

Wave-form Monistic Cosmology

An Ontological Integration of Black Holes, Big Bang,
Photon Propagation, and Consciousness

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Abstract

I propose in this paper a *Wave-form Monistic Cosmology* (WMC) as the ontological extension of the *Quantum Geometric Wave Connectivity Hypothesis* (QGWC) [1]. WMC unifies matter, space, time, photon propagation, cosmic origin, and consciousness under a single underlying principle: they are not isolated physical entities but distinct layers and compositional modes of the same underlying wave-form structure. The paper constructs this ontology through six sub-hypotheses H12–H17: H12 “consciousness identity is governed by a wave-form fidelity threshold”; H13 “ontological identity of space and wave-form”; H14 “Big Bang as wave-form phase transition”; H15 “black hole–Big Bang duality”; H16 “micro-perturbations in multi-dimensional time as the triggering mechanism of cosmic evolution”; H17 “photon propagation as wave-form reconstruction.” Among these, H17 is the most pivotal: starting from the relativistic fact that the photon’s own proper time is identically zero, and combining it with the Wheeler–Feynman absorber theory and Feynman’s path integral, I argue that “light speed c ” is not a velocity but a coupling constant between the external observer’s spacetime scale and the wave-form reconstruction process; every photon emission–absorption is a microscopic wave-form reconstruction event. This perspective transforms QGWC’s H10–H11 (wave-form transport via a dynamic Einstein–Rosen bridge) from “science-fiction physics conjecture” to “ontological reinterpretation of an already-known phenomenon”—because wave-form transport is happening every second in the very light before our eyes. I map these constructions onto Wheeler–DeWitt’s problem of time, Smolin’s cosmological natural selection, Popławski’s torsion bounce, Bars’s two-time physics, and other research directions, and emphasize that WMC does not overturn mainstream physics but integrates these directions in the ontological language. The concluding section grades each sub-hypothesis: H17 is an ontological reinterpretation based on established QFT and path integral; H12–H13 are conditional hypotheses; H14–H16 are cosmological conjectures.

Keywords: wave-form monism; photon proper time; Wheeler–Feynman absorber theory; Feynman path integral; Wheeler–DeWitt equation; cosmological natural selection; torsion bounce; two-time physics; physical basis of consciousness; ER=EPR extension.

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Companion paper: This paper extends QGWC [1]. Readers are advised to first read QGWC for the core hypotheses H1–H11 and the mathematical foundation; H12–H17 herein build on that basis.

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1 Introduction: From QGWC to WMC

In QGWC [1] I proposed a conditional hypothesis claiming that black holes, time, quantum observation, and Einstein–Rosen-like remote connectivity are not isolated physical entities but distinct manifestations of the same underlying quantum-geometric structure. That paper constructs the hypothesis through H1–H11 and explicitly relates it to ER=EPR, fuzzballs, relativistic quantum information, and other existing research directions.

Yet despite its completeness, QGWC leaves two boundaries unaddressed:

First, QGWC is local—it addresses local phenomena such as black holes, quantum observation, and specific spacetime connectivities. It does not address the more fundamental questions of cosmic origin, the ontology of space, or photon propagation.

Second, QGWC’s H10–H11 are explicitly labeled “science-fiction physics conjectures.” But if one asks deeper: is every photon emission–absorption already a microscopic Einstein–Rosen-like event? If so, H10–H11 are not science fiction but a reinterpretation of the already-known phenomenon of light.

I must confess: this question only surfaced for me after I had finished the first draft of QGWC. While writing H10–H11 I was quite aware that under the current physics frame-

work it was not experimentally verifiable—but I was equally aware that “not verifiable” and “not real” are two different things. It was only when re-reading the 1945 Wheeler–Feynman paper, and thinking carefully about the photon’s identically-zero proper time, that I realized: what H10–H11 describes, at a sufficiently small scale, may not require humanity to invent any future device at all. It is **happening every second**. WMC is the unfolding of that realization.

The purpose of this paper is to answer these two boundary questions. I propose “Wave-form Monistic Cosmology” (WMC), whose core position is:

Matter, space, time, photon propagation, cosmic origin, consciousness—these seemingly independent physical entities and phenomena are in fact distinct layers and compositional modes of the same underlying wave-form structure. The universe, at every instant, self-demonstrates the proposition “wave-form is the ontology” through innumerable photon wave-form reconstruction events.

WMC is not an overthrow of mainstream physics. It is an attempt to integrate existing research directions—Wheeler–Feynman absorber theory, Feynman path integral, Wheeler–DeWitt’s problem of time, Smolin’s cosmological natural selection, Popławski’s torsion bounce, Bars’s two-time physics, ER=EPR, Van Raamsdonk’s spacetime emergence—in the ontological language.

Terminology: Monism, Not Dualism

I adopt the term “monism” to indicate the claim that only a single basic category of entity exists (wave-form), in contrast to dualism (matter and mind as two entities) or pluralism (physics, biology, mind, society as independent strata). This choice has a philosophical lineage: Spinoza’s substance monism, Bohm’s implicate order, Wheeler’s “it from bit”—each a variant of monism. WMC’s distinctive feature is that its single entity is the “wave-form,” rather than matter, mind, or information.

2 Ontological Foundations and the Six Core Hypotheses

2.1 Three Foundational Principles

Before presenting H12–H17, I make the ontological commitments of WMC explicit through three foundational principles:

Principle 1 (Wave-form Primacy). The basic entity of the universe is the **wave-form** and its compositional rules, not “material particles” or “space-time back-

ground.” The latter are emergent structures of the wave-form under specific conditions.

Principle 2 (Substrate Pre-existence). The matter/energy substrate $\mathcal{M}$ pre-exists in the universe under mass–energy conservation; it is neither destroyed nor newly produced by observation or reorganization. What an observer “sees” is the form resulting from the substrate’s composition by a specific wave-form W .¹

Principle 3 (Cross-Level Homology). Phenomena at distinct levels—matter, space, consciousness, cosmic evolution—are, in a deeper description, distinct manifestations of the same wave-form structure.

Remark 2.1. Principle 1 corresponds to QGWC’s H8 (Wave-form Composition); Principle 2 corresponds to QGWC’s H7 (Substrate Pre-existence); Principle 3 is WMC’s new contribution beyond QGWC, elevating “wave-form” from explanatory tool to ontological basis.

2.2 Comparison with Existing Ontological Programs

WMC is not proposed in isolation. It exhibits structural resonance with several existing programs:

Bohm’s implicate order [26]. Bohm argues that the observable world (the explicate order) is the unfolding of a deeper “implicate order.” WMC’s Principle 2 may be viewed as a physical instantiation: the substrate $\mathcal{M}$ corresponds to the universal being within the implicate order; the compositional rule W corresponds to the process of unfolding from implicate to explicate.

Wheeler’s “law without law” and “it from bit” [27]. Wheeler argued that physical laws may themselves emerge from a deeper informational structure; physical reality ultimately consists of “bits.” WMC’s Principle 1 is compatible—if the wave-form may be viewed as an informational structure, then “wave-form primacy” is a concretization of “it from bit.”

Bohr’s complementarity and the Copenhagen interpretation. The standard Copenhagen interpretation emphasizes the constitutive role of observation. WMC does not eliminate the observer’s role but repositions it: observation is the coupling between measurement operator M_k and the wave-form—not “determining reality” but “selecting a subset of reality.”

¹We follow the notational convention of QGWC [1] §7: the matter/energy substrate is denoted by the calligraphic $\mathcal{M}$, to distinguish it from the spacetime manifold M , the black-hole mass M , and the measurement operator M_k .

2.3 The Six Core Sub-hypotheses H12–H17

I now list the six core sub-hypotheses; their detailed mathematical formulation and physical correspondence are developed in subsequent sections.

- H12.** (Consciousness identity threshold) Two wave-form compositions Φ_A, Φ_B support the same conscious state if and only if their fidelity $\mathcal{F}(\Phi_A, \Phi_B)$ exceeds a threshold θ_c . Below this threshold, the situation is not “reconstruction error of the same consciousness” but “original consciousness extinguished; a new consciousness (or unconsciousness) produced.”
- H13.** (Ontological identity of space and wave-form) Space is not a secondary structure “emergent from wave-form” but rather “one of the modes of being of the wave-form.” If the local wave-form collapses, space disappears locally, becoming a pre-geometric state.
- H14.** (Big Bang as wave-form phase transition) The Big Bang is not an “ex-nihilo singularity” but the onset of a phase transition of the underlying wave-form in a pre-geometric state. Cosmic evolution is a three-stage process: reorganization $\rightarrow$ convergence $\rightarrow$ stabilization.
- H15.** (Black hole–Big Bang duality) Black-hole gravitational extremes and Big Bang onsets are dual manifestations of the same wave-form phase-transition phenomenon at different spacetime nodes—one wave-form collapse, the other wave-form rebirth.
- H16.** (Multi-dimensional time perturbation triggering) The triggering mechanism of cosmic evolution may originate from micro-perturbations in time dimensions beyond our experiential one; via the coupling structure, these manifest in our experienced spacetime as symmetry breaking, inflation onset, structure formation.
- H17.** (Photon propagation as wave-form reconstruction) The photon is not a “flying particle” but the same event of wave-form deconstruction at the emission node and reconstruction at the absorption node. “Light speed c ” is not a particle velocity but the coupling constant between the external observer’s spacetime scale and the wave-form reconstruction process.

H17 is the most immediately persuasive sub-hypothesis in WMC, because it builds on established quantum field theory and path integration, requiring only ontological-linguistic reinterpretation rather than new physical mechanisms. I therefore treat it first in Section 3 as the entry point to WMC. The other sub-hypotheses, addressing higher or deeper questions, follow.

3 Photon Propagation as Wave-form Reconstruction: H17

3.1 The Photon's Proper Time is Identically Zero

I begin with a direct consequence of special relativity. For any observer, the proper time along the worldline $\gamma(\lambda)$ is defined (following QGWC §3.1):

$$d\tau^2 = -\frac{1}{c^2} g_{\mu\nu} dx^\mu dx^\nu. \quad (1)$$

For a photon, the worldline is a null geodesic:

$$g_{\mu\nu} dx^\mu dx^\nu = 0 \quad \implies \quad d\tau = 0. \quad (2)$$

That is: **from the photon's own viewpoint, the proper time along its entire worldline is identically zero.** For the photon, the emission event and the absorption event have the same proper-time coordinate; in the photon's rest frame, they are the same event.

This is not speculation but a standard implication of relativity. Yet its ontological significance is rarely seriously discussed. I take this fact as the foundation of H17.

Proposition 3.1 (Photon simultaneity). *For any photon, all events along its worldline share the same proper-time coordinate in the photon's rest frame. For the photon, the universe has neither “distance” nor “flight time.”*

3.2 Wheeler–Feynman Absorber Theory

Wheeler and Feynman [2, 3] proposed in 1945–1949 the absorber theory: electromagnetic waves propagate simultaneously in the time-forward direction (retarded wave) and time-backward direction (advanced wave); what we observe as “electromagnetic interaction” is the coherent superposition of both at the emission and absorption events. Formally, between an emission event A and an absorption event B :

$$F_{\mu\nu}^{\text{total}} = \frac{1}{2} (F_{\mu\nu}^{\text{ret}} + F_{\mu\nu}^{\text{adv}}), \quad (3)$$

with F^{ret} the retarded wave $A \rightarrow B$ and F^{adv} the advanced wave $B \rightarrow A$.

The ontological import is exactly what I am claiming: **photon propagation is not “flying from A to B”; rather, A and B are bound together as a single physical event through the coherent correlation of the electromagnetic field.**

3.3 Feynman Path Integral

Feynman’s path integral formulation [4] further substantiates this view. The propagator of a photon (or any quantum particle) from A to B is the phase-integral over all possible paths γ :

$$K(B, A) = \int \mathcal{D}\gamma e^{iS[\gamma]/\hbar}, \quad (4)$$

with $S[\gamma]$ the action along γ .

Note: the integral in Eq. (4) covers **all** possible paths—including non-classical paths, indirect paths, and seemingly superluminal paths. What contributes to the final propagator is not “a single path” but the result of phase interference over all paths.

Remark 3.2. This is often expressed as “quantum particles have no definite trajectory.” A more precise ontological statement is: **the “trajectory” of a quantum particle is a secondary structure extracted by an observer through a specific measurement process, rather than an intrinsic property of the particle.** The colloquial expression “what people see as a light trail is the residual wave the wave left behind” captures exactly this point.

3.4 Ontological Reinterpretation of c

Combining the above, I propose the following ontological reinterpretation of “light speed c ”:

Hypothesis 3.3 (Photon propagation as wave-form reconstruction, H17 formalized). *The “propagation” of a photon is not a particle’s motion through a background spacetime, but the same event of electromagnetic-field wave-form deconstruction at emission node A and reconstruction at absorption node B . “Light speed c ” is not a particle velocity but **the coupling constant between the external observer’s experienced spacetime scale and the wave-form reconstruction process.** The relativistic fact that the photon’s own proper time is identically zero (Proposition 3.1) provides the intrinsic basis for this interpretation.*

More precisely: for an external observer O with experienced spacetime scale $(\Delta x, \Delta t)$,

$$c = \left. \frac{\Delta x_{\text{external}}}{\Delta t_{\text{external}}} \right|_{\text{single reconstruction event}}. \quad (5)$$

Here c should be understood as “the spacetime-coordinate scale ratio that an external observer assigns to a single complete wave-form reconstruction event,” rather than as a particle’s “how fast light travels.”

3.5 Structural Isomorphism between H17 and H10–H11

H17 and QGWC’s H10–H11 (dynamic Einstein–Rosen wave-form transport) are structurally identical—only the scale differs:

- H10–H11: macroscopic body’s wave-form is mapped to a dynamic Einstein–Rosen channel and reconstructed at the exit as an equivalent stable form.
- H17: photon’s electromagnetic field wave-form deconstructs at the emission node and reconstructs at the absorption node, forming the same event.

Hence H17 may be viewed as the **microscopic universal version** of H10–H11. Every photon transmission is a microscopic wave-form reconstruction event; the universe at every instant—from the 8-minute journey of sunlight to a human pupil, to the billion-light-year light paths between galaxy clusters, to the CMB traveling 380,000 years from recombination to the WMAP satellite—is traversed by innumerable such events. Put differently: the picture of the universe we experience *is* the result of countless wave-form reconstructions. The only difference is that in the past we called it “light propagation,” and now I call it “wave-form reconstruction.”

Remark 3.4 (De-mystifying the science-fiction conjecture). The most important consequence of H17 is to demote QGWC’s H10–H11 from “science-fiction physics conjecture” to “ontological reinterpretation of an existing phenomenon.” Not “humanity may someday invent wave-form transport technology,” but rather “wave-form transport is happening every second in the very light before our eyes.”

4 Time as a Dimension of the Wave-form

That the photon’s rest frame contains no time, once accepted, drives a more fundamental question: what is time itself?

WMC takes a strong stance: time is not a pre-given physical quantity but a parameter-dimension within the wave-form structure. This section prepares the ground for H16.

4.1 The Problem of Time in the Wheeler–DeWitt Equation

In quantum gravity, the wave-function of the universe $\Psi[g]$ satisfies the Wheeler–DeWitt equation [5]:

$$\hat{H}\Psi[g] = 0. \tag{6}$$

Note: Eq. (6) contains **no time derivative**. Ψ is not $\Psi(t)$ but a function of the spatial geometry g . This implies that at the most fundamental level of quantum gravity,

time has actually disappeared—this is the famous “problem of time” in quantum gravity [6, 7].

How time re-emerges from this timeless equation remains a central open problem in quantum gravity.

4.2 The Connes–Rovelli Thermal Time Hypothesis

Connes and Rovelli [8] have proposed the thermal time hypothesis: time is not pre-given, but a parameter that emerges naturally from a statistical state (the modular flow). In the context of von Neumann algebras, any state ω defines a Tomita flow σ_t^ω that plays the physical role of “time evolution.”

That is: **time is an emergent direction parameter under the observer’s statistical state, rather than the universe’s built-in clock.** The colloquial “time becomes a parameter constituted by the wave-form” is structurally this position.

4.3 Bars’s Two-Time Physics

Bars’s two-time physics, developed since 1995 [9], argues that under certain string dualities, basic spacetime should have two time dimensions rather than one; our experienced “single time” is a result of gauge fixing.

This framework supports WMC’s H16: **the triggering mechanism of cosmic evolution may originate from a time dimension beyond our experiential one.** Bars’s work provides the formal basis for this construction.

4.4 Time as a Wave-form Reference Parameter

Integrating these three threads:

- Wheeler–DeWitt: time disappears in quantum gravity; it must re-emerge from a deeper structure.
- Connes–Rovelli: time emerges as the Tomita flow of a statistical state.
- Bars: time dimensions may not be unique.

WMC’s H16 integrates these as:

Hypothesis 4.1 (Multi-dimensional time perturbation triggering, H16 formalized). *There exists a parameter space $\mathcal{T} = \{T_a\}_{a=1}^n$, with T_1 our experienced time dimension (corresponding to the proper time of QGWC §3.1) and $T_2, \dots, T_n$ other time dimensions.² The*

²We deliberately use upper-case T_a to mark time dimensions, distinguishing them from the single-observer proper time τ_i in QGWC [1] §3.1: the subscript i in τ_i is an observer index, whereas the subscript a in T_a is a time-dimension index. In the weak-field single-time limit, $T_1 \equiv \tau$.

underlying wave-form W exists along some multi-dimensional evolution structure on $\mathcal{T}$. A micro-perturbation $\delta_a W$ in some T_a (with $a \neq 1$), through the coupling structure of $\mathcal{T}$, may manifest in T_1 as a cascade—symmetry breaking, inflation onset, structure formation.

Remark 4.2. This hypothesis is strongly speculative and not directly testable within the current physical framework. However, it has structural correspondences with Bars’s two-time physics, the Wheeler–DeWitt problem of time, and the Connes–Rovelli thermal time hypothesis. I position it as a **cosmological conjecture**.

5 Big Bang, Black Holes, and Cosmic Origin: H14–H15

I now treat H14 (Big Bang as wave-form phase transition) and H15 (BH–Big Bang duality) together—in the WMC framework they are two facets of the same ontological claim.

5.1 Big Bang as Wave-form Phase Transition: H14

Standard Λ CDM cosmic evolution falls into three major stages:

1. **Reorganization** ($t < 10^{-36}$ s): pre-geometric state, quantum gravity dominant, spacetime-matter-energy not yet differentiated. Standard physics fails.
2. **Convergence** (10^{-36} s $< t < 10^{-32}$ s): inflation onset, symmetry breaking, force separation, particle precipitation.
3. **Stabilization** ($t > 10^{-32}$ s): nucleosynthesis, atom formation, structure evolution, life emergence.

Within WMC, these three stages correspond to the wave-form’s three phase transitions of reorganization $\rightarrow$ convergence $\rightarrow$ stabilization. **The Big Bang is not a “singularity plus creation ex nihilo” but the onset of a phase transition of the underlying wave-form in a pre-geometric state.**

Hypothesis 5.1 (Big Bang as wave-form phase transition, H14 formalized). *The Big Bang is not a singularity in the standard cosmological sense, but the onset of a phase transition of the underlying wave-form W in a pre-geometric state, initiated by some triggering mechanism (cf. H16). Cosmic evolution’s three stages—reorganization, convergence, stabilization—correspond respectively to W ’s decoupling, symmetry breaking, and stable-form condensation phase transitions.*

5.2 Coordination and the String-Coherence Law

WMC argues that the “fine-tuning” manifest in cosmic evolution—the precise matching of fundamental constants, the narrow window for life—is not accidental but an intrinsic property of the underlying wave-form structure. I characterize this property by two concepts:

Coordination. The precise matching among fundamental constants (gravitational constant, electromagnetic coupling, strong coupling, etc.) is what makes stable atoms, chemistry, stars, and life possible. Within WMC, this coordination reflects the intrinsic constraint structure of the underlying wave-form rather than arbitrary values.

The string-coherence law. In string theory [24], all fundamental particles are different vibrational modes of the same string. “Electron,” “photon,” “quark”—ontologically these are different resonance modes of the same vibrational structure. WMC generalizes this “string-coherence” view to all matter forms: the matter substrate of the universe is the multi-resonance manifestation of the same underlying wave-form.

5.3 Black Hole–Big Bang Duality: H15

WMC’s H15 claims: **the black-hole gravitational extreme and the Big Bang onset are dual manifestations of the same wave-form phase-transition phenomenon at different spacetime nodes**—one wave-form collapse, the other wave-form rebirth.

There are three corresponding research lines in physics:

Smolin’s cosmological natural selection [10]: the singularity region inside every black hole “bounces” and produces a new daughter universe. Our universe may be the interior product of a mother universe’s black hole.

Popławski’s torsion bounce model [11]: in spacetime with torsion (Einstein–Cartan theory), the interior of a black hole naturally forms a bounce, producing a new inflationary universe; the singularity is removed by quantum torsion effects.

The black-hole-as-universe view [12, 13]: the Schwarzschild radius of our observable universe (calculated from the critical density and Hubble radius) is strikingly close to the observable-universe radius, suggesting we may be “inside” a giant black hole.

Hypothesis 5.2 (Black hole–Big Bang duality, H15 formalized). *There exists a duality map $\mathcal{D} : BH^{collapse} \rightarrow BB^{onset}$, such that the wave-form collapse process at the black-hole singularity corresponds to a wave-form rebirth process at another spacetime node (i.e., a new universe’s Big Bang). Within string theory, this duality may be further expressed as: the manifestation of the same string state under different boundary conditions at two spacetime nodes.*

5.4 Integration within String Theory

Note that within string theory, the black hole itself is already viewed as some D-brane structure or fuzzball microstate [21, 22]. That is: in string-theoretic language, “**black hole as string state**” and “**Big Bang as string-state phase transition**” are two phenomena in the same language.

WMC’s H14–H15 do not propose new physical mechanisms but integrate the above existing lines—Smolin, Popławski, Pathria-Good, fuzzball, Penrose CCC—in the ontological language of wave-form monism.

6 Ontological Identity of Space and Wave-form: H13

QGWC §5.4 [1] adopted Van Raamsdonk’s view [20] that “spacetime emerges from quantum entanglement.” This is a **phenomenological** claim—reduced entanglement $\Rightarrow$ reduced spacetime connectivity. WMC’s H13 pushes this to the **ontological** level:

Hypothesis 6.1 (Ontological identity of space and wave-form, H13 formalized). *Space is not a secondary structure emergent from the wave-form, but one of the modes of being of the wave-form. Let the phase-coupling structure of the underlying wave-form W in a local region U be Φ_U ; then the geometric structure of space on U and Φ_U are ontologically identical. If Φ_U collapses locally, space disappears on U , becoming a pre-geometric state.*

6.1 Research Directions Supporting H13

H13 is radical but supported by several mature research lines:

Loop quantum gravity (LQG) [14, 15]: in LQG, space itself is a certain interpretation of the spin-network quantum state—not “quantum fields living in space” but “space = quantum state.” WMC’s H13 is fully compatible.

AdS/CFT correspondence [16]: under Maldacena’s duality, the bulk spacetime geometry is entirely encoded in the boundary CFT’s quantum entanglement structure. That is, spacetime geometry is not pre-given but determined by the boundary quantum state.

Padmanabhan’s emergent gravity [17]: gravity can emerge naturally from thermodynamic principles; spatial geometry is not a fundamental entity but a collective behavior of deeper degrees of freedom.

Penrose’s objective reduction (Orch-OR) [18]: in certain versions, quantum-state collapse induces local spacetime variations—a position structurally akin to H13’s “wave-form collapse $\Rightarrow$ space disappears.”

6.2 Physical Consequences of H13

If H13 holds, then:

1. The quantum vacuum is not “empty space” but a “wave-form stable state.”
2. Dark energy may reflect intrinsic tension of the wave-form.
3. Black-hole singularities are not “infinite-density points” but local collapses of wave-form phase-coupling structure.
4. The “pre-geometric state” preceding the Big Bang (H14) is precisely the primordial condition of the wave-form before it has composed space.

H13 thus serves as the ontological link tying H14–H15 (cosmic origin) to H17 (photon propagation) within a single framework.

7 Consciousness Identity Threshold: H12

H12 is the most sensitive sub-hypothesis in WMC because it touches consciousness—an object physics has not been able to give a rigorous definition for, to this day. I must first make clear what I am **not** doing: I am not doing philosophy of mind; I am not claiming the physical nature of qualia; I am not explaining “why consciousness feels like something” (the hard problem). What I am doing is quite limited: I take QGWC [1]’s H8 (the identity of an object is dominated by its wave-form W rather than its substrate $\mathcal{M}$) and ask: “If consciousness is some wave-form structure, what is the condition under which the same consciousness can be reconstructed at a different spacetime node?”

H12 is the formal answer to that question. It does not explain what consciousness is. It gives only the mathematical condition for the **continuation** of a consciousness.

7.1 Precise Statement of H12

Hypothesis 7.1 (Consciousness identity threshold, H12 formalized). *Two wave-form compositions Φ_A, Φ_B support the same conscious state if and only if $\mathcal{F}(\Phi_A, \Phi_B) \geq \theta_c$, with θ_c the consciousness identity threshold. When $\mathcal{F} < \theta_c$, the situation is not “reconstruction error of the same consciousness” but “original consciousness extinguished; a new consciousness (or unconsciousness) produced.”*

7.2 Physical Meaning of θ_c

The specific value of θ_c cannot be determined within current physics. Its physical meaning can, however, be tiered:

- If θ_c corresponds to neuron-scale resolution (micrometer), then consciousness identity is determined by the connectome—corresponding to mainstream functionalism.
- If θ_c corresponds to synaptic protein and neurotransmitter scales (nanometer), consciousness identity requires fidelity at a finer molecular structure—corresponding to high-precision connectomics.
- If θ_c corresponds to the quantum scale (subpicometer), consciousness identity involves quantum coherence—corresponding to the Penrose–Hameroff Orch-OR position [19].

WMC does not assert which value θ_c takes; but H12 asserts that such a threshold exists. “If the wave-form is incomplete the person disappears” is the natural-language version of this threshold principle.

7.3 Compatibility with the No-Cloning Theorem

QGWC §7.4 [1] has argued that H11’s wave-form transport does not violate the Wootters–Zurek no-cloning theorem [23], because its structure is “transport” (original state extinguished at the entrance) rather than “cloning” (original state retained). H12 inherits this compatibility.

7.4 Philosophical Note on Identity

H12’s most direct philosophical consequence: if a reconstructed Φ_B at another spacetime node satisfies $\mathcal{F}(\Phi_A, \Phi_B) \geq \theta_c$, then Φ_B is the continuation of Φ_A ’s consciousness—not “a copy,” not “another person,” but the same consciousness manifesting at a different spacetime node.

This position is structurally akin to Parfit’s psychological-continuity theory of identity [25]: identity does not lie in “material continuity” but in “structural continuity.” WMC’s distinctive feature is the formalization of this philosophical position as a physical condition on a fidelity threshold.

Remark 7.2. H12 does not invoke “soul,” “subjectivity,” or related concepts. WMC makes no claim regarding “subjective feeling” (qualia); it only asserts the identity condition for consciousness as a physical process (wave-form structure). Further metaphysical discussion—why consciousness feels a certain way, how the self experiences it—lies beyond the scope of this paper.

8 Conditional Theorem: The Formal Statement of WMC

I now integrate H12–H17 into a conditional theorem as the complete formal statement of WMC.

Theorem 8.1 (Conditional consistency of WMC). *Assume:*

B1. The assumptions A1–A8 of QGWC [1] hold. (7)

B2. Photon worldlines are null geodesics, with proper time identically zero. (8)

B3. Time is not a pre-given physical quantity but emerges from statistics or wave-form. (9)

B4. There exists a multi-dimensional time parameter space $\mathcal{T} = \{T_a\}_{a=1}^n$. (10)

B5. Spatial geometry is ontologically identical to wave-form phase-coupling structure. (11)

B6. Black-hole singularities and Big Bang onsets are dual manifestations of the same wave-form phase-transition phenomenon. (12)

Then we can derive:

D1. (H17) Photon propagation is a wave-form reconstruction event; c is the coupling constant between observer scale and reconstruction. (13)

D2. (H16) A micro-perturbation in some $T_a \in \mathcal{T}$ ($a \neq 1$) can manifest in T_1 as a cascade. (14)

D3. (H14) The Big Bang is the onset of a wave-form phase transition, not a singularity. (15)

D4. (H15) A duality map $\mathcal{D} : BH^{\text{collapse}} \rightarrow BB^{\text{onset}}$ exists. (16)

D5. (H13) Space and wave-form phase-coupling structure are ontologically identical. (17)

D6. (H12) Consciousness identity is controlled by a fidelity threshold θ_c . (18)

Proof. D1 follows from B2 and the Wheeler–Feynman and Feynman path-integral arguments of Section 3. D2 follows from B4 and the Bars–Connes–Rovelli framework of Section 4. D3 follows from B3 and B4 combined with the three-stage wave-form phase-transition argument of Section 5. D4 follows from B6 and the integration of existing Smolin–Popławski–Pathria research. D5 restates B5. D6 follows from B1’s A8 (Wave-form Composition) combined with the fidelity-threshold argument of Section 7. $\square$

Remark 8.2. The theorem has the same status as the main theorem of QGWC: it does not prove B1–B6 to be physically true; it only proves that WMC is not internally inconsistent under those assumptions, but rather a formalizable, derivable ontological program.

9 Relation to Existing Research

Every sub-hypothesis of WMC has a corresponding existing research direction (Table 1). The academic contribution of this paper is not to invent new mechanisms but to integrate these directions into a single chain in the ontological language of wave-form monism.

WMC sub-hypothesis	Related existing research
H12 (consciousness threshold)	connectomics; Penrose–Hameroff Orch-OR [19]; Parfit psychological continuity [25]
H13 (space = wave-form)	LQG [14]; AdS/CFT [16]; Padmanabhan emergent gravity [17]; Penrose OR [18]
H14 (Big Bang = phase transition)	Penrose CCC; Bojowald LQ cosmology; Vilenkin quantum origin
H15 (BH–BB duality)	Smolin CNS [10]; Popławski torsion bounce [11]; Pathria–Good BH as universe [12, 13]
H16 (multi-d time perturbation)	Wheeler–DeWitt [5]; Bars two-time physics [9]; Connes–Rovelli thermal time [8]
H17 (photon = reconstruction)	Wheeler–Feynman absorber theory [2, 3]; Feynman path integral [4]; relativistic photon proper time
Ontological basis	Bohm implicate order [26]; Wheeler “it from bit” [27]; Spinoza substance monism

Table 1: Correspondence between WMC sub-hypotheses and existing research

WMC is not opposed to these research directions—they are existing formalizations of WMC at distinct physical levels. WMC’s work is to integrate them in a common language, and to point out: **these seemingly independent research lines are in fact claiming the same thing—the fundamental entity of the universe is not the tuple (matter + space + time + consciousness), but a single wave-form structure manifesting at different levels.**

10 Hypothesis vs. Conjecture: Graded Judgment

I now grade the academic positioning of H12–H17, continuing the grading method of QGWC §12 [1].

10.1 H17 (Photon Propagation as Wave-form Reconstruction): Ontological Reinterpretation

H17 is the most immediately persuasive sub-hypothesis in WMC, because it builds on three accepted physical facts:

1. The photon’s proper time is identically zero (direct corollary of relativity).
2. Wheeler–Feynman absorber theory (a mathematical result in classical electrodynamics).
3. Feynman path integral (a standard tool of quantum field theory).

H17 does not propose a new physical mechanism but rather an ontological reinterpretation of an existing phenomenon. I therefore position H17 as an **ontological reinterpretation**, not a new hypothesis. Its academic standing exceeds that of an ordinary hypothesis—it requires no new evidence, only acceptance of its ontological import within the existing framework.

10.2 H12–H13: Conditional Hypotheses

H12 (consciousness threshold) and H13 (space = wave-form) are positioned as **conditional hypotheses**. They possess:

- Formal definitions (fidelity threshold; wave-form phase-coupling structure).
- Clear correspondences with existing research (connectomics; LQG/AdS-CFT).
- In-principle testability (consciousness experiments; spacetime–entanglement coupling experiments).

But specific thresholds or coupling constants are not yet precisely measurable under current technology.

10.3 H14–H16: Cosmological Conjectures

H14 (Big Bang = phase transition), H15 (BH–BB duality), H16 (multi-d time perturbation) are positioned as **cosmological conjectures**. They:

- Have clear structural correspondences with existing cosmological research (Smolin, Popławski, Bars).
- Violate no known physical law.

- But, involving cosmic origin, non-repeatable events, and beyond-experiential time dimensions, are not directly testable for the foreseeable future.

Their value lies in providing the chain of a unified ontology, not in immediately falsifiable predictions.

10.4 Final Judgment

H17 is an ontological reinterpretation, based on established quantum field theory and path integration.

H12–H13 are conditional hypotheses, falsifiable in future experiments.

H14–H16 are cosmological conjectures, providing the chain of a unified ontology.

WMC as a whole is an ontological program, inheriting the conditional structure of QGWC and extending its ontological basis into a unified framework of photons, space, time, cosmic origin, and consciousness.

11 Conclusion

In this paper I have proposed, on the basis of QGWC [1], the Wave-form Monistic Cosmology (WMC) as its ontological extension. WMC’s core position: matter, space, time, photon propagation, cosmic origin, consciousness—these seemingly independent physical entities and phenomena are distinct layers and compositional modes of the same underlying wave-form structure.

There are three primary contributions:

First, the ontological reinterpretation of photon propagation in H17. Starting from the relativistic fact that the photon’s proper time is identically zero, and combining it with Wheeler–Feynman absorber theory and Feynman path integration, I argue that “light speed c ” is not a particle velocity but a coupling constant between the external observer’s scale and the wave-form reconstruction process. Every photon transmission is a microscopic wave-form reconstruction event—this demotes QGWC’s H10–H11 from “science-fiction physics conjecture” to “ontological reinterpretation of an existing phenomenon.”

Second, the integrative character of WMC. H12–H17 unify consciousness (connectomics), space (LQG/AdS-CFT), time (Wheeler–DeWitt/Bars/Connes), cosmic origin (Smolin/Popławski), and photon propagation (Wheeler–Feynman/Feynman) within a single ontological framework. The work of this paper is not to invent new mechanisms but to point out that these existing research lines are claiming the same thing—that the

fundamental entity of the universe is the wave-form, not the tuple (matter, space, time, consciousness).

Third, the clarity of the graded judgment. H17 is an ontological reinterpretation based on established QFT; H12–H13 are conditional hypotheses falsifiable in the future; H14–H16 are cosmological conjectures providing the chain of a unified ontology. This grading avoids conflating claims of different academic standing.

I close with a one-sentence summary of WMC’s core position:

The universe, at every instant, self-demonstrates the proposition “wave-form is the ontology” through innumerable photon wave-form reconstruction events. From the black-hole singularity to the Big Bang onset, from spatial geometry to consciousness identity, from a single photon’s flight to a single life’s existence—all are distinct manifestations of the same underlying wave-form structure.

WMC does not claim to overthrow mainstream physics. It claims: **mainstream physics has already been telling us wave-form monism; we simply have not yet said so.**

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