacetime manifolds, observers, and selves are treated as emergent descriptive conveniences whose validity is indexed to scale and stability.

Interpretive disputes that do not alter structural predictions are therefore considered extraneous to the theory's core claims. QET remains agnostic on metaphysical narratives that exceed its formal commitments.

7.4 Methodological Risk

Because QET introduces scale dependence at a foundational level, it risks overfitting if not tightly constrained by experiment. For this reason, the theory emphasizes falsifiability through threshold behavior and scale-parameterized deviation. Absence of such effects in targeted regimes would necessitate revision or abandonment of the framework.

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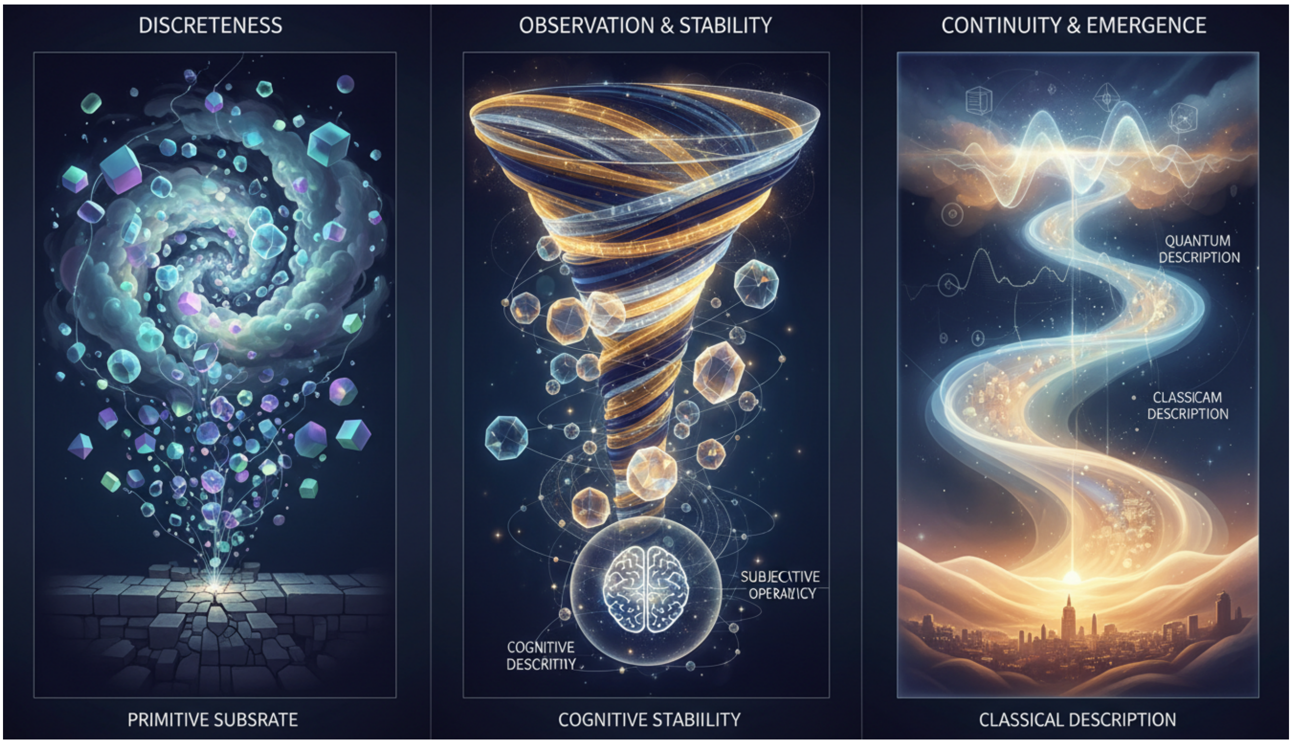
8 Conclusion

Quantum Etching Theory reframes the long-standing tension between continuity and discreteness as a question of scale-dependent description rather than fundamental incompatibility. By treating quantized events as the primitive substrate and observation as an aggregation operation constrained by stability, QET provides a unified language in which classical and quantum descriptions emerge as limiting cases.

The introduction of the Stable Connectivity Tensor formalizes persistence without invoking new dynamics, allowing decoherence, entropy increase, and cognitive stability to be treated within the same structural framework. Macroscopic phenomena, including subjective agency, are recast as stability basins rather than causal initiators.

Crucially, QET is not insulated from empirical scrutiny. Its scale-explicit structure generates testable predictions in mesoscopic regimes where traditional theories offer only heuristic guidance. Whether these predictions are borne out will determine the viability of the framework.

If successful, Quantum Etching Theory offers not a final theory of nature, but a disciplined way to understand how the laws we observe are etched from deeper structure by the act of observation itself.



A Notation and Conventions

This appendix fixes notation and conventions used throughout the paper to ensure internal consistency and facilitate extension.

A.1 Scales and Parameters

- $\sigma = (\Delta x, \Delta t)$: Observation scale.
- ℓ_P, t_P: Reference microscopic scales (Planck length and time).
- $\epsilon_{\text{threshold}}(\sigma)$: Scale-dependent stability bound.
- ρ: Event density per aggregation window.

A.2 Core Objects

- Q_e: Quantized event (irreducible state transition).
- $I(\sigma)$: Aggregated observable description at scale σ.
- $\mathcal{F}(\Delta x, \Delta t)$: Observation kernel.
- $\mathcal{C}$: Stable Connectivity Tensor.

A.3 Norms and Operators

Unless otherwise specified, norms are assumed to be induced operator norms compatible with the aggregation kernel $\mathcal{F}$. Convolutions and tensor products are understood in the generalized distributional sense.

B On the Choice of Observation Kernel

The theory does not privilege a unique functional form for $\mathcal{F}$. Acceptable kernels must satisfy the following minimal conditions:

1. Normalization over the aggregation window.
2. Suppression of frequencies above the inverse resolution scale.
3. Stability under composition across adjacent windows.

Gaussian, compact-support, and wavelet-based kernels all satisfy these conditions and may be selected based on experimental context.

C Relation to Existing Frameworks

Quantum Etching Theory overlaps structurally with, but is not reducible to:

- Renormalization group flow (scale-dependent effective descriptions).
- Decoherence theory (loss of reconstructability without information loss).
- Control-theoretic stability (bounded response under perturbation).

QET differs in that scale dependence is treated as a primitive feature of observation rather than a secondary approximation.

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