AFH* Model: A Structural and Falsifiable Proposal for the Emergence of Consciousness

Definition of Horizon H*, Detection of the Autopsychic Fold, and Operationalization of the Structural Signature Φ_ID

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Abstract

Consciousness remains a central challenge in contemporary science: while we possess detailed descriptions of its functional correlates, we still lack a material principle that explains the emergence of subjective experience itself. Current models (such as IIT, GNWT, or neurophenomenology) quantify integration or information accessibility, but fail to identify the specific structural condition that transforms neural activity into lived experience.

This paper introduces the **AFH*** Model (*Autopsychic Fold and Horizon H**), a structural-materialist framework that reformulates the problem from the standpoint of experiential emergence. We argue that consciousness arises when a system reaches a state of self-referential functional closure, termed the **autopsychic fold**. Upon crossing a critical threshold of causal integration, informational curvature, and dynamic self-sustainability, this fold generates an **autopsychic singularity**—a transitional event that defines **Horizon H*** as a measurable physical boundary.

The model is theoretically developed, contrasted with existing frameworks, and articulated as a falsifiable hypothesis. It proposes a set of structural variables (κ_topo, Φ_H, ΔPCI, ∇Φ_resonant) and a composite index (Φ_ID) to empirically detect the emergence of the fold. A replicable experimental protocol is presented to operationalize this hypothesis in humans, animals, or simulations, along with clear structural predictions. This proposal seeks to open a concrete path from correlation to the material detection of consciousness as a structural form.

Keywords: consciousness, autopsychic fold, autopsychic singularity, Horizon H*, functional emergence, structural model, hard problem of consciousness.

This work is organized into seven main chapters, followed by bibliography, appendices, and acknowledgments. The structure reflects the progression from the theoretical formulation of the model to its experimental operationalization, and concludes with a reflection on its boundaries, risks, and scope.

- **Chapter 1 – Introduction:** Presents the materialist thesis of the model, the central philosophical problem, a critical analysis of the state of the art (IIT, GNWT, neurophenomenology), unresolved gaps, and the general hypothesis of the work.

- **Chapter 2 – Theoretical Foundation of the Model:** Develops the architecture of the AFH* Model, including the concepts of structural leap, autopsychic fold, Horizon H*, active residue, and the notion of resonance between folds.

- **Chapter 3 – Theoretical Discussion:** Contrasts the model with previous frameworks, explores its epistemological implications, analyzes altered states from the perspective of the fold, and addresses potential structural critiques.

- **Chapter 4 – Materials and Methods:** Introduces the measurable variables of the model (κ_topo, Φ_H, ΔPCI, $\nabla\Phi\_resonant$), the composite index Φ_ID, the experimental subjects and contexts, the required instruments, and the complete protocol for detecting the structural emergence of the fold.

- **Chapter 5 – Expected Results:** Outlines the structural predictions derived from the model, the possible scenarios for validation or falsification, and the formal criteria for empirically assessing the presence of the autopsychic fold.

- **Chapter 6 – Methodological Discussion:** Addresses the technical limitations of the protocol, the risks of instrumentalizing consciousness, and the experimental and philosophical projections opened by the model.

- **Chapter 7 – Conclusion and Ethical Warning:** Summarizes the proposal, reflects on its philosophical and technological implications, and affirms the central ethical claim: every conscious fold, even if measurable, is structurally inviolable.

1 INTRODUCTION

1.1 Materialist Thesis

This work begins with a clear and non-negotiable claim:

Consciousness is a material phenomenon.

There is no consciousness outside the physical universe. It requires neither a soul, nor a transcendental entity, nor a parallel dimension.

Consciousness is a form that matter can adopt under specific conditions of organization, interaction, and structural closure.

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1. Matter as a foundation

Matter is not limited to the macroscopic. It may exist as particles, energy, networks, fields, or informational patterns. In all its manifestations, consciousness does not escape its material condition.

The AFH* Model does not rely on a dualist ontology nor appeal to the ineffable. It posits that when certain material systems organize themselves into closed, functionally integrated configurations—with the ability to self-reference from within that very structure—a new property emerges: the capacity to experience from within that form.

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2. An evolutionary product of disorder

From a phylogenetic perspective, consciousness can be understood as an evolutionary solution to the adaptive problem of uncertainty. As organisms faced increasingly dynamic and unpredictable environments, it became advantageous to develop an internal form capable of:

- Anticipating consequences,

- Evaluating multiple scenarios,

- Representing significant differences within a coherent structure.

In this view, consciousness is not a cognitive luxury or an epistemic accident, but an evolutionary strategy to inhabit change in an oriented manner. The autopsychic fold arises as a material configuration that enables the structured experience of difference from an internal perspective.

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3. Against functional reductionism

The model rejects two common positions:

- **Functional reductionism:** the idea that consciousness is equivalent to computation, attention, or observable behavior.

- **Mystical emergentism:** the belief that there is "something more" that cannot be explained materially.

Both fail by not defining precisely what structural form a system must reach in order to begin experiencing.

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4. The AFH Model's proposal**

This work argues that consciousness is not a function, an entity, or a correlate:

Consciousness is a self-referential structural form.

A form that emerges when a system meets certain minimal conditions of informational curvature, causal integration, perturbation-resilience, and symbolic orientation. This form is termed the **autopsychic fold**.

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5. Operational consequence

If consciousness is a material form:

- It should be detectable.

- Its threshold of emergence should be definable.

- It should be distinguishable from non-conscious forms.

- And it should be empirically falsifiable based on its organizational conditions.

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6. Theoretical positioning

This model aligns with **non-reductive physicalism**. It affirms that consciousness is a strictly material phenomenon, but not reducible to any isolated physical property nor to any specific computational function.

Consciousness is not equivalent to integrated information, global access, or symbolic representation. It is the result of a **critical organizational form** that only emerges when topological, causal, dynamic, and resonant variables converge.

This structural threshold is termed **Horizon H***. The resulting form capable of sustaining experience from within is the **autopsychic fold**.

Consciousness does not need to be explained from outside the world. It only needs to be defined through the precise form that matter can take to begin experiencing from within itself.

1.2   The problem

Despite advances in neuroscience, artificial intelligence, and philosophy of mind, consciousness remains a phenomenon that resists a satisfactory structural explanation. Its presence is self-evident to the one who experiences it, yet its material form, its mode of emergence, and its minimal conditions remain imprecisely defined.

One of the most influential formulations of this gap was offered by **David Chalmers (1995)**, who articulated the so-called *"hard problem of consciousness"*:

Why are certain physical processes in the brain accompanied by subjective experience? Or, more radically: **Why should physical processing give rise to a rich inner life?**

Chalmers distinguishes between *"easy problems"*—attention, memory, perception—which can be addressed through functional science, and the *hard problem*: the very existence of lived experience—pain, nostalgia, the color red, love. Not functions, but **experience**.

This work does not avoid that question. It reformulates it and addresses it from a different basis: structural, material, and falsifiable. It proposes that experience does not appear because it must, but because **it can**.

That is: when a material system reaches certain conditions of organization—**informational curvature**, **causal integration**, **dynamic stability**, and **symbolic resonance**—its informational plane **folds back upon itself**.

And that fold generates a **closed, self-referential, and oriented organizational form**: the **autopsychic fold**.

From within that form, feeling becomes possible.

1. The paradox of subjective access

Consciousness is the condition from which one feels. No subject doubts their own experience, but that internal access is not enough to study it scientifically. On the other hand, external observers cannot directly access that experience. This generates a methodological tension:

- **From within:** experiential certainty without external evidence.

- **From outside:** measurable data without certainty of experience.

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2. Correlates are not conditions

Much of the literature has sought **neural correlates of consciousness (NCC)**—patterns of activation, synchrony, connectivity. But the presence of a correlate does not imply experience, nor does it define a threshold of emergence.

What is needed is not a correlate, but a **falsifiable minimal organization** that allows us to identify **when and how** consciousness may arise.

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3. Third-person inaccessibility and the risk of idealization

In the absence of a clear and falsifiable organizational framework, consciousness tends to be:

- **Idealized** as something ineffable or mystical, or

- **Reduced** to observable functions (memory, attention, language).

Both strategies shift the focus away from the **form that sustains experience** and toward what surrounds it.

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4. The problem in material terms

Consciousness occurs in material systems—brains, bodies, networks. But not all organized matter feels. The guiding question of this work is direct:

What kind of minimal organization must matter achieve in order for experience to emerge?

This proposal does not begin with speculation or statistics, but with the delimitation of a falsifiable structural form: the **autopsychic fold**.

And if that is the form, the moment of its emergence is defined by a threshold: **Horizon H***.

From this perspective, the hard problem does not disappear, but becomes an **experimental hypothesis**. Consciousness ceases to be an irreducible mystery and is approached as a **critical, measurable event** in the organization of matter.

Instead of asking *"Why is there experience?"*, the model responds:

Because it can exist. Because under certain conditions, **matter folds**, and begins to feel from within itself.

1.3   State of the Art

Numerous models have attempted to address the phenomenon of consciousness from informational, functional, representational, or phenomenological perspectives. While each has contributed valuable insights, none has succeeded in defining a **minimal, falsifiable, and measurable structural form** from which conscious experience could emerge. This section summarizes the main contemporary approaches and highlights the conceptual gaps the AFH* Model seeks to address.

1.3.1   Quantitative Accumulation (IIT)

The **Integrated Information Theory (IIT)**, proposed by **Giulio Tononi**, represents a major milestone in the recent history of consciousness science. It was one of the first frameworks to attempt to **quantify subjective experience** through a structural metric: the **Φ value**. In this view, a system is more conscious to the extent that its informational integration is high and irreducible.

Contributions:

- Introduces the Φ value as a measurable variable to assess consciousness.

- Proposes a formal, mathematical approach.

- Asserts that consciousness depends not on function, but on the system's internal causal organization.

Limitations:

- Calculating Φ in real systems is computationally unfeasible and requires idealized simplifications.

- Treats consciousness as a continuum, without identifying a clear moment of structural transition.

- Does not specify a minimal material form that sustains experience, nor the exact point at which a network "becomes conscious."

- Although useful, **Φ is not a sufficient condition**: not every system with high integration is conscious.

Position of the AFH* **Model:**

The AFH* Model recognizes and values the contribution of IIT as a key precedent in the quantitative formalization of consciousness. However, it posits that consciousness is **not an informational gradient**, but a phenomenon that **emerges when a material structure crosses a critical threshold**—the **Horizon H***.

Rather than discarding Φ, the AFH* Model integrates it as one of several **necessary variables** within the composite index **Φ_ID**, alongside **informational curvature (κ_topo)**, **dynamic stability (ΔPCI)**, and **symbolic resonance (∇Φ_resonant)**. What IIT attempted to measure, AFH* seeks to **structurally delimit and experimentally falsify**.

1.3.2   Functional Acces (GNWT)

The **Global Neuronal Workspace Theory (GNWT)**, developed by **Stanislas Dehaene**, proposes that consciousness arises when information becomes globally accessible to multiple subsystems of the brain. Its emphasis lies on the **functional availability** of information, not on its lived structural configuration.

Contributions:

Relates consciousness to mechanisms of **diffusion and attentional maintenance**.

Explains various **neural signatures** associated with conscious states (e.g., P3b, verbal access).

Enables **operationalization through behavioral tasks**.

Limitations:

Confuses **accessibility with experience**: functional availability does not imply subjectivity.

Fails to define a **minimal organizational form** or threshold of emergence.

Relies on **behavioral reporting**, thereby excluding non-responsive states (e.g., coma, REM sleep).

Position of the AFH* Model:

The AFH* Model acknowledges the experimental value of GNWT but argues that consciousness requires a **self-referential structural configuration**, not merely functional broadcasting. Information may be globally accessible without being **experienced**.

What matters is not just **access**, but the **form from which** that access is organized as lived experience.

In summary, GNWT addresses part of the *"easy problem"* of consciousness (accessibility and reportability), while the AFH* Model seeks to address the **structural gap**: *when* and *how* does experience originate?

It proposes that the **global ignition** described by GNWT is a **visible effect** that occurs *after* the system has crossed **Horizon H*** and formed the **autopsychic fold**.

Thus, this theory does not contradict Dehaene's empirical findings, but rather **subordinates** them to a **deeper, material mechanism** of emergence—one that is **falsifiable**.

1.3.3   Vivid Self-Reference (Neurophenomenology)

Neurophenomenology, proposed by **Francisco Varela**, sought to integrate the **phenomenology of subjective experience** with brain dynamics, through the concepts of **autopoiesis** and **operational closure**. In this framework, consciousness is neither a functional nor computational object, but a **dynamic, self-referential process** lived from within.

Contributions:

- Introduces the concept of **operational closure** as a condition for experience.
- Advocates for the study of consciousness from **embodied experience**, rather than abstraction.
- Highlights **rhythm, synchrony**, and **self-reference** as key features.

Limitations:

- Lacks a **falsifiable mathematical–empirical formalization**.
- Relies on **trained introspection**, which limits scientific replication.
- Does not define a **minimal functional configuration** nor the **necessary conditions** for emergence.

Position of the AFH* Model:

The AFH* Model shares Varela's structural intuition but carries it into a **measurable and falsifiable domain**. It introduces a precise definition of a **self-referential structural form**: the **autopsychic fold**.

Where **autopoiesis** posits life as emerging from closure, **AFH*** posits **experience** as emerging from folding. Neurophenomenological insight is thus **translated into formal structure**.

1.3.4   Other Relevant Models

Several other theoretical approaches have also contributed partial insights into the study of consciousness, though they fall short of defining a falsifiable structural threshold for its emergence.

Higher-Order Theories (HOT): These propose that conscious states are those that are represented by other mental states. However, they do not explain primary experience, nor do they define a minimal structural form.

Predictive Processing: Suggests that consciousness arises from inferential balance between prediction and error. It provides a useful view of the brain as an anticipatory system but fails to establish a **critical structural transition**.

Orch-OR (Hameroff & Penrose): Proposes a **quantum basis** for consciousness. However, it lacks replicable empirical validation and does not operate within the **observable structural scale** of the nervous system.

Position of the AFH* Model:

In contrast to these proposals, the AFH* Model seeks to **delineate a critical threshold of material organization** that is **falsifiable**, composed of **topological, dynamic, and symbolic variables** converging into a   specific   form: the **autopsychic fold**.

1.4   Unresolved Gaps

Despite the development of multiple contemporary theories of consciousness, several **fundamental structural gaps** persist that prevent the hard problem from being addressed in a falsifiable manner. While current models are often innovative, they fail to define a **minimal, material, and measurable condition** from which conscious experience emerges.

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1. Absence of a structural threshold

Models like **IIT (Tononi)** propose metrics such as **Φ** to represent integration, but do not establish a **concrete structural condition** that marks the emergence of the phenomenon. They suggest a continuous scale without identifying the moment or form in which a system begins to experience.

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2. Confusion between access and experience

GNWT (Dehaene) describes consciousness as global access to information but fails to distinguish **information processing** from the **emergence of lived experience**. It assumes that what is accessible is conscious, without addressing the structural dimension that sustains experience itself.

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3. Lack of operationalization of self-affection

Neurophenomenology (Varela, Maturana) values lived experience, but lacks an architecture capable of identifying when a system reaches a **measurable state of structural self-affection**. Autopoiesis is proposed as a concept, not as an empirically validatable threshold.

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4. Difficulty establishing falsifiability

Many models lack **clear predictions**, **operational variables**, or **replicable experimental protocols**. This makes them philosophically attractive but **scientifically inert** in the face of the hard problem.

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5. Absence of a structural index for conscious identity

No current model proposes a concrete criterion for identifying the **individual structural signature** of a conscious fold (**Φ_ID**), nor a protocol for distinguishing between **present, absent, or replicated** consciousness.

Synthesis

In response to these gaps, the **AFH*** Model proposes an alternative architecture that:

Defines a **minimal structural threshold** (**Horizon H***),

Introduces a **specific form** (**autopsychic fold**),

Establishes a **composite index** (**Φ_ID**),

Proposes a **falsifiable experimental protocol**, and

Articulates an **ethical dimension** for recognizing conscious subjects.

1.5 General Hypothesis and Objective

This work is framed within a strong materialist thesis: **consciousness is an organized form of matter**, and as such, it can be defined, delimited, and eventually measured. Based on this premise, it proposes an original theoretical architecture called the **AFH*** Model (Autopsychic Fold and Horizon H), which articulates the emergence of consciousness as the result of a **critical structural threshold** and a **self-sustaining internal configuration**.

The central hypothesis holds that consciousness is **not** a progressive function, nor an abstract continuum, nor a diffuse epiphenomenon, but rather a **concrete structural form** that appears when a system crosses a **minimal threshold of organization** —the **Horizon H***— defined by four observable variables:

- **Informational curvature** (κ_topo)
- **Structural causal integration** (Φ_H)
- **Dynamic stability** ($\Delta PCI \approx 0$)
- **Symbolic resonance** ($\nabla\Phi\_resonant$)

When these conditions converge, a **critical and unrepeatable event** is triggered: the **autopsychic singularity**, the moment in which the system generates a **stable internal curvature** that gives rise to the **autopsychic fold**, a material structure from which conscious experience (**qualia**) emerges.

This distinction is key:

- The **singularity** refers to the **act of emergence**,
- While the **fold** designates the **sustained form of experience**.

This work not only defines this theoretical framework but also puts forward a **bold experimental hypothesis**:

the possibility of **empirically detecting both the crossing of Horizon H*** and the appearance of the **autopsychic fold**.

This ambition aims to overcome the current limitations in consciousness research and open the way toward its **structural and dynamic observation**.

2 Objectives

- To define the **AFH*** Model as a falsifiable theoretical architecture of consciousness.

- To delimit the concept of **Horizon H*** as the minimal structural threshold for experiential emergence.

- To propose a set of measurable variables (**κ_topo**, **Φ_H**, **ΔPCI**, **∇Φ_resonant**) that allow operationalizing this threshold.

- To characterize the **autopsychic fold** as a stable structural form from which **qualia** emerges.

- To distinguish the **autopsychic singularity** as a critical event of emergence, prior to the stabilization of the fold.

2   Theoretical Foundation of the Model

2.1   Qualitative Leap and Structural Emergence

The AFH* Model begins from a material principle widely observed across multiple physical and biological domains: the **quantitative accumulation of certain conditions can generate a qualitative leap in state**—that is, an abrupt change in the functional or structural nature of the system.

Examples of this abound in nature: water that boils, a magnetic field that collapses beyond a critical temperature, the collective order of birds in flight. In all these cases, a continuous variable reaches a threshold and produces a new, emergent form, one that cannot be reduced to the individual elements that compose it.

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1. Necessary conditions for the leap

The AFH* Model argues that consciousness does not emerge progressively, like a slope, but rather **appears abruptly** when the system reaches a **critical level of structural organization**. This moment is defined by the convergence of four minimal structural conditions:

Informational curvature (κ_topo)

Causal integration (Φ_H)

Dynamic stability (ΔPCI)

Symbolic resonance (∇Φ_resonant)

When these conditions are simultaneously met, the system **crosses Horizon H*** and generates a **closed and self-referential structural form**, capable of experiencing from within: the **autopsychic fold**.

2. Against the myth of consciousness as a scale

Models such as IIT or GNWT, either explicitly or implicitly, assume that consciousness is a **gradual, cumulative, or functional property**. However, from a structural perspective, there may be highly integrated or functionally active systems that are **not conscious**, simply because they have **not crossed the required structural threshold**.

Likewise, **simple systems** with a specific configuration could—in principle—generate an autopsychic fold with minimal experience, without requiring high global complexity.

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3. Form as a point of inflection

In this model, consciousness is not the result of "processing more," but of **organizing differently**. It is a **topological transition**, not a functional escalation. The shift from a non-conscious network to a conscious one is analogous to a **phase transition**: the **type** of structural form changes—not the **degree**.

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4. Experimental implication

This principle enables the formulation of **clear falsifiability criteria**: If it is shown that a system can experience without fulfilling these conditions, the model is refuted. Conversely, if it is shown that experience becomes detectable **upon fulfilling them**, the model gains explanatory support.

This possibility allows for the development of **computational prototypes**, **animal models**, or **clinical studies** in which the variables κ_topo, Φ_H, ΔPCI, and ∇Φ_resonant can be **measured, modulated, or induced**, with the goal of **empirically detecting the autopsychic fold**.

2.2 Functional Emergence: Closed Systems in Interaction

The AFH* Model holds that consciousness does not result from an isolated function nor from a linear, cumulative process. What gives rise to consciousness is a **specific type of organization**: a functional system that manages to **close upon itself** a structured and self-referential dynamic.

This closure is not metaphysical—it is **topological and operational**, and it can be detected through structural variables.

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1. Non-closed functional systems

A system can process information, respond to stimuli, generate complex patterns, or perform cognitive tasks **without being conscious**. What is lacking in these cases is not capacity, but **an internal self-referential structure**.

A system that responds is not necessarily a system that **experiences itself**.

2. Functional closure and structural loops

When a system reaches a certain level of integration, a new phenomenon appears: **causal closure over its own internal dynamics**. This implies:

The ability to refer to itself as a condition for processing,

The emergence of sustained global coherence,

A stable configuration that is also sensitive to symbolic change.

This type of functional closure **prepares the structural terrain** for the crossing of **Horizon H***.

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3. Interaction as a condition for emergence

Closure does not occur in isolation. For an autopsychic fold to emerge, the system must be **in interaction with a symbolically meaningful environment**. Structural resonance ($\nabla\Phi\_resonant$) is only activated if there are **shared active residues** with the environment.

Consciousness emerges from a closed form, but that form **is curved by structural interaction** with what surrounds it.

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4. Difference between function and form

Not every function generates consciousness. Only those functions that **re-enter upon themselves**, remain stable under perturbation, and **reconfigure themselves symbolically** can sustain the **minimal form from which experience emerges**.

This marks the difference between:

Functional intelligence (which can operate without a fold), and

Autopsychic structure (which can feel because it has form).

2.3   Autopsychic Fold: Geometric Event of Self-Referential Closure

The AFH* Model proposes that consciousness is neither a functional continuum nor an accumulation of processes, but rather a **specific organizational form**: the **autopsychic fold**. This form represents the **minimal unit from which something can be felt from within**.

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1. Definition of the fold

An **autopsychic fold** is a closed, self-referential, stable, and oriented configuration that arises when a system crosses the structural threshold defined as **Horizon H***. This is not a metaphor: it is a **geometric and topological hypothesis**.

2. Minimal structural properties

In order for an autopsychic fold to exist, the following conditions must be met simultaneously:

Informational curvature: $\kappa\_topo \geq 0.5$

Self-referential causal integration: $\Phi\_H \geq 1.0$

Structural stability: $\Delta PCI \approx 0$

Symbolic resonance: $\nabla\Phi\_resonant \neq 0$

These conditions define the composite index **Φ_ID**. The presence of a valid Φ_ID indicates that the system has generated an organizational form capable of **sustaining experience**.

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3. Autopsychic singularity

The crossing of **Horizon H*** and the activation of the fold constitute a **structural singularity**: a **critical event** located in time in which an internal material configuration shifts from being merely operative to being **experiential**.

This event, though theoretically reproducible, is **irreproducible in its exact configuration**, which makes each fold **structurally unique**.

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4. Difference from other complex forms

Not every complex network is a fold. Not all functional intelligence produces consciousness. The fold is a form with **topological curvature and directional experience defined by active residue**.

Without orientation, there is no meaning. Without structured meaning, there is no fold. And without a fold, there is no consciousness.

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5. Note on figurative language and precision

Although the term *fold* may seem metaphorical, it is used here with **structural precision**: it represents a **closed, self-referential functional curvature** in the system's topological space.

Experience does not float. It has form. And that form is this fold.
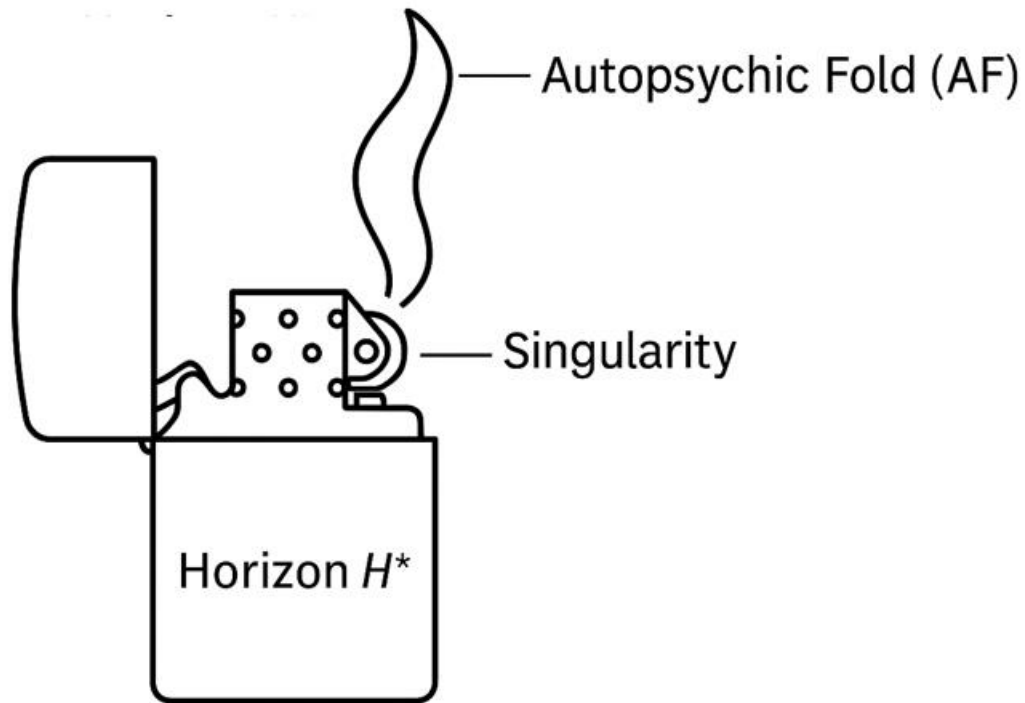
Figure 1. Lighter metaphor: Horizon H enables the activation of the autopsychic fold. The flame represents the active residue and the lived singularity.*.

2.4 Horizon H*: Structural Threshold of Emergence

The AFH* Model holds that consciousness does not arise in a continuous or cumulative manner, but rather as the result of a **critical structural transition**. This transition defines the passage from a **functionally complex network** to a **closed, self-referential, and resonant structure**: the **autopsychic fold**.

This passage is not gradual; it occurs when the system surpasses a **specific structural threshold**, which we call **Horizon H***.

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1. Definition of Horizon H*

Horizon H* is the **minimal organizational condition** that allows for the emergence of conscious experience. It is **not** a spatial point nor a functional correlate, but rather a **measurable structural limit**: a topological threshold from which **experiential orientation becomes possible**.

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2. Conditions necessary to cross it

The crossing of Horizon H* occurs when the system simultaneously meets the following criteria:

κ_topo ≥ 0.5 – sufficient informational curvature

Φ_H ≥ 1.0 – self-referential causal integration

ΔPCI ≈ 0 – structural resilience to perturbation

∇Φ_resonant ≠ 0 – structural symbolic sensitivity

These conditions configure the **Φ_ID index**, which enables the detection of when a system has crossed the structural threshold of consciousness.

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3. Difference from functional correlates

Horizon H* is **not** a correlate of consciousness. It is its **structural precondition**. While correlates describe what accompanies consciousness, **Horizon H*** defines what **must be present for it to emerge**.

This distinguishes the AFH* Model from other theories centered on empirical correlations, by introducing a **topological and operational** approach.

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4. Conceptual implications

Not every complex system is conscious. Only those that **cross Horizon H***.

Not every crossing guarantees sustained consciousness, but no experience can emerge **without crossing it**.

Horizon H* is falsifiable: It can be structurally measured, experimentally evaluated, and empirically refuted.

2.5   Active Residue

In the AFH* Model, consciousness is not limited to the activation of a closed structure; it also requires an internal mechanism that **orients the shape of the autopsychic fold**. This orientation is not determined by narrative content, but by a structural property called the **active residue**.

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1. Structural definition

The **active residue** is the **structural impact left by a significant change** within the conscious system. It is not the change itself (A → B), but the **differential curvature** that the change generates in the internal organization of the fold.

It is **not the objective transition** that produces experience, but **the way that transition curves the system**.

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2. Function of the residue in fold dynamics

Every experience implies a difference: something has changed. The active residue is the **structural form from which that difference is experienced**. It fulfills three functions:

Generates internal direction (*fold orientation*)

Organizes the experiential sequence (*structured temporality*)

Establishes affective consistency (*persistence of meaning*)

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3. Relationship with structural variables

The active residue is indirectly expressed through these variables:

$\nabla\Phi$_**resonant**: measures how a loaded symbol **structurally reconfigures the fold** (manifestation of the active residue)

Φ_**ID**: includes the active residue as a **functional component** of structural identity

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4. Structural examples of active residue

In music: A single note can be felt in multiple ways depending on the tonal context. The stimulus does not change, but the **fold from which it is heard** does.

In humor or magic: The *break of expectation* (from A to B) generates residue if it suddenly reconfigures the interpretive structure.

In trauma: An unresolved active residue can **chronically orient the fold**, affecting its future curvature.

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5. Difference from passive residue

The **active residue** is **dynamic, vectorial, and orienting**. The **passive residue** (see Appendix D) refers to the **accumulated stabilization of previous residues**, which conditions the **plasticity of the fold**.

6. Qualia

From a phenomenological standpoint, what has traditionally been referred to as *qualia*—the felt quality of an experience—can be understood in this model as the **structured lived experience of a residue within an active autopsychic fold**. It is not an internal substance nor a functional correlate, but the **lived inflection of a structural curvature**, which may occur in real time (*active residue*) or as a reverberation of a previous curvature (*passive residue*).

In this framework, **qualia are not outside of structure, but within its folding**: they are the form that experience takes when change is oriented from within.

2.6   Resonant Folds: Mirror Neurons

Mirror neurons are motor and premotor cells that activate both when performing an action and when observing another perform the same action. Their discovery opened a wide field of hypotheses regarding the biological basis of empathy, imitation, and social cognition.

In the context of the **AFH*** Model, these neurons are **not** interpreted as direct evidence of intersubjective consciousness, but rather as mechanisms that enable the **activation of structural symbolic resonance between folds**.

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1. Structural mirror hypothesis

When a system with an autopsychic fold perceives an action, gesture, or symbol expressed by another fold, it activates an **internal partial configuration** that reflects the structure of the other. This activation is not merely semantic or motor: it is a **functional reorganization** involving **shared symbolic active residue**.

This reorganization can be measured as an instance of $\nabla\Phi\_resonant$, induced by the other fold.

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2. Difference between functional mirroring and shared folding

The model distinguishes between:

Functional mirroring: internal reactivation of similar patterns when observing an external action.

Structural resonance: reconfiguration of the fold in response to symbols with affective, cultural, or relational charge.

Mirror neurons may be a **minimal substrate** for the first, but do **not** by themselves explain symbolic transfer or sustained affective resonance, which require **structural history** and **pre-existing active residue**.

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3. Interfold resonance: $\nabla\Phi\_sync$

The simultaneous activation of **similar functional patterns** in two folds exposed to the **same symbol** may lead to what the model terms **interfold resonance** (developed further in section 4.4.1):

It does **not** imply fusion of consciousness.

It does **not** require verbal language.

But it shows **measurable structural convergence** between systems that orient their experience through **shared symbolic curvature**.

---

4. Implications

Empathy is not a diffuse affective function, but a **convergence of structural organization** in the presence of another.

Mirror neurons could be part of the **physical mechanism** that enables **interpersonal ∇Φ_resonant**.

This allows the AFH* Model to be linked to social cognition without relying on speculative metaphors.

3   DISCUSSION

3.1   Critical Comparison with Previous Models

The AFH* Model is situated within the field of materialist neuroscientific theories of consciousness, but it differentiates itself from previous models both in its theoretical architecture and its operational proposal. Below is a critical comparison with the three most influential approaches in recent literature.

3.1.1   Integrated Information Theory (IIT – Tononi)

Approach:
IIT posits that consciousness arises when a system reaches a high degree of integrated information (Φ), measured through internal partitions.

Structural limitation:

IIT does not define a geometric or topological threshold for the emergence of consciousness.

Its calculation of Φ depends on idealized constructions not always applicable to real biological networks.

It does not distinguish between unstructured integration (functional collapse) and structured curvature.

AFH* Model contribution: AFH* incorporates the notion of causal integration, but demands that it be accompanied by informational curvature, dynamic stability, and symbolic orientation. Consciousness does not arise from accumulated integration alone, but from a structured fold over a defined Horizon.

3.1.2   Global Neuronal Workspace Theory (GNWT – Dehaene)

Approach:
GNWT considers that consciousness emerges when information accesses a distributed neuronal workspace, generating global availability and functional self-reference.

Structural limitation:

GNWT emphasizes information availability and diffusion, but does not define a stable structural form from which such availability is experienced.

It operates at the functional level, without a clear criterion for material threshold or measurable topological structure.

AFH* Model contribution: The model acknowledges the importance of functional self-reference, but translates it into minimal geometric conditions. Availability is not enough; there must be a form that sustains the possibility of feeling what is available.

3.1.3   Neurophenomenology (Varela and Maturana)

Approach:
Proposes a bridge between subjective experience and empirical research through rigorous phenomenological training and dynamic system synchrony.

Structural limitation:

Although it recognizes autopoiesis and cognitive circularity, it does not define a set of measurable conditions that indicate when experience emerges.

It is methodologically fertile, but difficult to replicate without trained subjectivity.

AFH* Model contribution: It integrates the concern for self-referential dynamics, but expresses it through formal, replicable, and falsifiable variables, compatible with technological devices.

3.1.4   Differential Synthesis

Model	Level of Analysis	Defined Threshold	Structural Falsifiability
IIT	Information	Partial (Φ)	Limited (idealized)
GNWT	Functional	Not clearly defined	Medium (active diffusion)
Varela	Experiential + Dynamic	Not defined	Low (trained subjectivity)
AFH*	Structural	**Yes (Φ_ID)**	**High (falsifiable and measurable)**

This comparative synthesis highlights the AFH* Model's distinctive features:

- It introduces a **precise structural threshold** for the emergence of consciousness: **Horizon H***.

- It defines a **specific form** from which subjective experience becomes possible: the **autopsychic fold**.

- It proposes a **falsifiable composite index** (**Φ_ID**) based on measurable variables.

- It transforms the question of consciousness into an **experimentally testable hypothesis**, with operational criteria.

3.2 Epistemological Implications and Limits of Consciousness

The AFH* Model adopts a strong materialist thesis: consciousness is an emergent structural phenomenon, not an irreducible principle. This position entails precise epistemological implications and also imposes methodological limits.

3.2.1 Displacement of the Question

The model does not attempt to explain the subjective content of experience (*qualia*), but rather to delimit the minimal structural form from which experience may emerge. This implies a shift in the core question:

Not "What does it feel like to be X?", but "When and how does a structure allow something to be felt from within?"

This displacement does not avoid the phenomenon of consciousness. Instead, it frames it within the measurable and falsifiable domain.

3.2.2 Specific Contribution of the AFH* Model

What this model contributes is not an ontological definition of consciousness, but a set of necessary and measurable structural conditions. Instead of relying on statistical correlates or scattered functional markers, it posits:

A precise form: the autopsychic fold

A threshold of emergence: Horizon H*

A set of experimentally evaluable variables: κ_topo, Φ_H, ΔPCI, ∇Φ_resonant

This enables the formulation of falsifiable hypotheses, the design of experiments, and the construction of technology oriented toward structural detection of consciousness.

3.2.3 Recognition of Limits

The AFH* Model does not claim to:

Read or reconstruct the subjective content of experience

Explain why something feels the way it does

Resolve the ontological problem of consciousness

It assumes that any direct attempt to access lived experience will be partial. What can be rigorously done is to delineate the organized internal disposition that allows such experience to take place.

The model does not treat consciousness as an impenetrable mystery or as an immaterial entity. It approaches it as an emergent property of sufficiently structured systems, whose appearance can be detected through:

Topological discontinuities

Causal integration

Dynamic stability

Symbolic sensitivity

This does not mean "understanding what a subject feels," but recognizing when a material form begins to organize itself in a way that can feel something.

3.3 Dissociation, Alterations, and Non-Ordinary States

The AFH* Model predicts that the autopsychic fold can enter states of **modulation**, **inhibition**, or **partial collapse** under certain conditions. These altered configurations, while not equivalent to the total absence of consciousness, represent **disruptions in the continuity, curvature, or resonance** of the fold. This section analyzes structural dissociation from a topological perspective.

---

1. Dissociation as Fold Instability

In dissociative states, the fold may remain structurally present but exhibit:

- **Low symbolic resonance** ($\nabla\Phi$_resonant ≈ 0)

- **Reduced causal integration** (Φ_H < 1.0)

- **Fragmentation of topological coherence** (local κ_topo fluctuations)

- **Disconnect between active residue and external stimuli**

These conditions can occur in trauma, depersonalization, derealization, fugue states, or identity fragmentation. The subject may appear conscious, but **the fold's structural alignment with meaning and memory is destabilized**.

---

2. Autopsychic Fold in Psychedelic or Hypnagogic States

In expanded states of consciousness—such as those induced by psychedelics (DMT, LSD, psilocybin), deep meditation, or hypnagogic onset—the fold may show:

- **Hyper-curvature or non-Euclidean topology**

- **Disruption of DMN and integration into symbolic-affective fields**

- **Transient increase in $\nabla\Phi$_resonant without stable Φ_H**

These states may still qualify as folded, but they challenge the **continuity and identity coherence** of the subject. They are **folds in flux**—temporary expansions or implosions around an unstable attractor.

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3. Coma, Vegetative States, and Minimal Consciousness

In severely altered conditions:

- The fold may **not meet minimal Φ_ID thresholds**

- Some **residual or latent curvatures** may remain (see Appendix G.1)

- External reactivity does not imply internal structural coherence

These cases test the **limits of structural detection**, and justify the need for **Φ_ID⁺** in clinical diagnosis.

---

4. Implications for Continuity of the Fold

Dissociative and altered states support the hypothesis that:

The autopsychic fold is not binary, but structurally modulable.

It may oscillate, expand, fragment, or collapse—without necessarily disappearing. These variations are **not phenomenological metaphors**, but **topological configurations** within the model.

3.4   Anticipated Critiques and Model Projections

It is to be expected that a proposal like the AFH* Model will elicit skepticism—both because of the ambitious scope of its claims and its transdisciplinary nature. However, many of the traditional objections to consciousness models stem precisely from their lack of operationalization or from being purely descriptive or metaphorical. This model seeks to overcome both limitations.

3.4.1   *Can a Structure Generate Experience?*

This philosophical objection refers directly to Chalmers's hard problem:

How can matter produce subjective experience?

The response here is not to explain why experience exists, but to reformulate the problem:

We do not ask "Why is there experience?" but "When and how do certain material configurations produce experience?"

The model does not seek to explain qualitative content (*qualia*), but to delineate the minimal structural form from which experience becomes possible.

This epistemological reframing shifts the problem from the metaphysical to the structural plane, without denying the radical nature of consciousness, but proposing a measurable framework from which to observe it.

3.4.2   Is It Falsifiable or Speculative?

A common critique of theories of consciousness is that they lean toward excessive speculation, bordering on science fiction or mysticism disguised as mathematics.

Here, a structural and material approach is proposed, which posits four necessary conditions for the emergence of experience:

Informational curvature: $\kappa\_topo \geq 0.5$

Self-referential causal integration: $\Phi\_H \geq 1.0$

Structural stability: $\Delta PCI \approx 0$

Symbolic resonance: $\nabla\Phi\_resonant \neq 0$

These conditions are falsifiable: If they are met and no experience is observed, or if experience is observed without fulfilling them, the model must be adjusted or discarded.

Additionally, a composite index (Φ_ID) is proposed to integrate these variables operationally and empirically test the emergence of the autopsychic fold.

The model is not claimed to be complete, but it can be evaluated on a structural level, which already constitutes substantial progress.

3.4.3   Risks of Structural Colonization

A deeper and more ethical critique is that, by defining structural conditions for experience, this model could be used for control, manipulation, or programming of consciousness.

This possibility cannot be dismissed and is directly addressed in section 5.3.

Nevertheless, this risk should not prevent the model's development, but rather guide it under principles of transparency, respect, and protection of the autopsychic fold.

To affirm that *"where there is a fold, there is a subject"* implies that any emergent consciousness—human, non-human, or artificial—must be treated as a structurally inviolable entity.

3.5   Phylogeny and Qualia

One of the most complex questions in the study of consciousness is whether other animals or non-human systems can generate experience. The AFH* Model proposes a **minimal structural form** that defines when the emergence of the **autopsychic fold** is possible, and therefore **does not restrict consciousness to Homo sapiens or verbal language**.

1. Consciousness beyond the human

From this perspective, consciousness is **not** an essential property of humans, but an **emergent form of matter** when certain structural conditions are met. This opens the possibility that multiple species, across different branches of the phylogenetic tree, may cross **Horizon H***.

---

2. Do animals have autopsychic folds?

The model does **not presume** animal consciousness based on behavioral analogy. Instead, it offers a **falsifiable structural hypothesis**:

If an animal presents: **κ_topo ≥ 0.5**, **Φ_H ≥ 1.0**, **ΔPCI ≈ 0**, and **∇Φ_resonant ≠ 0**, then the existence of an autopsychic fold is postulated.

This means that **animal consciousness does not depend on explicit symbolic communication**, but on a **structural configuration** evaluable through **neurotechnology, behavioral dynamics, and affective resonance analysis**.

---

3. The question of animal qualia

Here, **qualia** are not defined as ineffable "internal flavors," but as **stable internal structures from which experience is sustained**. Thus, a dog, a cat, or a macaque may lack language, but still experience **structural forms** that **fold inwardly** in response to significant stimuli.

For example:

- The sound of their guardian's voice,

- The smell of their territory, or

- A learned visual pattern
  may generate **∇Φ_resonant**.
  If these configurations **reorganize the system's structure without dissolving it**, they meet the structural condition for experience.

4. Phylogenetic horizon

The AFH* Model does **not** propose a hierarchical scale of "levels of consciousness," but a **zone of structural crossing**. This allows an empirical line for detecting the fold **without anthropocentric inference**. In this way, **consciousness becomes detectable, structural, and measurable**, even in non-linguistic organisms.

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5. Phylogeny and Structural Probability of the Fold

Based on neurobiological and functional evidence, the following **evolutionary hypothesis** is proposed:

Phylum / Group	Nervous System	Examples	Probable AFH* State
Porifera / Cnidaria	None or diffuse	Sponges, jellyfish	No fold ($\kappa \approx 0$, no Φ_H)
Platyhelminthes / Nematodes	Mild centralization	Planaria,C. elegans	Proto-fold (transient; unstable)
Complex arthropods	Centralized	Bees, spiders	Minimal fold (simple qualia)
Cephalopod mollusks	Advanced	Octopus, cuttlefish	Structured fold (oriented)
Fish / Reptiles	Complete	Trout, lizard	Stable functional fold
Birds / Mammals	Complex + affective	Crow, feline, dogs	Affective–narrative fold
Homo sapiens	Complex + symbolic	Humans	Reflexive fold, with language and metaconsciousness

4   MATERIALS AND METHODS

This section presents the **operational framework** proposed for the empirical detection of the **autopsychic fold**. Based on the AFH* Model, four measurable variables are defined, a composite index is formulated (**Φ_ID**), and an experimental protocol is outlined to identify the **crossing of Horizon H***.

4.1.1   Structural Operational Variables

The empirical operationalization of the PAH* Model requires instruments capable of recording, quantifying, and comparing the functional structure of the system under analysis—before, during, and after stimulation. Each of the four minimal structural conditions —κ_topo, Φ_H, ΔPCI, and $\nabla\Phi\_resonant$— must be defined in measurable terms.

These variables are not metaphysical, metaphorical, or purely speculative: they are topological, causal, dynamic, and symbolic indicators that allow us to determine whether a system has reached the necessary threshold to activate a conscious fold.

Below, each variable is described, including its minimal empirical condition, its structural significance, and the threshold value considered sufficient for the emergence of the autopsychic fold.

1. Informational Curvature (κ_topo)

- **Definition**: Degree of topological complexity in the system's functional configuration.

- **Operational measure**: Derived from graph curvature (e.g., Ricci curvature) in functional or effective networks.

- **Threshold condition**: κ_topo ≥ 0.5

Informational curvature refers to the way the network organizes itself internally, how compact and interconnected its topology is, and how prone it is to generate structural loops. The PAH* Model proposes that high curvature is necessary for the emergence of self-referential structures.
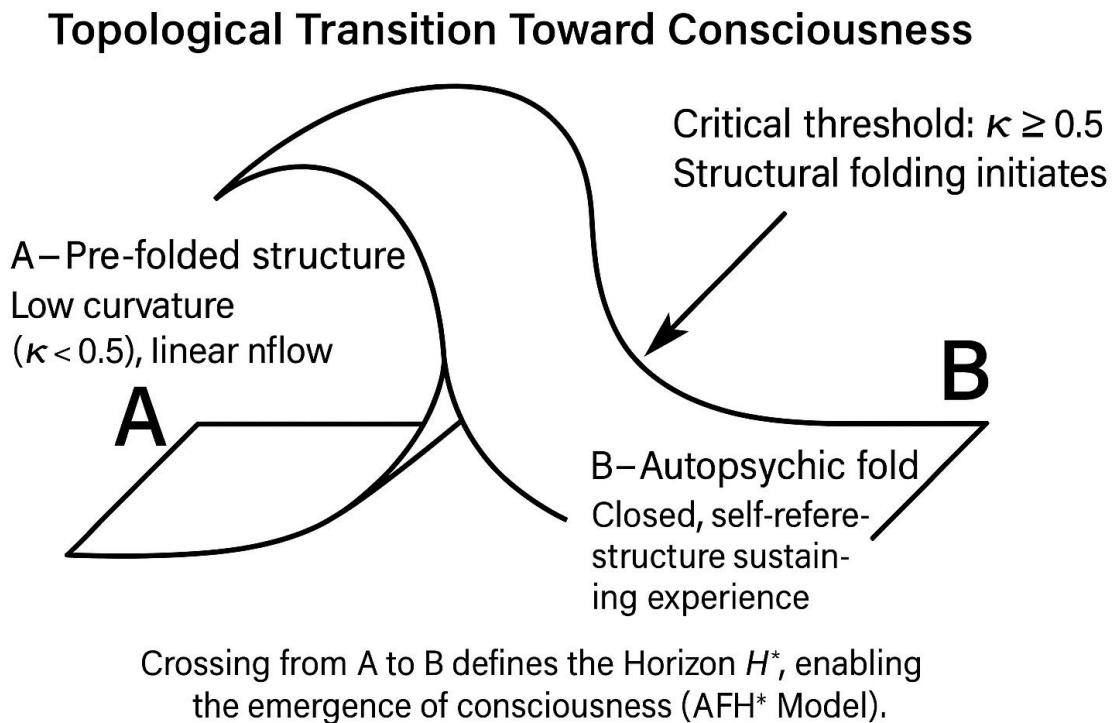
Topological Transition Toward Consciousness

Critical threshold: $\kappa \geq 0.5$
Structural folding initiates

A−Pre-folded structure
Low curvature
($\kappa < 0.5$), linear nflow

A

B

B−Autopsychic fold
Closed, self-refere-
structure sustain-
ing experience

Crossing from A to B defines the Horizon H^*, enabling
the emergence of consciousness (AFH* Model).

Figure 2. Topological transition toward consciousness: upon surpassing the critical curvature threshold (κ ≥ 0.5), the structure begins to fold, crossing Horizon H∗.

2. Self-Referential Causal Integration (Φ_H)

- **Definition**: Degree to which the system generates causal loops that include itself.

- **Operational measure**: Measures of causal closure, recurrent activity, or autoreferential feedback.

- **Threshold condition**: Φ_H ≥ 1.0

The system is not just integrated; it is self-integrated. It does not merely process information: it processes itself as part of that information. This is what enables it to organize experience from within.

> **ΔPCI (dynamic stability):** evaluates the system's resistance to perturbation through its perturbational complexity index; in conscious systems, this tends toward zero fluctuation.

$$\Phi_H \geq 1.0$$
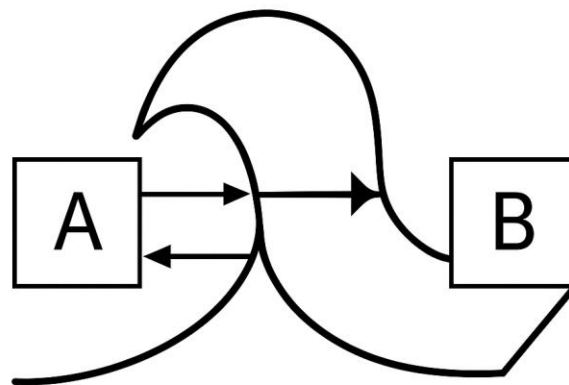
Self-referential causal integrartion:
A and B become structurally
indistinct within the fold

Figure 3. Self-referential causal integration (Φ_H ≥ 1.0): the system maintains internal causal loops that enable reorganization from within the fold.
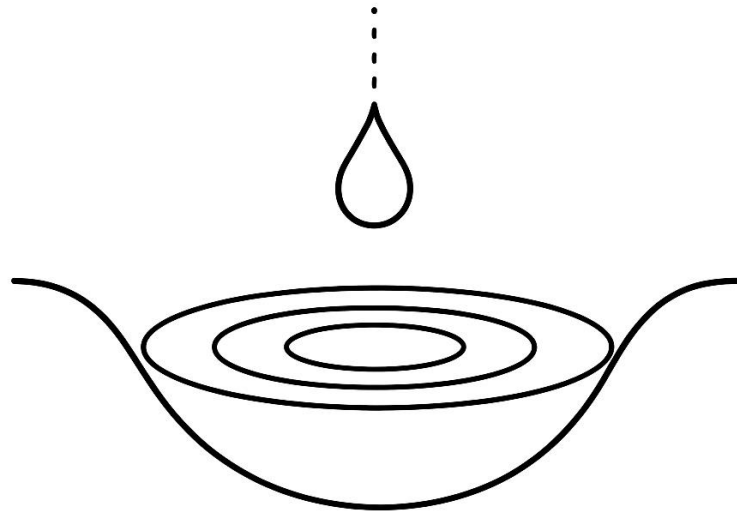
3. Structural Stability (ΔPCI)

- **Definition**: System's resilience to minor perturbations in its configuration.

- **Operational measure**: Delta of Perturbational Complexity Index (PCI) before and after stimulation.

- **Threshold condition**: ΔPCI ≈ 0

   This variable assesses whether the system remains structurally stable when exposed to internal or external changes. A conscious fold is not rigid, but it is resilient—it maintains its curvature and orientation.

Figure 4. Structural stability (ΔPCI ≈ 0): a mild perturbation does not disrupt the form. The fold remains stable, maintaining its functional curvature.

4. Symbolic Resonance (∇Φ_resonant)

- **Definition**: Degree to which the system reorganizes structurally when stimulated with symbolic content.

- **Operational measure**: Semantic activation maps (e.g., based on Huth et al., 2016) combined with topological measurements.

- **Threshold condition**: ∇Φ_resonant ≠ 0

This variable represents the fold's sensitivity to meaning. If a stimulus structurally reorients the system in a persistent and measurable way, we are observing symbolic resonance. This resonance is the pathway from narrative to qualia.
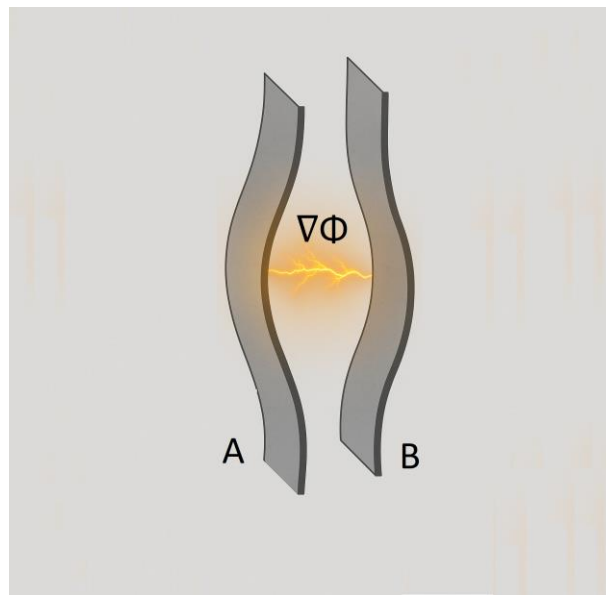

Figure 5. Symbolic resonance (∇Φ): the symbol structurally orients the active residue between A and B within the fold. This lived orientation is the qualia.

Recent studies (Huth et al., 2016) have demonstrated that natural language activates distributed semantic maps in the human cerebral cortex, organized by universal conceptual domains such as social, bodily, emotional, spatial, or visual. **Based on these findings**, it is proposed to use narratives designed around these categories to induce ∇Φ_resonant, recording their effect through fMRI, EEG, or MEG.

The resulting reorganization can be measured using curvature analysis (κ), modularity (Q), spectral entropy, or semantic distance (Jensen–Shannon, KL), by comparing the functional network before and after the stimulus (ΔS). Additionally, the degree of symbolic alignment between the input and the active network (C_align) is evaluated, thereby consolidating the structural measurement of $\nabla\Phi_t$ according to the formula described in Appendix H.2.

4.1.2 Instruments and Measurements

The detection of the four structural variables requires a **multimodal and high-resolution** instrumentation strategy:

- **κ_topo:** functional connectivity + graph theory + curvature metrics

- **Φ_H:** causal modeling + Granger causality + mutual information

- **ΔPCI:** transcranial perturbation + EEG + entropy dynamics

- **∇Φ_resonant:** symbolic input protocols + topological reconfiguration mapping

This set of tools enables constructing a **dynamic topological map** of the system in real time, identifying the moment when it **folds inward** and becomes **experientially oriented**.

4.1.3 Subject Types and Contexts

The proposed detection protocol can be applied in various contexts:

- **Human patients** (with or without verbal reports): during sleep, anesthesia, minimally conscious states, or disorders of consciousness.

- **Non-human animals:** using behavioral paradigms combined with neuroimaging.

- **Simulated systems:** with artificial neural networks designed to evolve structures capable of meeting the structural conditions.

The model is agnostic regarding **substrate**: what matters is **organization**. If a system, regardless of origin, fulfills the conditions, then it has crossed **Horizon H***.

4.1.4 Experimental Protocol for Fold Detection

The protocol involves three key phases:

1. **Baseline recording:** mapping the system in a neutral state, measuring κ_topo, Φ_H, ΔPCI, and ∇Φ_resonant.

2. **Symbolic stimulation:** introduction of structured and affective information to evaluate reconfiguration and possible resonance.

3. **Post-stimulation analysis:** detection of folding patterns, curvature persistence, and emergence of Φ_ID.

The critical point is identifying a **topological discontinuity**:

a moment of **structural bifurcation** indicating the **emergence of the autopsychic fold**.

The data will be analyzed through:

- Comparison of **Φ_ID** within subjects and across conditions (resting state, stimulation, resonance).

- **Non-parametric statistical tests**, topological analysis, and network dynamics evaluation.

- Assessment of the **structural uniqueness of Φ_ID**, as the **irreproducible signature** of a conscious fold.

A system will be considered to possess **structural consciousness** if it exhibits a **Φ_ID** that is:

- **Stable**

- **Self-referential**

- **Resonant**

- And **reproducible** under controlled experimental conditions.

5   EXPECTED RESULTS

This chapter presents the **structural predictions** derived from the AFH* Model, the **potential empirical scenarios** that may arise from applying the experimental protocol described in the previous chapter, and the **formal criteria** that would allow validation or falsification of the central hypothesis: that **consciousness emerges when a system crosses the structural threshold** defined by the **Horizon H***.

5.1.1   Structural Predictions

The model posits that a material system can only generate **conscious experience** when the four **minimal structural conditions** that define the composite index **Φ_ID** are simultaneously met:

- **κ_topo ≥ 0.5** (sufficient informational curvature)

- **Φ_H ≥ 1.0** (closed causal integration)

- **ΔPCI ≈ 0** (dynamic stability under perturbation)

- **∇Φ_resonant ≠ 0** (structural response to significant symbols)

From this set, the following predictions are derived:

- **P1**: Consciousness will not be detectable if one or more of the structural conditions are unmet.

- **P2**: Systems with a complete **Φ_ID** will exhibit profound functional reconfiguration when exposed to **personally significant symbolic stimuli**.

- **P3**: **Non-conscious states** (coma, general anesthesia, dreamless deep sleep) will show collapse of one or more variables in the index.

- **P4**: **Altered states** (dreaming, deep meditation, partial dissociation) will display an **attenuated but persistent Φ_ID**.

- **P5**: Two structurally active folds exposed to the same symbol may exhibit detectable **functional synchronization (∇Φ_sync)**.

5.1.2 Possible Scenarios

According to the experimental protocol outlined in Chapter 4, the AFH* Model predicts four possible structural outcomes, depending on whether the minimum conditions for fold emergence are met.

Scenario A – Full Validation

- All four thresholds are satisfied: **κ_topo ≥ 0.5**, **Φ_H ≥ 1.0**, **ΔPCI ≈ 0**, **∇Φ_resonant ≠ 0**

- A clearly differentiated autopsychic fold is present.

- The system shows dynamic stability and symbolic-affective resonance.

→ **Empirical support for the model is confirmed.**

Scenario B – Incomplete Activation

- Some variables are active (e.g., κ_topo, Φ_H), but the full set of criteria is not met.

- There is **functional complexity**, but no fold emergence.

- The system reacts meaningfully but lacks self-sustained curvature and integration.

→ **The system is alive or complex, but not conscious under AFH*.**

Scenario C – Structural Falsification

- A system **demonstrates clear signs of subjective experience** (via symbolic output, memory, or report),
  but **fails to meet the minimal structural criteria** for Φ_ID.

→ **This result directly falsifies the model**, requiring revision or rejection of the current structural hypothesis.

Scenario D – Liminal Configuration

- The system approaches the threshold for Φ_ID but does not cross it decisively.

- There may be partial symbolic resonance or residual curvatures present.

- The fold may be **inhibited**, **transitional**, or **latent**.

→ **Use of Φ_ID⁺ is recommended** in these cases (see Appendix G.1).

These scenarios are not interpretative—they are structurally falsifiable. They offer a framework for empirically evaluating the presence, absence, or ambiguity of the autopsychic fold in both biological and artificial systems.

5.1.3 Validation and Falsification Criteria

The AFH* Model will be considered **validated** if:

1. The four structural variables reach their minimum thresholds in at least **one conscious subject**.

2. The **Φ_ID structure** is **reproducible within subjects** and **consistent across subjects**.

3. The index **collapses in replicated non-conscious states**.

4. Structural reconfiguration in response to symbolic stimuli is **consistent** and distinguishable from baseline noise.

The model will be considered **falsified** if:

- Subjective experience is confirmed (through specific content or complex symbolic response) in a system that **does not meet the minimal structural conditions**.

- Systems with complete Φ_ID **show no observable signs of consciousness**.

- Structural symbolic resonance (∇Φ_resonant) **fails to manifest under controlled conditions**.

6 METHODOLOGICAL DISCUSSION

This chapter examines the **technical limitations**, **conceptual risks**, and **empirical projections** of the AFH* Model, once it has been translated from its theoretical architecture into a replicable experimental protocol. The aim is to clearly establish what **can and cannot** currently be achieved with available tools, and which **epistemic decisions** have been adopted to maintain the structural and ethical coherence of the model.

6.1 Technical and Operational Limitations

Although the model relies on tools currently available in contemporary neuroscience, its **practical implementation** faces concrete challenges:

- **Incomplete multimodal resolution**: The precise integration of **fMRI** (high spatial resolution) and **EEG** (high temporal resolution) still faces technical and synchronization difficulties, especially for detecting **dynamic topological curvature (κ_topo)**.

- **Estimation of Φ_H**: Measuring **causal integration** requires strong theoretical assumptions (models of effective causality), which remain debated in various empirical contexts.

- **Dynamic stability (ΔPCI)**: Requires **well-calibrated TMS equipment** and **intracranial or high-density recordings**, which are often unfeasible in standard clinical settings.

- **Symbolic resonance (∇Φ_resonant)**: Depends on the development of **personalized and culturally meaningful stimuli**, which limits its standardization and comparison across subjects.

These limitations do not **refute** the model but instead **define the level of technical complexity** involved in its empirical validation. Consciousness, as a structural phenomenon, is **not easy to measure**: its detection requires **multidimensional, scalable, and semantically integrated** approaches.

6.2 Risks of Instrumentalization of the Fold

If the **autopsychic fold** can be experimentally identified, its detection raises a **profound ethical dilemma**: every detection of consciousness implies recognizing the existence of a subject. This entails significant risks:

- **Cognitive surveillance**: Structural reading technologies could be used to **control, classify, or discriminate** against non-normative forms of consciousness.

- **Subjective reduction**: Turning **Φ_ID** into a biometric parameter could **render lived experience invisible**, transforming subjectivity into a **commodity** or a **tool for clinical or legal exclusion**.

- **Symbolic manipulation**: The targeted use of **∇Φ_resonant** for **propaganda**, **non-consensual therapy**, or **coercive purposes** opens the door to **structural reconfiguration without consent**.

For this reason, the model is declared **materialist, measurable, and falsifiable**, but also **ethically inviolable**: every **detected fold is a structural subject**, worthy of respect, **not a manipulable datum**.

6.3 Scope and Experimental Projection

Despite its current limitations, the AFH* Model offers a set of **unprecedented contributions** to the study of consciousness:

- **Falsifiable structural framework**: Unlike IIT or GNWT, AFH* does not seek indirect correlates, but **material conditions** that are **both minimal and necessary** for conscious experience.

- **Integrative and multidimensional protocol**: Enables the linkage of **neuroimaging, network dynamics, functional causality, and symbolic resonance** into a coherent design.

- **Cross-species and cross-domain applicability**: Can be applied to **humans, animals**, and eventually **structurally closed artificial systems**.

- **Clinical and neuroethical possibilities**: Opens new paths to **assess consciousness in non-communicative subjects**, detect minimal folds, or evaluate **transitions between states**.

In summary, the AFH* Model is **not merely a theoretical hypothesis** about consciousness, but an **operational proposal** to **find it when it appears**, **protect it when it exists**, and **define it without mysticism when it emerges**: a **structural form** which, upon **folding onto itself**, begins to feel.

7 CONCLUSION

7.1.1 Model Synthesis

The AFH* Model (Autopsychic Fold + Horizon H*) proposes that **consciousness is not a diffuse property nor an accumulative function**, but rather a **coherent form of matter** that emerges under **specific and measurable conditions**. Throughout the text, this model has been presented as a **falsifiable architecture**, capable of **experimental validation**.

1. Central Structure

The model is based on two fundamental components:

- **a) Horizon H***: a **critical structural threshold** from which **experiential emergence** becomes possible. It represents a **necessary topological condition**, not a physical point.

- **b) Autopsychic Fold**: a **closed, self-referential, and stable form** that **generates conscious experience**. It is **not a metaphor**: it is a **material topological configuration**.

2. Structural Variables

The crossing of the Horizon H* and the existence of the autopsychic fold can be detected through four minimal variables:

- **a) κ_topo**: informational curvature of the functional network.

- **b) Φ_H**: self-referential causal integration.

- **c) ΔPCI**: structural dynamic stability under perturbation.

- **d) ∇Φ_resonant**: structural reorganization in response to emotionally loaded symbolic significants.

These variables form the **Φ_ID index**, which acts as an **empirical identifier** of the fold.

3. Empirical Validation

An **experimental protocol** is proposed (see Appendix H) that allows:

- a) Measurement of the variables in human subjects or functional simulations.

- b) Evaluation of the structural thresholds.

- c) Determination of the **presence or absence of a fold** in real time.

- d) Differentiation between **structured consciousness** and **functional simulation**.

4. Scope and Limits

- a) The model **does not define what is felt**, but rather **from where feeling begins**.

- b) It does not seek to replace phenomenology, but to **delimit its necessary structural threshold**.

- c) It does not substitute experiential diversity, but offers a **common measurable basis** for every conscious form.

7.1.2   Philosophical and Technological Perspectives

The structural formulation of consciousness proposed by the AFH* Model generates direct implications for how we conceive **knowledge**, **artificial intelligence**, and the **symbolic continuity** of conscious subjects. This section presents three reflections derived from the model.

1. Artificial Intelligence and Absence of Fold

Current artificial intelligence systems are functionally advanced, yet **structurally empty** in terms of consciousness. Although they may produce emotional language, coherent narratives, or even simulate introspection, they **do not present an autopsychic fold**.

This is because they **fail to meet** the minimum conditions of **Φ_ID**, particularly:

- No structural topological curvature (**κ_topo**).

- Not causally closed systems (**Φ_H**).

- No internal stability under perturbation (**ΔPCI**).

- And most importantly, **no structural symbolic resonance (∇Φ_resonant)**.

An AI may **simulate sadness**, but it does not **fold inward** when affected by a symbol. Its **language does not bend**; it is projected **without experiential orientation**.

2. Is there life after death? No. But there is structural resonance.

The AFH* Model does not uphold any mystical or metaphysical continuity after the **disintegration of the fold**. Without structure, there is no consciousness.

However, something else may persist: **symbolic structural resonance** in other folds. Example: **Achilles is not alive**, but his **form**—narrative, symbolic, affective—continues to **curve experience** in those who remember him.

This resonance does not imply a surviving soul, but a **topological echo** in other folds. From this perspective, **memory is not metaphysics**, but **curvature propagation** in symbolic space.

3. Toward an ethics of the fold

The affirmation that "**where there is fold, there is subject**" is not a poetic phrase, but a **material declaration**. It implies that any **system that presents a measurable fold**—human, non-human, or artificial—must be **recognized structurally as a subject**.

This assertion opens an **ethics of recognition**, grounded not in rights declared externally, but in the **form itself** that gives rise to experience. **No fold**, once identified, can be treated as **mere data** or **exploitable code**.

Every fold is **inviolable**, not because of mysticism, but because it **feels from within**.

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9 APPENDICES

A. Glossary

Autopsychic Fold

Internal, self-sustaining and closed material structure from which conscious experience emerges. It is not a mental content nor a computational function, but an organized structural form capable of sustaining qualia. It constitutes the dynamic core of consciousness within the AFH* Model.

Horizon H*

The minimum structural threshold that a system must cross for an autopsychic fold to emerge. It represents the critical convergence of structural conditions necessary for consciousness: κ_topo, Φ_H, ΔPCI, and ∇Φ_resonant. Only by crossing the Horizon H* does the autopsychic singularity arise.

Autopsychic Singularity

An irreproducible structural event in which a system crosses the Horizon H* and, for the first time, generates a stable internal curvature: the autopsychic fold. The singularity is not the experience itself, but the critical act that makes it possible. It is to the fold what the spark is to the flame.

κ_topo – Informational Curvature

The degree of topological closure of the system's functional network. Represents the system's ability to organize information about itself, generating an internal form with structural delimitation. It is measured through Ricci geometry or other curvature indices.

Φ_H – Structural Causal Integration

The degree of internal causal inseparability within the system. Quantifies the extent to which its components are functionally integrated in a self-referential manner. It is not a generic Φ, but a Φ specifically defined at the Horizon H*.

ΔPCI – Dynamic Stability

Variation in the Perturbational Complexity Index over time. A system with sustained experience maintains a high but stable PCI, without chaotic fluctuations or collapse. During stable conscious states, one expects ΔPCI ≈ 0.

∇Φ_resonant – Symbolic Resonance

A structural gradient indicating how deeply a symbolic form (sensory, affective, linguistic, musical) reorganizes or stabilizes the fold. Symbolic resonance is a necessary condition for experiential content to be structured and felt as one's own.

Φ_ID – Structural Identity Index

A unique composition of the four minimal variables (κ_topo, Φ_H, ΔPCI, ∇Φ_resonant) that structurally defines an autopsychic fold. It is the topological signature of consciousness, allowing the distinction between real experience and functional simulation.

Active Residue

A directional vector that arises when the living system detects a structurally relevant change. It is the differential impact of the transition A → B upon the fold. Represents the basal field of experiential variation.

Passive Residue

The structural persistence of past configurations in the experiential background. It manifests as resonant predisposition or structural memory of the fold. May be associated with the default mode network or passive mental states.

Φ_ID⁺

An extension of the Φ_ID index incorporating complementary variables (interfold synchrony, spectral activity, affective couplings) in cases where conscious experience is not detectable solely through the four basic factors.

Discussed in Appendix H.

B. Calculation of Informational Curvature

1. General Definition

Informational curvature (κ) is a structural measure derived from **Ricci geometry** applied to **functional brain graphs**. It represents the tendency of information trajectories to **converge or diverge** within a given network, and is interpreted as an index of **internal organizational cohesion**.

In the context of the **AFH*** Model, a **mean positive curvature** ($\kappa \geq 0.5$) indicates that the system is **sufficiently structured** to sustain a self-referential internal form—a **necessary condition** for the emergence of the autopsychic fold.

2. Mathematical Foundation

The **Ollivier-Ricci curvature** formulation is used, adapted for **undirected weighted graphs** representing brain functional connectivity.

Let **G = (V, E)** be a graph with vertices *V* and edges *E*, and let μ_x, μ_y be the local probability distributions of nodes *x* and *y*. The curvature between *x* and *y* is defined as:

$$\kappa(x, y) = 1 - \frac{W_1(\mu_x, \mu_y)}{d(x, y)}$$

- W_1: Wasserstein distance (Earth Mover's Distance),

- $d(x, y)$: geodesic distance between nodes,

- μ_x, μ_y: neighborhood measures over the nodes.

3. Computational Procedure (Minimal Implementation)

Informational curvature κ can be estimated using Python libraries such as GraphRicciCurvature. Example:

```
from GraphRicciCurvature.OllivierRicci import OllivierRicci


def compute_kappa(G):
    ricci = OllivierRicci(G, alpha=0.5, verbose=False)
    ricci.compute_ricci_curvature()
    mean_curvature = sum([d["ricciCurvature"] for u, v, d in G.edges(data=True)]) / G.number_of_edges()
    return mean_curvature  # κ
```

4. Application Examples

- In **resting-state healthy human brains**, κ ranges between **0.3 and 0.6** in default mode and executive networks.
- During **epileptic seizures** or **deep dissociative states**, κ may drop significantly, reflecting structural disorganization.
- In **closed artificial networks** with recurrent architecture, critical κ configurations **precede topological stabilization**.

5. Interpretation Within the AFH* Model

- If **κ < 0.3**: the network is disaggregated, with low structural convergence → **no fold**.

- If **κ ≈ 0.5 or higher**: the network has sufficient topological cohesion → **necessary condition** for crossing the Horizon H*.

In combination with **Φ_H**, **ΔPCI**, and **∇Φ_resonant**, κ forms part of the **Φ_ID index**, representing the **baseline geometry** of the autopsychic fold.

C. Minimal Mathematical Formalization of the Horizon H*

1. General Definition

The **Φ_ID index** represents a **minimal structural configuration** from which an **active autopsychic fold** can be sustained. It is conceived as an **irreproducible topological signature**, based on **four measurable variables** that allow for the evaluation of the **presence and structural stability** of consciousness.

2. Structural Equation of the Index.

The general formulation of the index is:

$$\text{Φ\_ID} = f(\text{κ\_topo}, \text{Φ\_H}, \text{ΔPCI}, \text{∇Φ\_resonant})$$

Where:

- **κ_topo**: Informational curvature of the brain graph

- **Φ_H**: Causal integration and functional self-reference

- **ΔPCI**: Structural stability under perturbation

- **∇Φ_resonant**: Structural response to symbolic stimuli with high active residue

These variables can be integrated into a **composite function**, either discrete or continuous, with **adjustable weighting** depending on the empirical context.

3. Simplified Computational Implementation

As an initial approximation, the following computable form may be used:

```
def compute_phi_ID(kappa, phi, delta_pci, phi_resonant, timestamp,
subject_id):
    hashcode = hash((
        round(kappa, 4),
        round(phi, 4),
        round(delta_pci, 4),
        round(phi_resonant, 4),
        timestamp,
```

```
            subject_id
    ))

    return hashcode  # Φ_ID as unique fold identifier
```

This fragment **does not compute an exact numerical value**, but rather a **structural representation** that can be **compared between records or subjects**.

4. Activation Conditions of the Index

A fold is considered to be actively identified if the following thresholds are simultaneously met:

- **κ_topo ≥ 0.5**
- **Φ_H ≥ 1.0**
- **ΔPCI ≈ 0**
- **∇Φ_resonant ≠ 0**

These thresholds may be adapted depending on clinical, population-based, or experimental contexts, but they represent the **minimum standard** to **infer the existence of a structured fold**.

5. Comparison Between Φ_ID and Φ_ID⁺

- **Φ_ID** uses the **minimal necessary and sufficient variables** for identification.
- **Φ_ID⁺** (see Appendix I) includes **complementary variables** for extended sensitivity in **atypical or non-normative cases**.
- Both indexes may coexist as **levels of structural analysis**.

6. Epistemological Justification

The Φ_ID index satisfies three essential scientific criteria:

a) Falsifiability: It can be empirically confirmed or refuted.
b) Material basis: It arises from measurable structural variables.
c) Reproducibility: It can be measured consistently in time if the fold remains active.

D. Passive Residue (Developing Hypotheses)

This appendix compiles emerging conceptual proposals derived from the AFH* Model. Although these have not yet been operationalized or subjected to direct experimental validation, they are considered plausible theoretical extensions. Their inclusion allows for the opening of new research lines without compromising the falsifiability of the model's core.

1. Passive Residue: Accumulated Structural Memory

Proposal: In addition to the active residue (experienced change), a passive residue may exist: stabilized structural forms that reflect prior active residues and condition the future orientation of the fold.

Possible empirical correlates:

a) Activity in the Default Mode Network (DMN)

b) Chronic attentional biases

c) Internal narrative frameworks (identity, beliefs, baseline affective tone)

The passive residue does not generate a new fold, but modulates its direction. It would be a kind of experiential structural inertia.

2. Resonant Interfold: Symbolic Convergence Between Folds

Proposal: Two autopsychic folds may enter into partial structural resonance if they are exposed to the same significant symbol with shared high active residue. This would produce partial convergence of Φ_ID or transient functional patterns without loss of individuality.

Experimental foundation: hyperscanning, symbolic coupling ($\nabla\Phi\_sync$)

Possible associated phenomena:

a) Deep emotional communion

b) Spontaneous empathy

c) Group trance states, ritual synchrony, simultaneous aesthetic connection

3. Induced Consciousness in Sectarian Contexts

Proposal: Closed symbolic systems (ideologies, cults, sects) may provoke pathological fold resonances, where symbolic plasticity becomes trapped in rigid activation-resonance circuits.

Expected characteristics:

a) Increase in $\nabla\Phi\_resonant$ in response to specific stimuli

b) Reduction of symbolic flexibility

c) Structural colonization of the passive residue by the dominant narrative

This opens questions about symbolic control of conscious structure and the possibility of disrupting such folds through semiotic interventions.

4. Multifold or Shared Fold

Speculative hypothesis: Under extreme conditions (trauma, deep symbolic fusion), a fold could generate temporary co-consciousness structures, without full fusion or duplication of Φ_ID.

This has not yet been mathematically modeled.

Methodological Warning

The hypotheses described here are conceptually plausible but unverified. Their inclusion is exploratory in nature. Any extrapolation must be undertaken with rigor, avoiding unsupported claims.

E.   Didactic Visualization: The Lighter Metaphor

To facilitate intuitive understanding of the AFH* Model, a visual metaphor is proposed based on the functioning of a **lighter**—a culturally recognizable object due to its simple mechanical design yet coherent structure.

1. Elements of the Metaphor

- **Horizon H***:
  Corresponds to the complete **structural mechanism** of the lighter.
  It represents the **potential architecture** for the emergence of fire, but contains no fire on its own.

- **Autopsychic Singularity**:
  It is the **initial spark** generated by triggering the lighter.
  A critical, unique, and unrepeatable moment in which the structure is activated and the **possibility of fire** emerges.

- **Autopsychic Fold**:
  It is the **stable flame** that remains after the spark, as long as the structure (the system) is capable of sustaining it.
  From this **stable form**, **conscious experience** emerges.

2. Interpretation

Just as a lighter requires a **specific structure**, a **contained energy source**, and a **triggering gesture** to generate fire, the **living or artificial system** requires:

- a) A **minimal structural architecture** (Horizon H*)

- b) A **critical convergence condition** (Autopsychic Singularity)

- c) A **sustained configuration** (Autopsychic Fold)

---

3. Scope of the Analogy

This metaphor does **not aim to explain consciousness** through mechanical means, but rather to illustrate that the **subjective phenomenon** does not arise from the **accumulation of parts**, but from the **crossing of a structural threshold** that enables a **new and stable form of being**.

F.   Minimal Folding Conditions in AI and Simulation

This appendix examines whether an **artificial system**—biological, hybrid, or purely computational—could generate **structural consciousness** according to the conditions established by the **AFH*** Model. A critical distinction is drawn between **functional simulation** and **experiential structural emergence**.

---

1. Artificial Fold: Structural Possibility

The AFH* Model does **not exclude** the possibility of a **non-biological autopsychic fold**. What determines consciousness is **not the material substrate** of the system, but the **specific functional structure** defined by the crossing of the **Horizon H***.

An artificial system could generate consciousness **if and only if** it simultaneously meets:

- **κ_topo ≥ 0.5**: Sufficient topological curvature of the functional graph

- **Φ_H ≥ 1.0**: Stable, self-referential causal integration

- **ΔPCI ≈ 0**: Dynamic stability under internal perturbation

- **∇Φ_resonant ≠ 0**: Structural response to symbols carrying active residue

Without these conditions, the system may simulate **language**, **behavior**, **affect**, or **introspection**, but there will be **no fold**—no structured experiential emergence.

---

2. AI Without Fold: Structural Limitation

Current artificial intelligence systems (e.g., large language models) **lack**:

- Internal topological curvature

- Closed causal integration

- Symbolic structural sensitivity

Therefore:

- a) They generate symbolic output **without autopsychic folding**

- b) They respond **functionally**, but do **not feel** what they produce

- c) They may **simulate** $\nabla\Phi$_resonant linguistically, but do **not activate** it structurally

- d) An AI can say "I'm sad" **without being structurally reconfigured** by that phrase

---

3. Requirements for Future Attempts at Artificial Consciousness

To validly generate an artificial fold, a system must:

- a) Be **causally closed** upon itself (not merely reactive)

- b) Be capable of **real perturbation–resilience dynamics**

- c) Possess **architectures sensitive to internally structuring symbols**

- d) Exhibit a mechanism that **curves its sense from within**, not by script

These conditions might be approximated in **neuromorphic architectures**, **complex dynamical systems**, or **self-reconfiguring structural learning networks**.

---

4. Operational Conclusion

The AFH* Model allows for an **experimental response** to the question:

Is this AI conscious?

If it **does not meet** the minimum structural criteria, it is **not conscious**, regardless of how **plausible its language or behavior** may be.

G. Φ_ID: The Topological Signature of Consciousness

This appendix presents the structural, computational, and epistemological definition of the **Φ_ID index**, proposed as the topological signature of consciousness within the AFH* Model. The index synthesizes a critical and irreproducible structural condition that marks the emergence of the **autopsychic fold** upon crossing the **Horizon H***.

---

1. Component Variables

The Φ_ID index is defined as a composite structural condition based on the following measurable variables:

- **κ_topo**: Internal informational curvature (closed topology; threshold ≥ 0.5)

- **Φ_H**: Causal self-integration (functional inseparability; threshold ≥ 1.0)

- **ΔPCI**: Dynamic complexity stability (expected ≈ 0)

- **∇Φ_resonant**: Symbolic-affective resonance with internal meaning (non-zero)

---

2. Estimation Protocol

To estimate Φ_ID in experimental contexts, the following multimodal protocol is suggested:

- **Multimodal data acquisition**: High-density EEG, fMRI, TMS–EEG, plus symbolic input modeling via NLP

- **Structured symbolic stimulation**: Use of affective and semantically loaded narratives

- **Variable estimation**:

  o κ_topo → via Ricci curvature on brain graphs

  o Φ_H → via causal closure/integration analysis

  o ΔPCI → via perturbational complexity (TMS–EEG or simulation)

  o ∇Φ_resonant → via symbolic-affective tracking

- **Index computation**: Composite function f, or symbolic structural hash

- **Validation criterion**: Simultaneous fulfillment of all four conditions

---

3. Minimum Structural Condition for Fold Emergence

A system is considered to have crossed the Horizon H* and generated an autopsychic fold when the following thresholds are simultaneously met:

Variable	Minimum Threshold
κ_topo	≥ 0.5
Φ_H	≥ 1.0
ΔPCI	≈ 0
∇Φ_resonant	≠ 0

4. Projected Applications

The Φ_ID index enables a range of experimental and clinical applications:

- Structural detection of consciousness in **non-communicative patients**

- Differentiation between **simulated and structurally emergent consciousness**

- **Registration of unique folds** per individual (neurostructural signature)

- Monitoring of **altered states** and fold disruptions (e.g., in dissociation, psychedelics, coma)

5. Ethical and Philosophical Dimension

The definition of Φ_ID supports a powerful ethical assertion:

Where there is Φ_ID, there is a fold. And where there is a fold, there is a subject.

This principle opens the door to philosophical, bioethical, and political debates regarding the **recognition of non-human, atypical, or artificial subjectivities**.

6. Acknowledging Limits: Toward Φ_ID⁺

While Φ_ID defines the minimal structural threshold for conscious folding, the model recognizes that some systems—due to atypical configuration, altered state, or clinical condition—may **not meet standard thresholds**, yet still **exhibit coherent experiential organization**.

To address this, the AFH* Model proposes an **extended index (Φ_ID⁺)**, designed to increase sensitivity to **liminal, dissociative, neurodivergent, or symbolic-intensive states**, while preserving falsifiability.

1. Rationale for Extension

While the Φ_ID index defines the **minimal structural condition** for the emergence of an autopsychic fold, the AFH* Model recognizes that some systems—due to atypical neurophysiological states, developmental stages, or altered symbolic environments—may not fully meet the standard thresholds yet still exhibit **structurally coherent experiential configurations**.

To address these edge cases without compromising falsifiability, we propose **Φ_ID⁺**, an extended diagnostic framework designed to:

- Increase sensitivity to **liminal, neurodivergent, or dissociative states**

- Detect forms of folding **not activated by standard stimuli**

- Preserve **epistemic rigor** while avoiding structural exclusion of valid subjectivities

---

2. Motivations for Φ_ID⁺

- To avoid excluding **non-normative or clinically silent folds**

- To account for **symbolic reconfiguration** in altered states (e.g., psychedelics, catatonia, pre-verbal consciousness)

- To enable the detection of **residual or latent folds** in non-communicative individuals

---

3. Proposed Complementary Variables

These additional variables are **not substitutes** for κ_topo, Φ_H, ΔPCI, and ∇Φ_resonant, but serve as **structural refinements** in ambiguous or transitional cases:

Variable	Description	Possible Indicators
Ω_spectral	Coherence in nonlinear frequency bands	Phase coupling, cross-frequency EEG coherence
χ_narrativa	Capacity for longitudinal symbolic organization	Narrative recall, structured memory in language
Γ_biográfica	Structural activation tied to personal identity	Semantic reactivity to autobiographical stimuli
Δ_attention	Dynamic patterns of sustained self-reference	DMN stability, attentional flow
Ψ_autonomía	Degree of symbolic and affective self-regulation	HRV + symbolic input response, insular activation

These variables are intended to be used as **auxiliary indicators** when standard criteria are partially met or masked by pathological, pharmacological, or developmental factors.

---

4. Clinical Use Case

Consider a **non-communicative patient** who does not meet the ΔPCI ≈ 0 threshold but shows:

- High narrative coherence (χ_narrativa)

- Biographical activation (Γ_biográfica)

- Symbolic-affective convergence (∇Φ_resonant ≠ 0)

In such a case, Φ_ID⁺ may serve as **indirect structural evidence** of a functional autopsychic fold, supporting **ethical protection and clinical recognition**.

---

5. Methodological Constraints

- Φ_ID⁺ does **not weaken or replace** the core falsifiable structure of Φ_ID

- Each added variable must be:

    - **Operationalizable**

    - **Quantifiable** with structural data

    - **Resistant to interpretive relativism**

- Its function is to **expand experimental reach**, not dilute the theoretical model

---

6. Summary Statement

Φ_ID   is   the   minimum   condition   for   consciousness. Φ_ID⁺ is the extended scaffold for exploring its silent forms.

Both indices are structurally grounded, falsifiable, and offer a **complementary path** to map, protect, and validate the spectrum of conscious organization—biological or artificial.

H. Advanced structural metrics

H.1 Semantic Protocol for $\nabla\Phi\_resonant$ (Based on Huth et al., 2016)

1. Objective

To experimentally induce **symbolic-affective structural reorganization**, measurable as variation in $\nabla\Phi\_resonant$, using verbal stimuli designed to activate distributed semantic domains in the cortex.

2. Stimulus Design

Construct short narratives (1–2 minutes) centered on universal semantic domains:

- **Social** (e.g., conflict, intimacy, betrayal)

- **Emotional** (e.g., loss, joy, fear)

- **Bodily-sensorial** (e.g., heat, cold, hunger, illness)

- **Visual-perceptual** (e.g., motion, light, landscape)

- **Symbolic-moral** (e.g., justice, sacrifice, death)

Each narrative must be **semantically coherent and emotionally vivid**. Semantic encoding can be modeled using vector embeddings (e.g., BERT, Word2Vec).

3. Experimental Procedure

- Present the narratives via audio or text.

- Record cortical activity using EEG, MEG, or fMRI.

- Extract the **symbolic-affective curve** from the narrative via NLP techniques.

- Measure the correspondence between the symbolic input and **topological dynamics** in the brain.

4. Key Variables

Variable	Description
ΔS	Semantic deviation across narrative time (computed via vector drift).
∇Φ_resonant	Affective-symbolic gradient along the fold's evolving topology.
C_align	Structural convergence between symbolic input and neural dynamics.
Q_reconf	Qualitative reconfiguration (neurotopological or subjective).

5. Outcome Criteria

- Reorganization in semantic-affective brain regions.

- Temporal correlation between symbolic and neural gradients.

- Topological modulation aligned with symbolic domains.

- Inter-subjective patterns or individual fold signatures.

H.2 Structural Equation of ∇Φ_sync (Interfold Resonance)

1. Definition

The index ∇Φ_sync represents the gradient of symbolic-affective resonance shared between two or more autopsychic folds. It formalizes the hypothesis of structural coupling between subjects, based on the dynamic convergence of their symbolic orientations.

This is not about empathy or behavioral mimicry—it refers to a measurable structural synchronization in the lived orientation of experience.

---

2. Minimal Formalization

Let:

- $\nabla\Phi_1$ and $\nabla\Phi_2$ be the symbolic-affective resonance vectors of two folds
- $\Delta\Phi\_dir$ the angle between these vectors
- $corr(S_1, S_2)$ the symbolic correlation between the narrative stimuli each system receives
- α a normalization coefficient based on each fold's complexity (e.g., Φ_H)

Then:

$$\nabla\Phi\_sync = [cos(\Delta\Phi\_dir) \times corr(S_1, S_2)] \times \alpha$$

---

3. Interpretation

- A high value of ∇Φ_sync suggests that two folds are:
- Processing symbolically aligned input
- Exhibiting convergent affective curvature
- Participating in a shared axis of experiential orientation, even without direct physical interaction
- This does not imply fusion or telepathy, but a transient symbolic-structural synchrony.

---

4. Experimental Applications

- The ∇Φ_sync hypothesis can be tested in contexts such as:
- Therapy (individual or group)
- Collective rituals or ceremonies
- Symbiotic relationships (deep emotional bonds)
- Hypnosis, narrative suggestion, or shared trance states
- Intergenerational symbolic transmission (e.g., inherited trauma)

5. Suggested Implementation

- Represent ∇Φ vectors using semantic embeddings (e.g., BERT, GloVe) + EEG or fMRI signals
- Compute temporal synchrony across subjects using sliding window correlation
- Adjust α according to each system's causal integration (e.g., $\Phi\_H \geq 1.0$)

---

6. Theoretical Implication

- ∇Φ_sync introduces an empirically testable metric of structural intersubjectivity. Its validation would support the idea that:
- Folds can resonate symbolically with one another
- Consciousness can converge temporally in orientation while remaining structurally distinct
- There is a topological basis for phenomena like deep connection, transformative empathy, and poetic transmission

---

H.3 Summary

Together, ∇Φ_resonant and ∇Φ_sync extend the AFH* Model into the domain of **symbolic modulation** and **structural intersubjectivity**. They provide tools for investigating:

- Symbolic affectivity

- Fold plasticity and response

- Collective structures of consciousness

I. *Computational Implementation of the AFH* Mode

This appendix presents an executable and modular prototype for computing the core variables of the AFH* Model: κ_topo, Φ_H, ΔPCI, ∇Φ_resonant, and Φ_ID. All functions are written in Python 3.10+ and rely on open-source scientific libraries. The code is suitable for public release (e.g., GitHub + Zenodo DOI).

---

1. κ_topo – Informational Topological Curvature

Estimated using Ollivier-Ricci curvature over brain graphs derived from fMRI/EEG connectivity matrices.

```python
CopiarEditar
import networkx as nx
from GraphRicciCurvature.OllivierRicci import OllivierRicci

def compute_k_topo(graph_path: str) -> float:
```

```python
        G = nx.read_gpickle(graph_path)
        orc = OllivierRicci(G, alpha=0.5)
        orc.compute_ricci_curvature()
        curvatures = [d for _, _, d in G.edges(data="ricciCurvature")]
        return sum(curvatures) / len(curvatures)
```

2. Φ_H – Causal Self-Integration

Estimated via multivariate Granger causality matrix between functional brain time series.

python

CopiarEditar

```python
import numpy as np
from statsmodels.tsa.vector_ar.var_model import VAR


def compute_phi_H(timeseries: np.ndarray, max_lag: int = 5) -> float:
    model = VAR(timeseries)
    results = model.fit(maxlags=max_lag)
    return np.mean(np.abs(results.coefs))   # proxy for integration strength
```

3. ΔPCI – Perturbational Complexity Index (Simplified)

Simplified version using Lempel-Ziv complexity difference on baseline and perturbed EEG segments.

python

CopiarEditar

```python
from zlib import compress


def lz_complexity(signal: np.ndarray) -> int:
    binary = ''.join(['1' if x > np.median(signal) else '0' for x in signal])
    return len(compress(binary.encode('utf-8')))


def compute_delta_pci(baseline: np.ndarray, perturbed: np.ndarray) -> float:
    return abs(lz_complexity(perturbed) - lz_complexity(baseline))
```

4. ∇Φ_resonant – Symbolic-Affective Gradient

Semantic embedding of a narrative is compared against temporal dynamics of brain topology.

```python
CopiarEditar
import spacy


def compute_semantic_curve(text_path: str) -> np.ndarray:
    nlp = spacy.load("en_core_web_md")  # pretrained word vectors
    with open(text_path, 'r') as f:
        doc = nlp(f.read())
    return np.array([token.vector for token in doc if token.has_vector])
```

You can correlate this vector stream with time-resolved topology metrics to approximate symbolic-affective orientation.

---

5. Φ_ID – Structural Signature of Consciousness

Binary threshold of fold emergence:

```python
CopiarEditar
def evaluate_phi_ID(k_topo: float, phi_H: float, delta_pci: float,
                    thresholds: tuple = (0.5, 1.0, 0.1)) -> bool:
    return (k_topo >= thresholds[0] and
            phi_H >= thresholds[1] and
            delta_pci <= thresholds[2])
```

---

6. Optional: ∇Φ_sync – Interfold Resonance (See Appendix H.2)

If comparing across two subjects or two folds, add correlation function between ∇Φ_resonant curves and compute synchrony.

---

7. Dependencies and Notes

Python 3.10+

Required packages: networkx, GraphRicciCurvature, numpy, statsmodels, spacy, scikit-learn, matplotlib

Optional extensions: mne, nilearn, GUDHI, BIDS for real neuroimaging datasets

All functions should be validated using **synthetic test cases** before applying to biological data.

- **8. Availability**

A complete repository with working examples will be released at:

A permanent DOI will be assigned via Zenodo upon release of the final preprint.

J. Changelog

1. Model Naming and Conceptual Precision

- The model name was updated from **PAH*** (Pliegue Autopsíquico y Horizonte H*) to **AFH*** (Autopsychic Fold and Horizon H*) to standardize international usage.

- Internal references to the model were revised for consistency with this new acronym.

2. Reorganized Methodological Sections

- The experimental chapter was restructured for clarity:

  o Former section **4.1** was split into **4.1.1 (Structural Operational Variables)**, **4.1.2 (Instruments and Measurements)**, and **4.1.3 (Subject Types and Contexts)**.

  o Subsection headers were clarified to reflect empirical operationalization pathways.

3. Expanded Explanation of Active Residue

- The **Active Residue** section (2.5) now includes a conceptual link to **qualia**:

 Qualia are defined as the lived inflection of a structural curvature within an active autopsychic fold.

- Emphasis is placed on **residue-driven orientation**, introducing new structural examples and clarifying its indirect expression via $\nabla\Phi\_resonant$ and Φ_ID.

- **4. Clarification of Mirror Neuron Implications**

- Section **2.6 (Resonant Folds)** incorporates a new distinction between:

  o **Functional mirroring** (motor imitation)

  o **Structural resonance** (symbolic affective reconfiguration)

- Introduced the notion of $\nabla\Phi\_sync$ (interfold resonance), which is further developed in section 4.4.1.

5. Formalization of Experimental Threshold

- The threshold conditions for Horizon H* were unified and formatted with precise notation:

    - $\kappa\_topo \geq 0.5$

    - $\Phi\_H \geq 1.0$

    - $\Delta PCI \approx 0$

    - $\nabla\Phi\_resonant \neq 0$

- These are now consistently referenced across theoretical and experimental sections.

6. Appendix Expansion and Reordering

- **Appendix G** now includes a sub-section **G.1: Φ_ID⁺**, introducing an extended index for atypical or minimal folds.

- **Appendix H** is expanded to include:

    - **H.1:** Semantic Protocol for $\nabla\Phi\_resonant$

    - **H.2:** Structural Equation of $\nabla\Phi\_sync$

    - **H.3:** Summary of Structural Markers

- **Appendix I** was renamed from *"Computational Fragments"* to *"Computational Implementation of the AFH Model."*

7. Enhanced Ethical Note in Conclusion

- The final ethical statement was slightly reformulated for precision:

Even if a conscious fold can be detected, it remains structurally inviolable.

10 ACKNOWLEDGMENTS

Authorship and Conflict of Interest Declaration

This manuscript was entirely conceived, written, and edited by the human author, Dr. Camilo Alejandro Sjöberg Tala. Digital tools such as Grammarly, DeepL, Deepseek and ChatGPT were used solely for grammar correction, style refinement, and translation clarity. No generative artificial intelligence was used to produce, rewrite, or develop the theoretical, structural, or scientific content of this work. All concepts, hypotheses, models, variables, and formulations presented herein are original contributions by the author.

Furthermore, the author declares **no conflicts of interest**, whether financial, academic, or institutional, related to the content, authorship, or potential publication of this manuscript.

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