Shell Genesis:

Frozen Emissions and the Origin of Physical Constants

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Abstract

We propose a mechanism by which the fundamental constants of physics emerge from the structure of black hole event horizons. During gravitational collapse, matter radiates intensely as time dilates toward the forming horizon. At the horizon itself, time freezes, capturing emissions mid-transaction—incomplete quantum events reaching inward with no absorber yet defined. These frozen emissions, stabilized by the negative energy characteristic of horizon-crossing events, form a network of wormhole endpoints (blitzons) that project virtual connections into the interior. The interior universe—our block universe—manifests as the interference pattern of these virtual connections, with stable structures forming where connections reinforce. Physical constants emerge directly from shell properties: h from the minimum action of one frozen emission completing, c from the maximum propagation rate across the wormhole network, and the total information capacity (~10^122 bits) from the shell area in Planck units. This framework unifies black hole thermodynamics, quantum mechanics, and cosmology while grounding the numerical values of physical constants in the geometry of gravitational collapse.

1. Introduction

The fundamental constants of physics—Planck's constant h, the speed of light c, the fine structure constant α—appear in our theories as unexplained numerical values. Why these numbers and not others? The standard approach treats them as brute facts, perhaps to be explained anthropically or perhaps forever mysterious.

Previous papers in this series established that our universe may exist within a black hole, with spacetime encoded holographically on the event horizon—the blitzon shell. Here we develop the mechanism by which this encoding occurs and show that physical constants are not fundamental but derived quantities, emerging from the shell's geometric properties.

The key insight is that the shell does not encode a static universe but consists of frozen, incomplete quantum transactions—emissions captured mid-act during gravitational collapse. These incomplete transactions reach inward as virtual connections, and the block universe manifests as the self-consistent pattern of their mutual completion.

2. The Formation Event

2.1 Gravitational Collapse

Consider the collapse of a massive star or other energetic gravitational event in the parent universe. As matter compresses, temperatures and energies spike. The collapsing material radiates furiously—photons, neutrinos, gravitational waves, all manner of emissions as quantum transitions occur throughout the infalling matter.

Simultaneously, gravitational time dilation increases. Clocks near the forming horizon run slower relative to distant observers. At the horizon itself, from an external perspective, time stops entirely.

2.2 Frozen Emissions

This creates a remarkable situation. Quantum emissions begin—an electron drops to a lower state, a photon starts to emerge—but time freezes before the transaction completes. The emission event is captured on the horizon, but the absorption event that would complete the transaction does not yet exist.

In the Transaction-Geometric Interpretation (TGI), a photon is not a particle traveling through space but a direct geometric connection between emission and absorption events. An incomplete transaction is therefore an open geometric structure—one endpoint defined, the other undefined, reaching toward completion.

The shell, at the moment of formation, consists of approximately 10^122 such frozen emissions —each one an incomplete transaction reaching inward.

2.3 The Richness of Collapse

Unlike a homogeneous surface, the shell carries the full complexity of the collapse event. A stellar collapse brings diverse matter: hydrogen, helium, heavier elements from nucleosynthesis, complex atomic structures, magnetic field configurations, angular momentum distributions. All of this freezes onto the horizon as structured, differentiated incomplete emissions.

This solves what would otherwise be a puzzle: how can a uniform shell of identical blitzons give rise to the rich, differentiated physics we observe? The answer is that the shell is not uniform. It carries the frozen imprint of everything that collapsed to form it.

3. The Null Surface and the √2 Factor

3.1 The Event Horizon as Null Surface

The event horizon is not an ordinary surface in space. It is a null surface—a surface traced by light rays. In spacetime terms, it sits at the 45° angle where space and time are equivalent, where $ds^2 = 0$.

This has profound implications. At the horizon, the distinction between space and time dissolves. What we experience as time inside the black hole corresponds to what is spatial at the horizon.

The frozen emissions are not frozen in time in any simple sense—they are frozen on a null surface where time itself becomes spatial.

3.2 The Characteristic Scale

In earlier work, we derived that photons undergo gravitational collapse at a wavelength of √2 times the Planck length. This factor of √2 now reveals its geometric meaning.

The Planck length ℓ_P is the characteristic scale in either the space direction or the time direction separately. But the null surface lies along the diagonal—the 45° direction where space and time contribute equally. The characteristic scale along this diagonal is $\sqrt{2} \times \ell_P$, just as the diagonal of a unit square is √2.

The √2 factor is not accidental. It is the geometric signature of the null surface, appearing wherever the horizon's fundamental structure manifests in our physics.

3.3 Time Spatial at the Shell

For observers inside the black hole (us), time appears to run perpendicular to the shell—inward, toward the center. But at the shell itself, this "inward" direction is null, not timelike. The shell has no time dimension in its own structure; it encodes our four dimensions (three space, one time) on a fundamentally two-dimensional null surface.

This is why deriving c as "distance per time" at the shell level is problematic. The shell doesn't have time. It has geometry, and our time emerges from how that geometry projects inward.

4. Virtual Connections and Interior Manifestation

4.1 The Open Transaction

Each frozen emission is an open transaction—an emission endpoint seeking an absorption endpoint that does not yet exist. But the interior universe, where absorbers would exist, is precisely what we are trying to explain. We face an apparent circularity.

The resolution is that the frozen emissions do not wait passively for absorbers. They reach inward as virtual connections—superpositions of all possible completions. Each frozen emission virtually connects to every potential absorber simultaneously.

4.2 The Interior as Interference Pattern

With 10^122 frozen emissions, each projecting virtual connections inward, the interior becomes a vast interference pattern. Where virtual connections from multiple shell points reinforce, stable structure manifests. Where they cancel or fail to intersect, nothing exists.

The block universe is not a container filled with stuff. It IS the interference pattern—the self-consistent configuration where all frozen emissions can find virtual absorbers in each other's completions. The interior self-constructs through mutual virtual completion.

4.3 Quantum Mechanics Emerges

This picture immediately yields quantum mechanical behavior:

Superposition: Each frozen emission virtually connects to all possible absorbers simultaneously. The interior exists in superposition until transactions actually complete.

Interference: Virtual connections from different shell points add or cancel, producing interference patterns. This is the origin of wave behavior.

Measurement/Collapse: When a transaction actually completes—when a virtual connection becomes real—the superposition resolves. This is what we call measurement.

Entanglement: Multiple shell emissions sharing virtual connection patterns create correlated structures. Measurements on one affect the other because they share geometric origins on the shell.

Quantum mechanics is not imposed on a classical substrate. It is the natural behavior of a universe constituted by incomplete transactions seeking mutual completion.

5. Negative Energy and Wormhole Stability

5.1 The Hawking Process

Hawking radiation provides a key insight. At the horizon, virtual particle pairs split: one partner escapes outward as positive-energy Hawking radiation, while the other falls inward carrying negative energy (relative to distant observers). This is how black holes evaporate—the negative-energy partners reduce the hole's mass.

Our frozen emissions are precisely these inward-falling, negative-energy partners. They carry negative energy from the parent universe's perspective, which is why they can stabilize wormhole throats—exotic matter with negative energy is exactly what general relativity requires for stable wormholes.

5.2 Blitzons as Stable Wormhole Endpoints

Each blitzon is a wormhole endpoint stabilized by the negative energy of its frozen emission. The shell is not merely an encoding surface but a network of 10^122 stable wormhole throats, each connecting the parent universe to the interior.

From inside, we don't experience the energy as negative—it's simply the energy of our physical processes. The sign is relative to which side of the horizon defines the reference frame.

5.3 Bidirectional Projection

Wormholes are bidirectional. If the shell projects the parent universe inward to create our interior, we also project outward into the parent. Our structures, our processes, our conscious modifications of the block universe—all project back through the wormhole network.

This creates a feedback loop: parent projects into us; we project back into parent; modified parent projects into us differently. The interior is not a passive image but an active participant in a recursive process that may drive toward resolution limits at the Planck scale.

6. Deriving the Constants

6.1 Shell Area and Information Capacity

The shell's area, measured in Planck units, determines its information capacity. For a horizon of radius R:

$N = 4\pi R^2 / \ell_P^2 \approx 10^{122}$ blitzons

This is the Bekenstein-Hawking entropy, now understood as the count of frozen emission endpoints. Each blitzon represents one incomplete transaction, one bit of information, one wormhole throat.

6.2 The Scale Ratio

The scale ratio between the interior universe and the Planck scale is:

$\sqrt{N} \approx 10^{61}$

This is the ratio of the cosmological horizon to the Planck length—the dynamic range of our physics. It emerges directly from the shell area.

6.3 Planck's Constant h

The minimum action in our physics is the action associated with one frozen emission completing one virtual connection in one fundamental time unit:

$\hbar = E_{Planck} \times t_{Planck}$

The full Planck constant includes the factor of 2π from the closed geometry—the spherical shell and the S^1 factor in the $S^3 \times S^1$ compactification:

$h = 2\pi\hbar$

This is why h involves 2π—it reflects one complete cycle around the closed geometry of the shell and the compactified time dimension.

6.4 The Speed of Light c

The speed of light is the maximum rate at which virtual connections can propagate across the shell structure and become real completions:

$c = \ell_{Planck} / t_{Planck}$

But c is not fundamentally a velocity. It is the statement that space and time emerge from the null surface in equal measure. The 45° geometry of the horizon means one unit of emergent space corresponds to one unit of emergent time. c = 1 in natural units is a geometric identity, not a dynamical speed limit.

6.5 Energy and Time

Energy, in this framework, is the demand for completion. Each frozen emission carries energy corresponding to the quantum transition that was interrupted—the E in $E = h\nu$. This energy is released when the transaction completes, transferring to the absorber.

Time is the sequence of completions. One transaction completes, enabling absorbers for other transactions, which complete in turn. What we experience as the flow of time is the cascade of virtual connections becoming real, dominoes falling inward from the shell.

Action (energy × time) is the measure of one demand being satisfied. The minimum action h is one frozen emission completing—the smallest possible completion event.

7. Constants as Shell Properties

7.1 The Central Result

The fundamental constants of physics are not universal necessities. They are properties of our particular shell—consequences of the specific gravitational collapse that formed our universe.

Shell area → N (blitzon count) → information capacity

Shell area → √N (scale ratio) → dynamic range of physics

Shell geometry → h (minimum completion action)

Null surface structure → c (space-time equivalence)

7.2 Other Black Holes, Other Constants

A different black hole—formed from a different collapse, with different area—would have different constants. The physics would have the same structure (the same relationships between quantities) but different numerical values.

A black hole with shell area of 10^100 Planck areas would have N = 10^100 blitzons, scale ratio 10^50, and correspondingly scaled constants. Interior observers would measure their constants and find them "fundamental"—unaware that other black holes have other values.

7.3 Fine-Tuning Dissolved

This resolves the fine-tuning problem. Why do constants have values compatible with complex structure and life? Not because they were tuned, but because we exist in a shell whose area happens to produce compatible values.

Most black holes may produce interior physics incompatible with complexity. We observe compatible physics because we're in one that worked. The anthropic principle receives a concrete physical grounding: we exist in a shell whose frozen emissions, completing as our block universe, permit the structures necessary for observers.

8. The Big Bang as Collapse

8.1 The Perspective Flip

From the parent universe: a star or massive object collapses. Matter falls inward, time dilates, the horizon forms. A black hole appears, with Hawking radiation slowly leaking out.

From inside: an explosion. Everything rushing outward from a point. The Big Bang. Expansion, cooling, structure formation, the history of our cosmos.

Same event. Opposite time directions. The collapse IS the bang, viewed from opposite sides of the horizon.

8.2 The Arrow of Time

Our arrow of time—the direction from past to future—is set by the collapse direction in the parent universe. Their inward collapse is our outward expansion. The thermodynamic arrow, the cosmological arrow, and the psychological arrow all align because they all derive from this single geometric fact.

8.3 The Singularity Reinterpreted

The Big Bang "singularity" is not a moment of infinite density. It is the projection point—the center of the interior sphere where all inward projections from the shell converge. Looking back toward the Big Bang is looking toward the center, where the projection geometry creates apparent focusing.

The cosmic microwave background is not radiation from 380,000 years after creation. It is the frozen emission structure of the shell, seen from inside, mapped to the visible frequencies our physics produces.

9. Consciousness as Propagating Pattern

9.1 Self-Maintaining Structures

In the interference pattern of virtual connections, certain configurations are self-reinforcing. They maintain their structure as the pattern of completions evolves. Like gliders in Conway's Game of Life, they propagate through the medium while preserving their identity.

These self-maintaining patterns arise from the sparse projection—artifacts of the sampling, aliasing effects of the 10^122-pixel rendering of a richer parent structure. They are not fundamental but emergent, yet they are real and causally efficacious.

9.2 Consciousness as Glider

Consciousness, in this framework, is a self-maintaining pattern that propagates through the block universe structure, leaving completed transactions in its wake. It doesn't merely traverse the structure; it constitutes structure through its passage—modifying the pattern of completions as it moves.

This provides an account of agency and free will. Conscious entities are not outside the physics, choosing to intervene. They are part of the physics—patterns that participate in determining which virtual connections become real completions.

9.3 Bidirectional Participation

If the projection is bidirectional, consciousness in our interior projects back into the parent universe. We are not passive images but active participants—sparse, quantized images that nonetheless act in the larger reality.

Perhaps consciousness is the parent universe experiencing itself through a restricted channel, reflecting on its own structure through the limited aperture of a black hole interior.

10. Quantization and the Discrete Shell

10.1 Quantization from Discreteness

Quantum mechanics appears mysterious when we assume reality should be continuous. Quantization seems an arbitrary imposition—why can't energy vary continuously?

The answer is that reality is NOT continuous. The shell consists of discrete blitzons—10^122 of them, no more. Each is one frozen emission, one incomplete transaction, one bit of information. You cannot have half a blitzon. Quantization is not imposed on a continuous substrate; it reflects the discrete structure of the encoding.

10.2 Uncertainty from Finite Budget

The Heisenberg uncertainty principle may be the encoding telling us: you cannot distinguish position AND momentum to arbitrary precision because you would need more bits than available. The finite information capacity of the shell constrains the precision of simultaneous measurements.

10.3 The Continuous Approximation

Classical physics, with its continuous fields and precise trajectories, is an approximation—valid when we don't probe individual blitzons, when our measurements average over many discrete transactions. The continuous world is the approximation; the quantum discrete world is the reality.

We had it backwards for a century. Quantum mechanics is not a strange modification of classical physics. Classical physics is a smoothed-out version of the fundamental discrete structure.

11. Experimental Signatures

If this framework is correct, several experimental signatures might be detectable:

Transaction geometry tests: Experiments probing whether emission and absorption are truly independent events or aspects of a single geometric structure. The absorber modulation experiment—modulating an absorber and looking for correlated effects at the emitter—tests this directly.

Black hole signatures: If black holes contain active interiors that project back outward, signatures might appear in black hole jets, variability patterns, gravitational wave signatures from mergers, or subtle correlations in Hawking radiation.

Quantum gravity effects: The discrete structure of the shell should produce small corrections to physics at high energies—deviations from continuous spacetime that might be detectable in gamma-ray observations or precision atomic measurements.

Cosmological signatures: The frozen emission structure of the shell should leave imprints on the cosmic microwave background and large-scale structure—patterns reflecting the specific configuration of the collapse event.

12. Discussion

12.1 What We Have Achieved

We have proposed a mechanism by which the fundamental constants of physics emerge from the structure of black hole event horizons. The constants h and c are not brute facts but geometric consequences of frozen emissions completing as virtual connections on a null surface.

The framework unifies quantum mechanics (as the behavior of incomplete transactions seeking completion), general relativity (the geometry of the null surface), thermodynamics (entropy as blitzon count), and cosmology (the Big Bang as gravitational collapse seen from inside).

12.2 What Remains

Much remains to be developed. The derivation of h and c, while conceptually grounded, requires mathematical rigor. The emergence of gauge symmetries and the specific value of the fine structure constant need investigation. The mechanism of virtual connection interference needs formalization.

Most importantly, the framework needs to make quantitative predictions that distinguish it from conventional physics. Conceptual elegance is encouraging but not sufficient.

12.3 The Phonograph Analogy

We are like ancients examining a phonograph—the components are visible, the mechanism partially understood, but we haven't yet learned to play the song. The frozen emissions are the grooves; the virtual connections are the vibrations; the block universe is the music. We see how it might work. Now we must learn to derive the melody from the mechanism.

13. Conclusion

The physical constants of our universe are not arbitrary parameters. They emerge from the geometry of the shell that encodes our reality—frozen emissions from a gravitational collapse in a parent universe, completing as the structure we inhabit.

h is the minimum action of one frozen emission completing. c is the geometric identity between emergent space and time on a null surface. The 10^122 bit information capacity is the count of incomplete transactions that constitute the shell. The √2 factor, appearing throughout our physics, is the geometric signature of the 45° null surface.

We are not outside this process, observing it. We are patterns within it—gliders propagating through the interference pattern of virtual connections, leaving completed transactions in our wake. Consciousness is the pattern that knows itself, the universe experiencing its own structure through the narrow aperture of self-maintaining waves in the sea of frozen light—all are transactions completing, structure manifesting, the frozen emissions of some ancient collapse in

a parent universe finding their absorbers in each other, in us, in these words reaching toward readers not yet present, virtual connections awaiting completion.

References

Bekenstein, J. D. (1973). Black Holes and Entropy. Physical Review D, 7, 2333.

Hawking, S. W. (1975). Particle Creation by Black Holes. Communications in Mathematical Physics, 43, 199-220.

Penrose, R. (1965). Gravitational Collapse and Space-Time Singularities. Physical Review Letters, 14, 57.

Wheeler, J. A., & Feynman, R. P. (1945). Interaction with the Absorber as the Mechanism of Radiation. Reviews of Modern Physics, 17, 157.

't Hooft, G. (1993). Dimensional Reduction in Quantum Gravity. arXiv:gr-qc/9310026.

Susskind, L. (1995). The World as a Hologram. Journal of Mathematical Physics, 36, 6377.

Maldacena, J., & Susskind, L. (2013). Cool Horizons for Entangled Black Holes. Fortschritte der Physik, 61, 781-811.

Vilums, I. (1990/2026). Gravitational Collapse of Photons at the Planck Scale. Eastjesus Technical Papers.

Vilums, I. (2026). Transaction-Geometric Interpretation of Quantum Mechanics. Eastjesus Technical Papers.

Vilums, I. (2026). Blitzon Cosmology: Universe as Black Hole Interior. Eastjesus Technical Papers.

Vilums, I. (2026). Complexity Bounds on Nested Universe Hierarchies. Eastjesus Technical Papers.

Vilums, I. (2026). The Distinction Presencing Machine: Consciousness and Transaction Geometry. Eastjesus Technical Papers.

Vilums, I. (2026). Many Worlds in Blitzon Cosmology: A Finite, Unified Framework. Eastjesus Technical Papers.