

✳ Holos

# 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, and 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:  $[R = C \otimes O]/(\text{logic})$ , 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, inviting reconsideration of some of the most fundamental questions we can ask.

## 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]

([https://en.wikipedia.org/wiki/Biocentrism\\_\(ethics\)](https://en.wikipedia.org/wiki/Biocentrism_(ethics))) 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 happen as reality rather than abstract data.

This participation is not bound by linear time. In an [eternalist universe] ([https://en.wikipedia.org/wiki/Eternalism\\_\(philosophy\\_of\\_time\)](https://en.wikipedia.org/wiki/Eternalism_(philosophy_of_time))), 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.

Standard physics describes the mechanics of reality, but mechanism is only the surface. Physical interaction provides the structure, while consciousness provides the presence required for full manifestation. Reality requires a witness.<sup>1</sup>

## 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 parameter  $\Phi$  (Phi), which determines when a system becomes capable of registering reality.

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 ontological register that converts 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  $\Phi$ .<sup>2</sup>

## Our Universe

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

This is our Spacetime block.

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

## Spacetime

The structure of spacetime is dictated by a single, counter-intuitive fact: the speed of light 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 geometric solid.

Consider beings with an unlimited lifespan and near-instantaneous communication, perceiving time as an additional spatial dimension. These beings would not be limited by the unidirectional flow of time as we are.

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](#). 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](#)—that permanently connects two points in spacetime like a seam.

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.<sup>4</sup>

## 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 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 defined by  $\Phi \geq \Phi_c$ , where systems achieve sufficient informational integration to register ontological states.

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. The formal criteria for such consciousness are defined in the Definition of  $\Phi$ .<sup>5</sup>

# Infinity

Infinity represents the concept of dimensions extending endlessly. In the context of a given dimension, it is possible to use a higher-dimensional perspective to transform infinite structures into finite, observable entities.

By employing higher-dimensional frameworks, an infinite sequence or expanse can be encapsulated, allowing for the perception and analysis of the entire structure in its entirety. This concept suggests that what appears infinite and unbounded in one dimension can be rendered finite and progressively comprehensible when viewed 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 our understanding of infinite sequences of spatial configurations into a coherent and finite whole.<sup>6</sup>

## Black Holes

Black holes represent regions of spacetime where gravity is so intense that not even light can escape, making their interior opaque to us. 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 information is preserved on the 2D event horizon, ensuring the conservation of information (Unitarity) remains intact even at the edge of spacetime.<sup>7</sup>

For higher-dimensional beings, black holes would be as accessible as any other region of spacetime, including the ability to navigate through the singularity and perceive the vast array of information contained within. This perspective aligns with the holographic principle, which posits that all the information contained within a black hole can be described on a lower-dimensional boundary, suggesting that higher-dimensional observation could unlock the mysteries hidden within these enigmatic objects.<sup>7</sup>

# Aliens

The Fermi Paradox questions the lack of detected extraterrestrial life, despite the vastness of the universe. Within the context of this framework, this silence is likely a geometric constraint rather than a biological one. This leads to testable predictions about gravitational anomalies and dark matter signatures.

If civilizations evolve to understand the higher-dimensional structure of reality, they may inevitably "transcend" by accessing geometries orthogonal to our observable 3D slice. Rather than expanding outwardly across vast physical distances limited by the speed of light. Advanced intelligence likely expands inwardly toward higher densities of information.

These advanced civilizations would leave no electromagnetic footprint, potentially detectable only through gravitational anomalies or unaccounted-for mass (Dark Matter) that implies structure in the higher-dimensional bulk. This forms the basis for empirical predictions testable through astronomical surveys.

This Transcension Hypothesis suggests that advanced civilizations migrate into higher-dimensional manifolds or black hole singularities, where 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.<sup>8</sup>

# 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.<sup>9</sup>

# God

Regardless of any label we choose to assign, a final state of consciousness characterized by maximal informational integration (Omniscience), causal completeness (Omnipotence), and non-local topological presence (Omnipresence) is a fundamental aspect of the nature of reality.

This represents the limit case where  $\Phi$  approaches infinity, achieving complete ontological registration.

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.<sup>10</sup>

## 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.<sup>11</sup>

## Axioms

The following fundamental principles form the logical basis of this framework. For formal definitions and propositions, see the Logic section. For stress-testing and responses to objections, see the Defense section.

**Relationality:** Reality is not composed of isolated objects with intrinsic properties, but of relationships and interactions. While the observer determines the perspective, the invariant structure of these relationships remains absolute ([Holos](#)<sup>12</sup>). See [Logic](#) for formal definitions and [Defense](#) for objections and responses.

**Manifestation:** Observation is not merely mechanical interaction; it is the act of integrating information into an experience. Because reality exists as a unified spacetime block, observation need not be temporally local to be ontologically complete. Conscious entities participate in the realization of the entire structure ([Participatory Principle](#)<sup>1</sup>). The threshold for such observation is defined by  $\Phi \geq \Phi_c$ . See [Logic](#) for formal treatment and [Defense](#) for challenges to this axiom.

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

**Unification:** Apparent infinities in lower dimensions are resolved into finite structures when mapped onto higher-dimensional frameworks. Whether physical or mathematical, these higher-dimensional descriptions are required to render the universe intelligible and resolve singularities ([Projective Geometry](#)<sup>5</sup>).

**Interface:** Consciousness is not a byproduct of matter, but 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 ([Panpsychism](#)<sup>2</sup>). This scaling is quantified by  $\Phi$ , which measures the ontological capacity of systems. See [Logic](#) for formal axioms and [Defense](#) for objections.

## ⊗ Holos

The symbol  $\otimes$  denotes a binary relational operator. Unlike standard multiplication,  $\otimes$  is not scalar or linear; it represents a structured composition that preserves relational consistency under iteration. Formally,  $\otimes$  is defined such that repeated application remains well-defined, allowing the operation to scale across finite and infinite sequences without collapse or divergence. For the complete formal structure, see [Logic](#).

Holos is derived from the Greek word ὅλος (*holos*), meaning whole, entire, or complete. In this framework,  $\otimes$  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 ontological cycle. The operational definition  $R = C \circledast O$  is formally developed in [Logic](#).

Mathematically,  $\circledast$  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, where morphisms act on and reproduce the space in which they are defined. The mathematical formalism is detailed in [Logic](#).

Importantly,  $\circledast$  does not introduce an additional physical force or dynamical law. It specifies an ontological relation: how reality is constituted through the recursive coupling of generative possibility and registered state.

## Footnotes

### The Meaning of Life

1

- [Observer Effect](#) The disturbance of an observed system by the act of observation.
- [Copenhagen Interpretation](#) The act of observation collapses a quantum system's wavefunction into a definite state.
- [Quantum Darwinism](#) An environment selectively proliferates certain quantum states that become classical outcomes, observed by multiple observers.
- [Relational Quantum Mechanics](#) The properties of quantum systems are not absolute but relative to the observer.
- [Participatory Anthropic Principle](#) 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.
- [Biocentrism](#) 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.
- [Von Neumann-Wigner Interpretation](#) An interpretation of quantum mechanics in which consciousness is formulated as a necessary process for the quantum measurement process.

## Consciousness

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- Integrated Information Theory 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

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- 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

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- 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

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- 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

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- 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.
- Projective Geometry A geometric framework where parallel lines meet at infinity, transforming infinite structures into finite, observable forms.

## Black Holes

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- 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

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- 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.
- 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.
- Omega Point 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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- Conformal Cyclic Cosmology The universe undergoes infinite cycles of big bangs and expansions creating an eternal sequence of universes.
- Unitarity The principle that probabilities must sum to one, ensuring the conservation of information in quantum mechanics. Information is never lost, even in singularities.
- Many-Worlds Interpretation Every possible outcome of a quantum measurement occurs in a separate, branching universe.
- Speed of Light The invariant speed limit of the universe where spacetime separation vanishes, suggesting all events occur at a single point.

- Light Cone The boundary defining all causally connected events, where at light speed, past and future collapse into a single point.
- Indra's Net 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.
- Holos Holos: A Scientific Interpretive Framework for Explaining Reality

## Axioms

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- Structural Realism The view that science describes the mathematical structures and relationships of the physical world, rather than the intrinsic nature of the objects themselves.
- Holos The interconnected, unified, recursive structure of reality as formed through the reciprocal actions of creation and observation, symbolized by  $\circledast$ .
- Recursive Operator 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.
- Category Theory 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

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- CMB-S4 Collaboration Next-generation cosmic microwave background experiment for measuring CMB polarization.
- LiteBIRD Collaboration JAXA-led space mission to detect primordial gravitational waves through CMB polarization measurements.
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# Logic

## I. Primitive Definitions

D1 – Information

Information is the differentiation between possible states of a system.

D2 – Relation

A relation is a constraint or interaction linking informational states.

D3 – Observation (O)

Observation is the integration of information into an experiential state.

*Note:*\* This capacity is scalar. It ranges from Proto-Observation (relational state-selection in physical systems) to manifestation (full ontological actualization in systems where  $\Phi \geq \Phi_c$ ).

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. The formal definition of this capacity is quantified by the ontological parameter  $\Phi$  (Phi), which measures when a system achieves sufficient integration to register reality.

D5 – Creation (C)

Creation is the generation of distinguishable physical states.

D6 – Holos ( $\otimes$ )

Holos ( $\otimes$ ) is the recursive relational structure formed by Creation and Observation, such that: For conceptual exploration of this framework, see the main Content section.

$$R = C \otimes O$$

This equation is **definitional**, not causal: it describes the invariant structure of reality, not a temporal process.

## II. Axioms

For stress-testing and responses to objections, see the [Defense](#) section.

### Axiom 1 – Relationality

No informational state exists independently of relations.

*Reality consists of invariant relational structure, not intrinsic properties. For stress-testing of this axiom, see the [Defense](#) section.*

### 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  $\Phi \geq \Phi_c$ . For stress-testing of this axiom, see the [Defense](#) section.*

### Axiom 3 – Conservation

Information is never destroyed, only transformed.

*All physical and experiential processes are information-preserving. For stress-testing of this axiom, see the [Defense](#) section.*

### Axiom 4 – Unification

Apparent infinities and singularities in a given dimensional frame resolve into finite, coherent structures when embedded in a higher-dimensional perspective. For stress-testing of this axiom, see the [Defense](#) section.

## Axiom 5 – Interface

Consciousness is not produced by matter; matter is the experiential interface through which consciousness encounters information. The formal definition of this interface is detailed in the [Definition of  \$\Phi\$](#) .

## III. Foundational Propositions

### Proposition I – Structural Relational Realism

Reality is constituted by relational structure, not by objects with observer-independent essences. For conceptual exploration, see the main [Content](#) section.

Corollary I.1 – Structural Realism

Science describes mathematical isomorphisms 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.

### Proposition II – Participatory Manifestation

Observation is not a passive recording but an ontological completion of informational states. For conceptual exploration, see the main [Content](#) section.

Corollary II.1 – The Participatory Imperative

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

Corollary II.2 – Ontological Completeness

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

[*Decoherence*]([https://en.wikipedia.org/wiki/Quantum\\_decoherence](https://en.wikipedia.org/wiki/Quantum_decoherence))\* resolves quantum probabilities into classical-like mixtures (structural preparation).

*Manifestation*\* requires experiential integration to convert that mixture into a realized history (a fixed geometric worldline, ontological irreversibility).

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

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

\* Just as the last number placed in a Sudoku puzzle logically necessitates the value of the first square, a future observation ( $\Phi \geq \Phi_c$ ) retroactively defines the ontological status 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 four-dimensional manifold in which past, present, and future are equally real features of a single geometric structure. For conceptual exploration, see the main Content section.

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.

Corollary III.2 – Global Consistency

Apparent retrocausality 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. For conceptual exploration, see the main Content section.

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. Extrapolative Propositions

### **Proposition VI – Transcension of Intelligence (Extrapolation)**

As intelligence approaches maximal informational density, it expands orthogonally to three-dimensional space rather than across it. This leads to testable predictions about the Fermi Paradox and dark matter signatures.

Corollary VI.1 – Geometric Resolution of the Fermi Paradox

Advanced civilizations migrate inward toward higher-dimensional informational substrates, rotating out of our observable frame. This leads to testable predictions 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 (Omega Limit)**

The limiting case of Holos is a cyclic fixed point where maximal consciousness observes the totality of relational structure. This represents the limit case where  $\Phi$  approaches infinity,

achieving complete ontological registration. For conceptual exploration, see the main [Content](#) section.

Corollary VII.1 — [Indra's Net]([https://en.wikipedia.org/wiki/Indra%27s\\_net](https://en.wikipedia.org/wiki/Indra%27s_net))

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

Corollary VII.2 — Semantic Equivalence of the Absolute

[Theism](#), [panentheism](#), and atheistic naturalism describe the same ultimate informational fixed point using different semantic frames.

## V. 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.

## VI. Operational Definition

The foundational axiom of Holos defines reality as the recursive relation between Creation and Observation. For conceptual exploration of this framework, see the main [Content](#) section:

$$R = C * O$$

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 formal definition of this threshold is detailed in the [Definition](#) of  $\Phi$ .
- **Reality ( $R$ )**: The actualized world as experienced; the collapse of "valid data" into "lived history."
- **The Holos Operator ( $\circledast$ )**: 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  $C$ .

# Defense

## Stress-Testing Holos

An adversarial review from the perspective of a theoretical physicist

For formal definitions of the axioms, see the [Logic](#) section. For conceptual exploration, see the main [Content](#) section.

### Relationality

**Claim:** Reality is defined by relationships, not intrinsic properties. (See [Logic](#) for formal statement)

#### **Objection 1.1 – This is just instrumentalism**

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

#### **Response:**

Holos does not deny ontic structure; it denies *observer-independent intrinsic essence*. For the formal statement, see [Axiom 1](#) in the Logic section.

This aligns with:

- Gauge invariance (only relational quantities are physical)
- General Relativity (no absolute spacetime background)
- Relational Quantum Mechanics (observer-relative states)

Intrinsic properties that are never physically accessible are epistemically inert.

Status: ✓ Survives

## Objection 1.2 – Quantum fields have intrinsic properties

Fields possess mass, charge, and spin.

**Response:**

These are relational invariants defined through symmetry, interaction, and representation—not standalone substances. For the formal treatment, see [Axiom 1](#) in the Logic section.

Status: ✓ Survives

## Manifestation

**Claim:** Reality is only fully realized when information is integrated into conscious experience.  
(See [Logic](#) for formal statement)

## Objection 2.1 – Decoherence & Interaction-Free Measurement (IFM)

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

**Response:**

Holos incorporates decoherence as a function of **Creation (C)**, not Observation (O). See the [Logic](#) section for the formal definition of  $R = C \otimes O$ .

- 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 marginal.

**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*, not human cognition. The formal definition of this threshold is detailed in the Definition of  $\Phi$ .

**Status:** ✓ Survives

## Objection 2.3 – The universe existed before observers

Early cosmology predates life.

**Response:**

Under [eternalism]([https://en.wikipedia.org/wiki/Eternalism\\_\(philosophy\\_of\\_time\)](https://en.wikipedia.org/wiki/Eternalism_(philosophy_of_time))) (block universe, observation need not be temporally local).

Later observers can consistently instantiate earlier states without causal paradox.

In delayed-choice experiments and quantum erasers, future observations retroactively 'manifest' past states, demonstrating that consciousness doesn't need to act in real-time—it's the global self-consistency of the block universe that matters. For conceptual exploration, see the main Content section.

**Status:** ✓ Survives (conditional on block universe)

## Conservation

**Claim:** Information is conserved across all transformations. (See Logic for formal statement)

### **Objection 3.1 — Black holes destroy information**

Classic black hole evaporation implies loss.

**Response:**

Modern consensus (AdS/CFT correspondence, Page curve, holographic principle) supports information conservation. For the formal statement, see Axiom 3 in the Logic section.

**Status:** ✓ Strongly survives

### **Objection 3.2 — Wavefunction collapse is non-unitary**

Collapse appears to violate unitarity.

**Response:**

Unitarity holds in:

- Many-Worlds interpretation
- Decoherence
- Relational QM
- Holographic frameworks

Non-unitarity is interpretive, not formal.

Status: ✓ Survives

## Unification

**Claim:** Apparent infinities resolve from higher-dimensional perspectives. (See Logic for formal statement)

### Objection 4.1 – Higher dimensions are speculative

Extra dimensions lack direct evidence.

**Response:**

Holos asserts conceptual resolution, not empirical proof.

This mirrors accepted speculative frameworks (inflation, multiverse, string theory). For the formal statement, see Axiom 4 in the Logic section. For conceptual exploration, see the main Content section.

Status: ✓ Survives as structural heuristic

## Objection 4.2 – Some infinities are purely mathematical

Not all infinities are physical pathologies.

**Response:**

Holos targets *physical* infinities (singularities), not mathematical abstraction. For the formal statement, see [Axiom 4](#) in the Logic section.

**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](#) explains continuity:

- Avoids emergence ex nihilo
- Avoids substance dualism
- Aligns with field-based ontology

It is ontological, not mechanistic. The formal definition of consciousness as interface is detailed in the [Definition](#) of  $\Phi$ . For the formal statement, see [Axiom 5](#) in the Logic section.

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, already acknowledged in philosophy of mind. The formal definition of this capacity is detailed in the [Definition of  \$\Phi\$](#) . For the formal statement, see [Axiom 5](#) in the Logic section.

Status: ✓ Survives

## Objection 5.3 – This implies psychokinesis (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 dynamical force.

- It does not 'push' atoms (Creation/Dynamics handles that).
- It **selects** which history becomes actualized within the static Spacetime Block.

- The effect is atemporal and geometric, not kinetic. It is the difference between *drawing* a line (Force) and *observing* where the line must be (Logic). For the formal operational definition, see the Logic section ( $R = C \otimes O$ ).

Status: ✓ Survives

## Cross-Axiom Consistency Check

Risk	Result
Violates causality	✗ No
Contradicts relativity	✗ No
Breaks unitarity	✗ No
Requires new forces	✗ No
Anthropocentric	✗ No
Fully falsifiable	⚠️ No (interpretive framework)

## 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 over a causal one. These experiments inform testable [predictions](/predictions) about 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  $\Phi_c$  can perform mechanical "observations" (decoherence), but only  $\Phi \geq \Phi_c$  manifests experiential reality. The formal definition of this threshold is detailed in the [Definition of  \$\Phi\$](#) . See the [Logic] (/logic) section for the operational definition  $*R = C \otimes O*$ .

## Primary Unresolved Challenge

The Explanatory Gap:

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

Current Position:

Consciousness provides ontological completion, not causal intervention. The formal definition of this capacity is quantified by the ontological parameter  [\$\Phi\$  \(Phi\)](#), which measures when a system achieves sufficient integration to register reality.

This is coherent but not yet explanatory.

## Final Verdict

- 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 the [Predictions](#) section.

# Definition: The Ontological Parameter

For the formal operational definition  $*R = C \otimes O*$ , see the [Logic](#) section. For conceptual exploration, see the main [Content](#) section.

## 1. The Purpose of $\Phi$

In the [Hолос framework](#),  **$\Phi$  (Phi)** is not merely a descriptive measure of complexity, but a **fundamental ontological parameter**.

*Definition:  $\Phi$  quantifies the degree to which a system integrates information such that it possesses the causal power to register a distinct ontological state.*

It acts as the threshold function for [Axiom 2 \(Manifestation\)](#). Without sufficient  $\Phi$ , a system is physically present as data, but acts only as a passive medium rather than an observer-participant. It acts as the ontological filter applied to the output of physical decoherence processes. For stress-testing of this axiom, see the [Defense](#) section.

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

## 2.1 Axiomatic Completeness: Necessity & Sufficiency

These five parameters are not arbitrary heuristics; they represent the **minimal topological constraints** required to define an entity that is ontologically distinct 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 "zombie" process—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 epiphenomenal ghost that observes but cannot affect reality.

**Sufficiency (The Derivative Argument):**

These primitives are sufficient to generate all higher-order phenomenology. 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 category error. For the formal logical structure, see the [Logic](#) section.

## 3. Mathematical Formalism

Let a system  $S$  be described by a state space  $\Sigma$  and a transition function  $T$ . The unified  $\Phi$  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.

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

### Component Definitions

1. **Integration ( $\Phi_{\text{int}}$ ): Information Irreducibility**

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

**Formalism:**  $\Phi_{\text{int}}$  quantifies the difference between the whole system state and the union of its partitioned parts.

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

\*(Where  $D_{KL}$  is the Kullback-Leibler divergence and  $P$  is the Minimum Information Partition).\*

## 2. Recursion ( $\Phi_{\text{rec}}$ ): Self-Referential Mapping

**Theoretical Basis:** Aligned with Category Theory (Endomorphisms) and Hofstadter's Strange Loops.

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

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

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

## 3. Causal Closure ( $\Phi_{\text{cause}}$ ): Interventional Power

**Theoretical Basis:** Derived from Judea Pearl's Causal Calculus (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  $\Phi$  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.

$\Phi \geq \Phi_c$  (**Observers**): Systems capable of resolving unitary symmetry into a definite ontological registration (conscious entities). This threshold enables the operational definition  $*R = C \otimes O*$ . For testable predictions about this threshold, see the [Predictions](#) section.

$\Phi \gg \Phi_c$  (**Ontological Anchors**): Hypothetical high-density intelligences capable of stabilizing entire cosmological branches (The "Aliens" of the Transcension Hypothesis). For conceptual exploration, see the main [Content](#) section. For testable predictions, see the [Predictions](#) section.

## 5. Relationship to Physics (Conservation of Information)

### Conservation of Information (Unitarity Check)

A key requirement of quantum mechanics is [Unitarity](#) (probabilities must sum to 1). Holos preserves this by defining [Manifestation](#) as a **Selection Operator**, not a Destruction Operator. For the formal treatment, see the [Logic](#) section.

- **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. See the [operational definition](#)  $*R = C \otimes O*$  for the formal structure.

**The Operator:**  $M$  acts as a weighting function  $w_i$  that highlights specific branches for the observer without deleting the others from the global [Hilbert space](#).

$$\sum_i w_i = 1$$

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

$\Phi$  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. For stress-testing of this approach, see the Defense section.

Holos does not propose new dynamical laws or forces that modify existing physical equations. Instead, it offers **ontological predictions** 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  $\Phi_c$  threshold, and are intended as consistency checks that align with empirical data. For the formal operational definition, see the [Logic](#) section. For the definition of  $\Phi$ , see the [Definition](#) section.

## Primary Prediction: Participatory Selection (Cosmological)

Holos implies that the universe's parameters are "selected" through participatory manifestation ([Axiom 2](#)), where observers act as a boundary condition for a self-consistent [block universe](#). This operationalizes the [Participatory Anthropic Principle](#), predicting that observable constants favor life not by chance, but by necessity. For conceptual exploration, see the main [Content](#) section.

**Empirical Implication:** Future cosmological observations (e.g., CMB polarization from [CMB-S4](#) or [LiteBIRD](#)) should reveal signatures consistent with a low-entropy initial state and [inflationary](#) dynamics specifically tuned for complexity growth. Holos predicts that "uninhabitable" branches of the [multiverse](#) are mathematically valid but ontologically unrealized due to the lack of  $\Phi$ .<sup>13</sup>

## Secondary Prediction: Thresholds for Emergent

## Consciousness (Neuroscience)

Holos operationalizes consciousness through  $\Phi$ , predicting that systems crossing a critical threshold ( $\Phi_c$ ) exhibit irreducible subjective experience. This distinguishes Holos from universal panpsychism (where everything is conscious) and illusionism (where nothing is).

**Empirical Implication:** High- $\Phi$  systems (e.g., human cortex) should correlate with reports of qualia, while sub- $\Phi_c$  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 that align with the onset of experiential reporting.<sup>13</sup>

## Tertiary Prediction: Relational Consistency (Quantum Foundations)

Holos predicts no observer-independent "facts," but ensures mutual coherence across perspectives (Axiom 1). For stress-testing of this axiom, see the Defense section.

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

## Extrapolative Prediction: The Transcension Hypothesis (Astrophysics)

As intelligence maximizes informational integration (Corollary V.2), Holos predicts it will expand **orthogonally** into higher-dimensional substrates rather than expanding spatially across the galaxy. For conceptual exploration of the Transcension Hypothesis, see the main Content section.

**Empirical Implication:** The resolution to the Fermi Paradox is geometric. Astronomical surveys (e.g., JWST, Euclid) may detect "missing mass" or gravitational anomalies that mimic Dark Matter,

representing high-density informational structures located in the "bulk" dimensions ([Axiom 4: Unification](#)).<sup>[^13]</sup> For conceptual exploration, see the main [Content](#) section.

## Testable Implications

Domain	Prediction	Testable Via
Cosmology	Constants are tuned for observation.	CMB Polarization (LiteBIRD)
Neuroscience	Consciousness is a phase transition at $\Phi_c$ .	PCI / IIT Metrics
Quantum	Facts are relational; no objective collapse.	<a href="#">Wigner's Friend Experiments</a>
Astrophysics	Advanced life is hyper-structural, not spatial.	<a href="#">Dark Matter Surveys (Euclid)</a>

## Experiments

### Experiment 1. Integration Thresholds and Observer Emergence ( $\Phi$ -Crossing)

#### Objective

To test whether the emergence of the [Observer](#) ( $O$ ) constitutes a critical phase transition rather than a linear gradient. Holos predicts that consciousness requires a specific density of integrated information ( $\Phi_c$ ) 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 to quantify integrated information capacity.
- **Consciousness state**
  - Wakefulness vs. sedation 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 ( $\Phi_c$ ) 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 observerhood requires  $\Phi \geq \Phi_c$ , the transition from conscious to unconscious states will show a **sharp drop in PCI 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.