

THE BOUNDARIES OF CONTINUOUS GEOMETRY

I. Spacetime as a Bounded Manifold

Spacetime is a boundary. The boundary is created by what we “call” universal constants. But mathematics learned long ago that what we designate as “physical,” “material,” or the “real world” has an immediate relevance, but not a universal relevance. Mathematics has no allegiance to spacetime limitations—only to consistency within self-created or “supposed grounds,” which must be respected until those grounds give way to more exact interpretations. In the 20th and 21st centuries, mathematics’ boundedness to spacetime has dramatically changed.

II. Semiclassical Fields and the Schrödinger Wave Mechanics

One example is the behavior of sub-atomic particles. In our everyday vernacular, we say that these particles “pop in and out of existence,” meaning they exit and re-enter our spacetime manifold. More specifically, we can model this boundary crossing via the continuous probability wave fields of the Schrödinger equation:

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

The particle doesn't randomly vanish into a magical vacuum; rather, its underlying wave function ψ describes a continuous cloud of possibilities that expands, contracts, and shifts across a multi-dimensional phase-space.

To understand how a system avoids collapsing into pure chaos, we need to look at its **phase-space**. In classical physics, if you want to track a moving object—say, a pinball bouncing through a machine—you can't just look at a normal three-dimensional map of its positions. If you take a still photograph of the pinball, you know exactly *where* it is, but you have no idea how fast it's moving or which bumper it's about to smash into. You lack the information needed to predict its future.

To solve this, physics invented phase-space. It is an imaginary, higher-dimensional mathematical arena where every single point represents a complete, synchronized state of reality. For every degree of freedom a system has, its phase-space allocates two axes: one for its **position** (q) and one for its **momentum** (p). If your system is a single sub-atomic particle, its phase-space is a smooth, continuous six-dimensional landscape (three axes for coordinates, three for trajectories). If your system is a massive, complex biological macromolecule like a chromosome, its phase-space explodes into millions of dimensions.

When a system evolves over time, it traces a continuous path—a trajectory—through this multi-dimensional field of play. It is the ultimate map of accessible information. In standard, uncorrelated classical systems, a trajectory will wander ergodically through this space, eventually sampling every available nook and cranny until it thermalizes, dissolves, and forgets where it started. It is the mechanical equivalent of information fading away like the morning dew.

But quantum mechanics, governed by the Schrödinger wave function $\psi(x, t)$, alters the rules of the game. Because the Heisenberg Uncertainty Principle establishes that you can never simultaneously pin down a particle's exact position and its exact momentum to absolute zero variance:

$$\Delta q \cdot \Delta p \geq \frac{\hbar}{2}$$

Therefore, phase-space ceases to be an infinitely smooth, continuous sheet. Phase-space describes what in popular culture we call particles “popping in and out of existence.” So why is there something rather than nothing? Because spacetime boundaries are set by universal constants.

III. Universal Constants

The universal constants slice phase-space into a discrete field, irreducible cells of accessible information. The universal constants give us a certain amount of predictability as irreducible cells of discrete information. In physics, a universal constant (or fundamental physical constant) is a measurable, unchanging physical quantity that remains invariant throughout the entire spacetime manifold. They are the structural pillars that write the rules of our universe, dictating everything from the speed of information to the absolute limit of smallness. To understand how they create the boundaries of our physical reality, they are logically grouped into three distinct tiers: the foundational **Planck-scale constants**, the **primary cosmic parameters**, and the **derived composite metrics**.

a. The Foundational Planck-Scale Constants

These four constants are the absolute bedrock of modern physics. Together, they establish the minimum allowable limits of metrics like length, time, and mass, serving as the boundary line where smooth spacetime ends and pure mathematical information takes over.

- **The Reduced Planck Constant ($\hbar$):** Equal to exactly $6.62607015 \times 10^{-34}$ joule-hertz⁻¹ (divided by 2π). This constant is the core governor of quantum mechanics and wave-particle duality. It dictates the minimum possible

pixelation size of phase-space and prevents physical systems from collapsing into absolute entropic chaos.

- **The Speed of Light in a Vacuum (c):** Equal to exactly 299,792,458 meters per second (or roughly 186,282 miles per second). This acts as the absolute cosmic speed limit for the propagation of all mass, energy, and information across spacetime.
 - **The Gravitational Constant (G):** Equal to approximately $6.67430 \times 10^{-11} \text{ m}^3 \cdot \text{kg}^{-1} \cdot \text{s}^{-2}$. This constant sets the intrinsic strength of the gravitational force, defining how matter warps the geometry of spacetime.
 - **The Boltzmann Constant (k_B):** Equal to exactly 1.380649×10^{-23} joule per kelvin. This bridges the macroscopic world of temperature with the microscopic scale of thermal kinetic energy and information entropy.
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b. The Primary Cosmic Parameters

These constants dictate the fundamental properties of matter, charge, and the large-scale expansion dynamics of the cosmological vacuum.

- **The Cosmological Constant (Λ):** Symbolized by the Greek letter Lambda, this represents the intrinsic energy density of empty space (vacuum energy), which acts as the driving force behind the accelerated expansion of the observable universe.
 - **The Elementary Charge (e):** Equal to exactly $1.602176634 \times 10^{-19}$ coulombs. This is the absolute quantum unit of electric charge carried by a single proton or electron.
 - **The Electron Rest Mass (m_e):** Equal to approximately $9.1093837 \times 10^{-31}$ kg.
 - **The Proton Rest Mass (m_p):** Equal to approximately $1.67262192 \times 10^{-27}$ kg.
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c. The Dimensionless "Fine-Tuning" Constants

In advanced theoretical physics, the most "pure" universal constants are those that are **dimensionless**—meaning they are pure numbers independent of any human-created system of units (like meters or seconds). If any of these numbers drifted by even a fraction of a percent, the sub-atomic stability of matter would disintegrate, preventing the formation of atoms, molecules, or life.

- **The Fine-Structure Constant (α):** Equal to approximately $\frac{1}{137}$ (≈ 0.00729735). This quantifies the exact strength of the electromagnetic interaction between sub-atomic particles, essentially determining how tightly electrons are bound to atomic nuclei.
- **The Proton-to-Electron Mass Ratio (μ):** Equal to approximately 1836.152. This is the invariant mass relationship between the core nucleons and their surrounding shells.

A universal constant like the Planck length tells us that whatever we mean by a physical "thing" has an absolute limit to its smallness within spacetime. But that physical limit is no barrier for mathematics. When "something" becomes smaller than what a universal constant allows, our historic language stumbles, resorting to the phrase "popping out of existence." Why, yes—just as easily as it pops out, mathematical consistency allows it to pop right back in.

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IV. String Invariants and Semiclassical Uniformity

One clear mathematical example of how particles "pop in and out of existence" is the framework developed during the golden era of String Theory. While the grand cosmology of string theory found no final physical shore to rest on, the mathematics developed along the way still does an extraordinary job of tracking and explaining how these structures shift across boundaries—of explaining how "things pop in and out of existence." In particular, we find that sub-atomic particles like quarks, which possess distinct "flavors," exhibit a structural uniformity that mathematics exposes. After all, without these sub-atomic boundaries, there would be no periodic table of chemistry. And without the periodic table utilized extensively by chemistry, there would be no, what we call, "us." And then, there was quantum physics.

THE METAMATERIAL FRONTIER: MATH, CHAOS, & SELECTION

V. Semantics and the Disruption of the Apple Cart

Talk about upsetting the apple cart of history. Quantum physics, information theory, and a very peculiar kind of chaos—for which our language has no safe haven—takes us straight into what Lewis Carroll called *Alice in Wonderland*. Folks, we are “not in Kansas anymore,” in case you haven’t noticed. I authored a multi-volume series, *Quanta, Alterity, and Love*, to attempt to give some perspective on these topics and show how history has yet to catch up with their incredible implications. What is too small, too vacant, and becoming less meaningful is our day-to-day language—the residue of history which evaporates eventually in the rising of an alien sun.

We think of Artificial Intelligence as something weird and threatening, but long before AI, something absolutely incredible was operating behind the scenes of language, understanding, and material structure. Even now, we can only wonder what all this could “mean.” But we can certainly glean what it does *not* mean by looking at the vacancy of meaning in our day-to-day semantics and our fading, desperate attempts to resurrect the historic ghosts of meanings in metaphysics. This brings me to my recent series of papers, which are officially Patent Pending.

VI. The Mandate for Physical Prototyping

First, I am not at all convinced my paper's thesis is correct—which is precisely why I prioritized a strict series of physical experiments to test it. I have even specified the exact empirical grounds in these experiments that would prove my theory wrong. I have no vested interest in defending an error. Furthermore, I have no intention of making money on this idea. My sole concern for creating the patents is so that I can leverage them to secure grants or attract investors to pay for the experiments. Each experiment would cost a university about \$100,000 to run, give or take \$50,000 or so. And even if my framework is proven wrong, the negative result will simply clear the path for more advanced philosophical ideas about what may actually be the case.

VII. Historical Premonitions and the Indivisible Point

The theory I embarked on was brought about by historic fascinations with prime numbers, which go way back. For centuries, mathematicians from Euclid to Gauss treated primes—positive whole numbers divisible only by 1 and themselves—as the atomic, indivisible "building blocks" of arithmetic. They marveled at how a sequence so strictly defined could distribute itself along the number line with the erratic, unpredictable texture of pure chaos. Primes represent the ultimate strength of structural constraint: they cannot be broken down, they cannot be negative, and they march on infinitely in the positive direction.

Recently, a revolutionary breakthrough in analytic number theory—the proof of bounded gaps between primes—unlocked a profound paradox: within the infinite, chaotic expanse of numbers, there exist endless series of prime number sets that are entirely finite in their spacing. Let's unpack this: Quantum physics has found that there are states called eigenstates—"pure states"—which function as the precise mechanisms allowing atoms to absorb and shed energy without collapsing into pure chaos. Could these pure states, which allow for any such thing as being, stability, repeatability, and learning, have a direct relationship to the rigid distribution of prime numbers? Could this inherent strength of limitation be something that evolution "capitalized" on through eons of trial and error? But first, let's look at prime numbers in more detail.

HARMONIC TRUNCATION VS. ARITHMETIC RIGIDITY

VIII. Symmetrical Sine Wave Axes and Zero Crossings

Prime numbers have an issue with divisibility which is actually very interesting. To start to illustrate this, look at the Fourier transform, which beautifully shows us how a highly complex, chaotic waveform can mathematically be broken down into the infinite sum of very simple and highly geometric sine waves.

The sine wave is symmetrical around a graph plotted with time or radians on the horizontal axis and amplitude on the vertical axis. These coordinates do not have to be strict relationships of amplitude and time or radians; there must simply be an established relationship between the chosen axes. In broader physical manifolds, there is no reason why there has to only be two axes—but let's keep it simple for now. You can see from the graphic that when the wave crosses the zero-amplitude line, that specific point is called a zero-crossing. For a highly complex, ugly looking waveform, the Fourier transform mathematically breaks it down into a composite choir of simple sine waves, each crossing the horizontal axis at different values. Through this configuration, it can very accurately approximate, or even definitively re-create, the original wave shape.

IX. Truncation Paradoxes and Complex Degrees of Freedom

Depending on the underlying complexity, some waveforms can be fully re-created using a finite series of components. However, many complex, chaotic systems cannot be captured by a finite series; they require an infinite sum of sine waves to be fully resolved. In this case, how close the re-created wave comes to the original is determined entirely by how many waves you choose to use to approximate it, since handling an infinite series is not practical in our limited world. We must truncate the infinity to achieve a functional, predictable baseline. Yet, the recreated waveform may still inevitably retain its zero crossings.

If the composite, re-created complex waveform crosses the zero axis, it indicates a structural uniformity—a recurrence that can be characterized across the real number line by rational and irrational numbers. This leads into what we call imaginary numbers, which is another story altogether. This framework might lend another possible interpretation of negative numbers, which can be taken simply as a reverse direction within a spacetime manifold, but may also possess additional hidden meanings in physics, cosmology, and the complex variables used throughout mathematics. The core clue remains simplicity and divisibility.

For real and imaginary numbers, divisibility can get incredibly complicated very quickly. In a physical system, this is like saying there could be an overwhelming number of complex degrees of freedom that dissolve into entropic decay. But prime numbers are completely immune to this splitting. They are NOT divisible except in two ways: by one, and by themselves. This severe structural limitation implies that they cannot be negative numbers, yet they can march on infinitely in the positive direction.

X. Quantum Scars, Macromolecular Memory and Phase-Space

Consequently, the conclusion is that there is a certain odd kind of resilience or strength born entirely from the severe constraints and limitations of prime numbers, which has driven our historical fascination for many centuries. Could this structural strength be something that evolution capitalized on through eons of trial and error?

If so, it tells us exactly how quantum physics creates the semiclassical facsimile called quantum scarring—a kind of temporalizing macromolecular memory. Quantum scars are essentially pathways of memory etched inside a storm of chaos. They represent a localized ability to create stable repetition. And through that repetition, nature stabilizes sub-atomic particles, atoms, molecules, and eventually, the long-chain chromosomes that host life.

Phase-space is where our prime-number sets perform their finest work. By spacing the physical G-C pinning blocks along a DNA backbone according to a rigid arithmetic distribution, we are essentially drawing an unyielding, protective lattice directly across the system's phase-space. When external thermal noise tries to scramble the chromosome, the chaotic trajectories can no longer wander ergodically. The prime-number boundaries act as hard, insurmountable barriers, forcing the probability waves to localize along narrow, recurring loops. This is the exact mechanism of a **quantum scar** and the molecular stability afforded by eigenstates (pure states). Eigenstates are an arithmetic template stamped onto phase-space that traps information, keeps the polymer stable, and allows a localized facsimile of memory and repetition to emerge from pure chaos.

XI. Eigenstates and Accessible Information Fields Reviewed

Let's unpack this: As mentioned already, quantum physics has found that there are states called eigenstates—"pure states"—which function as the precise mechanisms allowing atoms to absorb and shed energy without collapsing into pure chaos. This persistence in spacetime, the ability of atoms to absorb and release variations of energy without giving way to quantum chaos, relies on this precise mathematical balance of retaining a finite but very long sequence of prime numbers. Could these pure states, which allow for any such thing as being, stability, repeatability, and learning, have a direct relationship to prime numbers?

All of this depends entirely on accessible information. From the earliest beginnings of quantum theory, the Schrödinger wavefunction and its predecessors have relied on a notion called phase-space. In the simplest idea, phase-space might be thought of as the total field of accessible information which allows us a modicum of predictability. This is where we enter Information Theory.

Information theory tells us that everything is composed of tiny bits of information, like an on or off switch. But within our spacetime limitations, we only ever glimpse or have accessibility to a finite amount of information. (Are we beginning to see the relationship to primes?) Just like our standard mathematical models truncate an infinite set of sine waves to approximate a complex physical waveform, we operate with a finite set of accessible information. And wonder of wonders, even that finite set gives us the possibility of repeatability—the bedrock of finite mathematics, sciences, language, and human understanding.

In a complementary fashion, the recent breakthrough in understanding prime number sequences tells us that there are finite sets of prime numbers that we can define mathematically. These finite prime number sets may go a very long way, but eventually, they have an end. Might we think of this as accessible information? Additionally, there are mathematically an infinite series of these finite prime number sets. By "infinite," we mean that like truncating complex waveforms to approximate a complex wave, it gives us a relative amount of predictability (finiteness), and at the same time, finiteness can

never be complete in itself—it must always give way to a radical alterity of the infinite, the endless series of these finite sets of prime number sequences.

PHILOSOPHICAL MUSINGS OF STRATIFIED ALTERITIES

XII. Finite Collections across the Infinite Continuum

The recent breakthrough in understanding prime number sequences shows us that these dynamically evolving finite sets of primes reach a hard structural end. Simultaneously, the finite sets of prime numbers themselves can exhibit infinite variations, making them persistent in the determinant of existence. By "infinite," we mean that just as truncating a complex Fourier waveform gives us a relative amount of predictability and presence, our finiteness must always be truncated—can never be complete in itself. Existence must always be mutable—giving way to infinite varieties of finite sets—prime number sequences. Change, adaptability and uniqueness are contingent upon dynamically varying prime number sequences. Perhaps this inherent adaptability in "limitation" could be taken as what history thinks of as learning, as predictability, and as material presence. But inaccessible information extending through infinite series of dynamically changing finite prime number sets may completely change our perspective opening up what we may mean by "me here now".

XIII. The Levinasian Encounter: From Biophysics to Ethics

Like information, what "is" dissipates like the morning dew in the face of infinity. And these alterities are not comparable, since everything that is anything is absolutely contingent on the specific information we have access to in part and the information we cannot have access to. As we have learned, the infinite series of prime numbers vastly exceeds our spacetime boundaries—and so does everything we term as "we" or "I".

Perhaps the philosopher Emmanuel Levinas calls the infinite—the anonymous buzzing of raw existence the *il y a* ("there is")—what we have referred to as what we have no informational access to. It is the vast background noise completely vacant of human semantics. Meaning which cannot simply be forced into the predictable, finite boxes of day-to-day language. For Levinas, the encounter with radical alterity—the realization that the other represents an infinity we cannot access or control—is what calls us into a strict, immediate imperative for ethics brought to us in the face-to-face encounter of the other.

I have intentionally transitioned from biophysics to ethics because science in itself makes no moral imperative to ethics and the Other. Ultimately, only that ethical transition makes anything like “life” worth living, or capable of hosting true meaning. A more poetic way of saying this is that we do not simply *have* faces, but we *face* the Other. And we face not just other people, but other alterities—allegorically perhaps like alterities in our physical environment but these are **entirely distinct and not comparable** to the alterity we face in the other.

So, this is the overarching vision that spanned my books and these patent-pending papers: an exploration of the possible links connecting genomics to the mathematics of infinite sets of finite prime number sequences. We stand at the vanishing point where what we are, what we think, and the information we define as “me” may extend much further into the infinite than we can imagine—or we can simply choose to vanish into the mere finiteness of our own temporary, historically contrived tales of ‘me’.