1. Introduction

1.1 The Problem of Spacetime Ontology

Physics treats spacetime as the stage on which everything happens.
General relativity treats it as a smooth geometric manifold.
Quantum field theory treats it as a fixed background.

Quantum gravity attempts to quantize it, discretize it, or replace it with algebraic structures.

But all of these approaches share the same assumption:

> **Spacetime is fundamental.**

This assumption creates the deepest fractures in modern physics:

- singularities
- divergences
- the measurement problem
- the incompatibility of quantum discreteness with geometric continuity
- the tension between nonlocal entanglement and local causal structure
- the arrow of time vs. time-reversal symmetry

These are not technical problems.

They are ontological problems.

They arise because spacetime is being treated as the foundation when it is actually the **summary** of something deeper.

1.2 Why Geometry Cannot Be Fundamental

Geometry presupposes:

- distances
- durations
- continuity
- differentiability
- metric structure

But ED shows that at the micro-scale:

- there are no distances
- there are no durations
- there is no manifold

- there is only **becoming**
- and the **participation structure** that relates micro-events

Geometry is what thick, committed participation looks like when coarse-grained.
It is not the substrate of reality.

It is the **shadow** of ED gradients.

This is why geometry breaks down at singularities and Planck scales:

it was never fundamental to begin with.

1.3 Why Information Cannot Be Fundamental

Information theory treats information as a substance that flows, is stored, is conserved, or is lost. But information presupposes:

- stable records
- classical states
- committed histories
- thick participation

These are **late-stage** features of ED, not primitives.

Information cannot be fundamental because:

- micro-events are not committed
- uncommitted channels do not encode definite states
- decoherence and commitment create records
- classical thickening stabilizes them

Information is a **constraint** on participation, not a substance.

It emerges only after commitment.

1.4 ED as the Substrate Beneath Geometry and Information

Event Density provides the ontology that both geometry and information lack:

- **Micro-events**: the atomic units of becoming
- **Participation**: the relational substrate
- **Uncommitted channels**: the source of quantum possibility
- **Commitment**: the source of classical definiteness
- **Thickening**: the source of geometric stability
- **ED gradients**: the source of curvature and causal structure

From these primitives:

- spacetime emerges as a **thick participation manifold**
- geometry emerges as **coarse-grained participation resistance**
- information emerges as **constraints on commitment histories**
- the arrow of time emerges from **irreversible commitment**

ED does not modify spacetime.

It **precedes** it.

1.5 Aim of the Paper

This paper develops the ED account of spacetime, geometry, information, and temporal asymmetry. We show that:

- spacetime is not fundamental
- geometry is emergent
- information is relational constraint
- causal structure arises from participation limits
- horizons are decoupling surfaces
- the arrow of time is the asymmetry of commitment
- Einstein's equations are large-scale summaries of ED gradients
- quantum gravity is the wrong question; ED is the right ontology

The goal is not to reinterpret spacetime but to **derive it**.

Paper 10 completes the macro-scale half of the ED program.

Together with Paper 9, it shows that the same primitives — micro-events, participation, ED gradients, and commitment — govern:

- quantum behavior
- classical geometry
- relativistic structure
- cosmological evolution

ED becomes the ontological foundation beneath physics.

2. From Micro-Events to Manifolds

2.1 Micro-Events Are Not in Space

In ED, micro-events are the atomic units of becoming.

They are not located *in* space because space does not yet exist at the micro-scale.

A micro-event has:

- no position
- no extension
- no duration
- no trajectory
- no embedding in a manifold

It is a discrete act of becoming, defined only by:

- its **participation relations**
- its **commitment order**
- its **integration into other micro-events**

Space is not the container of micro-events.

Space is what **stable participation adjacency looks like** when coarse-grained.

2.2 Participation Adjacency as the Proto-Geometry

Two micro-events are “near” each other only in the sense that:

- they integrate each other’s becoming
- they share participation bandwidth
- their relational timing is tightly coupled

This is **participation adjacency**.

It is the micro-scale precursor of:

- spatial proximity
- metric distance
- geometric structure

But it is not geometric itself.

It is purely relational.

Space emerges when participation adjacency becomes:

- stable
- redundant
- thick
- committed

In other words:

space is the classical limit of participation adjacency.

2.3 Extended Structures from Stable Participation Networks

A single micro-event is atomic.

But a *network* of micro-events can form a stable structure if:

- participation bandwidth is high
- commitment histories reinforce each other
- ED gradients remain smooth
- relational timing is coherent

These networks behave like:

- worldlines
- trajectories
- extended objects
- classical systems

But these are not fundamental.

They are **patterns of committed micro-events**.

Extended structure is not “in” space.

It is what space *is* when viewed at scale.

2.4 Space as the Coarse-Grained Summary of Participation

When participation networks become thick and stable:

- adjacency becomes transitive
- relational timing becomes consistent
- ED gradients become smooth
- commitment histories align

This produces the large-scale illusion of:

- continuity
- dimensionality
- metric structure
- geometric relations

Space is the **macroscopic summary** of these properties.

It is not a container.

It is a **summary statistic** of relational becoming.

2.5 Time as the Coarse-Grained Summary of Commitment Order

Time is not a dimension.

It is the **order of commitments**.

Micro-events commit irreversibly.

This produces:

- temporal direction
- temporal ordering
- temporal asymmetry

When coarse-grained:

- commitment order becomes “time”
- commitment rate becomes “duration”
- ED gradients become “time dilation”

Time is not a coordinate.

It is the **macroscopic appearance** of irreversible becoming.

2.6 Why Manifolds Appear

A manifold appears when:

- participation adjacency becomes smooth
- commitment histories become thick
- ED gradients vary slowly
- relational timing becomes coherent
- classicality dominates

In this regime:

- space appears continuous
- time appears continuous
- geometry appears smooth
- causal structure appears geometric

But these are emergent illusions.

The manifold is the **shadow** of ED’s relational architecture.

2.7 The Micro → Macro Transition

The transition from micro-events to manifolds is the transition from:

- thin → thick participation
- uncommitted → committed structure
- relational adjacency → geometric distance
- commitment order → temporal dimension
- ED gradients → curvature

This is the architectural heart of Paper 10:

> **Spacetime is what thick, committed participation looks like when viewed from far away.**

3. Geometry as Coarse-Grained Participation

3.1 Geometry Is Not a Background

In classical physics, geometry is a fixed stage.
In general relativity, geometry is dynamical but still fundamental.

In quantum gravity, geometry is quantized, discretized, or algebraized.

All of these approaches assume:

> **Geometry exists prior to physical processes.**

ED reverses this assumption.

Geometry is not the substrate.

Geometry is the **summary** of how participation behaves when thick, stable, and committed.

There is no metric at the micro-scale.

There is only:

- participation adjacency
- ED gradients
- commitment order

Geometry is the large-scale appearance of these relational structures.

3.2 Distance as Participation Resistance

Two regions “feel” distant when:

- participation bandwidth between them is low

- relational timing is weakly coupled
- ED gradients resist integration
- commitment histories diverge

This resistance is what becomes **distance** when coarse-grained.

Thus:

- high participation → short distance
- low participation → long distance
- zero participation → causal disconnection

Distance is not a primitive.

It is the **macroscopic measure of participation resistance**.

3.3 Curvature as ED Gradient Structure

Curvature is not a property of a manifold.

It is the **pattern of ED gradients** across a participation network.

Where ED changes smoothly:

- participation pathways are stable
- geodesics remain straight
- geometry appears flat

Where ED changes sharply:

- participation pathways bend
- relational timing shifts
- geodesics curve

Curvature is the **shadow** of how ED varies across regions.

This reframes general relativity:

- Einstein's equations describe how ED gradients behave when thick
- curvature is the large-scale summary of those gradients
- matter is the distribution of committed micro-events
- geometry is the relational consequence

Nothing "curves" space.

Participation structure curves **geometry**.

3.4 Geodesics as Stable Participation Pathways

A geodesic is not a path in a manifold.

It is a **stable participation pathway** — the route through which micro-events integrate most efficiently.

A geodesic is the path that:

- minimizes participation resistance
- maximizes relational coherence
- aligns with ED gradients
- preserves commitment stability

This is why:

- free-fall is inertial
- light follows null geodesics
- curvature redirects trajectories

Geodesics are not geometric objects.

They are **participation-optimal histories**.

3.5 Dimensionality as a Large-Scale Illusion

Dimensionality is not fundamental.

It emerges when:

- participation adjacency becomes transitive
- ED gradients vary smoothly
- commitment histories align
- classical thickening stabilizes structure

The number of effective dimensions is the number of **independent participation directions** available at scale.

This explains:

- why micro-scales do not have a fixed dimensionality
- why dimensionality can change in extreme regimes
- why quantum gravity struggles with “dimensional reduction”
- why ED avoids these paradoxes entirely

Dimensionality is a **macroscopic regularity**, not a micro-scale fact.

3.6 Why Geometry Appears Smooth

Geometry appears smooth because:

- micro-events are dense in classical regimes
- participation is thick and redundant
- ED gradients vary slowly
- commitment histories reinforce coherence

Smoothness is not a property of the substrate.

It is the **statistical effect** of many micro-events behaving coherently.

This is why geometry breaks down at:

- singularities
- Planck scales
- horizons
- quantum regimes

Smoothness is a large-scale illusion.

3.7 Geometry as the Classical Limit of Participation

The architectural summary:

> **Geometry is the coarse-grained appearance of participation resistance, ED gradients, and commitment coherence.**

- Distance = participation resistance
- Curvature = ED gradient structure
- Geodesics = stable participation pathways
- Dimensionality = large-scale participation regularity
- Smoothness = classical thickening

Geometry is not the foundation of physics.

It is the **classical limit** of ED.

4. Spacetime as a Thick Participation Manifold

4.1 Classical Spacetime Requires Thick Participation

Quantum behavior requires thin, fine-grained participation.

Classical behavior requires thick, redundant participation.

Spacetime belongs to the classical regime.

A spacetime manifold appears only when:

- participation is **dense**
- commitment is **rapid and irreversible**
- ED gradients vary **smoothly**
- relational timing is **coherent**
- micro-event histories are **highly redundant**

In this regime, the participation network becomes so stable that it can be approximated as:

- continuous
- differentiable
- metric
- geometric

This approximation is what we call **spacetime**.

Spacetime is not the substrate.

It is the **classical limit** of ED.

4.2 Why Spacetime Is Thick

Thickness means:

- many micro-events commit in tightly coupled patterns
- participation bandwidth is high and redundant
- commitment histories reinforce each other
- ED gradients change slowly enough to appear smooth

This redundancy produces:

- stable trajectories
- persistent objects
- well-defined causal structure
- geometric regularity

Thickness is what makes spacetime *look* continuous even though the underlying ontology is discrete.

4.3 Locality as a Property of Thick Participation

Locality is not a micro-scale fact.

It is a **macro-scale illusion** produced by thick participation.

Two regions appear “local” when:

- their participation adjacency is strong

- their ED gradients are smooth
- their commitment histories align
- their relational timing is coherent

Locality is the **emergent structure** of thick participation networks.

This explains:

- why quantum systems violate classical locality
- why entanglement is nonlocal but never causal
- why classical objects obey local dynamics
- why spacetime locality breaks down near horizons and singularities

Locality is not fundamental.

It is the **shadow** of classical thickness.

4.4 Horizons as Decoupling Surfaces

A horizon is not a geometric boundary.

It is a **participation boundary**.

A horizon forms when:

- ED gradients become steep
- participation bandwidth across a surface collapses
- micro-events on one side cannot integrate micro-events on the other
- commitment histories diverge irreversibly

This produces:

- causal disconnection
- information inaccessibility
- thermal behavior (Hawking/Unruh)
- entanglement across the boundary

Horizons are not mysterious.

They are **structural decoupling surfaces** in the participation network.

This ties directly back to Paper 6.

4.5 Why Spacetime Is Stable Only in the Classical Regime

Spacetime dissolves when:

- participation becomes thin

- ED gradients fluctuate rapidly
- commitment histories lose coherence
- micro-event discreteness dominates

This happens at:

- quantum scales
- Planck scales
- singularities
- early-universe epochs
- horizon interiors

Spacetime is stable only when participation is thick enough to support:

- smooth ED gradients
- coherent relational timing
- redundant commitment histories

Outside this regime, spacetime is not meaningful.

4.6 The Manifold as a Large-Scale Approximation

A manifold is a mathematical idealization of:

- smooth ED gradients
- stable participation adjacency
- coherent commitment order
- thick classical structure

It is a **model**, not an ontology.

The manifold appears because:

- micro-events are dense
- participation is redundant
- ED gradients vary slowly
- classical thickening suppresses discreteness

This is why:

- geometry breaks down at singularities
- spacetime dissolves at quantum scales
- dimensionality can change in extreme regimes
- quantum gravity struggles with “quantizing” geometry

The manifold is the **wrong level of description** for micro-events.

4.7 The Architectural Summary

Spacetime is not the stage on which physics happens.

It is the **classical appearance** of ED's relational architecture.

- **Space** = stable participation adjacency
- **Time** = commitment order
- **Distance** = participation resistance
- **Curvature** = ED gradient structure
- **Locality** = thick participation coherence
- **Horizons** = decoupling surfaces
- **Geometry** = coarse-grained participation

Spacetime is the **thick participation manifold** that emerges when micro-events commit in dense, redundant patterns.

5. Information as Participation Constraint

5.1 Information Is Not a Substance

Physics often treats information as if it were a kind of fluid:

- stored
- transmitted
- conserved
- lost
- encoded
- erased

But all of these metaphors presuppose:

- stable states
- committed histories
- classical redundancy
- thick participation

These are **late-stage** features of ED, not primitives.

At the micro-scale:

- micro-events are uncommitted
- participation channels coexist
- relational timing is distributed
- no definite state exists

There is nothing to “store” or “transmit.”

Information cannot be fundamental because the substrate of reality — micro-events and participation — does not contain stable, committed states.

Information is not a thing.

It is a **constraint** on how becoming can unfold.

5.2 Records as Committed Participation Histories

A “record” is not a physical object.

It is a **pattern of committed micro-events** that:

- persists
- is redundant
- is stable under environmental integration
- can influence future participation

A record is a **thickened commitment history**.

This reframes:

- memory
- measurement outcomes
- classical states
- macroscopic objects
- data storage
- physical “bits”

All of these are **commitment patterns**, not fundamental entities.

Information is the **constraint** imposed by these patterns on future participation.

5.3 Entropy as the Distribution of Commitment Histories

Entropy is not disorder.
Entropy is not ignorance.

Entropy is not “missing information.”

In ED:

- entropy measures how many commitment histories are compatible with the current participation structure
- high entropy = many viable histories
- low entropy = few viable histories

Entropy is the **structural freedom** of the participation network.

This reframes:

- thermodynamic entropy
- black hole entropy
- entanglement entropy
- coarse-graining
- statistical mechanics

All become statements about **how commitment histories constrain future becoming**.

5.4 Mutual Information as Shared Participation Structure

Mutual information is not a measure of “shared bits.”

It is a measure of **shared participation structure**.

Two systems have high mutual information when:

- their commitment histories are correlated
- their participation networks overlap
- their ED gradients align
- their future commitments are constrained together

This reframes:

- entanglement entropy
- classical correlations
- decoherence
- measurement
- communication

Mutual information is the **degree to which two systems share becoming**.

5.5 Information Flow as Participation Reconfiguration

Information does not “move.”

What moves is **participation structure**.

When a system “receives information,” what actually happens is:

- its participation network is reconfigured
- its viable commitment histories change
- its future becoming is constrained differently

This reframes:

- communication
- computation
- signaling
- measurement
- observation

Information flow is **participation reconfiguration**, not transmission of a substance.

5.6 Why ED Reframes the Holographic Principle

The holographic principle states that the information content of a region is proportional to its boundary area. ED reframes this:

- a boundary is a **participation bottleneck**
- horizons are **decoupling surfaces**
- commitment histories inside cannot influence outside
- the boundary encodes the **constraints** on participation across it

Thus:

- the “information” on the boundary is the **set of constraints** imposed by the horizon
- the area law reflects the **participation capacity** of the boundary
- black hole entropy counts **viable commitment histories**, not microstates

The holographic principle becomes a statement about **participation geometry**, not information storage.

5.7 The Architectural Summary

Information is not fundamental.

It is the **constraint structure** that emerges when participation becomes thick and commitments become stable.

- **Records** = committed micro-event histories
- **Entropy** = distribution of viable histories
- **Mutual information** = shared participation structure
- **Information flow** = reconfiguration of participation
- **Holography** = constraints imposed by decoupling surfaces

Information is the **classical shadow** of ED’s relational architecture.

6. The Arrow of Time as the Asymmetry of Commitment

6.1 Time’s Arrow Cannot Be Statistical

In classical physics, the laws are time-reversal symmetric.
In statistical mechanics, the arrow of time is explained by probability.

In cosmology, it is attributed to special initial conditions.

All of these approaches assume:

- the underlying ontology is time-symmetric
- the arrow of time is emergent
- irreversibility is an illusion or approximation

ED rejects this assumption.

The arrow of time is not emergent.

It is **ontological**.

It arises from the **irreversibility of commitment**.

6.2 Micro-Events Commit Irreversibly

A micro-event cannot:

- un-commit
- reverse its becoming
- undo its integration
- erase its participation history

Commitment is a one-way process.

This is the fundamental asymmetry of ED:

Becoming is irreversible.

Commitment cannot be undone.

This irreversibility is the source of:

- temporal direction
- temporal ordering
- causal asymmetry
- the impossibility of “rewinding” reality

Time’s arrow is built into the substrate.

6.3 Decoherence → Commitment → Thickening

The arrow of time is the architectural sequence:

Decoherence

1. Participation thins; uncommitted channels lose definition.

Commitment

2. A micro-event selects a single viable channel.

Thickening

3. The committed structure becomes redundant and stable.

This sequence is **irreversible** because:

- thinning cannot be undone
- commitment cannot be reversed
- thickening reinforces the committed structure

This is the ontological origin of:

- classical irreversibility
- thermodynamic irreversibility
- causal asymmetry
- the psychological arrow of time

All arrows of time are shadows of **commitment asymmetry**.

6.4 Why Time Flows Forward

Time does not “flow.”

Becoming accumulates.

The forward direction of time is the direction in which:

- commitments accumulate
- histories thicken
- participation networks grow
- ED gradients evolve

The past is the set of **completed commitments**.

The future is the set of **uncommitted possibilities**.

This is not a metaphor.

It is the literal structure of ED.

6.5 Why the Past Is Fixed and the Future Is Open

In ED:

- the past is fixed because commitments are irreversible
- the future is open because uncommitted channels still exist

This explains:

- why records exist
- why memory works
- why causality is directional
- why we can influence the future but not the past

The asymmetry is structural, not statistical.

6.6 Why Time-Reversal Symmetry Is Only Approximate

Classical and quantum equations appear time-symmetric because:

- they describe **uncommitted evolution**
- they ignore commitment
- they ignore thickening
- they treat records as given

But the underlying ontology is not symmetric.

Time-reversal symmetry is the **illusion** that arises when:

- commitment is coarse-grained away
- thickening is ignored
- participation is treated as reversible

The symmetry is mathematical, not ontological.

6.7 The Arrow of Time Is the Arrow of Becoming

The deepest insight of this section is architectural:

Time's arrow is the asymmetry of commitment.

> **Commitment is the asymmetry of becoming.**

This unifies:

- thermodynamic irreversibility
- causal direction

- psychological time
- cosmological time
- quantum measurement irreversibility

All are expressions of the same structural fact:

micro-events commit irreversibly.

7. Dynamics as Geometry Evolution

7.1 Dynamics Are Not Laws Acting on a Manifold

In classical physics, dynamics are laws that act *on* spacetime.
In general relativity, dynamics are laws that act *as* spacetime.

In quantum mechanics, dynamics are laws that act *on* a state in spacetime.

All of these frameworks assume:

- a background manifold
- a pre-existing geometry
- a fixed notion of locality
- a temporal parameter

ED rejects this assumption.

There is no background.
There is no manifold.

There is only **participation geometry**, and it evolves.

Dynamics are not laws imposed on a substrate.

Dynamics **are** the evolution of the substrate.

7.2 ED Gradients Drive All Large-Scale Behavior

An ED gradient is:

- a variation in micro-event production rate
- a variation in participation bandwidth
- a variation in relational timing coherence

These gradients determine:

- curvature
- causal structure

- inertial behavior
- gravitational attraction
- horizon formation
- geometric evolution

In ED, “forces” are not fundamental.

They are **patterns in ED gradient evolution**.

7.3 Classical Dynamics as Thick Participation Reconfiguration

When participation is thick:

- commitment histories are stable
- ED gradients vary smoothly
- participation adjacency is coherent
- geometry is well-defined

In this regime, the evolution of ED gradients appears as:

- geodesic motion
- gravitational attraction
- curvature evolution
- Einstein’s equations

Einstein’s equations are not fundamental laws.

They are the **large-scale summary** of how ED gradients evolve in thick participation regimes.

7.4 Quantum Dynamics as Thin Participation Evolution

When participation is thin:

- uncommitted channels coexist
- relational timing is fine-grained
- ED gradients fluctuate
- commitment has not yet occurred

In this regime, the evolution of participation geometry appears as:

- Schrödinger evolution
- path integrals
- interference
- entanglement
- unitarity

Quantum dynamics are the **thin-regime expression** of participation evolution.

7.5 Why Quantum and Classical Dynamics Look Different

Quantum and classical dynamics appear incompatible because they describe **different participation regimes**:

- **Quantum:** thin, fine-grained, uncommitted
- **Classical:** thick, redundant, committed

But the underlying mechanism is the same:

> **Both are expressions of how participation geometry evolves.**

Quantum mechanics describes the evolution of **uncommitted** participation.

Classical mechanics describes the evolution of **committed** participation.

The difference is not ontological.

It is structural.

7.6 Why Dynamics Are Reversible in One Regime and Irreversible in the Other

In the thin regime:

- participation is uncommitted
- bandwidth is conserved
- relational timing is reversible
- no thickening occurs

This produces **unitary, reversible dynamics**.

In the thick regime:

- commitments accumulate
- histories reinforce
- thickening is irreversible
- ED gradients evolve asymmetrically

This produces **irreversible, classical dynamics**.

Reversibility and irreversibility are not contradictions.

They are **regime-dependent expressions** of participation evolution.

7.7 Geometry Evolution Is the Unifying Principle

The deepest insight of this section is architectural:

> **All dynamics — quantum, classical, and relativistic — are the evolution of participation geometry.**

- Quantum evolution = thin participation geometry
- Classical evolution = thick participation geometry
- Relativistic evolution = ED gradient geometry
- Measurement = commitment geometry
- Horizons = decoupling geometry

There are no separate laws.
There are no separate regimes.

There is one substrate — participation — and its geometry evolves.

8. Horizons, Causal Structure, and Information Flow

8.1 Causal Structure Is a Participation Constraint

In relativity, causal structure is geometric:

light cones, null surfaces, timelike vs. spacelike separation.

In ED, causal structure is **participation-theoretic**:

- micro-events can only integrate becoming within participation limits
- ED gradients constrain relational timing
- participation bandwidth cannot exceed local production rates
- commitment cannot propagate

These constraints produce:

- causal cones
- invariant speeds
- causal disconnection
- horizon behavior

Causality is not geometric.

Geometry is the **large-scale appearance** of causal participation limits.

8.2 Horizons as Participation Bottlenecks

A horizon forms when participation bandwidth across a surface collapses.

This happens when:

- ED gradients become steep
- relational timing decoheres across the boundary
- micro-events on one side cannot integrate micro-events on the other
- commitment histories diverge irreversibly

A horizon is therefore:

> **A structural decoupling surface in the participation network.**

This reframes:

- black hole horizons
- Rindler horizons
- cosmological horizons
- acoustic/analog horizons

All are **participation bottlenecks**, not geometric mysteries.

8.3 Why Information Cannot Cross a Horizon

In ED, “information” = constraints on participation and commitment histories.

A horizon blocks information because:

- participation adjacency collapses
- commitment histories cannot integrate across the boundary
- ED gradients prevent relational timing coherence
- micro-events cannot couple across the surface

Nothing “falls behind” a horizon in the classical sense.

Rather:

> **The participation network splits into two disconnected regions.**

This is why horizons behave thermally:

they are **participation sinks**.

8.4 Why Entanglement Can Span a Horizon

Entanglement is not information flow.

It is **shared uncommitted participation structure**.

Because shared structure can exist without micro-event integration:

- entanglement can span a horizon
- correlations persist
- no causal paradox arises
- no signal is transmitted

This resolves the apparent contradiction:

- information cannot cross a horizon
- entanglement can

Because they are different kinds of structure.

Information = committed structure

Entanglement = uncommitted structure

Horizons block the former, not the latter.

8.5 Black Hole Evaporation as Participation Re-Routing

Hawking radiation is usually described as:

- pair creation
- negative energy partners
- tunneling
- thermal emission

ED reframes it:

- horizons are participation bottlenecks
- ED gradients near the horizon are extreme
- uncommitted channels reconfigure
- commitment occurs asymmetrically
- participation structure “leaks” outward

Evaporation is not particle creation.

It is **participation re-routing** around a decoupling surface.

This avoids:

- information loss paradoxes
- firewall paradoxes
- complementarity contradictions
- unitarity crises

Because commitment is local and irreversible, not global and reversible.

8.6 Causal Cones as Participation Cones

A causal cone is not a geometric object.

It is the region in which:

- participation adjacency is nonzero
- relational timing is coherent
- ED gradients permit integration
- commitment histories can influence each other

Outside the cone:

- participation bandwidth is zero
- integration is impossible
- influence cannot propagate

This reframes:

- light cones
- causal diamonds
- global hyperbolicity
- causal ordering

All are **participation-defined**, not geometric primitives.

8.7 Information Flow as Participation Reconfiguration

Information does not move.

Participation structure changes.

When “information travels” from A to B:

- A’s commitment history constrains B’s future commitments
- participation adjacency carries the constraint
- ED gradients regulate the rate
- the reconfiguration propagates along stable participation pathways

This is why:

- signals follow geodesics
- nothing outruns causal cones
- communication requires thick participation
- quantum correlations do not transmit information

Information flow is **participation reconfiguration**, not substance transport.

8.8 The Architectural Summary

Horizons, causality, and information flow are not geometric facts.

They are **participation-theoretic structures**.

- **Causal structure** = participation limits
- **Horizons** = decoupling surfaces
- **Information flow** = reconfiguration of participation
- **Entanglement** = shared uncommitted structure
- **Evaporation** = participation re-routing
- **Light cones** = participation cones

The geometry of spacetime is the **classical appearance** of these deeper relational constraints.

9. Spacetime Breakdown at Micro-Scales

9.1 Spacetime Is a Large-Scale Approximation

Spacetime appears only when participation is:

- thick
- redundant
- committed
- smooth
- coherent

This is the classical regime.

But ED is not classical.

ED is micro-evental.

At sufficiently small scales:

- participation becomes thin
- ED gradients fluctuate
- commitment histories lose coherence
- adjacency becomes irregular
- discreteness dominates

The manifold approximation collapses.

Spacetime does not break.

It simply **stops being the right description**.

9.2 No Background Manifold Exists at the Micro-Scale

At the micro-event level:

- there are no points
- there are no coordinates
- there is no metric
- there is no topology
- there is no dimensionality

These are all **coarse-grained illusions** of thick participation.

Micro-events are not “in” spacetime.

Spacetime is what **dense micro-event commitment looks like** from far away.

This is why:

- quantum gravity cannot quantize geometry
- spacetime discreteness does not require a lattice
- Planck-scale structure is not geometric
- singularities are artifacts of the manifold model

The manifold is not fundamental.

Becoming is.

9.3 Why Geometry Fails at High Energies

At high energies:

- ED gradients become steep
- participation adjacency becomes irregular
- micro-event production rates spike
- commitment coherence breaks down

This produces:

- metric breakdown
- curvature divergence
- loss of locality
- horizon formation
- causal ambiguity

These are not physical catastrophes.

They are **failures of the geometric approximation**.

Geometry fails because it was never the substrate.

9.4 Singularities as Manifold Artifacts

Singularities occur when:

- ED gradients become too steep for the manifold approximation
- participation adjacency collapses
- commitment histories diverge
- thickening fails

General relativity predicts singularities because it assumes:

- smooth geometry
- differentiable structure
- continuous fields

ED predicts no singularities because:

- micro-events are discrete
- participation is finite
- ED gradients saturate
- commitment cannot diverge

A “singularity” is simply the region where **geometry stops being meaningful**.

9.5 Planck Scale as the Limit of the Manifold Approximation

The Planck scale is not a physical boundary.

It is the scale at which:

- participation becomes too thin
- ED gradients fluctuate too rapidly
- commitment coherence dissolves
- adjacency loses transitivity

Below this scale:

- spacetime dissolves
- geometry dissolves
- locality dissolves
- dimensionality dissolves

But ED remains perfectly well-defined.

The Planck scale is the **failure point of geometry**, not the failure point of physics.

9.6 Quantum Regimes Are Pre-Geometric

Quantum behavior is not “weird spacetime behavior.”

It is **pre-geometric behavior**:

- thin participation
- uncommitted channels
- fine-grained relational timing
- no stable adjacency
- no thickening

Quantum mechanics is the **mathematics of pre-geometric participation**.

This is why:

- quantum systems violate classical locality
- entanglement is nonlocal but not causal
- superposition is extended but not spatial
- measurement produces classical geometry

Quantum behavior is what reality looks like **before spacetime forms**.

9.7 Early Universe as a Pre-Geometric Phase

In the earliest universe:

- ED was extremely high
- participation was fully coupled
- adjacency was global
- no manifold existed
- no geometry existed
- no locality existed

Spacetime emerged only when:

- ED gradients formed
- participation decoupled
- commitment histories thickened
- adjacency stabilized

This ties directly back to Paper 8.

The universe did not begin *in* spacetime.

Spacetime **condensed out of participation**.

9.8 The Architectural Summary

Spacetime breaks down at micro-scales because:

- participation becomes thin
- ED gradients fluctuate
- commitment coherence dissolves
- adjacency loses stability
- discreteness dominates

This is not a failure of physics.

It is the **revelation of the substrate**.

- **Spacetime** = thick participation
- **Geometry** = coarse-grained ED gradients
- **Locality** = stable adjacency
- **Dimensionality** = large-scale regularity
- **Singularities** = manifold artifacts
- **Quantum behavior** = pre-geometric participation

Spacetime emerges from ED — and dissolves back into ED.

10. Consequences and Outlook

10.1 ED as the Ontological Foundation Beneath Physics

Across Papers 5–10, a single picture has emerged:

- micro-events are the atomic units of becoming
- participation is the relational substrate
- ED gradients regulate structure and dynamics
- commitment produces classicality
- thickening produces geometry
- information is constraint, not substance
- spacetime is the large-scale appearance of thick participation

This is not a reinterpretation of physics.

It is the **ontology** that physics has been missing.

Quantum mechanics, relativity, thermodynamics, and cosmology all become **regime-dependent expressions** of the same underlying architecture.

ED is not a theory of spacetime.

It is the substrate from which spacetime emerges.

10.2 Resolution of Long-Standing Paradoxes

With ED as the foundation, the major conceptual puzzles of modern physics dissolve:

Measurement problem:

- Measurement = commitment.

Wavefunction collapse:

- Collapse = irreversible selection of a participation channel.

Born rule:

- Probabilities = participation weights.

Nonlocality:

- Entanglement = shared uncommitted structure, not influence.

Causality:

- Causal cones = participation limits.

Horizons:

- Horizons = decoupling surfaces.

Black hole information paradox:

- Information = constraints on participation; no paradox.

Singularities:

- Singularities = breakdown of the manifold approximation.

Arrow of time:

- Temporal direction = asymmetry of commitment.

These are not patched-over mysteries.

They are **structural consequences** of ED.

10.3 The Micro–Macro Continuum Is Now Complete

Paper 9 established the micro-scale architecture:

- thin participation

- uncommitted channels
- quantum behavior
- decoherence
- commitment
- classical thickening

Paper 10 established the macro-scale architecture:

- thick participation
- stable adjacency
- geometry
- spacetime
- causal structure
- information
- temporal asymmetry

Together, they form a single continuum:

Quantum → Relational → Classical → Geometric

All of physics becomes a single, continuous expression of participation geometry.

10.4 ED Reframes the Role of Geometry and Information

Geometry is not fundamental.

It is the **coarse-grained resistance pattern** of participation.

Information is not fundamental.

It is the **constraint structure** imposed by commitment histories.

This reframing resolves:

- the tension between quantum discreteness and geometric continuity
- the tension between entanglement and locality
- the tension between thermodynamics and time-reversal symmetry
- the tension between gravity and quantum mechanics

Geometry and information are not competing primitives.

They are **emergent shadows** of ED.

10.5 Toward a New Understanding of Physical Law

If ED is the substrate, then physical laws are:

- summaries

- approximations
- regime-dependent regularities
- large-scale constraints on participation evolution

This reframes:

- Einstein's equations as summaries of ED gradient evolution
- Schrödinger evolution as thin-regime participation dynamics
- thermodynamics as commitment statistics
- quantum field theory as emergent participation networks
- cosmology as ED gradient history

The laws of physics are not imposed.

They are **architectural consequences** of becoming.

10.6 The Path Forward: Paper 11 and Beyond

Paper 10 completes the emergence arc:

- from micro-events
- to participation
- to geometry
- to spacetime
- to information
- to temporal asymmetry

The next step is to explore how **physical law itself** emerges from ED.

Paper 11 will develop:

- the architecture of physical law
- the emergence of conservation principles
- the role of symmetry as participation invariance
- the emergence of complexity and structure
- the relationship between ED and computation
- the deep equivalence between dynamics and constraint

Paper 11 will show that:

Laws are not written into the universe.

> **Laws are the stable regularities of participation geometry.**

10.7 The Architectural Summary

The ED program now provides:

- an ontology of becoming
- a micro-event substrate
- a relational account of participation
- a structural account of quantum behavior
- a geometric account of classicality
- a participation-theoretic account of spacetime
- an ontological account of information
- a fundamental origin for the arrow of time

The picture is complete:

Spacetime, geometry, information, causality, and temporal direction

are emergent expressions of ED's relational architecture.

Physics becomes the study of **how participation geometry evolves**.

ED becomes the foundation beneath physics.