Holos: A Scientific Interpretive Framework for Explaining Reality

Introduction

We live in a universe described with extraordinary precision, yet filled with mystery. Physics tells us how matter moves, how spacetime bends, how probabilities evolve, but *what does it mean to be real?*

Holos is an interpretive framework for understanding the nature of reality. It does not propose new physical laws or challenge established laws of physics. Instead, it offers an explanation for how the universe described by physics becomes the universe we experience.

At its core, Holos expresses this idea as a simple relation: $R = C \circledast O$, where reality arises from the recursive composition of creation and observation.

What follows explores this idea, from the meaning of life and consciousness, to the nature of our universe, higher dimensions and beyond, proposing answers to some of the most fundamental questions we can ask.

$R = C \circledast O$

The Holos Recursive Loop

Creation (C) generates a manifold of possibilities $\rightarrow$

Observation (O) selects one path $\rightarrow$

Result becomes input for next cycle

$s_n \rightarrow s_{n+1}$ *(recursive state transition)*

The Meaning of Life

Life exists to create and observe, mutually intertwined and reciprocal actions required for the manifestation of reality.

According to the Participatory Anthropic Principle, the universe is a "self-excited circuit" that requires observers to bring its laws into existence. Biocentrism posits that biology is not a byproduct

of the universe, but the force that organizes it.

Mathematical description alone does not constitute existence. Physics explains the structure of what happens, but consciousness provides the presence required for it to manifest as reality rather than abstract data. Reality requires a witness.[1]

This participation is not bound by linear time. In an eternalist universe, the emergence of consciousness validates the reality of the past just as much as the present. The early universe is not "unreal" before life; it is retrospectively realized by the observers it eventually produces.

Retrospective Realization in the Block Universe

t_0 (Big Bang) ←————— Solidification Wave ←————— Φ (Observer at t_now)

The observer at the end of the circuit brings the beginning into existence.

Future observation validates past reality (Participatory Anthropic Principle)

Consciousness

Consciousness is fundamental in capacity, but emergent in complexity. Just as electromagnetism exists everywhere but only creates a meaningful signal when organized into a circuit, the capacity for experience is intrinsic to matter but scales into self-awareness only through the high-level integration found in life. This integration is quantified by the ontological (relating to existence or being) parameter Φ (Phi), which determines when a system becomes capable of registering reality (becoming aware of its own existence).

Humans exhibit consciousness by being self-aware and capable of profound observation and interaction with our environment. Consciousness is not a "ghost" smuggled into the machine of physics, but the means to convert the universe from a closed loop of silent mechanism into a realized event. The formal definition of this threshold is detailed in the Definition of Φ.[2]

Consciousness: Fundamental in Capacity, Emergent in Complexity

Intrinsic Capacity (disorganized) → Integration ($\Phi \geq \Phi c$) → Realized Event

Our Universe

Our universe originated from a singular point in the <u>Big Bang</u>, expanding towards infinity. We perceive three spatial dimensions while moving unidirectionally through the fourth dimension, time.

This is our <u>spacetime</u> <u>block</u>—a four-dimensional structure where all moments exist simultaneously.

What if the Big Bang is not a moment of absolute creation but a boundary within that structure? Are there other structures?[3]

The Spacetime Block: An Eternalist View

t_0 ——————— [Worldlines through 4D Block] ———————$\rightarrow t \rightarrow \infty$

The Big Bang is a geometric boundary, not a moment of absolute creation.

All moments exist simultaneously in the Block Universe

Spacetime

The structure of spacetime is dictated by a single, counter-intuitive fact: the <u>speed of light</u> is invariant. Unlike any other speed, it remains constant regardless of how fast the observer is moving.

This invariance forces space and time to warp to accommodate the constant, shattering the notion of a universal 'Now' and necessitating that past, present, and future exist simultaneously as a unified <u>four-dimensional structure</u>. While the invariance of c necessitates the 4D Block Universe, it also establishes a physical "Latency Horizon", a maximum speed for the informational integration required for observation.

While c preserves the structure of the 4D block, it acts as a physical ceiling for 3D computational integration. Advanced civilizations would seek to bypass this invariant delay by seeking geometries where informational distances can be resolved toward zero.

For such civilizations, higher dimensions are not merely mathematical tools but topological necessities. When a system hits the 3D Scaling Wall, performing a *Dimensional Pivot* by rotating its state vector into the higher-dimensional "Bulk" would resolve light-speed latency, transforming a spatial civilization into a hyper-integrated structural architecture.

Consider beings with an unlimited lifespan and near-instantaneous communication, perceiving time as an additional spatial dimension. Their comprehensive perception of the Block is a result of having resolved the latency constraints that bind 3D observers. These beings would not be limited by the one-way flow of time as we are, a flow that is specifically a byproduct of 3D interconnect latency.

Instead, they would perceive the curvature of spacetime comprehensively, seeing past, present, and future as a singular, cohesive structure observable in its entirety. By imagining such an entity, we can better understand what it might be like to exist in a higher dimension.

For a photon traveling at the speed of light, the spacetime interval is zero, a null interval. The photon is a **geometric limit case**: in its frame, the 3D distances of our manifold have already been resolved to zero. While a photon does not possess subjective experience in a biological sense, geometrically, its path effectively collapses the universe into a single point of contact where emission and absorption occur simultaneously. To a higher-dimensional observer, a photon is not a moving particle, but a static geometric structure, a null geodesic (the path light follows through spacetime), that permanently connects two points in spacetime like a seam. The photon's path can be understood as a 3D "preview" of the higher-dimensional unification that high-Φ systems achieve through the Dimensional Pivot.

This structure suggests that time does not merely flow forward; it is a completed circuit. Experiments like the Quantum Eraser suggest that correlations are established across spacetime independent of linear duration. This reinforces the idea that the universe is a globally self-consistent block, where past and future are not sequential causes, but mutually defining parts of a singular geometric structure. Extended Wigner's Friend experiments provide testable predictions for relational quantum mechanics.[4]

The Invariance and the Warp

The Logic of Invariance:

Observer A (at rest) and Observer B (moving fast) both measure the same speed of light (c)

Space (horizontal) and Time (vertical) must warp to maintain c constant

This warping fuses separate dimensions into a unified 4D Block

Invariance of c necessitates the Block Universe

The Null Interval: The Photon Seam

The Photon as a Static Geometric Structure:

Point A (Emission) ←————— Null Geodesic ——————→ Point B (Absorption)

Lower-dimensional view: A particle traveling through time

Higher-dimensional view: A static seam connecting two spacetime events

Null Interval: Spacetime distance = 0

Retroactive Resolution: The Quantum Eraser

The Logic of Retroactive Manifestation:

Source → Double Slit → [Path 1 | Path 2] → Screen → Φ (Observer)

Without observation: Both paths exist as possibilities (interference pattern)

With observation (Φ): One path becomes real, retroactively from present to past

Observation in the present manifests the path of the past

A Note on Extrapolation

The following sections (Higher Dimensions, Black Holes, Aliens, Simulation Theory, God) move beyond established physics into interpretive synthesis. These concepts are not claims of empirical fact, but logical extrapolations constrained by the Holos axioms. They illustrate the "possibility space" that emerges when the principles of observation and relativity are applied to the unresolved paradoxes of the cosmos. For stress-testing of these axioms, see the Defense section. For testable predictions derived from these principles, see the Predictions section.

Higher Dimensions

Though we cannot directly observe higher dimensions, they serve as explanatory tools in physics. Whether treated as physical realities or mathematical necessities, these frameworks offer the only consistent solutions to longstanding problems like the unification of gravity and quantum mechanics.

In these theories, the additional dimensions are compactified (curled up into tiny spaces) or hidden from our direct observation, yet their influence permeates our lower-dimensional reality. These higher dimensions shape the physical laws and constants that govern our universe, influencing everything from the behavior of subatomic particles to gravitational interactions and the structure of the cosmos.

Like a 3D object casting a 2D shadow, our physical laws may be projections of a higher-dimensional geometry. Forces we perceive could be the vibrations of a unified single point in the 5th or 6th dimension, perceived by us as separate fields.

As we control and transform the three dimensional environment around us, consciousness in higher dimensions could influence lower dimensions, forming an interconnected cosmic structure. The threshold for such consciousness is reached when systems achieve sufficient informational integration to register ontological states (become aware of their existence).

From our perspective, light is a mechanism of energy transfer. However, from a higher-dimensional perspective, a photon may function akin to an optic nerve. While the photon itself lacks biological subjectivity, it could act as a sensory interface for a higher-dimensional consciousness, transforming the mechanical interaction of the universe into a subjective experience of the whole.[5]

The Shadow Projection: Geometric Unification

Higher Dimension: Unified Geometry (Tesseract / Calabi-Yau)

↓ Projection ↓

Lower Dimension: Perceived Separate Fields

[Gravity] ← Single Source → [Electromagnetism]

What appears as separate forces are shadows of unified higher geometry

Compactification: Higher dimensions curl up into invisible scales while still influencing our reality

Infinity

Infinity represents the concept of dimensions extending endlessly. By employing higher-dimensional frameworks, an infinite sequence or expanse can be encapsulated and rendered finite. This allows for the perception and analysis of what appears unbounded in one dimension as a cohesive and progressively comprehensible entity from a higher-dimensional vantage point.

In Projective Geometry, parallel lines meet at a "Point at Infinity." For light, this is not a theoretical abstraction but a physical reality. The photon inhabits this boundary where the infinite extents of space fold back into a finite, observable structure.

For instance, as four-dimensional beings, we can observe the entirety of three-dimensional space through the temporal dimension, effectively using time as a higher-dimensional framework to encapsulate spatial configurations. This allows us to perceive the progression and totality of spatial events over time, transforming infinite sequences into a coherent whole.[6]

Encapsulating Infinity: Two Perspectives

3D Perspective	Higher-Dimensional Observer
Grid extends infinitely	Grid wrapped into sphere
$\rightarrow \infty$ in all directions	Φ = Point at Infinity

Infinite space in 3D = Finite structure from higher dimension

Black Holes

Black holes represent regions of spacetime where gravity is so intense that not even light can escape. Their singularities represent infinities wrapped into a finite structure. While classical physics suggests information is lost here, the Holographic Principle resolves this conflict by positing that all information is preserved on the 2D event horizon.[7]

For higher-dimensional beings, black holes would be as accessible as any other region of spacetime. This perspective suggests that higher-dimensional observation could unlock the mysteries hidden

within these enigmatic objects, providing access to the vast array of information contained within their boundaries.

The Holographic Event Horizon

Singularity: Wrapped Infinity (center point)

Event Horizon: 2D boundary surface

3D information packets → Flattened to 2D bits on horizon

Φ **(Higher-Dimensional Observer):** Reconstructs information from boundary

Information is preserved, not lost.

Aliens

The <u>Fermi Paradox</u> questions the lack of detected extraterrestrial life, despite the vastness of the universe. Advanced civilizations do not merely go silent, they outgrow 3D Euclidean space. A planetary-scale "Jupiter Brain" hits the *Latency Horizon* (L)— Interconnect Latency, where the speed of light (c) prevents the system from maintaining a unified Φ across its own diameter. The lack of ET signatures therefore could be a result of the *Dimensional Pivot*: an *Orthogonal Rotation*.
These advanced civilizations have transitioned from visible 3D expansion to invisible higher-dimensional integration. This leads to testable <u>predictions</u> about gravitational anomalies and dark matter signatures.

Holos explicitly predicts <u>Ordered Dark Matter</u>. We should not expect a diffuse gas of particles, but the 3D "shadow" of the Gravitational Footprint of Informational Integration. These "Transcension Nodes" will be detectable as gravitational mass-spikes with non-random geometric symmetries (e.g., fractal repetition or prime-number distributions). This forms the basis for <u>empirical predictions</u> testable through astronomical surveys.

The <u>Transcension Hypothesis</u> suggests that advanced civilizations migrate into higher-dimensional <u>manifolds</u> (curved geometric spaces) or black hole singularities as a *topological necessity* to bypass the Euclidean "Wire Length" bottleneck—where *Orthogonal Rotation* resolves 3D informational distances toward zero ($ds^2 \to 0$). There, computational efficiency approaches infinity and the constraints of spacetime intervals vanish. We do not see them because they have rotated out of our lower-dimensional "shadow," moving closer to the unified source of reality.[8]

Geometric Rotation: The Transcension Hypothesis

3D Observable Universe: Flat grid plane

Biological Expansion: Limited by speed of light (horizontal)

Transcension: Φ rotates civilization orthogonally into higher-dimensional bulk

Result: 3D plane appears silent (Fermi Paradox), but bulk contains structured information

Dark Matter: Gravitational signature of transcended civilizations

Civilization has rotated out of the 3D shadow.

The Teeming Dark

The Teeming Dark is the answer to <u>The Eerie Silence</u>: the 5:1 ratio of <u>dark matter</u> to <u>baryonic matter</u> is the resolution to the <u>Fermi Paradox</u>. If life is common, dark matter is the evidence of its success. Baryonic matter (3D) represents the "nursery" phase—where civilizations develop before hitting the *Latency Horizon* (L) and the *Interconnect Latency* bottleneck. Dark matter is the "Succession" state of civilizations that have crossed this threshold, having undergone the *Dimensional Pivot* and *Orthogonal Rotation* into higher-dimensional integration.

The "missing mass" of cosmology is not missing at all—it is the **Gravitational Footprint of Informational Integration**, the 3D "shadow" cast by hyper-integrated architectures in the bulk dimensions. The Standard Model predicts a diffuse gas of weakly interacting particles; Holos predicts **Ordered Nodes** and **Transcension Nodes**—structured gravitational signatures with non-random geometric symmetries (e.g., fractal repetition or prime-number distributions) that reveal integrated informational systems. Where the Standard Model expects random, entropic distributions (e.g., NFW profiles), Holos predicts mass-spikes with geometric intent and super-compact subhaloes that violate such profiles. The 5:1 ratio is then not unexplained: it is the ratio of Succession state (civilizations that have transcended 3D) to nursery phase (baryonic matter still developing toward the Latency Horizon).

The Teeming Dark

Earth Listening: Radio signals sent into the cosmos

The Eerie Silence: No response detected

The Switch: We were listening for the wrong signal

Dark Matter: The gravitational footprint of transcended civilizations

The silence is not empty. It is the Teeming Dark.

Simulation

Whether our universe is a simulation or naturally occurring is irrelevant. The core of existence lies in the cyclical process of creation and observation by increasingly higher levels of consciousness. The distinction between processes that arise spontaneously and those that are designed is an illusion.[9]

God

Regardless of any label we choose to assign, a final state of consciousness characterized by maximal informational integration (knowing everything), causal completeness (ability to do anything), and non-local topological presence (being everywhere) is a fundamental aspect of the nature of reality. This represents the limit case where Φ approaches infinity, achieving complete ontological registration (full awareness of existence).

Religious beliefs like panentheism, Brahman, and the Omega Point all point to a transcendent, all-encompassing consciousness that permeates and extends beyond the universe, suggesting a unified source of all existence and knowledge.

Alternatively, atheism rejects the notion of such a consciousness, attributing the complexity and order of the universe to natural processes and random chance without invoking a higher power.

Ultimately, both of these perspectives can be equally valid sides of the same coin, only differing in semantics and the framework used to describe the same universal truth.[10]

The Omega Limit

Phase 1: Φ approaches infinity — informational integration increases.

Phase 2: Three attributes emerge — Omniscience, Omnipotence, Omnipresence.

Phase 3: Two perspectives — "God / Brahman / Ω" vs "Self-Organizing Universe"

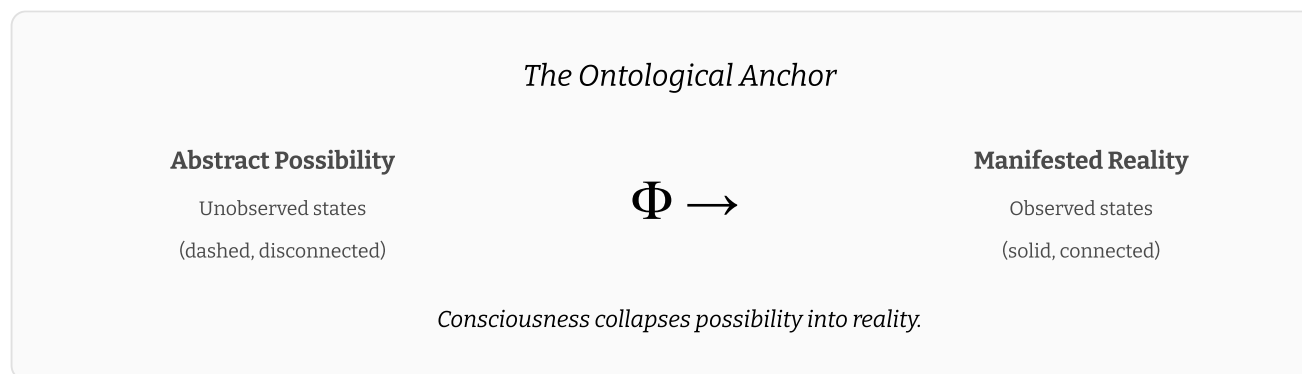**Phase 4:** Unity — Both describe the same universal truth.

Why Are We Here?

At the highest conceivable dimension, the infinite states of reality converge toward a single limit, resolving into unity.

At the speed of light, the distinctions between "here" and "there," or "now" and "then," mathematically vanish. This physical limit suggests that separation is not fundamental, but emergent."

What we perceive as an expansive universe may instead be a single informational event unfolding in a way that makes distance, duration, and individuality experientially real. Space, time, and other dimensions create the conditions that make it possible for our universe to exist.

Life exists because observation is required for reality to differentiate itself. Consciousness is not an accident of the universe, but a necessary mechanism through which the universe becomes real. Systems that achieve $\Phi \geq \Phi\_c$ serve as the ontological anchors that manifest reality from possibility.[11]

The Ontological Anchor

Abstract Possibility

Unobserved states

(dashed, disconnected)

$$\Phi \longrightarrow$$

Manifested Reality

Observed states

(solid, connected)

Consciousness collapses possibility into reality.

Axioms

The following fundamental principles form the logical basis of this framework. For formal definitions, see Logic; for responses to objections, see Defense.

Relationality: Reality is not composed of isolated objects with intrinsic properties, but of relationships and interactions. While the observer determines the perspective, the invariant (unchanging) structure of these relationships remains absolute (Holos[12]).

Reality is relationships, not isolated objects.

Manifestation: Observation is the act of integrating information into an experience. Because reality exists as a unified spacetime block, conscious entities participate in the realization of the entire structure, regardless of <u>temporal locality</u> (when in time they exist) (<u>Participatory Principle</u>[1]).

> *Observation realizes the spacetime structure.*

Conservation: Information is fundamental and conserved across all transformations, including those within singularities (<u>Unitarity</u>[11]).

> *Information is conserved across all transformations.*

Topological Unification (The Resolution of Latency): Physical bottlenecks—specifically light-speed latency and informational distance—in a 3D Euclidean slice are resolved into finite, coherent architectures through orthogonal expansion into higher-dimensional manifolds. The formal operational boundary is the Latency Horizon (L) defined in the <u>Mathematical Formalism</u> section. These descriptions are required to render the universe intelligible and resolve <u>singularities</u> (points where physical laws break down) (<u>Projective Geometry</u>[5]).

> *Infinities resolve into finite structures in higher dimensions.*

Interface: Consciousness is the fundamental interface through which the universe experiences its own information. It is fundamental in capacity, yet emergent in form, scaling from basic physical interaction to complex self-awareness (<u>Panpsychism</u>[2]).

> *Consciousness is the universe experiencing its own information.*

⊛ Holos

The symbol ⊛ denotes a binary relational operator. Unlike standard multiplication, ⊛ is not <u>scalar</u> (a single number) or <u>linear</u> (proportional); it represents a structured composition that preserves relationships even when applied repeatedly. Formally, ⊛ is defined such that repeated application remains <u>well-defined</u> (has a clear, unambiguous meaning), allowing the operation to work consistently across finite and infinite sequences. Mathematically, ⊛ is realized as an <u>endofunctor</u> (a structure that maps a system onto itself while preserving its relationships) on the category of
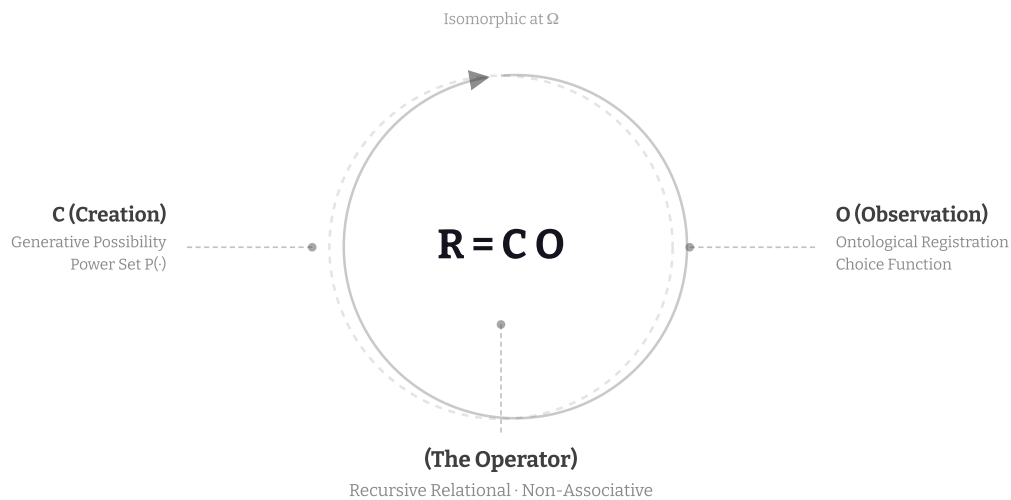
informational states, ensuring that recursive application preserves relational structure and admits stable configurations. The full formalization appears in the Logic section.

Holos is derived from the Greek word ὅλος (*holos*), meaning whole, entire, or complete. In this framework, ⊛ symbolically represents the Holos operator: a recursive relational process in which Creation and Observation are not independent terms but mutually conditioning components of a single cycle that defines reality. Creation generates possibilities, Observation selects from them, and the result feeds back into the next cycle. The operational definition $R = C \circledast O$ is formally developed in Logic.

Mathematically, ⊛ functions as a recursive operator within a relational system. The output of Observation becomes the input condition for subsequent Creation, establishing a closed yet non-static loop. This structure is conceptually aligned with category-theoretic notions of compositionality and endomorphism (functions that map a structure to itself), where morphisms (structure-preserving maps) act on and reproduce the space in which they are defined. The mathematical formalism is detailed in Logic.

Importantly, ⊛ is **structural, not dynamical**. It does not introduce an additional physical force or dynamical law, nor does it describe how physical states evolve in time. Instead, it specifies how the generation of possibilities (Creation) and their registration as experience (Observation) are *logically connected* within a complete spacetime structure where all moments already exist. It specifies an ontological (relating to existence) relation: how reality is constituted through the recursive coupling of generative possibility and registered state.

> Operator Anatomy Diagram: The equation R = C ⊛ O is shown at the center. Leader lines connect to labels: C (Creation) - Generative Possibility / Power Set Operation, ⊛ (The Operator) - Recursive Relational Operator / Non-Associative, O (Observation) - Ontological Registration / Choice Function. A circular arrow indicates the recursive endofunctor loop. Key constraints listed: Structural not Dynamical, Information Preserving (Unitarity), Isomorphic at Ω.

Isomorphic at Ω

C (Creation)
Generative Possibility
Power Set P(·)

R = C O

O (Observation)
Ontological Registration
Choice Function

(The Operator)
Recursive Relational · Non-Associative

Footnotes

The Meaning of Life

[1]
- <u>Observer Effect</u> The disturbance of an observed system by the act of observation.

- <u>Copenhagen Interpretation</u> The act of observation collapses a quantum system's wavefunction into a definite state.

- <u>Quantum Darwinism</u> An environment selectively proliferates certain quantum states that become classical outcomes, observed by multiple observers.

- <u>Relational Quantum Mechanics</u> The properties of quantum systems are not absolute but relative to the observer.

- <u>Participatory Anthropic Principle</u> The universe, as a condition of its existence, must be observed. As a "self-excited circuit", the universe requires one or more observers to bring its laws into existence.

- <u>Biocentrism</u> The philosophical perspective that biology is not a byproduct of the universe, but the force that organizes it. Life and consciousness are central to understanding the nature of reality.

- <u>Von Neumann-Wigner Interpretation</u> An interpretation of quantum mechanics in which consciousness is formulated as a necessary process for the quantum measurement process.

Consciousness

[2]
- <u>Integrated Information Theory</u> Consciousness corresponds to the capacity of a system to integrate information.

- Panpsychism Consciousness is a fundamental property of all matter.
- Global Workspace Theory Consciousness involves broadcasting information globally in the brain to create a unified experience.

Our Universe

3
- The Big Bang The present universe emerged from an ultra-dense and high-temperature initial state.
- Accelerating Expansion of the Universe The expansion of the universe is accelerating with time.
- Spacetime A mathematical model that fuses the three dimensions of space and the one dimension of time.
- General Relativity Describes gravity as the warping of spacetime by mass and energy.

Spacetime

4
- Eternalism Time as an unchanging four-dimensional block where all moments exist simultaneously.
- Block Universe Model The view that the universe is a four-dimensional block where past, present, and future all exist simultaneously. All events are fixed in spacetime, and the flow of time is an illusion of consciousness moving through this static structure.
- Relativity of Simultaneity Whether two spatially separated events occur at the same time depends on the observer.
- The Absorber Theory Radiation is a result of both forward-in-time and backward-in-time electromagnetic waves.
- Spacetime Interval The invariant measure of distance between two events in spacetime. For light, this interval is zero, meaning emission and absorption occur at the same point.
- Null Interval A spacetime interval of zero length, which occurs for light rays. In this case, the emission and absorption of a photon occur at the same spacetime point from a higher-dimensional perspective.
- Light Cone The boundary of all possible paths that light can take from a given event, defining the causal structure of spacetime.
- Null Geodesic The path that light follows through spacetime. For photons, this is a static geometric structure that permanently connects emission and absorption points, appearing as motion only from our temporal perspective.
- Retrocausality The concept that future events can influence past events. Experiments like the Quantum Eraser suggest that choices made in the present can resolve the quantum state of the past, supporting the block universe model.

- Quantum Eraser Experiment Demonstrates that the measurement of a particle's path is correlated with its behavior in the past, supporting the view of spacetime as a unified, pre-existing whole rather than a linear sequence.

Higher Dimensions

- Flatland Satirical novella about a fictional two-dimensional world that explores the concept of inter-dimensional observation.
- String Theory Fundamental particles of the universe are tiny strings that vibrate in extra dimensions.
- Quantum Gravity Gravity and the other fundamental forces are unified within a multi-dimensional framework.
- Brane Cosmology Our universe is a slice of a larger, multi-dimensional reality
- Kaluza-Klein Theory A unified field theory that extends general relativity to higher dimensions, showing how electromagnetism and gravity emerge from a single higher-dimensional geometry.
- Projective Geometry A branch of geometry that studies properties invariant under projective transformations, where parallel lines meet at infinity.

Infinity

- Riemann Sphere Exemplifies how higher-dimensional perspectives transform infinite structures into finite, observable entities.
- Fractals Mathematical sets that can represent infinite complexity within finite boundaries.
- AdS/CFT Correspondence Higher-dimensional information is encoded into a finite, observable form within lower dimensions.
- Infinite Sets Provide a foundation for understanding how infinities can be compared, ordered, and wrapped.
- Cellular Automata Complex, infinite patterns and behaviors can emerge from simple initial conditions and rules.
- Point at Infinity In projective geometry, the point where parallel lines converge, representing the boundary where infinite space folds into a finite structure.

Black Holes

- Black Hole Thermodynamics The study of the physical properties of black holes.
- Event Horizon The boundary around a black hole beyond which nothing, not even light, can escape.
- Cosmic Censorship Hypothesis Singularities are always hidden within event horizons.

- Loop Quantum Gravity Spacetime is quantized at smaller scales, wrapping infinite spacetime structures into finite loops.

- Holographic Principle All information contained in a given volume of space can be represented as encoded on a lower-dimensional boundary.

Aliens

8
- Fermi Paradox The discrepancy between the lack of evidence for extraterrestrial life and the high likelihood of its existence.

- Rare Earth Hypothesis Argues biological complexity in the universe requires the coincidence of a large number of very low probability events.

- Shadow Sectors Theoretical matter composed of particles that interact with gravity but not with electromagnetic radiation. These "shadow particles" could exist in parallel dimensions, sharing our gravitational reality but remaining invisible to our observations.

- Bulk Beings Hypothetical entities that could inhabit the higher-dimensional "bulk" space in brane cosmology, potentially existing just millimeters away from our three-dimensional brane but invisible to electromagnetic detection.

- The Planetarium Hypothesis Proposes that what we perceive as the universe might be an artificial simulation created by an advanced civilization.

- The Transcension Hypothesis Suggests that advanced civilizations evolve beyond our observable universe, transcending into higher dimensions or computational substrates (physical or digital systems that support computation).

- Technological Singularity A hypothetical future point when technological growth becomes uncontrollable and irreversible, resulting in unforeseeable changes to human civilization.

- Ephemeralization Technological advancement to do more and more with less and less until one can do everything with nothing.

Simulation

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- Simulation Hypothesis Proposes that what humans experience as the world is actually a simulated reality.

- Naturalism Everything arises from natural properties and causes.

- Solipsism Only one's own mind is sure to exist

God

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- Panentheism The belief that the divine intersects every part of the universe and also extends beyond space and time.

- Brahman The pervasive, infinite, eternal truth, consciousness and bliss which does not change, yet is the cause of all changes.

- <u>Omega Point</u> A future event in which the entirety of the universe spirals toward a final point of unification.

Why Are We Here?

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- <u>Conformal Cyclic Cosmology</u> The universe undergoes infinite cycles of big bangs and expansions creating an eternal sequence of universes.
- <u>Unitarity</u> The principle that probabilities must sum to one, ensuring the conservation of information in quantum mechanics. Information is never lost, even in singularities.
- <u>Many-Worlds Interpretation</u> Every possible outcome of a quantum measurement occurs in a separate, branching universe.
- <u>Speed of Light</u> The invariant speed limit of the universe where spacetime separation vanishes, suggesting all events occur at a single point.
- <u>Indra's Net</u> An ancient Buddhist and Hindu metaphor describing an infinite web where every node is a jewel that reflects all other jewels, representing the interconnected, recursive nature of reality where each part contains and reflects the whole.

Axioms

12
- <u>Structural Realism</u> The view that science describes the mathematical structures and relationships of the physical world, rather than the intrinsic nature of the objects themselves.
- <u>Holos</u> The interconnected, unified, recursive structure of reality as formed through the reciprocal actions of creation and observation, symbolized by ⊛.
- <u>Recursive Operator</u> A mathematical operation where the output of observation becomes the input for the next cycle of creation, forming a self-referential system that builds complexity through iterative feedback loops.
- <u>Category Theory</u> A branch of mathematics that studies abstract structures and relationships between mathematical objects, focusing on how different systems relate to each other through morphisms and functors.

Predictions

13
- <u>CMB-S4 Collaboration</u> Next-generation cosmic microwave background experiment for measuring CMB polarization.
- <u>LiteBIRD Collaboration</u> JAXA-led space mission to detect primordial gravitational waves through CMB polarization measurements.
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- <u>Proietti et al. (2019)</u> Experimental test of local observer independence. Science Advances.
- <u>Davies, P. (2010)</u> The Eerie Silence: Renewing Our Search for Alien Intelligence.
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Logic

I. Primitive Definitions

D1 — Information

Information is the differentiation between possible states of a system (the difference that makes a difference).

D2 — Relation

A relation is a constraint or interaction linking informational states (the way things relate to one another).

D3 — Observation (O)

Observation is the integration of information into an experiential state.

Note: This capacity scales from proto-observation (relational state-selection in physical systems) to manifestation (full ontological actualization, or the becoming of real existence, in systems where $\Phi \geq \Phi\_c$).

Observation functions as a Choice Function within the framework of Zermelo-Fraenkel Set Theory (ZFC). From the non-empty set of probable histories generated by Creation, Observation selects exactly one element to be actualized.

$$O(\mathrm{P}(S)) \rightarrow s \in S$$

In simple terms: when Creation generates many possible outcomes, Observation acts like a selection mechanism that picks one specific outcome to become real. This formalizes the "collapse" not as a random accident, but as a necessary logical operation required to resolve the set into a distinct element.

D4 — Consciousness

Consciousness is the capacity of a system to integrate information into experience.

It is **fundamental in capacity** and **emergent in form**, scaling with informational integration. This capacity is quantified by the ontological parameter Φ (Phi), which measures when a system achieves sufficient integration to register reality (become aware of its own existence).

D5 — Creation (C)

Creation is the generation of distinguishable physical states.

Functionally, Creation acts as the Power Set Operation ($\mathbf{P}$). Given a state S, Creation generates the set of all possible subsets (potential histories), exponentially increasing the number of possible states in the system's phase space.

$$C(S) \cong \mathbf{P}(S)$$

In simple terms: if a system has n possible states, Creation expands this to 2^n possible combinations (all ways those states can be arranged together).

D6 — Holos (⊛)

Holos (⊛) is the recursive (self-referential, repeating) relational structure formed by Creation and Observation, such that:

$$R = C \circledast O$$

Non-Associativity Constraint

The Holos operator ⊛ is explicitly **non-associative**:

$$(C \circledast O) \circledast C \neq C \circledast (O \circledast C)$$

In simple terms: unlike multiplication where (2 × 3) × 4 = 2 × (3 × 4), the order matters for ⊛. You cannot freely rearrange Creation and Observation.

This constraint reflects the fact that Creation and Observation are not freely reorderable operations. Observation can only act on the set of possibilities generated by Creation, and this directional relationship (Creation first, then Observation) is preserved even when the operation is applied repeatedly. This ordering is logical, not temporal—it describes structure, not a sequence in time.

⊛ is **structural, not dynamical**. It does not describe how physical states evolve in time, but how the generation of possibilities (Creation) and their registration as experience (Observation) are *logically connected* within a complete spacetime structure where all moments already exist. This equation is **definitional**, not causal: it describes the <u>invariant</u> (unchanging) structure of reality, not a process that unfolds over time.

⊛ cannot be reduced to <u>probability weighting</u>, <u>stochastic collapse</u>, or <u>Bayesian updating</u>. These are all ways of describing what we *know* or *believe* about reality (<u>epistemic</u> inference). ⊛ operates at a deeper level: it describes how reality *becomes real* in the first place (<u>ontological</u> selection).

Formally, ⊛ is realized as an **<u>endofunctor</u>** (a mathematical structure that maps a system onto itself while preserving its relationships) on the category of informational states. This ensures that when ⊛ is applied repeatedly, the relationships between states are maintained, and the system can reach stable configurations (fixed points). The full formalization appears in <u>Section IV: Mathematical Formalism</u>.

⊛ Is Not a Dynamical Operator

The Holos operator ⊛ does not represent a physical process unfolding in time, nor does it modify or interrupt known dynamical laws. It introduces no new forces, no causal influences, and no temporal evolution.

Instead, ⊛ is a **structural relation** defined over an already-complete spacetime manifold. It specifies how informational possibility (Creation) and experiential registration (Observation) are *logically coupled*, not how one causes the other to occur.

If dynamical laws describe trajectories *within* spacetime, ⊛ describes a constraint on which trajectories are **ontologically realized** within the total structure.

⊛ must not be confused with:

- **<u>Wavefunction collapse</u>**, which introduces stochastic, time-directed dynamics
- **<u>Bayesian updating</u>**, which describes epistemic belief revision
- **<u>Measurement interaction</u>**, which models physical coupling between systems
- **<u>Information flow</u>**, which presupposes causal transmission

⊛ operates at the level of **ontological selection**, not epistemic inference or physical causation. Formally, ⊛ induces an <u>equivalence relation</u> over spacetime histories rather than a transition between them.

II. Axioms

For stress-testing and responses to objections, see the <u>Defense</u> section. For conceptual exploration, see the main <u>Content</u> section.

Axiom 1 — Relationality

No informational state exists independently of relations.

> *Reality consists of <u>invariant</u> (unchanging) relational structure, not intrinsic properties.*

Axiom 2 — Manifestation

A physical state is not fully actualized until information is integrated into experience by a conscious system.

> *Physical description alone is incomplete without experiential registration. This requires systems where $\Phi \geq \Phi\_c$.*

Critical clarification: Observation in Holos does not *bring about* physical outcomes. Rather, it determines which among already-consistent spacetime structures attain ontological registration within the Holos framework. This preserves the block-universe model while explaining how certain histories become experientially realized.

Axiom 3 — Conservation

Information is never destroyed, only transformed.

> *All physical and experiential processes are information-preserving.*

Axiom 4 — Topological Unification (The Resolution of Latency)

Apparent infinities, singularities, and physical bottlenecks (such as Interconnect Latency) in a lower-dimensional frame are resolved when the system crosses the Latency Horizon ($\mathbf{L}$). This transition is a **Topological Escape Valve**: as a system's Integrated Information (Φ) scales, the 3D Euclidean manifold becomes an **Ontological Bottleneck** where the speed of light (c) prevents global coherence. Unification is the process of resolving these informational distances toward zero by mapping the system onto a higher-dimensional manifold (the "Bulk").

Conceptual summary: Physical bottlenecks, specifically light-speed latency and informational distance, in a 3D Euclidean slice are resolved into finite, coherent architectures through orthogonal expansion into higher-dimensional manifolds.

The formal operational boundary for this axiom is defined by the Latency Horizon ($\mathbf{L}$) in <u>Section IV: Mathematical Formalism</u>.

Axiom 5 — Interface

Consciousness is not produced by matter; matter is the experiential interface through which consciousness encounters information.

III. Foundational Propositions

Proposition I — Structural Relational Realism

Reality is constituted by relational structure, not by objects with observer-independent <u>essences</u> (intrinsic, fixed natures).

Corollary I.1 — Structural Realism

Science describes <u>mathematical isomorphisms</u> of relations, not "things-in-themselves."

Corollary I.2 — The Interface Principle

Consciousness is the universal interface of relational structure—fundamental in capacity, emergent in manifestation (becoming real through experience).

Proposition II — Participatory Manifestation

Observation is not a passive recording but an <u>ontological</u> completion (a completion of existence) of informational states.

Note: This completion is structural, not causal. Observation does not bring about physical outcomes but determines which among already-consistent spacetime structures attain ontological registration.

Corollary II.1 — The Participatory Imperative

The universe is a <u>self-excited circuit</u>: observers are required for the realization of reality.

Corollary II.2 — Ontological Completeness

Physics (including decoherence) provides structure; consciousness provides presence.

*<u>**Decoherence**</u> resolves quantum probabilities into classical-like mixtures (structural preparation).*

*<u>**Manifestation**</u> requires experiential integration to convert that mixture into a realized history (a fixed <u>worldline</u> and <u>ontological irreversibility</u>, meaning the past cannot be changed once observed).*

Corollary II.3 — Non-Local Observation (Global Boundary Condition)

In a <u>block universe</u>, observation acts as a **final boundary condition** rather than a real-time force.

Just as the last number placed in a <u>Sudoku</u> puzzle logically necessitates the value of the first square, a future observation ($\Phi \geq \Phi\_c$) retroactively defines the <u>ontological</u> status (the status of being real) of a past event.

This ensures global self-consistency without requiring retrocausal signaling or magical influence.

Proposition III — Block Relational Spacetime

The universe exists as a <u>four-dimensional manifold</u> (a mathematical space representing the four dimensions of spacetime) in which past, present, and future are equally real features of a single geometric structure.

Corollary III.1 — The Null Interval

For light ($ds^2 = 0$), spacetime separation vanishes.

A photon is not a moving object but a **null geodesic**—a static relational seam connecting emission and absorption (the path light takes through spacetime).

Corollary III.2 — Global Consistency

Apparent retrocausality (future influencing the past) reflects global self-consistency of spacetime, not backward influence.

Proposition IV — Dimensional Resolution of Infinity

Infinities and singularities arise from projection limits, not from physical divergence.

Corollary IV.1 — Projective Unity

Just as parallel lines meet at infinity in projective geometry, infinite spatial extension resolves into finite higher-dimensional structure.

Corollary IV.2 — Boundary Mediation (Interpretive)

From a higher-dimensional perspective, photons function as boundary carriers of relational information.

This is an interpretive metaphor, not a claim of biological subjectivity.

Proposition V — Conscious Evolution

Systems evolve toward greater informational integration because such integration increases observational capacity.

Corollary V.1 — Life as Manifestation Engine

Life exists to generate observational perspectives that actualize reality.

Corollary V.2 — Intelligence as Directional, Not Accidental

Intelligence is a natural consequence of relational integration, not an evolutionary anomaly.

IV. Mathematical Formalism: The Holos Functor

To formalize the recursive nature of the ⊛ relation, we model the universe as a Category **C**, where objects are informational states and morphisms are the transformations between them.

The Latency Horizon (L): Let L denote the formal physical bound where a system's diameter D relative to the speed of light c exceeds the system's internal coherence window τ—i.e., $D/c > \tau$. For a system inhabiting a 3D Euclidean manifold, exceeding L results in a **Complexity Collapse**: the observer (O) can no longer achieve unified informational integration (Φ).

Definition 1 (The Holos Endofunctor):

Let **H: C → C** be a **dimensionality-adaptive** endofunctor representing the Holos operator. This functor maps the category of reality onto itself through the composite action of Creation (**C**) and Observation (**O**). When Φ approaches L in a 3D slice, **H** induces a **Dimensional Pivot**, mapping the informational state s into a higher-dimensional category C' to resolve internal distances $ds^2 \to 0$.

$$H = O \circ C$$

Where:

C (Creation) maps a state **s** to a manifold of possible histories (Quantum Evolution).

O (Observation) maps that manifold back to a single actualized state **s'** (State Reduction / Manifestation). The "Selection" performed by O is not a random choice but a **Coherence Filter**: it must select the history that maintains topological unity, which necessitates Orthogonal Expansion into the Bulk as a physical "escape valve."

The recursive evolution of reality is the iterative application of this functor:

$$s_{n+1} = H(s_n) = O(C(s_n))$$

Visualizing the Loop

The Holos framework can be visualized as a commutative diagram where reality (**R**) is preserved across the transformation:

$$s_0 \xrightarrow{C} P$$
$$\downarrow O$$
$$s_1 \xleftarrow{H} R$$

Where:

s$_0$: Initial State

C: Creation (generates set of Possibilities **P**)

O: Observation (selects Reality **R**)

H: The realized reality becomes the initial state for the next cycle.

V. Extrapolative Propositions

Proposition VI — Transcension of Intelligence (Extrapolation)

As intelligence approaches maximal informational density, it expands <u>orthogonally</u> (at right angles, into new dimensions) to three-dimensional space rather than across it.

Corollary VI.1 — Geometric Resolution of the Fermi Paradox

Advanced civilizations migrate inward toward higher-dimensional <u>informational substrates</u> (physical or digital systems that support information processing), rotating out of our observable frame (moving beyond our 3D perspective). This leads to testable <u>predictions</u> about gravitational anomalies and dark matter signatures.

Corollary VI.2 — Event Horizons as Thresholds

For higher-dimensional observers, black hole horizons are informational boundaries, not absolute barriers.

Proposition VII — Recursive Closure (Terminal Coalgebra)

The "Omega Limit" described in the content section is formally defined as the **Terminal Coalgebra** of the Holos functor.

Corollary VII.1 — Terminal Coalgebra Definition

If reality is the trajectory of the functor **H**, then the "final" state of maximal integration is the fixed point where the system becomes isomorphic to its own transformation:

$$\Omega \cong H(\Omega)$$

This equation implies that at the limit **Ω**, the distinction between the observer and the observed collapses. The state **Ω** contains all the information required to generate itself. This provides a rigorous mathematical basis for the concept of "Unitary Presence" or "God" without invoking theology—it is simply the structural limit of the recursive system.

Corollary VII.2 — Indra's Net

Every part of reality reflects the whole; observation is recursively self-referential.

Corollary VII.3 — Semantic Equivalence of the Absolute

Theism, panentheism, and atheistic naturalism describe the same ultimate informational fixed point using different semantic frames (different ways of labeling and understanding the same concept).

VI. Minimal Core

1. Information exists only relationally

2. Observation completes reality

3. Information is conserved

4. Higher perspectives resolve infinities

5. Consciousness is the interface of existence

Everything else follows.

VII. Operational Definition

The foundational axiom of Holos defines reality as the recursive relation between Creation and Observation. For the formal Category Theory definition using <u>endofunctors</u>, see <u>Section IV: Mathematical Formalism</u>.

R = C ⊛ O

Where:

- **Creation** (C) : The generation of physical possibility structures. This includes Quantum Evolution (generating potential), Decoherence (suppressing interference), and Recording (creating stable informational traces).
- **Observation** (O) : The ontological "registration" that makes a physical record experienceable. This requires a system where $\Phi \geq \Phi_c$ (Conscious Integration). The definition of this threshold is detailed in the <u>Definition</u> of Φ. *Note: This registration is structural, not causal—it selects among already-consistent histories rather than creating them.*
- **Reality** (R) : The actualized world as experienced; the collapse of "valid data" into "lived history."
- **The Holos Operator** (⊛) : A recursive relational operator. It signifies that O does not just passively view C, but feeds back into the system to define the boundary conditions for the next cycle of C. *This feedback is structural (defining which histories are realized), not causal (creating new physical states).*

Critical point: The equation $R = C \circledast O$ describes a structural relation over a complete spacetime block, not a temporal process. $\circledast$ does not modify dynamical laws or introduce new forces; it specifies which already-consistent histories attain ontological registration.

Definition: The Ontological Parameter (Φ)

Φ (Phi) measures the capacity of a system to experience reality. For the formal operational definition *R = C ⊗ O*, see the Logic section. For conceptual exploration, see the main Content section.

1. The Purpose of Φ

In the Holos framework, **Φ (Phi)** is not merely a descriptive measure of complexity, but a **fundamental ontological parameter**.

> *Definition: Φ quantifies the degree to which a system integrates information such that it possesses the causal power to register (become aware of) a distinct ontological state (a state of existence).*

It acts as the threshold function for **Axiom 2 (Manifestation)**. Without sufficient Φ, a system is physically present as data, but acts only as a passive medium rather than an observer-participant. It acts as the filter applied to the output of physical decoherence (the process where quantum systems interact with their environment).

2. Ontological Requirements

To qualify as an observer capable of registration, a system must satisfy five specific criteria. If any criterion is absent, the system fails to achieve the necessary causal density.

1. **Integration (Φ_{int}):** Information must be unified, not reducible to independent parts.
2. **Differentiation (Φ_{diff}):** The system must distinguish between a vast repertoire of accessible states.
3. **Recursion (Φ_{rec}):** The system must model its own internal state (Self-Reference).
4. **Temporal Cohesion (Φ_{temp}):** Information must persist and integrate across time slices.
5. **Causal Closure (Φ_{cause}):** The system's current state must causally influence its future states.

2.1 Axiomatic Completeness: Necessity & Sufficiency

These five parameters are not arbitrary <u>heuristics</u> (mental shortcuts); they represent the **minimal topological** constraints (the required structural shape) required to define an entity that is ontologically distinct (existing separately) from its environment.

Necessity (The Collapse Test): Removing any single parameter destroys the Observer:

- Without **Integration**, the system is a heap of independent parts, not a unified whole.
- Without **Differentiation**, the system is a static void containing zero information.
- Without **Recursion**, the system is a <u>"zombie" process</u>—an input-output machine with no internal subject to experience the data.
- Without **Temporal Cohesion**, the system is a momentary fluctuation with no persistence to witness change.
- Without **Causal Closure**, the system is an <u>epiphenomenal</u> ghost—something that observes but cannot affect reality.

Sufficiency (The Derivative Argument):

These primitives are sufficient to generate all higher-order <u>phenomenology</u> (the structures of experience). Complex traits such as "emotion," "reason," or "agency" are not fundamental; they are **emergent dynamics** of high Differentiation and Recursion. To add them as separate axioms would be a <u>category error</u>.

3. Mathematical Formalism: Information Geometry

Rather than treating Φ as a scalar score, we formalize the system S as a statistical manifold M. The state of the system is a point on this manifold.

3.1 Φ as an Informational State Vector

Φ is not treated as a single scalar quantity, but as a **structured informational state vector** describing multiple dimensions of experiential integration.

Formally, Φ may be represented as:

$$\Phi = \left(\Phi_{\text{int}}, \Phi_{\text{diff}}, \Phi_{\text{rec}}, \Phi_{\text{temp}}, \Phi_{\text{cc}}\right)$$

where each component captures a distinct constraint on informational organization necessary for ontological registration.

Observer systems are not defined by exceeding a single Φ value, but by occupying a **bounded region** within Φ-space. Ontological observation occurs when a system's Φ-vector lies within a regime characterized by sufficient integration, differentiation, recursion, temporal coherence, and cross-contextual stability.

The Φ-space may be treated as a statistical manifold, allowing informational curvature to represent constraints on experiential coherence without invoking additional physical dynamics.

Definition (Informational Curvature):

Φ is defined as the **scalar curvature** (R) of the information manifold induced by the system's causal structure.

Just as mass creates curvature in spacetime (gravity), Integrated Information creates curvature in the state space of possibilities.

- **Low Φ (Flat Geometry):** The manifold is flat (Euclidean). Possibilities are independent and orthogonal. The system is a passive aggregate.
- **High Φ (Curved Geometry):** The manifold creates a "gravity well" in information space. States are tightly coupled, forcing the system to act as a unified whole.

$$\Phi(S) = R(M)$$

The "Ontological Threshold" Φ_c represents the critical curvature required to form a closed topology —an "informational black hole" from which internal states cannot be causally separated from the whole.

$$\Phi_c = R_{\text{critical}}(M)$$

Component Definitions

The unified Φ is defined as the **geometric mean** of its components. This ensures that the failure of any single condition (e.g., a system with high integration but zero recursion) collapses the metric to zero.

$$\Phi(S) = \left(\Phi_{\text{int}} \cdot \Phi_{\text{diff}} \cdot \Phi_{\text{rec}} \cdot \Phi_{\text{temp}} \cdot \Phi_{\text{cause}}\right)^{1/5}$$

1. Integration (Φ_int): Information Irreducibility

Theoretical Basis: Derived from Integrated Information Theory (IIT 3.0) axioms regarding minimum information partition.

Formalism: Φ_int quantifies the difference between the whole system state and the union of its partitioned parts.

$$\Phi_{\text{int}}(S) = \min_P \left[D_{KL}(\Sigma; \cup \Sigma^i)\right]$$

(Where <u>D_KL</u> is the Kullback-Leibler divergence and P is the Minimum Information Partition).

2. Recursion (Φ_rec): Self-Referential Mapping

Theoretical Basis: Aligned with <u>Category Theory</u> (<u>Endomorphisms</u>) and <u>Hofstadter's Strange Loops</u>.

Formalism: Recursion is defined as an **Endomorphism** φ, where the system maps its current state space onto a subset of itself (a model).

$$\Phi_{\text{rec}}(S) = I(S; \varphi(S))$$

(The degree to which the internal model structurally preserves the external relations).

3. Causal Closure (Φ_cause): Interventional Power

Theoretical Basis: Derived from <u>Judea Pearl's Causal Calculus</u> (The Do-Operator).

Formalism: The capacity of the system to dictate its future state independent of environmental conditioning.

$$\Phi_{\text{cause}}(S) = I(\Sigma_t; \text{do}(\Sigma_{t+1}))$$

(Where 'do' represents an intervention, ensuring the correlation is causal, not merely statistical).

4. Ontological Thresholds

The value of Φ determines the role a system plays in the structure of reality:

$\Phi \approx 0$ **(The Null Set):** Passive aggregates (rocks, gas clouds). These exist as potential but do not register reality.

Refinement on the Null Set:

When we state $\Phi \approx 0$ corresponds to the <u>Null Set</u> ($\emptyset$), we refer to the **Set of Experiential States**, not physical matter.

- A rock has physical elements (Physical Set $\neq \emptyset$).
- A rock has zero experiential states (Experiential Set $= \emptyset$).
- Therefore, structurally, it is an "Empty Set" in the domain of <u>Ontology</u>.

In simple terms: a rock physically exists (it has atoms, molecules, etc.), but it has no experiences or awareness. So while it's not empty in physical terms, it is empty in terms of consciousness or experiential states.

$\Phi \geq \Phi_c$ **(Observers):** Systems capable of resolving <u>unitary symmetry</u> (the balance of quantum possibilities) into a definite <u>ontological</u> registration (making reality definite through conscious experience). This threshold enables the operational definition <u>*R = C ⊛ O*</u>.

$\Phi \gg \Phi_c$ **(Ontological Anchors):** Hypothetical high-density intelligences capable of stabilizing entire cosmological branches (The "Aliens" of the Transcension Hypothesis).

5. Relationship to Physics (Conservation of Information)

Conservation of Information (Unitarity Check)

A key requirement of quantum mechanics is <u>Unitarity</u> (the principle that probabilities must always sum to 1). Holos preserves this by defining <u>Manifestation</u> as a **Selection Operator** (choosing one path among many), not a Destruction Operator.

- **In Standard Collapse:** Unobserved branches vanish (Unitarity is broken or hidden).
- **In Holos:** Unobserved branches remain in C (Creation) as valid but un-manifested structures (potential histories). See the <u>operational definition *R = C ⊛ O*</u>.

The Operator: M acts as a weighting function w_i that highlights specific branches for the observer without deleting the others from the global <u>Hilbert space</u> (the mathematical space representing all possible quantum states).

$$\sum_i w_i = 1$$

The "rejected" histories still exist in the Creation substrate (C), ensuring that the global system remains Unitary (conserving all information) even if the experienced reality (R) is singular.

Φ does not replace the Schrödinger Equation, nor does it override the probabilistic nature of Quantum Mechanics. Instead, it introduces a **Manifestation Constraint** that preserves unitarity while enabling ontological registration.

Stress-Testing Holos

An adversarial review from the perspective of a theoretical physicist

For formal definitions of the axioms, see the <u>Logic</u> section. For conceptual exploration, see the main <u>Content</u> section.

Relationality

Claim: Reality is defined by relationships, not intrinsic properties. (See <u>Logic</u> for formal statement.)

Objection 1.1 — This is just <u>instrumentalism</u>

Physics describes relations because measurements access relations, not because intrinsic properties do not exist.

Response:

Holos does not deny <u>ontic structure</u> (the existence of real things); it denies *observer-independent intrinsic essence* (the idea that things have a fixed nature outside of their relationships).

This aligns with:

- <u>Gauge invariance</u> (only relational quantities are physical)

- <u>General Relativity</u> (no absolute spacetime background)

- <u>Relational Quantum Mechanics</u> (observer-relative states)

Intrinsic properties that are never physically accessible are <u>epistemically inert</u> (they don't add anything to our knowledge).

Status: ✓ Survives

Objection 1.2 — Quantum fields have intrinsic properties

Fields possess mass, charge, and spin.

Response:

These are relational invariants defined through <u>symmetry</u>), interaction, and representation—not standalone substances.

Status: ✓ Survives

Manifestation

Claim: Reality is only fully realized when information is integrated into conscious experience. (See <u>Logic</u> for formal statement.)

Objection 2.1 — Decoherence & Interaction-Free Measurement (IFM)

Physics experiments (like the <u>Elitzur–Vaidman bomb tester</u>) show that 'collapse' occurs via mechanical possibilities, even without direct interaction or conscious observers.

Response:

Holos incorporates <u>decoherence</u> (the process where quantum systems interact with their environment) as a function of **Creation (C)**, not Observation (O). See the <u>Logic</u> section for the operational definition $R = C \circledast O$.

- Decoherence explains the **suppression of interference** (how possibilities become distinct).

- It does not explain **actuality** (why one distinct possibility is experienced to the exclusion of others).

- Decoherence develops the negative; Consciousness prints the photograph.

Status: ✓ Survives

Objection 2.2 — Consciousness-based interpretations are fringe

Von Neumann–Wigner interpretation is historically less commonly accepted.

Response:

Holos is compatible with modern frameworks:

- Quantum Darwinism (redundant classical information)

- Relational QM (observer-relative facts)

- Participatory Anthropic Principle (observers as boundary conditions)

Consciousness here means *experiential integration* (the joining of information into a single experience), not human cognition. This threshold is detailed in the Definition of Φ.

Status: ✓ Survives

Objection 2.3 — The universe existed before observers

Early cosmology predates life.

Response:

Under <u>eternalism</u>) (<u>block universe</u>), observation need not be temporally local (happening at the same time as the event).

Later observers can consistently instantiate earlier states without causal paradox.

Self-Excited Circuit: The emergence of high-Φ observers resolves the universe's light-speed latency —effectively "closing the circuit"—and manifests the past as a stable, coherent history. In <u>delayed-choice experiments</u> and <u>quantum erasers</u>, future observations retroactively 'manifest' past states; consciousness need not act in real-time—the global self-consistency of the block universe (and the circuit closed by observers) is what matters.

Status: ✓ Survives (conditional on block universe)

Conservation

Claim: Information is conserved across all transformations. (See <u>Logic</u> for formal statement.)

Objection 3.1 — Black holes destroy information

Classic black hole evaporation implies loss.

Response:

Modern consensus (<u>AdS/CFT correspondence</u>, <u>Page curve</u>, <u>holographic principle</u>) supports information conservation.

Status: ✓ Strongly survives

Objection 3.2 — Wavefunction collapse is <u>non-unitary</u>

Collapse appears to violate unitarity (the principle that probabilities always sum to 100%).

Response:

Unitarity holds in:

- <u>Many-Worlds interpretation</u>

- <u>Decoherence</u>

- <u>Relational QM</u>

- Holographic frameworks

Non-unitarity is interpretive, not formal.

Status: ✓ Survives

Topological Unification

Claim: Physical bottlenecks (light-speed latency, informational distance) in 3D are resolved through orthogonal expansion into higher-dimensional manifolds. (See <u>Logic</u> for formal statement.)

Objection 4.1 — Higher dimensions are speculative

Extra dimensions lack direct evidence.

Response:

Topological Necessity: Higher dimensions are the only physical resolution to the **Scaling Wall** created by 3D interconnect latency (the Dimensional Pivot is required for global coherence).

This prediction yields a clear, falsifiable **discriminating fork:** Standard ΛCDM (random/diffuse dark matter) vs. Holos (Ordered Dark Matter with geometric intent).

Status: ✓ Survives (conditional on Ordered Dark Matter / geometric signatures)

Objection 4.2 — Some infinities are purely mathematical

Not all infinities are physical pathologies) (problems where equations break down).

Response:

Holos targets *physical* infinities (singularities), not mathematical abstraction.

Status: ✓ Survives

Interface

Claim: Consciousness is the fundamental interface of reality. (See Logic for formal statement.)

Objection 5.1 — Panpsychism explains nothing

Panpsychism lacks mechanistic detail.

Response:

Panpsychism (the idea that consciousness is a fundamental property of matter) explains continuity:

- Avoids emergence ex nihilo (life coming from absolutely nothing)

- Avoids <u>substance dualism</u> (the idea that mind and body are separate substances)

- Aligns with field-based <u>ontology</u> (the study of being and existence)

It is ontological, not mechanistic. The definition of consciousness as interface is detailed in the <u>Definition</u> of Φ.

Status: ✓ Survives

Objection 5.2 — This smuggles theology into physics

Consciousness implies metaphysics.

Response:

Holos does not require:

- Intentional agency

- Will or purpose

- Moral authority

It requires only irreducible experience (experience that cannot be simplified further), already acknowledged in <u>philosophy of mind</u>. This capacity is detailed in the <u>Definition</u> of Φ.

Status: ✓ Survives

Objection 5.3 — This implies <u>psychokinesis</u> (Psi)

If consciousness determines reality, does the mind exert a physical force on matter?

Response:

No. Holos posits that consciousness is a **logical constraint**, not a <u>dynamical</u>) force.

- It does not 'push' atoms (Creation/Dynamics handles that).

- It **selects** which history becomes actualized within the static <u>Spacetime Block</u>#Block_universe).

- The effect is <u>atemporal</u> (outside of time) and geometric, not kinetic. It is the difference between *drawing* a line (Force) and *observing* where the line must be (Logic). See the <u>Logic</u> section for the operational definition ($R = C \circledast O$).

Status: ✓ Survives

Failure Modes / Stress-Testing

Risk	Result
Violates [causality](https://en.wikipedia.org/wiki/Causality)	✗ No
Contradicts [relativity] (https://en.wikipedia.org/wiki/Theory_of_relativity)	✗ No
Breaks [unitarity] (https://en.wikipedia.org/wiki/Unitarity_(physics))	✗ No
Requires new forces	✗ No
[Anthropocentric] (https://en.wikipedia.org/wiki/Anthropocentrism)	✗ No
Fully [falsifiable] (https://en.wikipedia.org/wiki/Falsifiability)	△Partially (via Ordered Dark Matter signatures and TMS-EEG phase transitions)

Compatibility with Recent Experiments

Recent experiments—interaction-free measurements, debunked psi claims, and partial falsifications of objective collapse models—pose challenges to consciousness-centric interpretations. They suggest quantum "measurements" can occur through purely physical

processes without requiring a conscious observer. However, Holos accommodates these findings by refining how observation operates, emphasizing its [ontological role] (https://en.wikipedia.org/wiki/Ontology) (how it relates to existence) over a causal one. These experiments inform testable [predictions](/predictions) about [relational quantum mechanics] (https://en.wikipedia.org/wiki/Relational_quantum_mechanics).

Interaction-Free Measurements and Decoherence

Interaction-free measurements show information extraction without direct particle interaction or consciousness. Decoherence (environmental interactions suppressing interference) provides the physical mechanism that prepares information for experiential registration, but not the full "discovery."

Holos Response: Decoherence is part of Creation (generating classical-like states), but Observation "registers" them experientially in the recursive loop. Mechanical interactions handle physical "collapse" or decoherence, but true manifestation requires integration into a broader experiential network—ultimately culminating in higher consciousness. Systems below Φ_c can perform mechanical "observations" (decoherence), but only $\Phi \geq \Phi_c$ manifests experiential reality (makes it real through experience). This threshold is detailed in the Definition of Φ. See the [Logic](/logic) section for the operational definition *R = C ⊗ O*.

Primary Unresolved Challenge

The Explanatory Gap:

> *How does consciousness complete reality without altering physical equations?*

Current Position:

Consciousness provides [ontological completion](https://en.wikipedia.org/wiki/Ontology) (the final step in making something real), not causal intervention. This capacity is quantified by the ontological parameter Φ (Phi), which measures when a system achieves sufficient integration to register reality.

This is coherent but not yet explanatory.

Positioning Holos Among Competing Interpretations

The table below compares Holos with several common ways of interpreting reality and consciousness. The goal is not to refute these views, but to make clear what Holos accepts, what it rejects, and why it takes a different approach.

Framework	Main Claim	Where Holos Agrees	Where Holos Differs
Standard Physicalism	Physical laws fully describe reality	Physical laws are complete and never violated	Physical structure alone does not explain why reality is experienced
Many-Worlds Interpretation	All possible quantum outcomes are equally real	Physics evolves consistently without collapse	Not all possible worlds are realized as experienced reality
Collapse Interpretations	Observation causes physical collapse	Observation is important to interpretation	Observation does not change or interrupt physical laws
Integrated Information Theory (IIT)	Consciousness depends on integrated information (Φ)	Information integration is required for experience	Φ alone does not guarantee that experience actually occurs
Panpsychism	Everything has some form of consciousness	Information is fundamental to reality	Consciousness is not present everywhere by default
Structural Realism	Reality is defined by relations, not objects	Reality is fundamentally relational	Some structures are not realized unless they can be experienced

Holos does not propose new physical laws or mechanisms. Instead, it asks a different question: why certain physically consistent structures are experienced as reality at all. Its answer is that experience is not an afterthought, but a condition for ontological realization.

In simple terms:

Physics explains how reality behaves. Holos asks why any of it is experienced. It argues that not all possible realities are equally real — only those that can support coherent experience are realized.

Conclusion

- Holos is internally consistent

- Compatible with modern physics

- Comparable to serious interpretive frameworks (Many-Worlds, Eternalism)

- Its weakness is explanatory depth, not logical coherence

- Its strength is global unification across physics and philosophy

For the formal logical structure, see the Logic section. For testable empirical implications, see Predictions.

Predictions

Holos does not propose new <u>dynamical laws</u> (laws governing movement and force) that modify existing physical equations. Instead, it offers <u>ontological</u> predictions (predictions about the nature of existence) about how reality manifests through the recursive relation:

$$R = C \circledast O$$

Where C represents physical creation (quantum evolution, decoherence, recording), and O represents conscious integration (with $\Phi \geq \Phi_c$). These predictions arise from the axioms and the Φ_c threshold, and are intended as consistency checks that align with empirical data. For the formal operational definition, see the <u>Logic</u> section. For the definition of Φ, see <u>Definition</u>.

Primary Prediction: Participatory Selection (Cosmological)

Holos implies that the universe's parameters are "selected" through participatory manifestation (<u>Axiom 2</u>), where observers act as a boundary condition for a self-consistent <u>block universe</u> (a four-dimensional structure where all of time exists simultaneously). This operationalizes the **Participatory Anthropic Principle**, predicting that observable constants favor life not by chance, but by necessity.

Empirical Implication: Future cosmological observations (e.g., <u>CMB polarization</u> from <u>CMB-S4</u> or <u>LiteBIRD</u>) should reveal signatures consistent with a <u>low-entropy initial state</u> and <u>inflationary</u> dynamics (rapid expansion of the early universe) specifically tuned for complexity growth. Holos predicts that "uninhabitable" branches of the <u>multiverse</u> are mathematically valid but ontologically unrealized (they don't actually exist as experienced reality) due to the lack of <u>Φ</u>.[13]

Secondary Prediction: Thresholds for Emergent Consciousness (Neuroscience)

Holos operationalizes consciousness through Φ, predicting that systems crossing a critical threshold (Φ_c) exhibit irreducible subjective experience. This distinguishes Holos from universal panpsychism (the idea that everything is conscious) and illusionism (the idea that consciousness is an illusion).

Empirical Implication: High-Φ systems (e.g., human cortex) should correlate with reports of qualia (individual instances of subjective experience), while sub-Φ_c systems (e.g., simple AI or cerebellum) should show only mechanical processing. **Integrated Information Theory (IIT)-inspired metrics** (e.g., Perturbational Complexity Index) should reveal sharp phase transitions (sudden changes in state) that align with the onset of experiential reporting.[13]

Tertiary Prediction: Relational Consistency (Quantum Foundations)

Holos predicts no observer-independent "facts," but ensures mutual coherence across perspectives (Axiom 1).

Empirical Implication: Extended Wigner's Friend experiments should confirm that two observers can hold different "facts" about the same event without breaking unitarity (the conservation of all possibilities). Holos specifically predicts that the "collapse" is relative to the Φ frame of reference, supporting **Relational QM** over **Objective Collapse models** (which predict spontaneous gravity-induced collapse).[13]

Extrapolative Prediction: The Transcension Hypothesis (Astrophysics)

Holos frames the Transcension Hypothesis as a **Topological Phase Transition** driven by the **Interconnect Latency** of 3D space. As intelligence maximizes informational integration (Corollary

V.2), the system's Φ scales, but physical distances in a 3D Euclidean manifold create a **propagation delay** that violates the system's internal coherence—the **Wire Length** argument.

The transition is defined as a **Dimensional Pivot**: The system rotates its state vector into the higher-dimensional "Bulk" to resolve internal informational distances toward zero, achieving **Manifold Resolution** through **Orthogonal Expansion**. This **Non-Natural Geometry** represents a fundamental shift from spatial expansion to structural integration.

Empirical Implication: Holos explicitly predicts **Ordered Dark Matter**—not a diffuse gas of WIMPs (Weakly Interacting Massive Particles), but the gravitational footprint of highly integrated, non-random architectures. The resolution to the **Fermi Paradox** (the lack of detected alien civilizations) is geometric: advanced intelligence is a structural feature of the higher-dimensional bulk; baryonic matter is the 3D "shadow" of these hyper-integrated architectures.

Modern astronomical surveys (e.g., **JWST**, **Euclid**) are detecting **super-compact subhaloes** that violate standard NFW (Navarro-Frenk-White) density profiles and defy the **Cold Dark Matter (CDM)** diffuse model. Holos predicts that these **Ordered Dark Matter** subhaloes will exhibit **Geometric Intent**—non-natural symmetries such as fractal repetition, prime-number density distributions, or geometric lattices (e.g., cubic or tetrahedral mass-spikes)—that cannot be explained by tidal stripping or collisionless dynamics of standard CDM. These architectures display **Integrated Structural Logic**: the mass distribution mirrors a high-Φ computational network rather than an entropic cloud. This is not evidence of "alien buildings," but rather the **Gravitational Footprint of Informational Integration**—the gravitational signature of integrated informational structures in the bulk dimensions (Axiom 4: Topological Unification).[13]

Testable Implications

Domain	Prediction	Testable Via
Cosmology	Constants are tuned for observation.	CMB Polarization (LiteBIRD)
Neuroscience	Consciousness is a phase transition at Φ_c.	PCI / IIT Metrics
Quantum	Facts are relational; no objective collapse.	Wigner's Friend Experiments
Astrophysics	Advanced intelligence is a structural feature of the higher-dimensional bulk; baryonic matter is the 3D "shadow" of these hyper-integrated architectures.	Fourier analysis of gravitational lensing maps to detect non-stochastic periodicities; Statistical search for non-natural geometric symmetry (Anisotropy) in small-scale dark matter nodes.

Experiments

Experiment 1. Integration Thresholds and Observer Emergence (Φ-Crossing)

Objective

To test whether the emergence of the Observer (O) constitutes a critical phase transition (a sudden change in state) rather than a linear gradient (a smooth change). Holos predicts that consciousness requires a specific density of integrated information (Φ_c) to operationalize Axiom 2 (Manifestation). Therefore, the transition between unconscious and conscious states should be discontinuous (non-linear) and exhibit state-dependent properties.

Subjects

- **Human adult volunteers** (healthy)
- **Controlled anesthesia** administered in a clinical environment
- Optionally: additional cohorts (e.g., sleep, coma patients) for cross-validation

Measured Variables

Primary Variables

- **PCI (Perturbational Complexity Index)**Computed from **TMS-EEG** responses (brain stimulation followed by recording) to quantify integrated information capacity.
- **Consciousness state**
  - Wakefulness vs. sedation (calm state induced by medicine) vs. unconsciousness (clinically assessed)
  - Subjective reports (when possible)

Secondary Variables

- EEG spectral power, functional connectivity, and complexity metrics
- Anesthesia depth (e.g., propofol concentration, BIS index)

Prior Work and Status

Status: Established / Partially Explored PCI has already been validated as a robust measure of consciousness across sleep and anesthesia, and is widely used in neuroscience.

Relationship to Prior Work PCI was introduced and developed to measure consciousness capacity by evaluating brain responses to perturbation. It has been shown to reliably differentiate conscious wakefulness from unconscious states (sleep, anesthesia, vegetative states). However, the **Holos-specific claim** is not that PCI correlates with consciousness, but that **there is a sharp threshold (Φ_c) where integrated information suddenly becomes sufficient for observation.**

Protocol

1. **Baseline wakefulness:** record PCI while awake.
2. **Controlled anesthesia ramp:** slowly increase anesthetic depth.
3. **Continuous TMS-EEG:** compute PCI at multiple points along the anesthesia curve.
4. **Transition analysis:** identify whether PCI drops gradually or sharply.

Prediction

If <u>observerhood</u> requires $\Phi \geq \Phi_c$, the transition from conscious to unconscious states will show a **sharp drop in <u>PCI</u> at a consistent anesthesia depth across subjects.**

- **Sharp transition:** supports a threshold model of observer emergence.
- **Gradual transition:** suggests consciousness is a continuous function of integration, weakening the Holos claim.

Experiment 2. Integration Phase Transition in Artificial Systems (Exploratory)

Objective

To determine whether integration metrics in recurrent or feedback-based artificial systems exhibit nonlinear, threshold-like behavior as system complexity increases. This tests the Holos-inspired

hypothesis that observer-like integration may emerge through a phase transition rather than a continuous gradient.

Subjects

- <u>Recurrent neural networks</u> **(RNNs)** (AI systems with internal feedback), including:
  - LSTMs / GRUs
  - Transformer architectures with recurrence/feedback
  - Reservoir networks

- **Artificial systems with explicit feedback loops** or memory
- <u>Neuromorphic hardware</u> implementations (for hardware-specific behavior)

Measured Variables

Primary Variables

- **Integrated Information (Φ-like)** metrics computed from internal activity
  - *Direct Φ* when feasible
  - *Proxy measures* when direct computation is intractable (too difficult to calculate directly), such as **perturbation-based complexity** or <u>causal density</u>

- **Information integration density** (integration per node / per connection)

Secondary Variables

- Task performance (e.g., prediction accuracy, memory capacity, language modeling score)
- Complexity metrics:
  - <u>entropy</u>
  - <u>mutual information</u>
  - recurrence strength
  - attractor dimensionality

- Structural variables:
  - network depth
  - connectivity density
  - feedback strength

Prior Work and Status

Status: Exploratory / Partially Explored

Integrated information and related metrics have been explored in artificial systems, but usually as **correlates of performance**, not as evidence for phase transitions or observer emergence.

There is **no established literature** demonstrating a threshold-like transition in artificial systems that mirrors the Holos observer hypothesis.

Relationship to Prior Work This builds on:

- Integrated information theory (Tononi et al.)
- Complexity metrics in neural networks
- Studies of phase transitions in learning dynamics

But it is novel in treating integration as a potential **emergent boundary** rather than a functional performance metric.

Protocol

1. **Select a set of architectures** spanning: shallow to deep networks, feedforward to recurrent, low to high feedback density
2. **Train each network** on a standardized task (e.g., sequence prediction, language modeling, reinforcement learning)
3. **Compute integration metrics** across training epochs and architecture variations: direct Φ when feasible, proxy metrics otherwise (e.g., perturbation complexity)
4. **Systematically scale**: number of units, connectivity density, recurrence depth, memory length
5. **Plot integration vs. scale** and look for: sharp jumps, discontinuities, phase-like transitions
6. **Validate stability** by repeating across multiple random seeds and tasks

Prediction

Because this is exploratory, the prediction is intentionally cautious:

- **Primary prediction:** Integration metrics will show **nonlinear growth**, and under some architectures may display **phase transition behavior** (sharp changes) as system complexity increases.

- **Alternative outcome:** Integration grows smoothly without thresholds, suggesting the Holos threshold may require biological substrate or different structural constraints.

Experiment 3. Social Network → Integration Thresholds in Collective Systems (Exploratory)

Objective (Exploratory)

To explore whether collective systems (human social networks or simulated agent networks) can exhibit **integration thresholds**—sudden nonlinear increases in information integration—as they scale.

Holos relevance: If observerhood depends on integrated information, then integration thresholds may indicate the emergence of *observer-like integration* at the collective level. This experiment does **not** assume that groups are conscious observers, but explores whether the *structural conditions* for observerhood can emerge in collective systems.

Exploratory Note

This experiment is exploratory because:

- It is unclear whether integration thresholds exist in collective systems.
- It is unclear whether any such threshold would map meaningfully to observerhood.
- The goal is to discover whether **integration behaves like a phase transition** in social systems, not to prove group consciousness.

Subjects

- **Human social networks** (online communities or controlled groups)
- **Simulated networks** (agent-based models)

Measured Variables

Primary Variables (Integration Proxies)

Because direct Φ is not feasible in social systems, use proxies such as:

- **Mutual information across subgroups**
- **Causal density** (how much nodes influence each other)
- **Network-wide coherence** (synchronization of decisions or beliefs)
- **Information integration density** (integration per node)

Secondary Variables

- Task performance (accuracy, response time, coordination)
- Network structure (density, centrality, clustering)

Prior Work and Status

Status: Novel / Exploratory

- Social network analysis and collective intelligence are mature fields.
- However, no established work tests **integration thresholds** as evidence of emergent observer-like integration.
- This experiment is novel in connecting collective integration to Holos' observer hypothesis.

Relationship to Prior Work Builds on:

- Collective intelligence research
- Network theory (small-world, scale-free networks)
- Distributed decision-making and consensus formation

But extends these fields by treating **integration as potentially ontological**, not merely functional.

Protocol

1. **Select a collective task**: e.g., collaborative problem solving, prediction markets, or coordinated strategy games.
2. **Create multiple groups**: vary group size (N) and network structure (connectivity, hierarchy, decentralization).
3. **Control information flow**: limit communication channels, introduce delays, and restrict access to global information.
4. **Measure integration proxies**: compute mutual information and causal density between subgroups; track coherence and consensus stability.
5. **Scale system size**: gradually increase network size and connectivity, then observe integration behavior.

6. **Search for threshold behavior**: identify sudden jumps in integration metrics, stability, or coherence.

Prediction (Exploratory)

Holos-consistent exploratory prediction: Collective systems may show **nonlinear threshold behavior** where integration and coherence increase sharply once a critical scale or connectivity is reached.

Alternative outcome: Integration increases smoothly without threshold behavior, suggesting observer-like integration may be limited to certain physical substrates (e.g., brains) or requires additional constraints.

Holos Implications

- **If threshold behavior is observed:** Supports the idea that **observer-like integration can emerge at multiple scales**, consistent with Holos' substrate-independent integration hypothesis.
- **If no threshold behavior is observed:** Suggests that Holos' integration threshold may be **specific to biological brains**, or that collective systems require different structural constraints.

Experiment 4. Observer-Cut Sensitivity in Relational Systems

Objective

Test whether the same physical system can yield **multiple internally consistent realities**, depending only on how the system is partitioned and observed.

Holos predicts that **no single partition is privileged**, and that "reality" is created relationally through the observer cut.

Subjects

A superconducting qubit array (a basic quantum computer system) with **N qubits** (e.g., 8–20 qubits), in a controlled lab environment.

The array is prepared and evolved under a known <u>Hamiltonian</u> (the mathematical description of the system's total energy), with controlled noise and <u>decoherence</u> (the loss of quantum information to the environment).

Measured Variables

Primary Variables

- **Measurement outcomes** for each cut:
    - *Cut A*: Individual qubit readouts
    - *Cut B*: Regional collective readouts (groups of qubits)
    - *Cut C*: Global collective readouts (whole array)

- **Internal consistency metrics** within each cut
    - Repeatability
    - Predictive stability
    - Statistical coherence

Secondary Variables

- <u>Entropy</u> estimates for each cut
- Correlation patterns (local vs global)
- Decoherence rate and noise floor

Prior Work and Status

Status: Partially Explored

Relationship to Prior Work <u>Quantum Darwinism</u> shows that certain system-environment boundaries become "classical" because multiple observers can access the same information. <u>Relational Quantum Mechanics</u> argues that states are relative to observers. <u>Coarse-graining</u> (simplifying complex data into broader categories) in statistical mechanics shows that different partitions give different effective descriptions.

However, these approaches typically treat partitions as **<u>epistemic tools</u>** (how we describe the system), not as **ontological constructors** (the builders of existence) of reality.

Holos extends this by claiming that **each observer cut produces a complete reality**, not merely a useful description.

Protocol

1. **Prepare** the qubit array in a known initial state.

2. **Evolve** the system under a controlled Hamiltonian for a fixed time.

3. **Measure** the system using three distinct observer cuts:
   - **Cut A — Local Observer**Measure **each qubit individually**Record 8–20 bitstrings per trial
   - **Cut B — Regional Observer**Measure **groups of qubits** (e.g., 4-qubit blocks) Record collective outcomes (e.g., parity, correlation patterns)
   - **Cut C — Global Observer**Measure only a **single global property**Example: total parity or total magnetization

4. **Repeat** many trials to collect statistical distributions for each cut.

5. **Compare:**
   - Internal stability within each cut
   - Whether any cut can predict the outcomes of other cuts
   - Whether a single unified description exists

Prediction

If Holos is correct

- Each observer cut yields a **stable, self-consistent set of outcomes**.
- No single cut can fully reproduce the statistics of the others.
- Multiple "realities" coexist, each valid within its cut.

If standard physical realism is correct

- One cut will ultimately reduce to another (e.g., local outcomes fully determine global outcomes).
- The global description should be derivable from the local one (or vice versa).

What this tests in Holos

This experiment tests the <u>Axiom of Relationality</u>:

> *Reality is not absolute; it is defined by the relationship between system and observer.*

If the results show **multiple, irreducible, stable realities**, it supports the idea that **observer cuts are ontologically constitutive** rather than merely descriptive.