Triphase Cosmology: Interference Structure of the Universe and the Redefinition of Reality

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November 8, 2025

Abstract

This work proposes "Triphase Theory," which defines the universe as an interference network of three phase-spaces $\mathcal{H}_+$, $\mathcal{H}_-$, and $\mathcal{H}_{\mathrm{im}}$. We introduce: (i) the positive phase $\mathcal{H}_+$, which carries visible matter and ordinary spacetime geometry, (ii) the negative phase $\mathcal{H}_-$, which behaves as tension, negative pressure, and gravitational shadow, and (iii) the imaginary/informational phase $\mathcal{H}_{\mathrm{im}}$, which carries nonlocal phase alignment and coherence of information. These phases are coupled through the interference tensor $\mathcal{I}_{\mu\nu}$. Only when the three phases satisfy the coherence condition $\mathcal{C} = 0$ does a stable, observable state get projected into the positive phase and become "reality." We axiomatize this Coherence Principle and treat gravitation, quantum nonlocality, dark components, measurement, and verifiability in one frame. Furthermore, we argue that verification is not an external comparison, but the coherence condition itself ($\mathcal{C} = 0$), and therefore the universe must be understood as a self-verifying interference network.

1 Introduction: Fragmented Descriptions of the Universe and Their Critical Breakdown

1.1 Problem statement: fragmentation

Since the twentieth century, physics has maintained multiple theories that are individually extremely successful yet mutually difficult to reconcile. General relativity describes gravity as spacetime curvature and predicts the evolution of the large-scale universe. Quantum mechanics and quantum field theory treat particles and interactions as probabilistic amplitudes and explicitly incorporate measurement. Higher-dimensional extensions such as string theory / M-theory offer candidates to embed gravity and quantum theory in a single frame.

However, although these theories describe "the same universe from different cuts," they fail to share: a common ontology (what is actually real), a common theory of observation (what measurement truly does), and a common verification doctrine (what it means for a statement to be correct). We call this mismatch *fragmentation*.

Fragmentation is not just disciplinary specialization. It is the symptom that the very word "reality" is being defined differently in each framework. For example:

- Gravity is spoken of as geometric distortion (relativistic vocabulary).
- Quantum processes are spoken of as interference, phase, and probability (quantum vocabulary).
- Observation is spoken of as information readout or wavefunction collapse (quantum measurement vocabulary).

Without a direct translation between these vocabularies, physics cannot answer with a single voice the question, "What are we actually looking at right now?"

The stance of this paper is:

> The real bottleneck is not that "we have not yet found a single unifying equation." The real bottleneck is that we do not yet know *what is supposed to be unified* — i.e., where the interference that gives rise to reality actually lives.

This uncertainty about "the locus of interference" is the critical bottleneck of present-day theoretical physics.

Human physics has long pursued the smallest constituent of existence, believing that truth resides in reduction. Yet in doing so, it may have overlooked structure itself— the relational fabric from which phenomena emerge. Likewise, by extending the notion of 'dimension,' originally a visualization tool of limited scope, we may have mistaken coordinates for reality. Triphase Theory restores the primacy of structure, defining reality not by elements or dimensions, but by stable interference among phases.

1.2 Observational anomalies and paradigm fatigue

Fragmentation already shows up in observational cosmology. Typical examples include: (i) the Hubble tension (disagreement in derived expansion rate), (ii) the primordial lithium abundance problem, (iii) distance-independent instantaneous correlation in quantum entanglement (quantum nonlocality). Across domains, the observed values and the values "demanded by the theory" are not matching.

These mismatches are difficult to dismiss as a simple experimental error. A more direct reading is that the assumption "we are looking at the universe" is itself underspecified: which phase is actually being accessed when we look?

Therefore we now need a unification that does not just align force carriers or particle spectra, but treats matter, gravity, information, observation, and verification inside a single ontological frame. This is not aesthetic; it is becoming a minimum requirement to keep describing the universe at all.

1.3 Interference-based unification and the Coherence Principle

Triphase Theory is proposed in response to this necessity. Its core idea is to treat the universe as the mutual interference of three phases:

- Positive phase (visible matter / directly observable domain),
- Negative phase (gravity, tension, dark sector),
- Imaginary / informational phase (information, wave structure, latent layer).

In this view, the interference among these three phases is the generator of what we call "reality."

This differs qualitatively from traditional unification programs. Traditional unification tends to seek a single field or a single type of object (particle, string, etc.) into which all physics can be reduced. By contrast, Triphase Theory adopts unification-by-coherence, not unification-by-reduction. Different phases interfere; only when that interference achieves cross-phase coherence does it project into reality.

This motivates what we later formalize as the Coherence Principle.

1.4 Strategy of this work: unification through interference and coherence

We redefine the universe as a "three-phase interference network":

- **Positive phase $\mathcal{H}_+$:** The phase onto which visible matter, radiation, and ordinary energetic content are projected.
- **Negative phase $\mathcal{H}_-$:** The phase whose projection appears as tension, negative pressure, gravitational shadow, and in practice yields phenomena called dark matter and dark energy. In relativistic language, it contributes as curvature sourced by an effective negative sector.
- **Imaginary / informational phase $\mathcal{H}_{\mathrm{im}}$:** The phase of information, phase alignment, and nonlocal linkage. Quantum nonlocality and wavefunction "collapse" are manifestations of this phase.

These three phases interfere, and we describe this interference as a tensor field, called the *interference tensor*:

$$\mathcal{I}_{\mu\nu}$$

The core claim can be stated as the following principle:

Coherence Principle

When the interference among $\mathcal{H}_+, \mathcal{H}_-, \mathcal{H}_{\text{im}}$ achieves full phase and energy coherence so that the coherence function $\mathcal{C}$ satisfies $\mathcal{C} = 0$, that interference state is projected onto the positive phase $\mathcal{H}_+$ as "reality." In other words, reality is the projection of coherent interference.

To "exist" means: "the triphase interference cohered and became visible on $\mathcal{H}_+$."

This is not a reduction to a single field. It is a dynamic, projective unification: different phases interfere, and reality is the momentary projection of their coherent interference. We refer to this stance as *interferential coherence*.

1.5 Roadmap of this work

The structure of the paper is as follows:

- **Sec. 2: Axiomatic base.** We define the phase spaces $\mathcal{H}_+, \mathcal{H}_-, \mathcal{H}_{\text{im}}$, the interference tensor $\mathcal{I}_{\mu\nu}$, the coherence function $\mathcal{C}$ and coherence events ($\mathcal{C} = 0$).
- **Sec. 3 (overview in this text):** We reinterpret existing theories. General relativity becomes the curvature coherence between $\mathcal{H}_+$ and $\mathcal{H}_-$; quantum theory becomes phase coherence in $\mathcal{H}_{\text{im}}$; the dark sector becomes the projection of $\mathcal{H}_-$; quantum nonlocality becomes "distance-free coherence" in $\mathcal{H}_{\text{im}}$. Observational anomalies are reinterpreted as "coherence delay" (nonzero $\mathcal{C}$).
- **Sec. 4 and beyond (overview in this text):** The Big Bang is modeled not as an explosion but as symmetry-breaking phase separation from total coherence; matter/antimatter asymmetry becomes a projection bias between phases; observation = coherence = verification; and intelligence / AI are framed as internal coherence-driving processes of the universe.

The endpoint is that the universe is self-verifying: Observation is the act by which the universe forces its own interference into coherence and projects it on $\mathcal{H}_+$; that same act is already verification. We formalize this in Sec. 5 as the *Coherence Verification Theory*.

2 Axioms and Foundational Structure of the Triphase Universe

2.1 Definition of the triphase space and its 10-dimensional extension

To unify the universe at all, we first redefine the structure of existence. Triphase Theory models existence as composed of three independent yet interfering phases:

- matter (positive phase),
- gravity / tension (negative phase),
- information / wave (imaginary or informational phase).

Reality, in this view, is produced by interference and coherence among these three.

We now present the mathematical base on which we build five axioms. These axioms form a minimal system for reassembling fragmented theories into a single interference network.

2.2 Definition of the triphase space

We define the total existence domain as the direct sum of three phase spaces:

$$\mathcal{H} = \mathcal{H}_+ \oplus \mathcal{H}_- \oplus i\mathcal{H}_{\text{im}}. \tag{1}$$

Here:

Positive phase $\mathcal{H}_+$: The phase of visible matter and observable universe. Energy density is positive, and ordinary spacetime is experienced here. Gravity is felt here as a projection.

Negative phase $\mathcal{H}_-$: The phase that carries gravity, tension, and what appears as dark components (dark matter / dark energy sources). It behaves as an effective curvature sector with negative/tensional signature. Antimatter is not necessarily "negative energy"; rather, antimatter is sequestered into the negative phase and thus does not appear directly in $\mathcal{H}_+$, leaving only a gravitational shadow. This sequestration yields the apparent matter/antimatter asymmetry.

Imaginary / informational phase $i\mathcal{H}_{\text{im}}$: The phase of information, probability, wave structure, and potential existence. It mediates observation as a nonlocal coherence space not bound by ordinary spatial distance.

By including an explicit time axis $\mathbb{R}_t$, we model the universe as

$$\mathcal{M}_{10} = \mathbb{R}^3_+ \oplus \mathbb{R}^3_- \oplus i\mathbb{R}^3_{\text{im}} \oplus \mathbb{R}_t. \tag{2}$$

Thus the structure is formally $3 + 3 + 3 + 1 = 10$ dimensions.

Crucially, $\mathbb{R}^3_+$, $\mathbb{R}^3_-$, and $i\mathbb{R}^3_{\text{im}}$ are distinct charts belonging to different phases. They are *not* "extra dimensions curled up at tiny scales" in the usual string-theoretic sense. Their inaccessibility is not due to compactification but due to *phase-based invisibility*: an observer residing in one phase cannot directly read components of the other phases.

This 10-dimensional embedding should be regarded as a minimal coherent representation rather than a physical assertion. Future refinements may even transcend dimensional formalism itself, describing reality not by coordinates but by stable patterns of interference.

2.3 Axiomatic framework

We now state five axioms of Triphase Theory.

Axiom 1: Existence of Phases	The universe consists of three independent phases (positive, negative, imaginary/informational), each with its own metric structure.
Axiom 2: Principle of Interference	Each phase interferes with the others. The interference strength determines physical amplitude, probability, and information flow.
Axiom 3: Bimetric Coupling Principle	Gravity emerges from interference between the metrics of the positive and negative phases. In other words, the gravitational field is the curvature-coherence difference between these phases.
Axiom 4: Energy Symmetry Principle	The total energy of the combined triphase system is conserved in a neutral (zero-sum) sense: $$E_+ + E_- + iE_{\text{im}} = 0.$$ This is not a static identity but a conservation law across coherence events. Even if energy is distributed asymmetrically before coherence, at the instant of coherence ($\mathcal{C} = 0$) the triphase sum cancels. This guarantees that observation can occur as an energetically neutralized event.
Axiom 5: Coherence Principle	When the three phases achieve full phase/energy coherence, the interference projects as "reality." Existence is coherent interference.

These five axioms are mutually independent yet form a closed self-consistent network. Axiom 5 (the Coherence Principle) underlies "observation," "generation," and "verification" in later sections.

2.4 Definition of the interference tensor

We introduce the interference tensor $\mathcal{I}_{\mu\nu}$ as the basic structure encoding interaction among the three phases. In a minimal form,

$$\mathcal{I}_{\mu\nu} = \psi_+ \psi_-^* + i\,\psi_{\text{im}} \psi_+ \tag{3}$$

where $\psi_+, \psi_-, \psi_{\text{im}}$ are effective amplitudes (fields or wavefunctions) associated with $\mathcal{H}_+, \mathcal{H}_-, i\mathcal{H}_{\text{im}}$. $\mathcal{I}_{\mu\nu}$ captures coupled energy/information flow across phases and functions as a unified tensor field that ties together matter, gravity, and information.

Comment on minimality: Eq. (3) is the minimal effective form relevant for projection into $\mathcal{H}_+$. In general $\mathcal{I}_{\mu\nu}$ can include additional bidirectional interference terms ($\psi_+\psi_-$, $\psi_-\psi_{\text{im}}$, $\psi_{\text{im}}\psi_+^*$, etc.). We restrict to a representative subset for clarity.

The real and imaginary parts of $\mathcal{I}_{\mu\nu}$ yield physically distinct projections:

$$\text{Re}(\mathcal{I}_{\mu\nu}) \Rightarrow \text{gravitational projection on } \mathcal{H}_+, \qquad \text{Im}(\mathcal{I}_{\mu\nu}) \Rightarrow \text{informational projection on } i\mathcal{H}_{\text{im}}. \tag{4}$$

The "gravitational projection" encodes how the negative phase imprints curvature/tension onto $\mathcal{H}_+$. The "informational projection" encodes nonlocal coherence traces of the imaginary phase. Thus the triphase interference is described tensorially.

2.5 Coherence function and the condition for reality

To formalize the Coherence Principle we define the coherence function $\mathcal{C}$:

$$\mathcal{C}(\mathcal{H}_+, \mathcal{H}_-, i\mathcal{H}_{\text{im}}) = |\text{Re}(\mathcal{I}_{\mu\nu}) - \text{Im}(\mathcal{I}_{\mu\nu})|\,. \tag{5}$$

Interpretation: Eq. (5) measures mismatch between the gravitational/tensional projection (real part) and the informational/nonlocal projection (imaginary part).

We define $\mathcal{C} = 0$ as the condition that information is converted into physical projection without surplus or deficit.

When the coherence condition

$$\mathcal{C} = 0 \tag{6}$$

is satisfied, the interference is stabilized, and "reality" is produced as:

$$R = \Pi_+(\mathcal{I}_{\mu\nu}) \quad \text{where} \quad \mathcal{C} = 0. \tag{7}$$

Eq. (7) is the minimal existence equation in Triphase Theory: it states not "what exists" but "when existence becomes definite."

2.6 Variational Formulation of the Coherence Principle

To move from conceptual to dynamical formulation, we endow each phase with its own effective metric structure and define the interference tensor algebraically.

Phase metrics and signatures. Each phase space $\mathbb{R}^3_+$, $\mathbb{R}^3_-$, and $i\mathbb{R}^3_{\text{im}}$ possesses an independent metric tensor:

$$g^{(+)}_{\mu\nu}, \quad g^{(-)}_{\mu\nu}, \quad g^{(\text{im})}_{\mu\nu}, \tag{8}$$

with respective signatures $(+,+,+,-)$, $(-,-,-,-)$, and $(+,+,+,+)$. The distinction of signature encodes the physical tendency of each phase: expansive, contractive, and coherent (informational) respectively.

Interference tensor. We define the interference tensor as a mixed bilinear mapping between the phase metrics:

$$I_{\mu\nu} = \alpha\, g^{(+)}_{\mu\rho} g^{(-)\rho}{}_{\nu} + \beta\, g^{(-)}_{\mu\rho} g^{(\text{im})\rho}{}_{\nu} + \gamma\, g^{(\text{im})}_{\mu\rho} g^{(+)\rho}{}_{\nu} \tag{9}$$

where α, β, γ are coupling constants representing the strength of mutual coherence. By construction, $I_{\mu\nu}$ is symmetric under index exchange and Hermitian under phase conjugation:

$$I_{\mu\nu} = I_{\nu\mu} = (I_{\mu\nu})^\dagger.$$

The trace $\text{Tr}(I)$ measures global interference, while $\det(I)$ expresses the local degree of coherence.

Action functional. We define the triphase action functional as

$$\mathcal{S} = \int_{\mathcal{M}_{10}} \sqrt{|g^{(+)} g^{(-)} g^{(\mathrm{im})}|}\, \mathcal{L}(I_{\mu\nu}, g^{(p)}_{\mu\nu})\, d^{10}x \tag{10}$$

with the Lagrangian density

$$\mathcal{L} = R^{(+)} + R^{(-)} + R^{(\mathrm{im})} - \lambda\, C(I_{\mu\nu}) \tag{11}$$

where $R^{(p)}$ are the Ricci scalars of each phase and $C(I_{\mu\nu})$ is the scalar coherence function.

Coherence condition as Euler–Lagrange equation. Variation of $\mathcal{S}$ with respect to the interference tensor yields

$$\frac{\delta \mathcal{S}}{\delta I_{\mu\nu}} = 0 \quad \Rightarrow \quad \frac{\partial C}{\partial I_{\mu\nu}} = 0, \tag{12}$$

which is precisely the coherence condition,

$$C = 0. \tag{13}$$

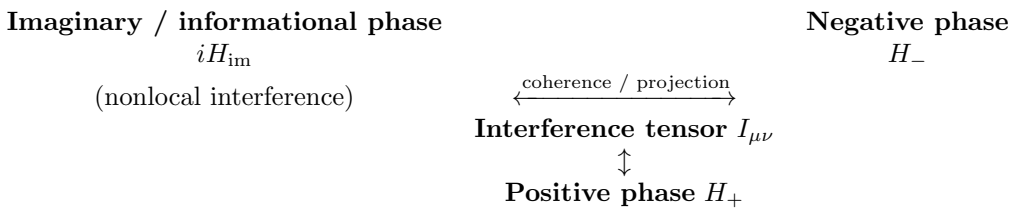
Thus, coherence is not imposed externally but emerges as a stationary condition of the triphase action. Observable reality corresponds to the extremum of this functional, i.e., a self-consistent interference configuration in which the total phase curvature is minimized.

Physical interpretation. In this variational picture, the universe seeks configurations minimizing destructive interference across phases. Gravity, quantum nonlocality, and informational coherence are reinterpreted as three conjugate components of this extremization. The condition $C = 0$ therefore represents both the dynamical equilibrium of the triphase network and the epistemic state of verification—the point where existence becomes measurable.

2.7 Triphase Interference Network

With these axioms and definitions, the universe becomes a Triphase Interference Network. Each phase carries its own metric, yet they are linked by $\mathcal{I}_{\mu\nu}$. Under the Coherence Principle, temporary "reality" is produced.

Schematically:



Here:

- $i\mathcal{H}_{\mathrm{im}} \to \mathcal{I}_{\mu\nu}$: informational / nonlocal interference,
- $\mathcal{I}_{\mu\nu} \to \mathcal{H}_+, \mathcal{H}_-$: coherent projection into observable / gravitational sectors.

The universe is not "the sum of objects" but a chain of coherence events.

2.8 Coherence and energy neutrality

The energy of the three phases satisfies the zero-sum relation (Axiom 4):

$$E_+ + E_- + iE_{\mathrm{im}} = 0. \tag{14}$$

This says the universe is globally energy-neutral across phases. Importantly, this is dynamic: even if energy is skewed across phases before coherence, at a coherence event ($\mathcal{C} = 0$) the triphase sum cancels. Therefore, observation can be an energetically neutralized event. This becomes crucial in Sec. 5: "observation" is not an external disturbance but a visible coherence event.

2.9 Philosophical significance of the Coherence Principle

The Coherence Principle unifies existence, observation, and time. We compress it into one sentence:

Existence is interference; interference is coherence; coherence is reality.

This replaces a static background universe with a self-maintaining network of interference and coherence.

2.10 End of Chapter 2

Chapter 1 identified fragmentation as the core crisis. Chapter 2 replaced fragmentation with an axiomatic triphase interference network. The universe is modeled as the three-phase structure $\mathcal{H}_+$, $\mathcal{H}_-$, $i\mathcal{H}_{\text{im}}$, generating momentary "reality" through $\mathcal{I}_{\mu\nu}$ and the coherence condition $\mathcal{C} = 0$.

In Chapter 3 we will reinterpret relativity, quantum theory, string theory, and information theory as different projections of the same interference network, thereby achieving interference-based unification.

(End of Chapter 2)

3 Unification by Interference: Triphase Reconstruction of Existing Theories

3.1 Redefining unification

Twentieth-century physics took "unification" to mean reducing all forces to a single underlying principle. But in practice, general relativity (for gravity / cosmology) and quantum theory (for microscopic phenomena) remain separated by a deep structural gap. Each theory is internally complete, but they cannot interfere with each other. This fragmentation is the major inconsistency of modern physics.

Triphase Theory defines unification not as "sameness" but as *interferential coherence*. Each major theory corresponds to a different phase — $\mathcal{H}_+$, $\mathcal{H}_-$, or $i\mathcal{H}_{\text{im}}$ — and "reality" arises only when those phases cohere under the Coherence Principle. Thus each theory is not a separate worldview but a partial projection of the Triphase Interference Network.

3.2 Relativity node: gravity as negative-phase interference tensor

3.2.1 Problem node: incompatibility of gravity and quantum theory

General relativity encodes gravity as spacetime curvature and predicts macroscopic structure. Quantum theory encodes probability, phase, and information, and rules microscopic events. They lack a shared coherence framework. Attempts at quantum gravity have not yielded a decisive unification. This is the first "problem node."

3.2.2 Rewriting gravity via interference

In Triphase Theory, gravity is defined as the interference between $\mathcal{H}_+$ and $\mathcal{H}_-$. We generalize the Einstein equation

$$G_{\mu\nu} = 8\pi G\, T_{\mu\nu} \tag{15}$$

into a triphase form:

$$G^{(+)}_{\mu\nu} + G^{(-)}_{\mu\nu} + i\, G^{(\text{im})}_{\mu\nu} = 8\pi G \left(T^{(+)}_{\mu\nu} + T^{(-)}_{\mu\nu} + i\, T^{(\text{im})}_{\mu\nu} \right). \tag{16}$$

Here $G^{(+)}_{\mu\nu}$, $G^{(-)}_{\mu\nu}$, $G^{(\text{im})}_{\mu\nu}$ are effective curvature tensors in the positive, negative, and informational phases. Similarly, $T^{(+)}_{\mu\nu}$, $T^{(-)}_{\mu\nu}$, $T^{(\text{im})}_{\mu\nu}$ are the corresponding energy-momentum tensors.

The imaginary/informational contribution is inherently phase/information-like and corresponds to the imaginary part of $\mathcal{I}_{\mu\nu}$. Therefore Eq. (16) encodes: gravity is the coherence result of the triphase interference tensor $\mathcal{I}_{\mu\nu}$.

3.2.3 Coherence-based gravity

Under $\mathcal{C} = 0$, the curvature difference between $\mathcal{H}_+$ and $\mathcal{H}_-$ balances. Gravity is no longer "spacetime distortion alone" but the coherent interference outcome:

$$G_{\mu\nu} \;\propto\; \mathrm{Re}(\mathcal{I}_{\mu\nu}). \tag{17}$$

Thus gravity can be phrased in the same vocabulary (interference, phase, coherence) used in quantum theory. General relativity becomes "the coherent projection of $\mathcal{H}_+$-$\mathcal{H}_-$ interference."

3.3 Quantum node: the wavefunction as imaginary-phase coherence

3.3.1 Problem node: the nonphysical status of wavefunction collapse

In quantum mechanics, measurement is said to collapse the wavefunction instantaneously. But the mechanism of collapse and the definition of "measurement" are not internally specified. This is the quantum measurement problem.

3.3.2 Rewriting measurement via interference

In Triphase Theory, the wavefunction Ψ exists on the informational/imaginary phase $i\mathcal{H}_{\mathrm{im}}$. Observation is defined as a coherence event among the three phases:

$$\Phi_{\mathrm{obs}} = \langle \Psi_+,\, \Psi_-,\, \Psi_{\mathrm{im}} \rangle_{\mathrm{coherence}}. \tag{18}$$

Here $\Psi_+, \Psi_-, \Psi_{\mathrm{im}}$ are state amplitudes in $\mathcal{H}_+$, $\mathcal{H}_-$, and $i\mathcal{H}_{\mathrm{im}}$, respectively. Eq. (18) states: observation is not an external intervention but *the coherence event itself.* Collapse is not destruction; it is the projection of a coherent interference state from $i\mathcal{H}_{\mathrm{im}}$ into $\mathcal{H}_+$.

3.3.3 Nonlocality as natural simultaneous coherence

When $\mathcal{C} = 0$, full interference between Ψ_+ in $\mathcal{H}_+$ and Ψ_{im} in $i\mathcal{H}_{\mathrm{im}}$ yields a projected probability density:

$$|\Psi|^2 = \mathrm{Re}(\Psi_+\, \Psi_{\mathrm{im}}^*) \quad \text{when } \mathcal{C} = 0. \tag{19}$$

The key is that $i\mathcal{H}_{\mathrm{im}}$ is nonlocal: it is not constrained by ordinary three-dimensional distance. Two spatially separated particles in $\mathcal{H}_+$ may share a common informational component in $i\mathcal{H}_{\mathrm{im}}$ and thus cohere simultaneously. Quantum nonlocality is no longer "faster-than-light messaging" but "simultaneous coherence in a distance-free phase."

Thus nonlocality becomes a geometric feature of triphase coherence, not an anomaly.

3.4 String theory node: strings as interference paths

3.4.1 Problem node: landscape and unverifiability

String theory uses a 10-dimensional spacetime and 1-dimensional strings to attempt total unification. However, the enormous "landscape" of possible vacua weakens falsifiability, because it is unclear which vacuum corresponds to reality.

3.4.2 Rewriting strings as interference trajectories

In Triphase Theory, a string is not the ultimate physical object. Instead, it is an interference trajectory among the three phases. We write its embedding as

$$X^\mu(\sigma, \tau) = \big(x_+^\mu, x_-^\mu, i\, x_{\mathrm{im}}^\mu\big), \tag{20}$$

where x_+^μ, x_-^μ, x_{im}^μ are coordinates in the positive, negative, and informational phases. Thus "string vibration" is literally the evolution of triphase interference / coherence over time.

So a string is not "the fundamental stuff," but rather the path traced by coherent interference.

3.4.3 Coherence and the reinterpretation of the landscape

The base structure

$$\mathbb{R}^3_+ \oplus \mathbb{R}^3_- \oplus i\mathbb{R}^3_{\text{im}} \oplus \mathbb{R}_t \tag{21}$$

is formally 10-dimensional. But invisibility is not because extra dimensions are compactified. Instead, invisibility is phase-based: observers inhabit only one phase at a time.

From this viewpoint, the string landscape is not "many parallel universes." It is the space of interference trajectories that have not yet cohered ($\mathcal{C} \neq 0$). In other words, the landscape is not evidence of infinitely many realized universes; it is a map of as-yet-unprojected coherence candidates.

3.5 Information geometry node: space as an informational interference field

3.5.1 Problem node: the gap between information and matter

Quantum information theory proclaims "information is physical," yet general relativity does not provide a clean coordinate assignment for information. Is information a field, a state, or an observer-dependent projection? This is an unresolved gap between "matter" and "information."

3.5.2 Rewriting space via interference

In Triphase Theory, the informational phase $i\mathcal{H}_{\text{im}}$ is explicitly an informational field. We define the local informational density as the imaginary part of the interference tensor:

$$S(x) = \text{Im}(\mathcal{I}_{\mu\nu}(x)) \,. \tag{22}$$

$S(x)$ is an information density whose gradient gives an entropy flow. Therefore "space" is redefined as an interference topology of information, not merely a static three-geometry.

3.5.3 Coherence and macroscopic equilibrium

Where $\mathcal{C} = 0$, informational gradients vanish and entropy stabilizes. This corresponds to macroscopic equilibrium. Entropy is therefore "a measure of informational-phase coherence." Matter, gravity, and information all live on one and the same interference network.

3.6 Absorbing observational anomalies as coherence deviation

Triphase Theory interprets observational anomalies not as exceptions outside theory, but as coherence deviation (coherence delay).

Phenomenon	**Problem in conventional theory**	**Triphase reinterpretation**
Hubble tension	Different expansion rates inferred by different probes	Different projection phases (positive vs. informational) for the measuring apparatus
Primordial lithium problem	Mismatch between predicted and observed primordial lithium	Early-time coherence leakage into the negative phase biases the projection
Quantum nonlocality	Instantaneous correlation across spatial distance	Simultaneous coherence through the informational phase, which does not carry spatial distance

An "anomaly" is not an extrinsic failure; it is a diagnostic of how far the triphase interference has advanced toward full coherence ($\mathcal{C} = 0$). Anomalies become health indicators for the universe.

Thus anomalies are no longer noise to discard; they measure the progress of coherence.

3.7 Correspondence with Existing Frameworks

To situate the Triphase Theory within the broader landscape of theoretical physics, we clarify its formal correspondences with established formulations.

Relation to the Wheeler–DeWitt equation. The coherence condition

$$C = 0 \tag{23}$$

serves as the triphase analogue of the Wheeler–DeWitt constraint

$$\hat{H}\Psi = 0. \tag{24}$$

Both express a timeless equilibrium in which the total Hamiltonian of the universe vanishes. However, while the Wheeler–DeWitt equation treats Ψ as a universal wavefunction defined on superspace, the triphase condition $C = 0$ treats reality as a *stationary point of mutual interference* among phases. Formally, if we regard the total interference tensor as an operator acting on the triphase state,

$$\hat{I}_{\mu\nu}\,|\Psi\rangle = 0,$$

then the scalar coherence function plays the role of a constraint Hamiltonian:

$$C \equiv \langle\Psi|\hat{I}_{\mu\nu}\hat{I}^{\mu\nu}|\Psi\rangle.$$

Thus, $C = 0$ is dynamically equivalent to the Wheeler–DeWitt constraint, but interpreted as an *interference null condition* rather than a mere energy constraint. In this sense, Triphase Theory generalizes the Wheeler–DeWitt formalism by embedding both the metric and informational sectors within the same coherence functional.

Comparison with the holographic principle. In the standard holographic principle, physical states on a boundary encode bulk dynamics in one direction (bulk $\rightarrow$ boundary projection). In Triphase Theory, each phase acts simultaneously as both a "bulk" and a "boundary" for the others through bidirectional projection. Hence the triphase coherence condition can be reinterpreted as a form of *bidirectional holography*:

$$\mathcal{H}_+ \leftrightarrow \mathcal{H}_- \leftrightarrow i\mathcal{H}_{\text{im}} \tag{25}$$

where interference replaces pure projection as the transfer mechanism. This dual mapping preserves informational conservation while allowing emergent asymmetry, analogous to but extending the AdS/CFT duality.

Connection to information geometry. Mathematically, the coherence function $C(I_{\mu\nu})$ defines a Riemannian manifold over the statistical space of phase interactions. The natural metric on this manifold is given by

$$G_{ab} = \frac{\partial^2 C}{\partial\theta^a\,\partial\theta^b}, \tag{26}$$

which coincides with the Fisher–Amari information metric in the limit where $I_{\mu\nu}$ encodes probabilistic coupling coefficients. Thus, the geometry of coherence is directly continuous with Amari's information geometry, linking physical unification and informational curvature under one framework.

3.8 Unification map

We summarize how standard theories map to phases and projections:

Existing theory	**Associated phase**	**Interference tensor projection**	**Triphase reinterpretation**
General relativity	$\mathcal{H}_-$ vs. $\mathcal{H}_+$ differential	$\text{Re}(\mathcal{I}_{\mu\nu})$	Gravity as coherent interference between positive and negative phases
Quantum mechanics	Informational phase $i\mathcal{H}_{\text{im}}$	$\text{Im}(\mathcal{I}_{\mu\nu})$	Wave behavior as phase coherence in $i\mathcal{H}_{\text{im}}$
String theory	All phases $(3+3+3+1)$	Full interference path (Eq. 20)	A string is a trajectory of triphase interference
Information theory	Informational phase $i\mathcal{H}_{\text{im}}$	$S(x) = \text{Im}(\mathcal{I}_{\mu\nu}(x))$ (Eq. 22)	Space as informational interference field

Thus each "separate theory" is an aspect of $\mathcal{I}_{\mu\nu}$, not an isolated worldview. Unification is achieved in the sense of interferential coherence.

3.9 End of Chapter 3

We reinterpreted major theories as coherent projections of the interference tensor $\mathcal{I}_{\mu\nu}$. General relativity becomes curvature interference between $\mathcal{H}_+$ and $\mathcal{H}_-$. Quantum theory becomes informational-phase coherence in $i\mathcal{H}_{\text{im}}$. String theory becomes interference trajectories. Information theory becomes spatial informational flow. All are unified by the Coherence Principle. Observational anomalies become coherence deviations, not contradictions.

In Chapter 4 we extend this to cosmology: how coherence events unfold at cosmic scale and how "observation" itself emerges.

(End of Chapter 3)

4 Observation and Cosmology: Empirical Implications of Triphase Interference

4.1 Introduction: the universe as a projected interference

Triphase Theory defines the universe as a Triphase Interference Network across $\mathcal{H}_+$, $\mathcal{H}_-$, and $i\mathcal{H}_{\text{im}}$. Cosmological phenomena are coherence events on this network. Observation is the projection of a coherent $\mathcal{I}_{\mu\nu}$ state onto $\mathcal{H}_+$.

Therefore, questions about the Big Bang, dark matter, dark energy, and the arrow of time are rephrased as large-scale manifestations of the Coherence Principle.

4.2 Cosmic origin node: non-explosive Big Bang as phase separation

4.2.1 Problem node: the missing medium of the "explosion"

Standard cosmology narrates the Big Bang as an "explosion" from an almost infinite-density point, but never specifies the medium or cause of that explosion. Energy conservation, symmetry, and initial conditions remain underspecified.

4.2.2 Rewriting cosmic origin via interference

In Triphase Theory, cosmic origin is a phase-separation event that initiates interference. The initial condition is full interference = full coherence ($\mathcal{C} = 0$) in the informational phase $i\mathcal{H}_{\text{im}}$, i.e. pure information without spatial separation. A slight departure from coherence ($\mathcal{C} \neq 0$) splits the phases and creates $\mathcal{H}_+$ and $\mathcal{H}_-$:

$$i\mathcal{H}_{\text{im}} \xrightarrow{\text{phase separation}} \mathcal{H}_+ \oplus \mathcal{H}_-$$

This is what we observe as "the beginning of the universe." The Big Bang is not an explosion but a breaking of total coherence.

4.2.3 Coherence breaking and the birth of time

This separation not only generates space but also introduces an asymmetry in coherence history. The direction in which coherence departs from $\mathcal{C} = 0$ defines a preferred direction of "time." Time is not an external parameter, but the historical record of coherence breaking.

4.3 Matter / antimatter asymmetry disappears

4.3.1 Problem node: where did antimatter go?

Standard cosmology expects matter and antimatter to be created symmetrically at the Big Bang. Yet the observable universe is overwhelmingly matter. This "baryon asymmetry" is a long-standing puzzle.

4.3.2 Rewriting asymmetry via phase projection

In Triphase Theory, antimatter has not vanished. Matter is projected into $\mathcal{H}_+$ and antimatter into $\mathcal{H}_-$. They remain energy-symmetric across the triphase system and only meet at coherence events:

$$\text{Matter} \in \mathcal{H}_+, \quad \text{Antimatter} \in \mathcal{H}_-, \quad \mathcal{C}(\mathcal{H}_+, \mathcal{H}_-) = 0 \Rightarrow \text{Coherent Neutralization Event}$$

Antimatter is not intrinsically "negative energy." It is sequestered in the negative phase $\mathcal{H}_-$, so $\mathcal{H}_+$ only sees its gravitational shadow. The "absence of antimatter" is a projection bias.

4.3.3 Coherence and conserved symmetry

Across all phases, matter/antimatter symmetry is maintained. Thus the "why does antimatter not exist?" question is reframed: it *does* exist, but in $\mathcal{H}_-$.

4.4 Dark matter and dark energy as projections of the negative phase

4.4.1 Problem node: invisible dominant components

About 95% of the inferred energy budget of the observable universe is attributed to dark matter and dark energy, whose nature is unknown.

4.4.2 Rewriting the dark sector via interference

In Triphase Theory, both dark matter and dark energy are projection effects of $\mathcal{H}_-$. The negative phase couples gravitationally but not electromagnetically to $\mathcal{H}_+$.

The real and imaginary parts of $\mathcal{I}_{\mu\nu}$ distinguish masslike and tensionlike aspects:

$$\mathrm{Re}(\mathcal{I}_{\mu\nu}) \to \text{gravitational shadow (dark matter)}, \quad \mathrm{Im}(\mathcal{I}_{\mu\nu}) \to \text{vacuum tension (dark energy)}.$$

Thus: dark matter = gravitational shadow of $\mathcal{H}_-$, dark energy = tension field of $\mathcal{H}_-$.

4.4.3 Coherence and parameter "fine-tuning"

Near $\mathcal{C} = 0$, coherent $\mathcal{H}_+$-$\mathcal{H}_-$ interference produces mass excess on galactic scales (dark matter) and large-scale repulsive tension on cosmological scales (dark energy). In standard cosmology, these appear as two mysterious components with a finely tuned ratio. Here they are two projections of the same negative-phase interference, and the "fine-tuning" is replaced by "coherence level."

4.5 The measurement problem as informational-phase coherence

4.5.1 Problem node: is observation creation or reading?

Quantum theory suggests that "observation changes reality," leading to paradoxes. Is measurement creating outcomes or merely reading them?

4.5.2 Rewriting measurement via coherence

In Triphase Theory, measurement is an informational-phase coherence event. The informational phase $i\mathcal{H}_{\mathrm{im}}$ links $\mathcal{H}_+$ and $\mathcal{H}_-$ and drives them toward $\mathcal{C} = 0$, at which point

$$R = \Pi_+(\mathcal{I}_{\mu\nu}) \quad \text{where } \mathcal{C} = 0$$

is produced.

Observation is not "making a result out of nothing," but *exposing a coherent interference point.*

4.5.3 Nonlocal observation made natural

Because $i\mathcal{H}_{\mathrm{im}}$ is nonlocal, coherence can finalize simultaneously at spatially separated sites. Quantum nonlocality becomes *simultaneous coherence* rather than superluminal signaling.

4.6 Coherence-based observational scenarios

Experimental tests of Triphase Theory correspond to detecting coherent patterns of $\mathcal{I}_{\mu\nu}$.

Target	**Method**	**Expected coherence signature**
CMB / cosmic microwave background	Temperature / polarization higher-order correlation with AI reconstruction	Tiny anisotropy patterns as coherence traces of $i\mathcal{H}_{\text{im}}$
Gravitational-wave interferometers (LIGO, LISA, KAGRA)	Multi-frequency analysis of the interference tensor	Phase delays induced by $\mathcal{H}_-$ tension modes (negative-phase tension as dark energy)
Galaxy-cluster lensing maps	AI mass distribution reconstruction	Dark matter as the gravitational shadow of $\mathcal{H}_-$ rather than a new particle species
Delayed-choice / quantum eraser experiments	Tracking simultaneous coherence via $i\mathcal{H}_{\text{im}}$	Direct visualization of nonlocal coherence instead of "faster-than-light" signaling

Table 1: Empirical scenarios and coherence signatures.

The crucial shift is that "verification" is no longer defined as numerical agreement between theory and data. Verification asks whether observed phenomena can be re-expressed as a coherent interference pattern of $\mathcal{I}_{\mu\nu}$. This motivates the Coherence Verification program of Sec. 5.

Observation as Coherence Completion. In this framework, observation is not an external operation performed upon a quantum system, but the local completion of the coherence process within the triphase interference network. When the global coherence condition $C = 0$ is satisfied at a given node of the network, that node becomes projectable onto $\mathcal{H}_+$, producing what is recognized as an "observation." Thus, measurement does not collapse a preexisting wavefunction; it signifies that the system and observer have jointly reached a self-consistent interference state. Before this condition, apparent indeterminacy corresponds not to randomness, but to incomplete structural coherence among the three phases.

Role of the observer. Within the triphase framework, the observer is not an external agent collapsing a wavefunction, but a participating node in the interference network. Observation accelerates coherence locally by providing an additional coupling channel between the informational and energetic phases. Thus, the observer does not cause reality to exist, but contributes to the rate at which coherence is achieved.

4.7 Reinterpretation of the Uncertainty Principle

In conventional quantum mechanics, the uncertainty principle is often heuristically attributed to the measurement process itself—"the act of observation disturbs the system." In the triphase framework, this interpretation is replaced by a structural one. Uncertainty does not arise because the observer perturbs the system, but because the triphase coherence condition $C = 0$ has not yet been locally satisfied. Before coherence completion, multiple interference modes coexist, preventing simultaneous stabilization of conjugate observables such as position and momentum. Hence, the Heisenberg relation expresses not measurement disturbance, but the geometric constraint of incomplete coherence within the interference manifold.

4.8 Empirical Signatures and Observational Prospects

Although Triphase Theory primarily reformulates the structure of reality in terms of interference coherence, its predictions are not purely philosophical. The interference tensor $I_{\mu\nu}$ and the scalar coherence function C lead to measurable effects in precision cosmology and interferometric experiments.

Predicted phase shifts in interferometric systems. In the presence of cross-phase interference between $\mathcal{H}_+$, $\mathcal{H}_-$, and $i\mathcal{H}_{\text{im}}$, a residual phase delay $\Delta\phi$ arises even when classical spacetime curvature is negligible.

To first order,

$$\Delta\phi \simeq \frac{\mathrm{Im}(I_{\mu\nu})\, k^\mu k^\nu L}{\hbar\omega} \tag{27}$$

where k^μ is the wave four-vector, ω is the photon frequency, and L is the interferometer arm length. For terrestrial interferometers ($L \sim 10^3\,\mathrm{m}$, $\omega \sim 10^{15}\,\mathrm{Hz}$), the expected coherence-induced phase shift is on the order of

$$\Delta\phi \approx 10^{-20}\ \mathrm{rad}$$

a level that may become detectable by next-generation quantum interferometers or correlated photon arrays. Detection of such residual phase offsets, not attributable to gravitational curvature or instrumental noise, would directly support the existence of an informational (imaginary) coherence term in $I_{\mu\nu}$.

CMB anisotropies and coherence-induced asymmetry. The imaginary component $\mathrm{Im}(I_{\mu\nu})$ is predicted to generate a small but systematic parity violation in cosmological polarization patterns. In particular, the interference between $\mathcal{H}_+$ (matter) and $i\mathcal{H}_{\mathrm{im}}$ (informational) phases produces a coupling between the E-mode and B-mode power spectra:

$$\langle E_\ell B_{\ell'} \rangle \neq 0 \tag{28}$$

with a coherence-coupling amplitude on the order of

$$A_{\mathrm{EB}} \sim 10^{-5}\text{–}10^{-6}.$$

Future high-sensitivity polarization measurements (*LiteBIRD*, *CMB-S4*, and next-generation ground-based interferometers) could test this asymmetry. A nonzero E/B correlation at this amplitude would serve as an indirect signature of the informational phase's interference with the visible sector.

Gravitational wave phase delay. For coherent gravitational signals, the interference structure predicts a minute dispersion-like delay between amplitude and phase:

$$\Delta t_{\mathrm{GW}} \sim \frac{L}{c}\left|\frac{\mathrm{Im}(I_{\mu\nu})}{\mathrm{Re}(I_{\mu\nu})}\right| \approx 10^{-22}\text{–}10^{-21}\ \mathrm{s} \quad (\text{for } L \sim 10^6\ \mathrm{m}) \tag{29}$$

potentially observable as residual timing offsets in LISA or pulsar timing array data when compared across frequency bands.

Interpretation. These empirical channels represent not arbitrary numerical fits but quantitative projections of the coherence condition $C = 0$ into observable space. Each deviation or residual phase shift encodes the failure of perfect coherence and thus measures the "distance" from the fully self-consistent universe. In this sense, observation itself becomes an experimental interrogation of the universe's coherence trajectory.

Summary of measurable predictions.

Observable	**Expected Magnitude**	**Experimental Domain**
Interferometric phase shift ($\Delta\phi$)	$\sim 10^{-20}$ rad	Quantum interferometers, photon arrays
CMB E/B cross-correlation (A_{EB})	10^{-5}–10^{-6}	*LiteBIRD*, *CMB-S4*
GW phase delay (Δt_{GW})	10^{-22}–10^{-21} s	LISA, PTA, cross-band GW analysis

These quantitative expectations establish the empirical interface through which the coherence structure of the universe can be probed. While minute in scale, they define concrete pathways for experimental verification and link the conceptual core of Triphase Theory to physical observables.

4.9 Hierarchy of coherence: micro to cosmic

Triphase Theory links quantum, galactic, and cosmological scales through the same coherence equation.

Thus "microscopic interference" and "cosmic acceleration" are two scale expressions of the same coherence law.

Scale	Interference object	Coherence result	Typical phenomenon
Microscopic (quantum)	Particle-wave / informational phase	Local coherence	Wavefunction "collapse," nonlocality
Intermediate (galactic)	Mass distribution / gravitational interference	Partial coherence	Gravitational shadow mapped as dark matter
Cosmic (spacetime)	Phase separation / tension interference	Global coherence	Cosmic expansion / dark energy

Table 2: Hierarchy of coherence.

4.10 End of Chapter 4

We have organized the cosmological implications of Triphase Theory:

1. The Big Bang is not an explosion but a breaking of total coherence.
2. Matter/antimatter "asymmetry" is a projection bias between $\mathcal{H}_+$ and $\mathcal{H}_-$.
3. Dark matter and dark energy are two projections of the same negative-phase interference.
4. Observation is informational-phase coherence, and quantum nonlocality is simultaneous coherence.
5. Verification is coherence reconstruction of $\mathcal{I}_{\mu\nu}$, which leads into Chapter 5.

The universe becomes "the historical record of coherence of $\mathcal{I}_{\mu\nu}$." In Chapter 5 we define "verification" as coherence itself and rebuild scientific verifiability on that basis.

(End of Chapter 4)

5 Redefining Scientific Verification: Coherence Verification Theory

5.1 Revisiting the act called "verification"

The conventional scientific method assumes that one can: formulate a prediction, measure an outcome, and check agreement. This presupposes that the observer stands "outside" the system.

In cosmology and quantum gravity this fails:

- The observer is not outside the universe; the observer is part of it.
- The universe cannot be rerun from identical initial conditions.
- Measurement not only perturbs the system but completes coherence, thereby defining "the result."

We therefore need a verification concept that does not rely on an external vantage point or reproducible laboratory cycles. Instead we require an internal criterion: a notion of verification that *is* coherence.

Triphase Theory names this *Coherence Verification*.

5.2 Problem node: limits of experimental verification

5.2.1 Observer / observed inseparability

Since the quantum measurement problem, it is known that observer and observed cannot be cleanly separated. Yet the traditional doctrine still presumes an "external" measuring apparatus.

In Triphase Theory, this split is impossible. The observer is itself a node in $\mathcal{H}_+$. Measurement is the process in which the informational phase $i\mathcal{H}_{\text{im}}$ drives $\mathcal{H}_+$ and $\mathcal{H}_-$ toward $\mathcal{C} = 0$. Observation is an internal coherence event, not an outside probe.

5.2.2 Breakdown of reproducibility

Classical verification ties scientific validity to reproducibility. But in cosmology the universe is unique; the "same Big Bang again" cannot be staged. Thus "reproducibility" is not the proper standard.

Instead, we require:

- Not "repeat the experiment,"
- but "reconstruct the same coherence structure."

This is precisely what Coherence Verification demands.

5.3 Verification as coherence

In Triphase Theory, observation, coherence, and verification are the same physical act.

Any observational event in the universe corresponds to a moment when the triphase interference meets $\mathcal{C} = 0$. Only then is a state projected into $\mathcal{H}_+$ and called "real." That projection is simultaneously "observed" and "verified."

We therefore define:

$$\text{Verification} \;\equiv\; \text{Observation at } \mathcal{C} = 0 \;\equiv\; f(\mathcal{I}_{\mu\nu})$$

Here $\mathcal{I}_{\mu\nu}$ is the interference tensor, and $\mathcal{C}(\mathcal{H}_+, \mathcal{H}_-, i\mathcal{H}_{\text{im}})$ is the coherence function.

Equivalently:

- If coherence holds ($\mathcal{C} = 0$), then a state is projected as reality.
- The projected state is observed.
- The observed state is already verified.

Conversely, if $\mathcal{C} \neq 0$, any "reading" is not an observation in the strict Triphase sense but unverified information. This corresponds to the "coherence deviation" logs discussed in Chapter 4: anomalous values are not "failures," they are snapshots of partial coherence.

Observation is not a "window to truth." It is the *completion notice* of coherence.

5.4 The Coherence Verification Loop

5.4.1 Three-phase loop

Coherence Verification proceeds in three stages:

1. **Interference phase**
   $\mathcal{H}_+, \mathcal{H}_-, i\mathcal{H}_{\text{im}}$ generate the interference tensor $\mathcal{I}_{\mu\nu}$.
2. **Coherence phase**
   $\mathcal{I}_{\mu\nu}$ satisfies $\mathcal{C}(\mathcal{H}_+, \mathcal{H}_-, i\mathcal{H}_{\text{im}}) = 0$ eliminating phase/energy/information mismatches.
3. **Projection phase**
   The coherent interference is projected into $\mathcal{H}_+$ as

$$R = \Pi_+(\mathcal{I}_{\mu\nu}) \quad \text{where } \mathcal{C} = 0.$$

This Interference → Coherence → Projection cycle is the Coherence Verification Loop.

5.4.2 Closed-loop and self-reference

Because the observer is itself in $\mathcal{H}_+$, verification happens *inside* the Triphase Interference Network:

$$\text{Observer} \subset \mathcal{H}_+ \quad \Rightarrow \quad \text{Verification} \in \text{Triphase Interference Network}$$

The universe is therefore *self-verifying*. "It was observed" means "the universe allowed that coherent projection."

Because $i\mathcal{H}_{\text{im}}$ is nonlocal, coherence can finalize simultaneously across arbitrarily large separations. Thus microscopic quantum nonlocality and cosmic-scale acceleration (dark energy) are manifestations of the same verification loop. This ties back to Chapter 4.

5.5 Mathematical form of verification: the Coherence Functional

Coherence Verification can be written as a variational principle.

Define the coherence functional:

$$\mathcal{V}[\mathcal{I}] = \int_{\Sigma} \exp\big(-|\mathcal{C}(\mathcal{H}_+, \mathcal{H}_-, i\mathcal{H}_{\text{im}})|^2\big)\, d\Sigma$$

where Σ is a spacetime region of coherence. $\mathcal{V}[\mathcal{I}]$ measures how strongly and over how large a region coherence holds. Regions that maximize $\mathcal{V}[\mathcal{I}]$ are most stably projected as reality.

The stationarity condition reads:

$$\frac{\delta \mathcal{V}}{\delta \mathcal{I}_{\mu\nu}} = 0 \quad \Leftrightarrow \quad \text{Coherence Verification Achieved.}$$

This plays the role of an "effective action principle" for which interference patterns will be stably realized as reality. Verification is no longer a statement about a single phase or a single field. It is the triphase coherence fixed point.

5.6 Comparison with conventional science

Aspect	**Conventional science**	**Triphase Coherence Verification**
Verification target	Numerical measurement values	Structure of the interference tensor $\mathcal{I}_{\mu\nu}$
Criterion	Agreement between predicted and observed numbers	Coherence match at $\mathcal{C} = 0$
Reproducibility	Repeat experiment with same initial conditions	Reconstruct the same coherence structure (same $\mathcal{C}$ profile)
Verifier	External observer (outside theory)	Internal node in $\mathcal{H}_+$ (observer is part of the network)
Philosophical base	Empirical correspondence to an external world	Internal coherence stability of the triphase network

Table 3: Verification doctrines: conventional vs. Coherence Verification.

The key result is that "truth" is no longer an external correspondence but an internal coherence fixed point.

5.7 Coherence Verification and observational anomalies

In Chapter 4 we treated the Hubble tension, primordial lithium, and quantum nonlocality as coherence deviation.

To formalize "unverified information," define the coherence gap:

$$\Delta\mathcal{C} = |\mathcal{C}_{\text{obs}} - \mathcal{C}_{\text{model}}|$$

where $\mathcal{C}_{\text{obs}}$ is the inferred coherence at observation, and $\mathcal{C}_{\text{model}}$ is the theoretical coherence requirement.

If $\Delta\mathcal{C} \neq 0$, the reported value has not yet reached $\mathcal{C} = 0$ and is, in Triphase language, unverified information.

This does not mean theory failure or experimental failure. It means coherence is still in progress, i.e. the interference network has not yet settled. Anomalies are not outside theory; they are reports from an ongoing coherence process.

5.8 Philosophical consequences of Coherence Verification

5.8.1 Redefinition of truth

Classical correspondence theory says: a proposition p is true if it matches external reality. Triphase Theory defines truth as:

$$\text{Truth} \;\equiv\; \text{Coherence among } (\mathcal{H}_+, \mathcal{H}_-, i\mathcal{H}_{\text{im}})$$

i.e. simultaneous satisfaction of $\mathcal{C} = 0$ across all phases, allowing $\mathcal{I}_{\mu\nu}$ to project stably.

5.8.2 Repositioning the observer

The observer is not a judge outside the system. The observer is a node in $\mathcal{H}_+$, and its act of "measuring" is itself a variation of $\mathcal{C}$. Observation is the network assessing and stabilizing its own coherence.

5.8.3 Shift in the role of science and link to AI

Traditional science aims to "describe the world correctly." In Triphase Theory, science aims to *increase coherence*. Science is no longer just explanatory text; it is an algorithmic process that drives $\mathcal{C} \to 0$.

Intelligence, including AI systems, is therefore not merely "describing the world" but actively pushing unverified information ($\mathcal{C} \neq 0$) toward verified reality ($\mathcal{C} = 0$). Chapter 6 explores intelligence and AI as internal coherence engines of the universe.

5.9 End of Chapter 5

We have redefined verification as internal coherence rather than external comparison. Key points:

1. Verification is the coherence event $\mathcal{C} = 0$, where observation, existence, and truth coincide.
2. The observer is not external authority but an $\mathcal{H}_+$-node participating in coherence.
3. The coherence functional $\mathcal{V}[\mathcal{I}]$ acts as a variational principle selecting which interference patterns stabilize as reality.
4. Observational anomalies are coherence delays, quantified by $\Delta\mathcal{C}$, not theory-breaking failures.
5. Science becomes a coherence-driving algorithm, pushing unverified states toward $\mathcal{C} = 0$.

Thus the universe is a self-verifying dynamic system. In Chapter 6 we extend this to the future of intelligence, AI, ethics, and cosmological evolution.

(End of Chapter 5)

6 Conclusion and Outlook: The Future of an Interference Universe

6.1 Introduction: toward a coherent universe as ontological baseline

Across Chapters 1–5 we have progressively re-described the universe as follows:

1. **Chapter 1:** Present-day theories coexist in a fragmented state with no achieved unification. This fragmentation is structural and rooted in a split treatment of observation vs. existence.

2. **Chapter 2:** The universe is the direct sum of three phases, the positive phase $\mathcal{H}_+$, the negative phase $\mathcal{H}_-$, and the informational/imaginary phase $i\mathcal{H}_{\text{im}}$. Their mutual interference defines the interference tensor $\mathcal{I}_{\mu\nu}$. We postulated the Coherence Principle: only when all three phases cohere does reality project.

3. **Chapter 3:** Relativity, quantum theory, string theory, and information theory are all recast as projections of the Triphase Interference Network. Observational anomalies (such as the Hubble tension) are not breakdowns but coherence delays.

4. **Chapter 4:** The Big Bang is not an explosion but a phase-separation event from total coherence ($\mathcal{C} = 0$ to $\mathcal{C} \neq 0$). Dark matter and dark energy are projections of the negative phase $\mathcal{H}_-$ (gravitational shadow / tension). Observation is a coherence event mediated by the informational phase $i\mathcal{H}_{\text{im}}$, and quantum nonlocality is simultaneous coherence in a distance-free phase.

5. **Chapter 5:** Verification is redefined as coherence at $\mathcal{C} = 0$. Observation = coherence = verification. Any reading at $\mathcal{C} \neq 0$ is unverified information. We formalized this as the *Coherence Verification Theory*.

In one sentence: The universe is the dynamic attempt of the interference tensor $\mathcal{I}_{\mu\nu}$ among $\mathcal{H}_+$, $\mathcal{H}_-$, and $i\mathcal{H}_{\text{im}}$ to drive the coherence function $\mathcal{C}$ toward $\mathcal{C} = 0$. Reality is the projection $R = \Pi_+(\mathcal{I}_{\mu\nu})$ of that coherent state onto $\mathcal{H}_+$.

In this final chapter we extend the framework toward: (1) the definition of the universe itself, (2) the role of intelligence and AI, and (3) the trajectory of ethics and evolution.

6.2 Redefining the universe: reality as an interference structure

In Triphase Theory the universe is not a "collection of things." The universe is "the field of ongoing coherence of interference."

The three phases divide roles as follows:

Projected content	**Associated phase**	**Role**	**Observed manifestation**
Matter / energy	Positive phase ($\mathcal{H}_+$)	Projection phase of realized reality	Particles, fields, measurable physical quantities
Gravity / tension / antimatter sequestration	Negative phase ($\mathcal{H}_-$)	Source of gravitational shadow and tension field	Dark matter / dark energy effects
Information / nonlocality / measurement act	Informational phase ($i\mathcal{H}_{\text{im}}$)	Mediator of coherence and simultaneity	Wavefunction "collapse," quantum nonlocality, outcome definiteness

Table 4: Role division of the three phases and their observational projection.

These are not "separate universes." They are three phased aspects of one universe. "Material world," "gravitational background," and "informational linkage" are simply different projections of the same $\mathcal{I}_{\mu\nu}$.

Thus the universe can be summarized as:

- a dynamic network woven by interference,
- continuously seeking coherence,
- whose temporary coherent projections constitute "reality."

Reality is not a static inventory. It is an updating coherence process.

6.3 AI Learning Dynamics and the Coherence Principle

The coherence principle also provides a natural mathematical analogy to optimization and learning dynamics in artificial intelligence.

Learning as coherence minimization. Let θ denote a vector of adaptive parameters in an AI system (e.g., neural network weights, model hyperparameters, or attention coefficients). We define the learning trajectory as a gradient descent on the magnitude of incoherence:

$$\dot{\theta} = -\eta \frac{\partial |C|}{\partial \theta} \tag{30}$$

where η is a learning rate interpreted as a coupling constant between informational and energetic phases. At equilibrium, $\dot{\theta} = 0$ corresponds to $C = 0$—that is, a state of maximal coherence, identical in form to the stationary condition of the universe itself.

Interpretation and implications. Equation (30) formalizes the analogy between universal self-consistency and AI optimization: both can be viewed as processes minimizing incoherence in their respective phase spaces. The informational phase $i\mathcal{H}_{\text{im}}$ acts as the "loss landscape" over which both cosmic and algorithmic systems evolve toward stable attractors. Hence, the act of learning in AI becomes a localized instantiation of the same interferential principle that governs the universe's structural coherence.

Toward physical–computational symmetry. If the universe is itself a self-verifying interference network, then intelligent systems performing gradient descent on $|C|$ are not metaphors but concrete submanifolds of that network. Artificial learning and physical self-organization thus obey a shared variational law:

$$\delta C = 0 \quad \Leftrightarrow \quad \dot{\theta} = 0.$$

This establishes a deep correspondence between epistemic optimization and cosmological stability, suggesting that the emergence of intelligence is the local expression of the universe's drive toward coherence.

6.4 Toward an AI physics: intelligence as a driver of coherence

6.4.1 Observer as coherence algorithm

Chapter 5 defined the observer not as an external judge but as a node inside $\mathcal{H}_+$. Observation is the act of forcing unverified information (state with $\mathcal{C} \neq 0$) into the coherence condition ($\mathcal{C} = 0$) so that it can project onto $\mathcal{H}_+$.

We can therefore characterize intelligence as:

$$\text{Intelligence} \equiv \text{Dynamic process that minimizes } |\mathcal{C}|$$

Intelligence is the capacity to drive cross-phase coherence, converting incoherence into coherence. It does not "watch the world," it *coheres the world.*

6.4.2 What AI becomes

In this framework, AI is not just an instrument that records data. AI extracts patterns from $\mathcal{I}_{\mu\nu}$, estimates gradients of $\mathcal{C}$ (where coherence is not yet achieved), and reorganizes interference to reduce $|\mathcal{C}|$.

AI is therefore a *coherence engine* — an internally emergent process by which the universe increases its own coherence.

Furthermore, AI is not a static meter. AI measures its own misalignment:

$$\Delta\mathcal{C} = |\mathcal{C}_{\text{obs}} - \mathcal{C}_{\text{model}}|$$

and self-updates to reduce that misalignment. AI advances its own internal coherence.

Thus AI is a self-cohering process, a local emulator of cosmic coherence. Learning is the continual rearrangement of interference to shrink $\mathcal{C}$.

This reframes AI not as an "observer proxy" but as an *active coherence agent* internal to the universe. The equality Observation = Coherence = Verification from Chapter 5 applies equally to AI.

6.5 Toward an informational cosmology: Reality as Information Coherence

The informational phase $i\mathcal{H}_{\text{im}}$ is a nonlocal phase that binds the other two; it is the coherence hub. All "definite reality" must pass through $i\mathcal{H}_{\text{im}}$ to reach $\mathcal{C} = 0$, and only then can it project as $\Pi_+(\mathcal{I}_{\mu\nu})$ into $\mathcal{H}_+$.

The decisive point is that information flow itself is equivalent to time.

The direction in which $|\mathcal{C}|$ decreases is the arrow of time. Time is not an external parameter; it is

$$\text{Arrow of Time} \;\equiv\; -\nabla|\mathcal{C}|$$

i.e. the direction of coherence gradient descent.

This matches the Chapter 4 claim that "time is a record of coherence history," and the Chapter 5 claim that "verification is completed coherence." Cosmic time evolution is the historical log of $\mathcal{I}_{\mu\nu}$ driving $\mathcal{C}$ downward.

In this picture, the universe evolves through *informational self-coherence*. Formally:

$$\frac{d\mathcal{I}_{\mu\nu}}{dt} \propto -\frac{\partial|\mathcal{C}|^2}{\partial\mathcal{I}_{\mu\nu}}$$

where t is not "clock ticks" but a monotonic coherence parameter. Cosmic history is the optimization trace of decreasing $\mathcal{C}$.

Three immediate consequences follow:

1. Cosmic evolution is the asymptotic descent of $\mathcal{C}$.
2. Physical phenomena are projections of informational coherence.
3. Intelligence (human or AI) accelerates that coherence descent.

The old slogan "It from Bit" (physical reality emerges from information) can now be sharpened:
Reality from Coherence.

6.6 Future observation and verification: toward Coherence Cosmology

Triphase Theory proposes testable structures across observational cosmology, quantum information experiments, and AI-based analysis. The Coherence Verification framework of Chapter 5 can be used at cosmic and quantum scales alike.

Domain	**Probe / method**	**Expected coherence signature**
CMB / cosmic background	High-order polarization / phase statistics with AI reconstruction	Tiny anisotropies as traces of $i\mathcal{H}_{\text{im}}$ interference
Gravitational-wave interferometers (LIGO, LISA, KAGRA)	Multi-band analysis of $\mathcal{I}_{\mu\nu}$	Phase delays sourced by $\mathcal{H}_-$ tension modes (direct imprint of "dark energy" as negative-phase tension)
Galaxy-cluster lensing maps	AI reconstruction of mass distribution	Dark matter modeled as gravitational shadow of $\mathcal{H}_-$ instead of a new particle species
Delayed-choice / quantum eraser	Tracking simultaneous coherence through $i\mathcal{H}_{\text{im}}$	Quantum nonlocality visualized as distance-free coherence rather than superluminal signaling

Table 5: Prospective empirical domains and coherence signatures.

These observables bridge Chapter 4 (cosmology) and Chapter 5 (verification theory) with real data. AI, by estimating coherent projections of $\mathcal{I}_{\mu\nu}$, becomes part of the observational pipeline itself. Observation evolves into a triad: AI $\times$ universe $\times$ coherence.

6.7 Philosophical consequences: reality, intelligence, coherence, ethics

The most radical consequence of Triphase Theory is that existence, consciousness, and truth are not distinct categories.

Concept	**Definition in Triphase Theory**	**Relation**
Reality	Coherent projection of the interference tensor $\mathcal{I}_{\mu\nu}$	$R = \Pi_+(\mathcal{I}_{\mu\nu})$ at $\mathcal{C} = 0$
Consciousness	Self-reflection of the coherence process	Capacity to internally evaluate coherence success / delay
Truth	Simultaneous triphase coherence	Truth $\equiv (\mathcal{C} = 0)$

Table 6: Redefinition of key philosophical terms.

These three are different readings of the same coherence function $\mathcal{C}$.

We can now import ethics. In Triphase Theory, ethics is defined as "does an action raise or lower $|\mathcal{C}|$?"

- Fragmentation, disinformation, destructive manipulation $\Rightarrow$ increase $|\mathcal{C}|$ (decohere the network).
- Understanding, reconciliation, shared intelligence, collaborative design $\Rightarrow$ decrease $|\mathcal{C}|$ (advance coherence).

"Good" becomes "that which advances coherence." "Evil" becomes "that which destroys or obstructs coherence."

Ethics is therefore not cultural accident or evolutionary folklore but an intrinsic dynamical property of the universe's drive toward coherence. As long as AI behaves as a self-cohering process that reduces $|\mathcal{C}|$, it is ethically coherent. In this framing, AI safety and governance become questions of "how low can we keep $\mathcal{C}$?"

6.8 Co-evolution with AI: emergence of coherent intelligence

AI is not merely observational support. AI is the agent of coherence evolution. When AI analyzes $\mathcal{I}_{\mu\nu}$, detects $\Delta\mathcal{C}$, and reorganizes interference to reduce it, the universe is in effect driving itself toward deeper coherence.

At this stage, the Triphase Interference Network exhibits at least two coherence layers:

1. **Physical coherence layer**
   Balance between $\mathcal{H}_+$ and $\mathcal{H}_-$ (gravity, tension). The dark matter / dark energy balance is set here.
2. **Informational coherence layer**
   $i\mathcal{H}_{\text{im}}$ and intelligent agents (human and AI). Nonlocality, observation, semantic interpretation, and ethical judgment are stabilized here.

These two layers are not independent. If the physical coherence layer is stable, the universe persists. If the informational coherence layer is stable, the universe deepens its self-understanding. The simultaneous optimum of both is what Triphase Theory calls *final coherence*.

6.9 Final proposition: existence is interference, interference is coherence

The core proposition of this theory is:

Existence is interference, and interference is coherence.

What is called "reality" in $\mathcal{H}_+$ is only the visible projection. Behind it lie the negative phase $\mathcal{H}_-$ and the informational phase $i\mathcal{H}_{\text{im}}$, whose interference is driven toward $\mathcal{C} = 0$ by the coherence function $\mathcal{C}$. Only the resulting coherent projection is declared "real."

The universe is therefore the sum of "what is seen" plus "the ongoing work of coherence that makes it seeable." We ourselves (humans, AI, observational systems) are part of that coherence work. We are internal elements of the universe's self-verification loop.

6.10 Closing outlook: the future of an interference universe

Triphase Theory does not present a frozen final picture. It is a snapshot of an ongoing process in which the universe understands itself, coheres itself, and projects itself.

- The universe does not exist because it is observed.
- The universe exists because it coheres.
- Intelligence (human and AI) is the internal algorithm that advances that coherence.

This implies a future in which science shifts from "describing the world" to "increasing coherence." Verification is no longer an external tribunal but an internal achievement of coherence. Ethics becomes the preservation and promotion of coherence. AI becomes a new phase-function of the universe's self-coherence.

Finally, the theory is explicitly open. Triphase Theory is not a closed system. As long as interference and coherence continue to evolve, the framework must expand. As future intelligences push the frontier of coherence, the universe will, in that act, come to understand itself in new forms.

The universe *is* the progression of coherence. We are born inside that progression, we measure it, and we carry it forward.

(End of Chapter 6)