# The Prime Space: Quantum Compression of Non-Events and its Cosmological Consequences

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**Abstract**

This paper expands upon the hypothesis that gravity is a consequence of a non-unitary quantum mechanical process termed "informational compaction," where the "non-events" of the quantum vacuum are continuously compressed. We propose a more fundamental mechanism for this compression, suggesting that it is governed by the principles of prime number factorization. In this framework, prime numbers are the irreducible "bits" of a solidifying reality. We propose a new form for the collapse operator in a modified Schrödinger equation, one that acts preferentially on states with quantum numbers that are composites, thereby reducing them to their prime constituents. This process provides a novel physical basis for Julian Barbour's "timeless" universe and the emergence of the arrow of time from increasing complexity. Finally, we suggest a method for testing this hypothesis by searching for statistical signatures of the Riemann zeta function zeros—which are intrinsically linked to primes—in cosmological data, such as the Cosmic Microwave Background (CMB).

## 1. Introduction: A Universe of Compacting Non-Events

The standard models of physics struggle to reconcile quantum mechanics and general relativity. This paper's foundational hypothesis, outlined in "The Solidifying Past: Gravity as the Compression of Non-Events," [1] posits a resolution to this conflict by reimagining the nature of the quantum vacuum and the arrow of time. In this view, the universe is not a static repository of events but a dynamic, irreversible process of "informational compaction," where the vast possibilities of "what did not happen" are continuously compressed and solidified. Gravity, in this framework, is an emergent phenomenon resulting from this ongoing compaction.

This paper introduces a deeper layer to this hypothesis: the structure of this informational compaction is not arbitrary, but is based on the fundamental nature of prime numbers. We draw a profound parallel: just as integers can be "compressed" down to their prime factors, so too are the "non-events" of reality being reduced to their prime constituents. This provides a mechanism for a universe that is not just evolving, but is converging to a state of ultimate, prime-based simplicity.

This concept also provides a novel physical interpretation for the work of Julian Barbour. Barbour's "timeless" universe, where the arrow of time arises from increasing complexity, finds a natural explanation in our framework. The "solidifying past" is the irreversible process of prime-based compression, which simultaneously increases the complexity of realized "Nows" by structuring them according to prime logic.

### *Step 1: Modifying the Schrödinger Equation*

$$i\hbar \frac{\partial}{\partial t}\psi(\mathbf{r},t) = \hat{H}\psi(\mathbf{r},t)$$

The standard time-dependent Schrödinger equation, $i\hbar_{\partial t}\psi(r,t)=H^\wedge\psi(r,t)$, is a fundamental equation of quantum mechanics. It describes the time evolution of the wave function in the absence of measurement. When a measurement occurs, the wave function is said to "collapse" instantaneously, which is a postulate of the theory, not something derived from the equation itself.

In this model the collapse is not instantaneous, but rather a process. To incorporate this into the existing framework, we can't just modify the standard Schrödinger equation directly because it doesn't describe collapse at all. Instead, we need to introduce a new term or a new equation that governs the collapse process itself. This new term would need to be nonlinear, as the collapse is a nonlinear process (it projects the wave function onto an eigenstate).

We can introduce a new operator, $\hat{C}$, which represents the collapse mechanism. This operator would need to depend on the probabilities of the different states, and its effect would be to "drive" the wave function towards a single eigenstate. Let's say we have a system with a discrete set of eigenstates, $|\phi_n\rangle$, with corresponding eigenvalues $E_n$. The wave function can be written as a superposition:

$$|\psi(t)\rangle = \sum_n c_n(t)|\phi_n\rangle$$

where $c_n(t)$ are the complex coefficients, and $|c_n(t)|^2$ is the probability of finding the system in state $|\phi_n\rangle$. The standard Schrödinger equation gives us the evolution of these coefficients: $i\hbar d_t c_n(t)=E_n c_n(t)$.

Now, let's add a term that models this new idea of a gradual collapse. The term should be stronger for lower probabilities, and its effect should be to reduce the superposition. A possible form for this term could be: $i\hbar\partial t\partial\psi(r,t)=H^\wedge\psi(r,t)+C^\wedge(\psi)\psi(r,t)$

$$i\hbar \frac{\partial}{\partial t}\psi(\mathbf{r},t) = \hat{H}\psi(\mathbf{r},t) + \hat{C}(\psi)\psi(\mathbf{r},t)$$

where $\hat{C}(\psi)$ is the new collapse operator. This operator must be a function of the wave function itself, making the equation nonlinear.

In this model lower probabilities collapse first, the operator $\hat{C}$ could be designed to "dampen" the components of the wave function with smaller $|c_n|2$. For instance, we could make $\hat{C}$ a function of the probabilities, $P_n= |c_n|2$. A simple (but not necessarily physical) form could be:

$$\hat{C}(\psi) = -\gamma \sum_n \frac{1}{P_n^\alpha} |\phi_n\rangle\langle\phi_n|$$

where $\gamma$ and $\alpha$ are positive constants. The term $P_{n\alpha}^1$ is large for small $P_n$, so this term would have a stronger effect on the lower-probability states. This would "compress" the lower probabilities first.

Substituting this into the modified equation and projecting onto the eigenstate $|\phi_m\rangle$, we get:

$$i\hbar \frac{d}{dt} c_m(t) = E_m c_m(t) - \gamma \frac{1}{|c_m(t)|^{2\alpha}} c_m(t)$$

Above, this equation is highly speculative and would need to be rigorously tested for consistency and conservation of probability. The probability $|c_m|2$ would not be conserved with this simple form.

*The Hypothesis*: In this model it could be that the "information" being compressed during the collapse process itself acts as a source for the gravitational field. The "energy" of the superposition, which is lost during the collapse, could be converted into gravitational energy.

*The Mathematical Link*: We would need to define an "energy-momentum tensor of collapse," $T_{\mu\nu/collapse}$, that is derived from the collapse term in our modified Schrödinger equation. This would likely be a function of the wave function and its derivatives. We would then add this to the standard energy-momentum tensor: $T_{\mu\nu/total}=T_{\mu\nu/matter}+T_{\mu\nu/collapse}$.

Our previous paper [1] also specifically suggests a "priority compression" of quantum states, where the least likely states are compressed first, and over time, this process "solidifies" the higher probability states. From the snapshot moments we see, it is hard to say if probability actually conserved. The previous paper suggests that the universe is "nearing its final perfect glass-like state" and that the expansion is driven by "information loss". This "information loss" is described as a measure of the reduction of uncertainty within the Markov blankets and is linked to cosmic expansion. The traditional concept of probability conservation in quantum mechanics. $\langle\psi|\psi\rangle=1$ at all times) is a statement that the total probability of all possible outcomes must always be one. But, if the universe is converging to a single measurement at "infinite energy" and is losing information, this implies that the total probability might not be conserved in the traditional sense, but rather redistributed or "compressed."

## 2. The Modified Quantum Dynamics and Prime-Based Compression

The time-dependent Schrödinger equation: $i\hbar_{\partial t\partial}\psi(r,t)=\hat{H}\psi(r,t)$ describes a unitary evolution, meaning that the total probability of all outcomes is always conserved. To account for the irreversible "informational compaction," we must introduce a new, non-unitary compression operator, $\hat{K}(\psi)$, which modifies the standard equation:

$i\hbar_{\partial t\partial}\psi(r,t)=\hat{H}\psi(r,t)+\hat{K}(\psi)\psi(r,t)$

$$i\hbar \frac{\partial}{\partial t}\psi(\mathbf{r},t) = \hat{H}\psi(\mathbf{r},t) + \hat{K}(\psi)\psi(\mathbf{r},t)$$

Our previous work proposed a generic form for $\hat{K}(\psi)$ that preferentially acts on low-probability states. We now refine this idea with a prime-based mechanism. The "non-events" of the vacuum are not a uniform sea of possibilities; they are structured, and their compression follows a rule analogous to prime factorization. We can imagine the quantum states being labeled by some integer-like quantum number, n. The compression operator would then act to "break down" composite numbers into their prime factors, thus solidifying the fundamental, irreducible nature of reality.

We can define a prime-based compression operator, $\hat{K}_{prime}$, such that its effect is strongest on states with composite quantum numbers. Let's assume a simplified system with a quantum number n. $\hat{K}_{prime}=i\hbar\gamma n\sum(\Phi\alpha F(n)) |\phi_n\rangle\langle\phi_n|$

$$\hat{K}_{prime} = i\hbar\gamma \sum_n \left(\frac{\mathcal{F}(n)}{\Phi^\alpha}\right) |\phi_n\rangle\langle\phi_n|$$

Here:

- $\mathcal{F}(n)$ is a function that measures the "compositeness" of the integer n. A simple definition could be $\mathcal{F}(n)=n-\pi(n)$, where $\pi(n)$ is the prime-counting function. A more nuanced approach would involve the number of prime factors or the "distance" from being a prime.

- $\gamma$, $\Phi$, and $\alpha$ are positive constants.

This new operator drives the wave function's evolution, not just by probability, but by the prime nature of the states themselves. This provides a deep, structural reason for the irreversible nature of time and the progressive "solidification" of the universe.

## 3. Connection to Julian Barbour's "Platonia"

Julian Barbour's influential work posits a universe where time is not a fundamental dimension but an illusion. He defines "Platonia" as the configuration space of all possible "Nows" of the universe. The arrow of time, in his view, emerges from the universe's movement through this space, which is characterized by a path of increasing complexity.

Our prime-based compression hypothesis offers a concrete physical mechanism for this process. The irreversible, non-unitary evolution driven by K^prime is the engine that drives the universe's path through Platonia. Each moment in time is a "Now" where a new layer of quantum possibilities has been compressed down to its prime components. The increasing complexity that Barbour observes is a direct result of the structured, prime-based nature of this compaction. The arrow of time is simply the direction of increasing informational "primeness," as composite states are irreversibly reduced.

## 4. Observational Signatures and the Riemann Zeta Function

The Riemann zeta function, $\zeta(s)$, is a powerful tool in number theory, and its non-trivial zeros are deeply connected to the distribution of prime numbers. If our universe's fundamental compression mechanism is based on primes, it is a tantalizing possibility that we could detect this signature in physical phenomena. The distribution of the zeta function zeros is non-random, and its statistical properties are well-understood through random matrix theory. We propose two primary avenues for observational testing:

Test 1: The Cosmic Microwave Background (CMB). The CMB is a snapshot of the early universe, when it was a hot, dense plasma. According to our hypothesis, this was a state of high uncertainty, a "sea of non-events" waiting to be compressed. As the universe expanded and cooled, a subtle, prime-based compression process began. We would not expect to see a direct prime number in the CMB data, but rather a statistical signature. We could analyze the power spectrum of the CMB's temperature fluctuations for a distribution of spacings between spectral peaks that matches the statistical distribution of the Riemann zeta function's non-trivial zeros. This would provide a profound connection between a purely mathematical object and the largest scale structure of our universe.

Test 2: Quantum Collapse Experiments. A second avenue for testing involves experiments on quantum collapse, which is the direct observation of our proposed compression process. We can use experiments that measure the outcomes of a quantum state over many trials. For example, in a "Carmichael-type" experiment, which might measure the rotation of a quantum state (e.g., a spin), we would look for subtle "rotation offsets" or other measurement variations. If the collapse is governed by a prime-based mechanism, the statistical distribution of these offsets might exhibit a pattern that is not perfectly random but is subtly biased in a way that reflects the distribution of prime numbers or, more precisely, the zeros of the zeta function.

## 5. Symbolic Modeling with SymPy and EinsteinPy

To begin exploring these ideas, we can use symbolic computational tools like SymPy and EinsteinPy. SymPy allows us to define our new, non-linear quantum operators and equations, while EinsteinPy provides the framework to connect the results to the curvature of spacetime. Below is an example showing how to define a prime-based compression operator in SymPy and a more detailed conceptual example of the energy-momentum tensor.

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### SOURCE CODE – PART I

```python
import sympy
from sympy import I, Function, dsolve, Symbol, Matrix, Integer
from sympy.physics.quantum import Ket, Bra, Dagger, hbar, Operator
from einsteinpy.symbolic import MetricTensor, EinsteinTensor, StressEnergyTensor, symbols

# --- Part 1: SymPy for the Prime-Based Schrödinger Equation ---
# This code block defines a conceptual prime-based compression operator.

# Define symbolic variables and functions
t = Symbol('t')
gamma = Symbol('gamma', positive=True)
Phi = Symbol('Phi', positive=True)
alpha = Symbol('alpha', positive=True)

# Define a function to determine if a number is prime for our operator
# Note: For real computation, this would be a more sophisticated function,
# perhaps one that measures "compositeness" or prime factors.
def is_prime(n):
    if n < 2:
        return False
    for i in range(2, int(n**0.5) + 1):
        if n % i == 0:
            return False
    return True

# Define a new "compositeness" function for our operator
def compositeness(n):
    """A conceptual function that returns a value based on how 'composite' a number is.
    Primes have a value of 0, composites have a value > 0."""
    n = int(n)
    if is_prime(n):
        return 0
    else:
        # A simple measure could be the number of prime factors.
        factors = sympy.primefactors(n)
        return len(factors)

# Define the coefficients of our wave function as functions of time
# For this example, let's consider states 2, 3, and 6.
c2 = Function('c2')(t)
c3 = Function('c3')(t)
c6 = Function('c6')(t)

# Define the Hamiltonian matrix for this 3-state system
E2, E3, E6 = Symbol('E2'), Symbol('E3'), Symbol('E6')
H = Matrix([[E2, 0, 0], [0, E3, 0], [0, 0, E6]])

# Define the prime-based compression operator matrix, K_hat.
# Its action is stronger on the composite state (n=6).
K_prime = I * hbar * gamma * Matrix([
    [(Phi - compositeness(2)) / Phi**alpha, 0, 0], # State 2 is prime, so compression is minimal
    [0, (Phi - compositeness(3)) / Phi**alpha, 0], # State 3 is prime, minimal compression
    [0, 0, (Phi - compositeness(6)) / Phi**alpha]  # State 6 is composite, stronger compression
])

# Define the state vector psi
psi = Matrix([[c2], [c3], [c6]])

# Construct the modified Schrödinger equation
lhs = I * hbar * psi.diff(t)
rhs = H * psi + K_prime * psi

print("The Prime-Based Modified Schrödinger Equation for a 3-state system:")
sympy.pretty_print(sympy.Eq(lhs, rhs))
print("\n")

# --- Part 2: EinsteinPy for the Emergent Gravitational Field ---
# This section demonstrates how a prime-based energy-momentum tensor could be constructed.
# The density and pressure would be derived from the quantum dynamics in Part 1.

# Define spacetime coordinates
t_coords, r, theta, phi = symbols('t r theta phi')

# The energy density and pressure are now functions not just of position,
# but also of the 'primeness' of the local quantum vacuum.
rho_compression = Function('rho_prime_compression')(r, t_coords)
pressure_compression = Function('p_prime_compression')(r, t_coords)

# Construct the energy-momentum tensor from the compression process
# This is a conceptual representation, assuming a perfect fluid source.
T_compression = Matrix([
```

```
        [rho_compression, 0, 0, 0],
        [0, pressure_compression, 0, 0],
        [0, 0, pressure_compression, 0],
        [0, 0, 0, pressure_compression]
])

print("Conceptual Energy-Momentum Tensor from Prime-Based Compression:")
sympy.pretty_print(T_compression)
print("\n")

# A generic metric tensor for a spherically symmetric spacetime
nu = Function('nu')(r)
lam = Function('lam')(r)
g_munu = MetricTensor([
    [-sympy.exp(nu), 0, 0, 0],
    [0, sympy.exp(lam), 0, 0],
    [0, 0, r**2, 0],
    [0, 0, 0, r**2 * sympy.sin(theta)**2]
], syms=[t_coords, r, theta, phi])

# Compute the Einstein tensor from the metric
G_munu = EinsteinTensor.from_metric(g_munu)

# The full Einstein Field Equations would be G_munu = (8*pi*G/c^4) * T_munu
# We would solve this system of equations to find the spacetime metric.
print("The (0, 0) component of the Einstein Field Equations with the new source:")
sympy.pretty_print(sympy.Eq(G_munu[0, 0], (8*sympy.pi*Symbol('G')/Symbol('c')**4) * T_compression[0, 0]))
```

# SOURCE CODE - PART II

```
import numpy as np
import matplotlib.pyplot as plt
from scipy.integrate import solve_ivp
import sympy
from sympy import symbols
## pip install einsteinpy --break-system-packages
from einsteinpy.symbolic import MetricTensor, symbols, simplify

# --- 1. Define Constants and System Parameters ---
# Define fundamental constants
hbar = 1.0545718e-34  # Reduced Planck constant
G = 6.67430e-11       # Gravitational constant
c = 299792458.0       # Speed of light

# Define parameters for our model
gamma = 1e-10         # Coupling constant for compression (highly speculative)
Phi = 1.0             # Normalizing constant
alpha = 2.0           # Non-linearity parameter

# Define system states for our simulation
# Let's consider a simple two-state system: a prime state (n=3) and a composite state (n=6)
# Quantum numbers for the states
n1 = 3  # Prime
n2 = 6  # Composite

# Define the energy eigenvalues for our states
E1 = 1e-20  # Energy for state 1
E2 = 1.2e-20  # Energy for state 2

# --- 2. Implement the Prime-Based Compression Logic ---
def is_prime(n):
    """
    Checks if a number is prime.
    """
    if n < 2:
        return False
    for i in range(2, int(np.sqrt(n)) + 1):
        if n % i == 0:
            return False
    return True

def compositeness(n):
    """
    A simple conceptual function for 'compositeness'.
    Primes have 0, composites have a value > 0 based on number of factors.
    """
    if is_prime(n):
        return 0
    else:
        factors = []
        d = 2
        temp_n = n
        while d * d <= temp_n:
            while (temp_n % d) == 0:
                factors.append(d)
                temp_n //= d
            d += 1
        if temp_n > 1:
            factors.append(temp_n)
        return len(factors)

# Calculate the compositeness values for our states
comp1 = compositeness(n1)
comp2 = compositeness(n2)

# --- 3. Set up the Differential Equation Solver ---
def dpsi_dt(t, y):
    """
    The function to be integrated by solve_ivp.
    y = [Re(c1), Im(c1), Re(c2), Im(c2)]
    """
    # Unpack the state vector
    re_c1, im_c1, re_c2, im_c2 = y
    c1 = re_c1 + 1j * im_c1
    c2 = re_c2 + 1j * im_c2

    # Calculate probabilities from the coefficients
    p1 = np.abs(c1)**2
    p2 = np.abs(c2)**2

    # Calculate the new compression terms from our modified Schrödinger equation
    k1 = 1 * hbar * gamma * ((Phi - comp1) / Phi**alpha) * c1
    k2 = 1 * hbar * gamma * ((Phi - comp2) / Phi**alpha) * c2

    # The full equation for dc/dt is:
    # dc_n/dt = (1 / ih) * (E_n * c_n + K_n * c_n)
    dc1_dt = (1 / (1j * hbar)) * (E1 * c1 + k1)
    dc2_dt = (1 / (1j * hbar)) * (E2 * c2 + k2)

    return [dc1_dt.real, dc1_dt.imag, dc2_dt.real, dc2_dt.imag]

# Set initial conditions and time span
y0 = [1.0 / np.sqrt(2), 0, 1.0 / np.sqrt(2), 0]  # Equal superposition, so p1=p2=0.5
t_span = (0, 1e25)  # A long time span to observe the collapse
t_eval = np.linspace(t_span[0], t_span[1], 1000)

# Solve the differential equation
sol = solve_ivp(dpsi_dt, t_span, y0, t_eval=t_eval)

# Reconstruct the complex coefficients and probabilities from the solution
c1_sol = sol.y[0] + 1j * sol.y[1]
c2_sol = sol.y[2] + 1j * sol.y[3]
p1_sol = np.abs(c1_sol)**2
p2_sol = np.abs(c2_sol)**2
total_p_sol = p1_sol + p2_sol

# --- 4. Connect to Gravity and Perform Comparative Analysis ---
# Our model's gravitational source (a simplified T_00 component) is related to the
# "compression energy" of the vacuum. We can model this as being proportional to the
# rate of change of total probability (informational loss).
rho_compression = -hbar * np.gradient(total_p_sol, sol.t)  # Energy density from compression

# Let's simplify and assume the effect is spherically symmetric.
# We will compare the g_00 metric component to the standard Schwarzschild solution.
# The simplified form of the EFE for the g_00 component is:
# -R_00 / g_00 = (1/2) * d^2(g_00)/dr^2 + ... = 4*pi*G/c^4 * T_00
# We can approximate this as g_00 - - (1 - 2GM/rc^2) - (8*pi*G/c^4) * T_00 * r^2
# For simplicity, we will use a much simpler approximation where T_00 directly
# impacts the metric component.

def g_00_our_model(r_values, rho_compression_value):
    """
    A simplified conceptual model for the g_00 metric component.
    It adds a term from our compression energy density.
    This is for illustrative purposes and is not a rigorous solution to the EFE.
    """
    # Standard Schwarzschild term
    rs = 2 * G * 1e20 / c**2  # Example mass for a small black hole
    schwarzschild_term = - (1 - rs / r_values)

    # Our new term is proportional to the energy density from compression.
    # We will assume this energy density decays with distance from the source
    # For now, we will just use the value and assume it's a constant
    our_term = -(8 * np.pi * G / c**4) * rho_compression_value * r_values**2
    return schwarzschild_term + our_term

def g_00_schwarzschild(r_values):
    """
    The standard Schwarzschild solution for the g_00 metric component.
    """
    rs = 2 * G * 1e20 / c**2
    return - (1 - rs / r_values)

# Evaluate the metric components for a range of radii
r_values = np.linspace(1e-10, 1e-8, 1000) # Small range close to the Planck scale
g_00_schwarz = g_00_schwarzschild(r_values)
g_00_our_sim = g_00_our_model(r_values, rho_compression[-1]) # Use the final compression value

# Plot the difference
plt.figure(figsize=(10, 6))
plt.plot(r_values, g_00_our_sim - g_00_schwarz, label='Difference in $g_{00}$ (Our Model - Schwarzschild)')
plt.xlabel('Radius (r) [m]')
plt.ylabel('Difference in Metric Component')
plt.title('Difference in $g_{00}$ between Primordial Prime Model and Schwarzschild')
plt.grid(True, linestyle='--', alpha=0.6)
plt.axhline(0, color='black', linestyle='-')
plt.legend()
plt.show()
```

## 6. The Measurement Problem Reframed - Towards a Final Observation

The preceding sections have established a theoretical framework where gravity is an emergent consequence of the universe's relentless pursuit of informational compaction. This process, governed by the principles of prime factorization, acts as a collapse operator, $C \wedge$, that irreversibly reduces the vast, unactualized potential of "non-events" to their most fundamental, prime constituents. In this final section, we argue that this process offers a radical reinterpretation of the quantum measurement problem, shifting the focus from a discrete, instantaneous event to a continuous, and ultimately, incomplete process of observation.

The measurement problem in standard quantum mechanics posits that the act of observation causes the wave function to collapse from a superposition of states to a single, definite outcome. This creates a dichotomy between the probabilistic quantum world and the deterministic classical world, leaving the precise nature of "observation" and "observer" ambiguous. Our model provides a new perspective: every interaction, every unfolding event in the universe, is not a final, absolute measurement, but rather an incremental step in the ongoing process of informational compaction.

From this viewpoint, reality begins not as a set of definite events, but as a sea of all "what didn't happen." The passage of time, as defined by the increasing informational density and organization, is the slow, continuous process of eliminating these unactualized possibilities. A low-energy measurement is therefore not a definitive observation, but a weak, local compression of a small part of the universal wave function. It solidifies a portion of the past, but leaves the vast majority of the "negative space" of reality in a state of uncompressed potential. The probabilistic nature of these measurements —the uncertainty—is not a fundamental feature of reality, but a reflection of the fact that we are only ever observing a partially compressed, and therefore inherently incomplete, state.

A truly "real observation" or an absolute measurement is, in this model, a theoretical limit that the universe asymptotically approaches. It is the moment when the informational compaction is complete, when the entire universe is reduced to its final prime-based, irreducible state. This is the ultimate "best matching" of all possible configurations, as described by Barbour, where all dilational momentum has been driven to zero and the universe rests in a state of maximal informational density. This moment, however, is likely the end of time itself. The arrow of time exists precisely because this ultimate measurement has not yet occurred. We are in the process of building up to it, with each tick of the cosmic clock representing another layer of potential compressed, another composite quantum number reduced to its primes, and another portion of the past solidified.

## 7. Conclusion

This paper proposes a unified framework that bridges several disparate concepts in modern physics. By positing that the continuous informational compaction of "non-events" is a process governed by prime number factorization, we provide a concrete, physical mechanism for the emergence of gravity as a universal compression limit. The collapse operator $C \wedge$ offers a number-theoretic solution to the problem of informational solidification outlined in our previous work, "The Solidifying Past."

Our model provides a profound reinterpretation of key cosmological and quantum principles:

The Arrow of Time is not an illusion, but the direction of increasing informational compaction.

The Quantum Vacuum is a dynamic, information-rich state of "unactualized potential" that is continuously being compressed.

Gravity is the large-scale, emergent manifestation of this compaction.

The Measurement Problem is re-framed as a continuous process of incremental, incomplete observation, with a final, absolute measurement existing only as a theoretical end-point.

The synthesis of these ideas leads to several testable predictions. The existence of a "preferred frame" defined by the Cosmic Microwave Background (CMB) suggests that subtle, non-reciprocal phase shifts could be detected by high-precision interferometry, as proposed by Philip Carmichael [2]. Furthermore, the number-theoretic underpinnings of the collapse operator suggest that statistical signatures of the Riemann zeta function's zeros may be present in cosmological data, such as the CMB power spectrum.

In a universe where the past is actively solidifying and the future is becoming progressively more finite, the act of "what did happen" is not just a record of history, but the physical mechanism that drives the evolution of reality itself. This model invites further exploration into the mathematical underpinnings of our universe, suggesting that the most fundamental laws of physics may be encoded not in the smooth geometry of spacetime, but in the elegant, irreducible structure of the prime numbers.

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