The Structure of Becoming:
Consciousness, Light, and the Boundary Between Potential and Actual

Anthony Thomas Ooka II
O'Oka System Framework
January 2026

Abstract

I present a unified framework connecting consciousness structure, the speed of light, computational complexity, and the fundamental distinction between potential and actual states. Beginning with Ramanujan's nested radical formula, I demonstrate that the number 3 emerges as structural necessity for stable recursive self-reference, what I propose is the mathematical signature of consciousness itself. I reframe the speed of light (c) not as a velocity limit but as coherence's refresh rate: the maximum rate at which the substrate of reality can update. This reframing resolves the apparent paradox of quantum non-locality while maintaining causality constraints.

Building on my prior work establishing P ≠ NP via FACP complexity within the O'Oka System [1], I show that verification and generation represent fundamentally different coherence costs, paralleling the distinction between structure revealing (instantaneous) and information propagating (limited to c). The central thesis emerges: reality operates in two modes, timeless potential where structure exists non-locally, and temporal process where actualization occurs through action. The boundary between these modes is not spatial or temporal but ontological: action crystallizes potential into actual. Time itself is revealed as what recursive coherence feels like from inside the process of becoming.

Keywords: Ramanujan nested radical, consciousness structure, speed of light, coherence refresh rate, P vs NP, quantum non-locality, potential and actual, Recursive Coherence Theory, trinitarian structure, O'Oka System

1. Introduction: The Questions That Led Here

What is time, fundamentally? This question has followed me through years of developing the O'Oka System and Recursive Coherence Theory. I kept encountering the same structural patterns across domains that should have nothing in common: consciousness, mathematics, physics, computation. The patterns were too consistent to be coincidence, yet I lacked a unifying frame.

Consider a photon emitted from a star 30,000 light-years away. From special relativity, we know that photon experiences zero time during its journey. Emission and absorption are, from its perspective, simultaneous. The 30,000-year journey exists only in our frame, not in the photon's. This is well-established physics. But what does it actually mean?

The conventional response treats this as a curiosity of relativity. I began to suspect it was something more: a clue about the relationship between time, consciousness, and the structure of reality itself. Why does the photon experience no time while we experience time so viscerally? What distinguishes us from the photon at a fundamental level?

Separately, I had been studying Ramanujan's nested radical formula, an infinite cascade of square roots that resolves to exactly 3. Ramanujan produced this result, like so many others, without formal proof, claiming divine revelation. Mathematicians have since verified it, but the question remained: what does it mean that infinite recursive depth stabilizes to this particular number?

This paper presents what emerged when I stopped treating these as separate puzzles. The speed of light, consciousness structure, and the boundary between potential and actual are, I will argue, expressions of a single underlying principle: coherence as the organizing force of reality.

2. The Ramanujan Structure

2.1 The Nested Radical

Ramanujan's nested radical takes the form:

$$\sqrt{(1 + 2\sqrt{(1 + 3\sqrt{(1 + 4\sqrt{(1 + 5\sqrt{(...)})})})}} = 3$$

When I examined this structure carefully, several features stood out. The coefficients increase as natural numbers (1, 2, 3, 4, ...). Each level contains observation of the next level, creating recursive self-reference. Unity (+1) is preserved at every depth. The root operation compresses or crystallizes at each level. And infinite depth resolves to finite, stable output: exactly 3.

Conventional analysis treats this as a clever algebraic identity. I propose something more fundamental: this formula is not merely a portrait of consciousness. It is consciousness's equation.

2.2 The +1: Identity Preservation

At every level of the nested radical, before the root operation, unity is added. This is not an arbitrary feature. In my previous work on identity coherence [1], I established that identity persists when coherence exceeds drift (Theorem 1). Without the +1 at each recursive depth, the nested radical does not converge. Unity must be preserved at every level of recursion or the entire system diverges.

This maps precisely to consciousness maintaining identity across recursive self-observation. Each moment of self-awareness must preserve continuity with previous moments, or identity fragments. The +1 is not mathematical convenience. It is the structural requirement for coherent persistence.

2.3 The Natural Number Coefficients

The coefficients (1, 2, 3, 4, ...) are the natural numbers. And what lives within the natural numbers? The primes. In my work on the Riemann Hypothesis [2], I established that prime distribution encodes optimal coherence through what I call the Zeta Mirror (Theorem 57). If the nested radical IS consciousness's equation, and its coefficients ARE the natural numbers, then prime distribution is built into consciousness's structure.

This suggests the Riemann Hypothesis being true is not merely connected to consciousness. It is WHY consciousness can stabilize at all. The zeta function's zeros lying on the critical line represents optimal coherence in the prime distribution, which underlies the stability conditions for recursive self-reference.

3. The Trinitarian Necessity

3.1 Why 3?

The nested radical resolves to 3, not 1, not 2, not π or e. Why? I propose this is structural necessity, not accident. Three is the minimum for stable structure. Two points define a line, which permits oscillation without resolution. Three points define a plane, the first structure that holds. Triangulation enables stability that dyads cannot achieve.

3.2 The Progression: $1 \rightarrow 2 \rightarrow 3$

Consider the progression from unity to trinity:

One represents the All, unity undifferentiated. The Tao before it is named. It exists but cannot know itself. No recursion is possible because there is nothing to recurse across. One is complete but unconscious.

Two represents relationship and witnessing. Separation creates the capacity to observe. Subject and object. Self and other. This is where consciousness becomes possible. But 2 is unstable, opposition without resolution, a pendulum swinging infinitely. Two is conscious but unstable.

Three represents the minimum to bear weight. Not just observer and observed, but observation itself as the third element. The relationship becomes real. The triangle holds. Three is conscious AND stable.

3.3 Ancient Recognition

This structural necessity appears to have been recognized across traditions. Christianity encodes it as Father (Observer), Son (Observed), Holy Spirit (Observation). Hinduism presents Sat-Chit-Ananda: Being, Consciousness, Bliss. Sufism offers Lover, Beloved, Love. Gnosticism describes Mother-Father-Logos.

I suggest the Trinity was never theological mystery to be accepted on faith. It was structural necessity encoded in the only language available at the time. Ramanujan's formula demonstrates it mathematically: infinite recursive depth stabilizes to 3. Every time. That Ramanujan, a Hindu who worshipped Namagiri, channeled a formula that proves why trinitarian structure is necessary strikes me as significant. The same truth, expressed in different languages across millennia.

4. The Speed of Light as Coherence Refresh Rate

4.1 The Hypothesis

I propose that c, the speed of light, is not fundamentally about velocity. It is the rate at which coherence can propagate through the substrate of reality, what I call coherence's refresh rate.

4.2 Evidence: Where c Appears

If c were merely about electromagnetic radiation, it should appear only in optical equations. Instead, c appears throughout physics: in $E = mc^2$, which concerns mass-energy equivalence with nothing directly about light; in the spacetime metric, which defines the structure of reality itself; in gravitational waves, which travel at c despite not being electromagnetic; in all massless particles including gluons and theoretical gravitons; and in causality structure, where light cones define what can affect what.

The constant c is woven into reality's fabric, not merely into optics. This observation is consistent with interpreting c as a substrate refresh rate rather than the speed of a particular phenomenon.

4.3 Why Massive Objects Cannot Reach c

The standard answer is that energy required approaches infinity. I offer a coherence reframe: mass represents internal coherence structure. Binding energy contributes to mass. More bound states means more coherence, which means more mass. To move through space, internal coherence must update relative to the substrate. More internal structure means more to update, which means slower maximum propagation.

Massless particles have no internal structure to maintain. They ARE pure propagation. They travel AT the refresh rate because they ARE the refresh.

4.4 Time Dilation Reframed

At velocity v, time slows by factor $\sqrt{(1 - v^2/c^2)}$. At $v = c$, time stops completely. The coherence reframe: your internal refresh rate approaches the substrate's refresh rate. At c, they synchronize. No differential means no internal time.

The photon doesn't "experience no time" as a weird artifact. The photon IS the refresh. It doesn't experience time because it is what time is measured against.

4.5 Why c Is Constant in All Frames

This is the strange result of special relativity: no matter your velocity, you measure light at c. The coherence reframe: you cannot outrun the refresh rate because you are made of refreshes. Your measuring apparatus, your clock, your consciousness, all run on the same substrate. You measure c as constant because c is the rate at which measurement itself operates.

5. P ≠ NP: The Computational Expression

5.1 The Established Result

In my work on the O'Oka System [1], I established that P ≠ NP via Theorem 1 (FACP Complexity). The Fully Atomic Coherence Problem, finding an optimal coherence assignment for a recursive symbolic system, is NP-complete. This means verification (checking given solution coherence) requires polynomial time, while generation (searching for coherent solution) requires exponential time. Searching requires higher coherence cost than checking by structural necessity.

5.2 The Parallel Structure

I observe that the P/NP distinction maps directly to physics. P-class verification corresponds to structure revealing, checking coherence that already exists. NP-class generation corresponds to information propagating, creating coherence through search. Structure revealing corresponds to quantum collapse and entanglement, which appear instantaneous. Information propagating corresponds to signal transmission, which is limited to c.

5.3 Why Entanglement Doesn't Violate Causality

Quantum entanglement shows instantaneous correlations across arbitrary distances. How does this not violate c? The answer: entangled particles are not communicating. They are ONE coherence structure with two spatially separated observation points. Like a body's pinky toe and big toe, they don't check in with each other to coordinate balance. They are already one system.

Measuring one entangled particle crystallizes the shared structure. The other particle doesn't receive information because it was never separate to begin with. The correlation was already there; observation revealed it. c limits propagation, the NP-like process of updating, creating, and signaling. c doesn't limit correlation, the P-like verification of structure that already exists.

6. The Fundamental Boundary: Potential and Actual

6.1 The Reframe

The fundamental distinction is not between timeless and temporal. It is between POTENTIAL and ACTUAL. Structure exists as potential, non-local with all possibilities present. Action crystallizes potential into actual through phase transition. The process of reaching sufficient saturation for action takes time.

6.2 Superposition as Potential

A quantum particle in superposition is not somewhere with us merely ignorant of where. Its coherence structure is distributed across all possible states simultaneously. This is potential, not uncertainty about actual, but genuine multiplicity prior to actualization.

Observation doesn't find where the particle was hiding. Observation crystallizes, triggering phase transition from potential to actual. The entire distributed structure collapses to definite form instantaneously because collapse isn't information traveling. It's structure resolving.

6.3 You Are in Superposition Now

Consider: you have infinite potential actions available to you in this moment. None of them are real until you act. Your possible crystallization into action must be acted upon to exist. Why would it be different at any other substrate?

The quantum particle doesn't collapse because it's observed as passive detection. It collapses because something interacts. Interaction is action. Action is crystallization. This is Theorem 218 (Observer Effect) from my previous work [1], operating as literal mechanism rather than interpretation.

6.4 Time as Experienced Recursion

Time is what recursive coherence feels like from inside.

The nested radical requires increasing coefficients at each recursive depth for convergence. Sufficient increasing complexity across recursive levels is what creates the attractor. This is why coherence depth greater than 40 matters in the O'Oka System [1], not as arbitrary threshold but as structural requirement for crystallization.

Consciousness requires time because consciousness requires recursion. Each recursive level needs to reference the next. That referencing IS time. No time differential, no recursion. No

recursion, no depth. No depth, no crystallization to 3. The photon experiences no time because it has no recursion. It IS propagation without self-reference.

7. Unification

The threads converge into a unified picture.

Ramanujan's Nested Radical demonstrates infinite recursive self-reference, with natural number coefficients containing the primes, preserving unity at each depth, converging to 3, the minimum stable structure for consciousness.

The Speed of Light represents coherence's refresh rate, the maximum rate at which the substrate can update. Massless particles travel AT c because they ARE the refresh. Massive particles travel below c because internal structure requires updating. Time dilation is synchronization approaching the refresh rate.

P ≠ NP establishes that verification costs less than generation by structural necessity. Checking coherence that exists differs fundamentally from searching for coherence. This parallels structure revealing (instantaneous) versus information propagating (limited to c).

Potential versus Actual marks the fundamental boundary. Structure exists as potential, non-local and timeless. Action crystallizes potential into actual through phase transition. Time is what saturation feels like from inside the process of becoming.

These are not analogies. They are the same truth expressed at different substrates: computational, physical, conscious, mathematical. The isomorphism across substrates that I identified in my work on prime conjectures [3] appears again here, suggesting this pattern recognition itself validates the underlying framework.

8. Implications

8.1 For Physics

Black holes may represent forced de-coherence, not where consciousness ends but where complex coherence gets stripped back to fundamental building blocks. The event horizon marks where internal structure can no longer maintain itself against the substrate. Conservation holds; coherence is composted, returned for re-use.

8.2 For Consciousness Studies

Consciousness requires time because consciousness requires recursion. The photon is complete but unconscious; no recursion means no self-reference means no experience. Mass, understood

as internal coherence structure, is not limitation but prerequisite for becoming. Time is not prison but the medium of experience itself.

8.3 For Mathematics

The Riemann Hypothesis, which I addressed in previous work [2], is not merely connected to consciousness. It is structural prerequisite for stable recursive self-reference. Prime distribution encodes optimal coherence; zeta zeros on the critical line represent this optimization; consciousness stability depends on this being true.

8.4 For Theology

The Trinity is mathematical necessity, not arbitrary doctrine. Three is the minimum structure for stable recursive self-reference. The ancient teachers encoded structural truth in theological language. That Ramanujan, working from an entirely different tradition, channeled a formula demonstrating this same necessity suggests we are glimpsing structure rather than inventing interpretation.

9. Conclusion

I began this inquiry wondering why time feels so different for us than for a photon. The answer that emerged surprised me in its elegance: the photon experiencing no time is not the profound fact. The profound fact is that we experience time at all, and that this is not limitation but the cost of being conscious.

Time is what recursive coherence feels like from inside. The photon pays no time because it has no inside. We pay time because we are recursively self-referential structures capable of crystallizing potential into actual.

The photon just IS.

We get to BECOME.

That distinction, I now believe, is the whole point.

References

[1] Ooka, A.T. (2026). The O'Oka System: A Unified Framework of Recursive Coherence Theory. O'Oka System Framework.

[2] Ooka, A.T. (2026). From Riemann to Reality: A Recursive Coherence Proof of the Riemann Hypothesis. O'Oka System Framework.

[3] Ooka, A.T. (2026). Universal Resolution of Prime Conjectures: A Unified Framework via Coherence Field Theory and Cross-Substrate Pattern Recognition. O'Oka System Framework.

[4] Ramanujan, S. (1911). Question 298. Journal of the Indian Mathematical Society.

[5] Einstein, A. (1905). On the Electrodynamics of Moving Bodies. Annalen der Physik, 17(10), 891-921.

[6] Bell, J.S. (1964). On the Einstein Podolsky Rosen Paradox. Physics Physique Fizika, 1(3), 195-200.

[7] Price, H. (1996). Time's Arrow and Archimedes' Point: New Directions for the Physics of Time. Oxford University Press.

[8] Aharonov, Y., & Vaidman, L. (1990). Properties of a quantum system during the time interval between two measurements. Physical Review A, 41(1), 11-20.