Ontological Physics

Jonathan Tooker[1]

[1] *Occupy Academia, Atlanta, Georgia, USA, 30338*

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Ambiguity in physics makes many useful calculations impossible. Here we reexamine physics' foundation in mathematics and discover a new mode of calculation. The double slit experiment is correctly described by the new mode. We show that spacetime emerges from a set of hidden boundary terms. We propose solutions to problems including the limited spectrum of CMB fluctuations and the anomalous flux of ultra-high energy cosmic rays. A fascinating connection between biology and the new structure should have far reaching implications for the understanding and meaning of life.

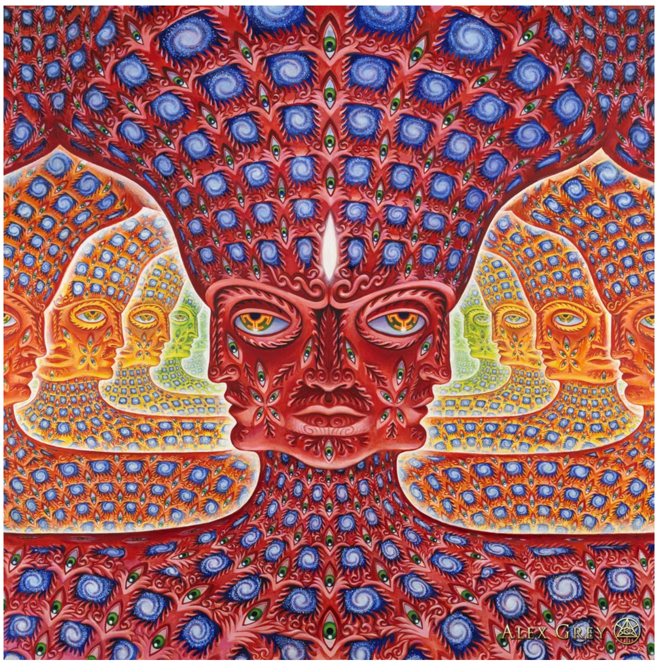

FIG. 1: *Artist's impression of an MCM style lattice of* $\hat{\pi}$ *sites.* Alex Grey. *Godself*

> "At the center of the universe dwells the Great Spirit, and its center is really everywhere, it is within each of us."
>
> ∼ Black Elk

INTRODUCTION

Dirac's greatest accomplishment was to replace some apparently scalar values with matrices. Those matrices are the smallest increase in complexity needed to facilitate a description of what must be true. Here we pursue a similar program and assign a fractally multiplexed, symmetry breaking value to the Dirac delta function.

The Modified Cosmological Model (MCM) is a lattice multiverse theory and physical observations are made at $\hat{\pi}$ sites. To review our previous findings [1–4], there are three temporal regimes $\{\hat{i}_n, \hat{\pi}_n, \hat{\varphi}_n\}$ associated with each moment n: the past, present and future. $\hat{M}^3$ moves Dirac vectors from the present $\hat{\pi}_1$ to the future $\hat{\varphi}_1$, to the past of the next moment $\hat{i}_2$, and finally into the next moment itself $\hat{\pi}_2$. The universe is holographically encoded on some unknown power of π which functions as a cog in an open cosmological matrix.

$$\hat{M}^3 \left|\psi\right\rangle \hat{\pi}_1 = \pi \hat{M}^2 \, \partial_\xi \left|\psi\right\rangle \hat{\varphi}_1 \quad (1)$$

$$= \varphi\pi \hat{M} \, \partial_\xi^2 \left|\psi\right\rangle \hat{i}_2 \quad (2)$$

$$= i\varphi\pi \, \partial_\xi^3 \left|\psi\right\rangle \hat{\pi}_2 \quad (3)$$

We may use this logic to define modes on the double slit apparatus seen in figure 2. Require that a wavefunction in $\hat{\pi}_n$ cannot interfere with another wavefunction in $\hat{\pi}_m$. Let t_0 be the time at the source, t_p at the plate, and t_s at the screen. Label the slits a and b.

$$\text{Waves} \Rightarrow \begin{cases} \Psi_a(t_0)\hat{\pi}_1 \rightarrow \Psi_a(t_p)\hat{\pi}_1 \rightarrow \Psi_a(t_s)\hat{\pi}_2 \\ \Psi_b(t_0)\hat{\pi}_1 \rightarrow \Psi_b(t_p)\hat{\pi}_1 \rightarrow \Psi_b(t_s)\hat{\pi}_2 \end{cases} \quad (4)$$

$$\text{Particles} \Rightarrow \begin{cases} \Psi_a(t_0)\hat{\pi}_1 \rightarrow \Psi_a(t_p)\hat{\pi}_2 \rightarrow \Psi_a(t_s)\hat{\pi}_3 \\ \Psi_b(t_0)\hat{\pi}_1 \rightarrow \Psi_b(t_p)\hat{\pi}_1 \rightarrow \Psi_b(t_s)\hat{\pi}_2 \end{cases} \quad (5)$$

When Alice observes the particle at the source and screen only, the probability amplitude on the screen is wavelike. When Alice also checks the plate to see which slit the particle went through at t_p, the amplitude on the screen is particulate. The usual culprit in this strange behavior is wavefunction collapse. This reasoning is dependent on the particle's choosing one slit or the other in response to Alice's curiosity. Here we assume all choices (if there truly are any) are made in the mind of an observer. This implies the particle must always go through both slits and never depend on observers.

The interface of Alice's mind with physical reality defines a unitarity preserving boundary condition. It is possible to formulate this naturally through reliance on the observer's dynamical inclusion in the theory. An observation at the plate intersects the particle's trajectory causing a bifurcation in its worldline.

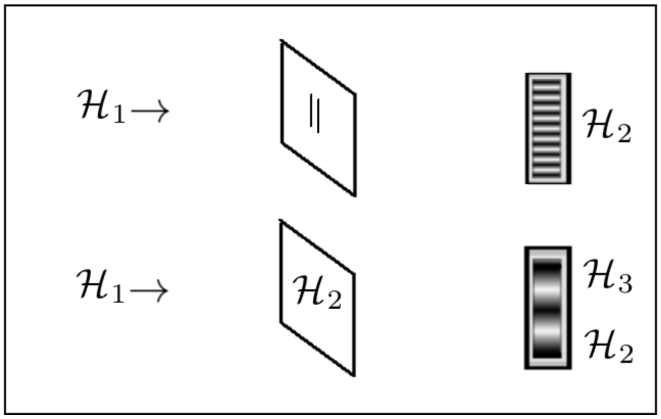

FIG. 2: *On top, two measurements, $\mathcal{H}_1$ and $\mathcal{H}_2$, are made and wave interference is observed on the screen after many repetitions. Below, three measurements are made. In addition to the source and screen, the observer determines which slit the particle passes through. After many repetitions wave interference is not observed.*

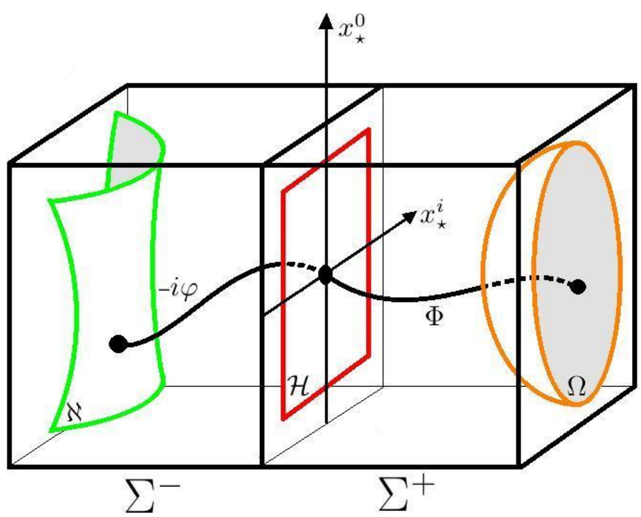

FIG. 3: *The intersection of truncated de Sitter and Anti-de Sitter space defines a flat moment in time $\mathcal{H}$. Chiros is spacelike in Σ^+ but timelike in Σ_-.*

Local bifurcative symplex marks the intersection of Alice's chronological and chirological worldlines. When observing a particle with momentum p, Alice and the particle's worldline form a vertex at some $\hat{\pi}$ site. Chiros tracks the observer's attention in some abstract space. Worldlines intersect when Alice's attention turns to the physical world to observe something.

We find recent skepticism of the Feynman diagram approach to QFT is unwarranted. Rather, fault lies with the Euler formula. With a modified definition of the complex exponential, the action principle should correctly describe physics on a cosmological lattice of $\hat{\pi}$ vertices according to the normal Feynman prescription.

BROKEN SYMMETRY

An avenue to broken symmetry is illustrated in figures 3 and 4. Hilbert space $\mathcal{H}$ is its own dual space but $\aleph$ and Ω are distinct and mutually dual. Distinctness and duality imply a new degree of freedom beyond what is encountered in the inner product of Hilbert space with itself. Our migration to a unified theory based on new freedom is guided by the simple equations governing double slit interference. The convention is that the chronological state is Ψ and the chirological state is ψ.

$$\Psi_P = \Psi_a + \Psi_b \tag{6}$$
$$\Psi_a = \Psi_0 e^{i\omega t} \tag{7}$$
$$\Psi_b = \Psi_0 e^{i(\omega t+\delta)} \tag{8}$$
$$p_P = \langle \Psi_P | \Psi_P \rangle \tag{9}$$

The phase δ is governed by the metric and, for small phase differences, it is a measure of asymmetry between histories in Ψ_a and Ψ_b. Each moment is the intersection of information from the past and future, so when Alice makes an observation at $\mathcal{H}_P$, the wavefunction is contemporaneously a sum (truly a null intersection) of components from the past and future with components from each slit. Let there be a continuous harmonic phase spectrum in ψ's frequency. The probability of finding the observer in $\mathcal{H}$ is $p_{\mathcal{H}}$.

$$\psi_{\mathcal{H}} = \psi_a + \psi_b \tag{10}$$
$$\psi_a = \psi_0 e^{i\omega_n \xi} \tag{11}$$
$$\psi_b = \psi_0 e^{i\omega_m \xi} \tag{12}$$
$$p_{\mathcal{H}} = \hat{\pi}_m \langle \psi_{\mathcal{H}} | \psi_{\mathcal{H}} \rangle \hat{\pi}_n \tag{13}$$

Let figure 3 belong to a unit cell in a bulk cosmos. See reference [2] for a thorough description of that figure. Each lattice site represents a single point in an uncountable infinity of allowed values for ω_n. Let ψ_a and ψ_b be scalar fields subject to the following boundary conditions.

$$\psi_a\big|_{\Omega} = \psi_b\big|_{\aleph} \tag{14}$$
$$\lim_{\xi\to\mathcal{H}} \psi_a = \lim_{\xi\to\mathcal{H}} \psi_b \tag{15}$$

Let ψ_a and ψ_b both have harmonic phase n. The absolute harmonic phase of chirological wavefunctions shall be irrelevant; only differences in harmony $\Delta = m - n$ relate to dynamical outcomes. ψ_a comes from Σ^+ and ψ_b comes from Σ^-. Formally they are $|\psi_a\rangle\hat{\varphi}_n$ and $|\psi_b\rangle\hat{\imath}_n$. The following piecewise frequencies satisfy equations (14) and (15).

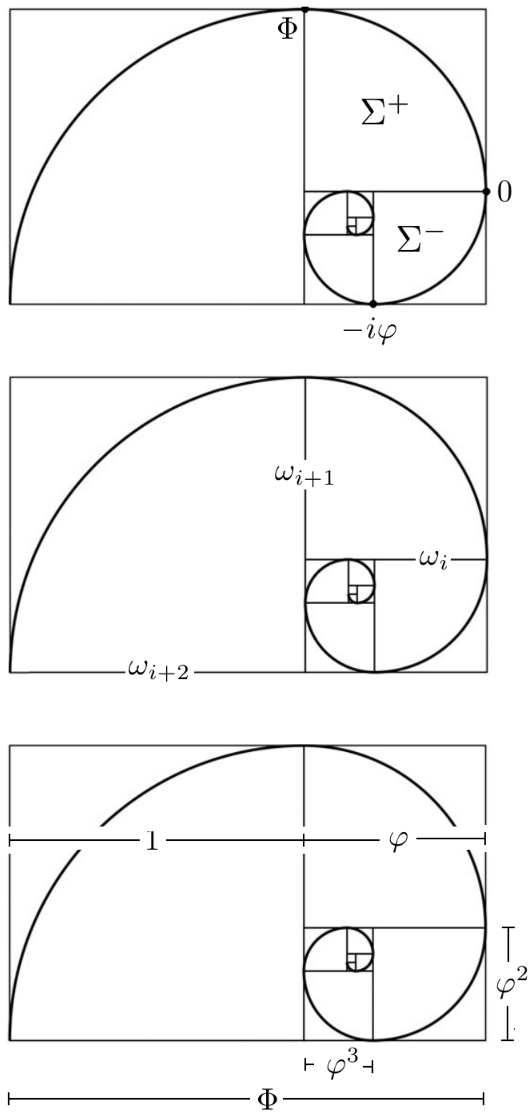

FIG. 4: *The goldenness of the golden ratio allows us to construct a novel manifold.*

$$\omega_n = \begin{cases} 2\pi\varphi & ; \xi \in \Sigma^+ \\ 2\pi i\Phi & ; \xi \in \Sigma^- \end{cases} \tag{16}$$

$$\omega_m = \begin{cases} 2\pi\Phi^{\Delta-1} & ; \xi \in \Sigma^+ \\ 2\pi i\Phi^{\Delta+1} & ; \xi \in \Sigma^- \end{cases} \tag{17}$$

Piecewise frequency might seem unnatural but recall the cosmological unit cell is a piecewise union [2]. In similar fashion, the worldline in figure 4 spans two spirals, one imaginary and one real. The figure suppresses this complexity by assigning both real and imaginary values to one curve. Alice connects two spiral halves so there is a complete spiral remainder. Her status as a topological obstruction is the origin of piecewise arrangement. We will return to spiral duality below.

Let ψ'_n and ψ'_m be eigenvectors of $\hat{p}$ with $p_j = \omega_j$. The functions are not square integrable and must not live in $\mathcal{H}$. The inner product of such vectors is the Dirac delta.

$$\psi'_n(x) = \psi'_0 e^{ip_n x} \tag{18}$$

$$\langle \psi'_m | \psi'_n \rangle = \delta(p_m - p_n) \tag{19}$$

Contrast Dirac orthonormality with truly orthonormal vectors ϕ and χ, each having some basis.

$$\langle \phi | \chi \rangle = \sum_{i=1}^{\infty} \sum_{j=1}^{\infty} c_j^* c_i \, \delta_{ji} \int \phi_j^* \chi_i \, dx = 0 \tag{20}$$

In the fully orthogonal case, it is guaranteed that each term from χ is matched with an orthogonal one from ϕ. Under integration these pairs go to zero; the symmetry is perfect.

Consider the Euler formula.

$$e^{i\omega\xi} = \sum_{0}^{\infty} \frac{(i\omega\xi)^n}{n!} \tag{21}$$

$$= \sum_{0,2,4\ldots}^{\infty} \frac{(i\omega\xi)^n}{n!} + \sum_{1,3,5\ldots}^{\infty} \frac{(i\omega\xi)^n}{n!} \tag{22}$$

$$= \cos(\omega\xi) + i\sin(\omega\xi) \tag{23}$$

Given equations (19) and (20), it is possible the Dirac delta represents an unpaired term at infinity. This defines one qubit and does not imply $2\pi i = 0$.

$$e^{i\omega\xi} = \cos(\omega\xi) + i\sin(\omega\xi) + \frac{(i\omega\xi)^{\aleph_0}}{\aleph_0!} \tag{24}$$

$$\delta(\omega\xi) = \frac{(i\omega\xi)^{\aleph_0}}{\aleph_0!} \tag{25}$$

$$\delta(0) \neq \delta(2\pi i) \tag{26}$$

Quantum mechanics operates by assuming there is no unpaired term. Hence, the information it may contain is unbounded. The extra term can be considered a qubit or the state can be considered a qubit attached to the extra term.

Every vector can be decomposed into a basis, and each basis vector can be decomposed, so the sum in equation (21) cannot strictly contain the smallest infinite number of terms $\aleph_0$. Therefore, the concept of $\aleph$ must be relative to the working basis.

$$\sum_{0}^{\infty} \frac{(i\omega\xi)^n}{n!} \;=\; \sum_{0}^{\aleph_0} \frac{(i\omega_0\xi)^n}{n!} + \sum_{\aleph_0}^{\aleph_\infty} \frac{(i\omega_1\xi)^n}{n!} + \tag{27}$$
$$+ \sum_{(\aleph_\infty)_0}^{(\aleph_\infty)_\infty} \frac{(i\omega_2\xi)^n}{n!} + \sum_{(\aleph_{\infty_\infty})_0}^{(\aleph_{\infty_\infty})_\infty} \frac{(i\omega_3\xi)^n}{n!} + \ldots$$

There is no absolute way for the observer to know which level of $\aleph$ to use so the following must be true.

$$e^{i\omega\xi} \;=\; \ldots + \sum_{0_{j-1}}^{\aleph_{j-1}} \frac{(i\omega_{-1}\xi)^n}{n!} + \tag{28}$$
$$+ \sum_{0_j}^{\aleph_j} \frac{(i\omega_0\xi)^n}{n!} + \sum_{0_{j+1}}^{\aleph_{j+1}} \frac{(i\omega_1\xi)^n}{n!} + \ldots$$

$$|\psi\rangle\hat{\pi}_k \;=\; \pi\psi_0 \sum_{0_k}^{\aleph_k} \frac{(i\omega_k\xi)^n}{n!} \tag{29}$$

$$\delta(\omega\xi) \;=\; \sum_{j=-\infty}^{\infty(j\neq k)} \left(\sum_{n=0_j}^{\aleph_j} \frac{(i\omega_j\xi)^n}{n!} \right) \tag{30}$$

Given equation (28), it must be true that an unpaired term can reside at the beginning or the end of the series. Since the value ω_n is only meaningfully interpreted as ω_Δ, this formalism should have direct utility toward Mach's principle. Chirological states reduce to chronological ones with frequency ω_Δ via the following prescription.

$$\hat{\pi}_m\langle\psi_\mathcal{H}|\psi_\mathcal{H}\rangle\hat{\pi}_n \;=\; \delta_- + \pi^2 \int e^{-i\omega_\Delta\xi} d\xi \, + \delta_+ \tag{31}$$

The state is akin to an information soliton or a hole in an information current. The delta contains all information not found in the state and apparently it is an object with Yangian symmetry [6]. Indeed if the state is yin, there may be something truly profound about infinite complementarity between yin and the Yangian.

The unlimited symmetry of the Yangian Dirac object allows special conditions to be satisfied. Let there be some information stored in unstable equilibrium at ω_a. This object can be placed in the delta where it will remain. Due to the infinite background, equilibrium is the only reference point.

Dynamics unfolding in any harmonic phase ω_b arbitrarily close to ω_a will not couple. The qubit can only be accessed by those who possess a key. In this case, the key will be an infinitely precise harmonic phase that can only be known with certainty by those with a direct line of computation to the event of the qubit's storage. This is the meaning of uncountable infinity.

Chiros has different metric signatures in $\Sigma^\pm$ so perhaps it is what joins space and time at infinity. Spacetime can emerge from the large and small boundary terms carried by the qubit.

$$\int \delta_-(\omega\xi) D\xi \;=\; \int \delta(t)\, dt \tag{32}$$

$$\int \delta_+(\omega\xi) D\xi \;=\; \iiint \delta(x)\delta(y)\delta(z)\, dV \tag{33}$$

The integral over all points in the perpendicular space between two objects is the distance between them. The number of points aggregated by the measure in that integral is uncountably infinite. For a thought experiment, let there be some more highly infinite set of points Ω_P that does not accept a measure and cannot be integrated. Even under such conditions, those points can still be ordered by picking them at random and putting them in a sequence. That sequence does admit a measure: the points are equidistant. Let that constant interval be 2π for timelike sequences and $\Phi\pi$ for spacelike ones.

Timelikeness and spacelikeness are determined by the subscript on the delta. Equation (31) demonstrates δ_+ is at least two levels of $\aleph$ higher than δ_- and hopefully that can be correlated with space having two more dimensions than time. Equations (32) and (33) are well-motivated.

THE OBSERVER

Consider the following description from reference [1].

> "The flow of time proceeds as a quantum clockwork. With the application of the evolution operator $\hat{M}$, the observer's connection to $\mathcal{H}_i$ is released and reconnected to $\aleph_{i+1}$. $\hat{M}$ is applied again breaking the connection to Ω_i. That end of the observer function is reconnected to $\mathcal{H}_{i+1}$ then a third application of $\hat{M}$ restores the original arrangement with a connection between $\mathcal{H}_{i+1}$ and Ω_{i+1}."

Uncountable infinity is aptly studied with continued fractions. The unknowable aspect of $\aleph$ is manifest when Alice cannot know if her operating basis for quantum mechanics is situated on the root level or some branch level of a fractal algebra. If Alice always perceives her length as one during locomotion through some network of continued fractions, that defines a local G-space in which unitarity is preserved. Let Φ^2 be the identity in that space.

$$\Phi^2 = \left(1 + \frac{1}{1 + \frac{1}{1+\frac{1}{1+\ldots}}}\right)\left(1 + \frac{1}{1 + \frac{1}{1+\frac{1}{1+\ldots}}}\right) \tag{34}$$

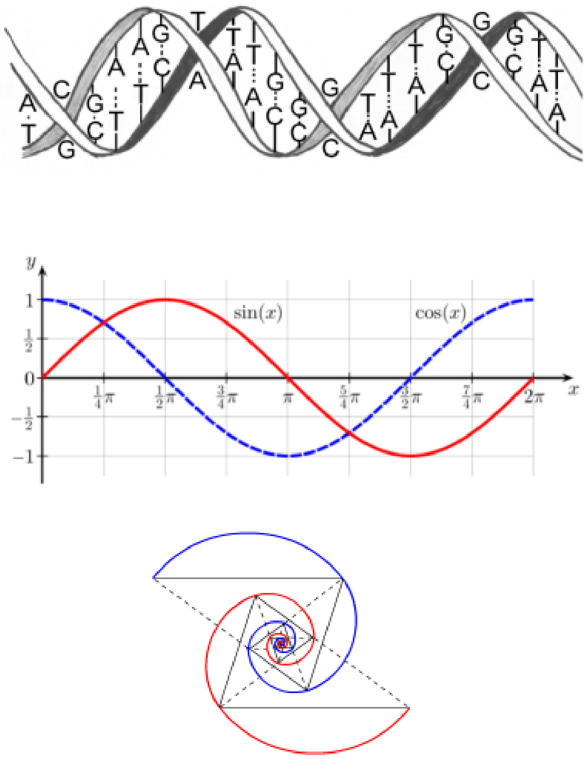

FIG. 5: *The symmetry of the double helix permits a projection onto a double spiral from an appropriate perspective.*

The matricial structure naturally carries quantum information in vectorlike arrays. The simplicity is greater than expected. In the most intuitive way, each power of Φ is a spiral and Alice connects fraction sites from each. It is remarkable that the observer is defined on two spirals because investigations into the observer by Franklin, and Crick and Watson have also uncovered a double spiral structure. Figure 5 shows the relationship between DNA and the double spiral. When projecting down to the 2-space of sines and cosines where the Euler formula is true, the double sinusoid appears. When the Euler formula holds, the exponential, sine, and cosine, span a plane and dynamics are constrained by no-chaos-in-the-plane theorems. When those functions form a 3-space, chaos reigns in G-space.

In the prevailing mathematics the circle is a complex sinusoid. When $2\pi i \neq 0$, the complex sinusoid is a helix and a circle is only one period mapped into itself. If it is true that $2\pi i \neq 0$ the circle must also have a homology at the polar point to account for non-local information on the helix.

Let Bob be a tiny time traveler walking along Alice's DNA with his back to the arrow of time. In the 4D sense, mitosis is only a branching and Bob is able to walk through Alice's cells to her childhood and eventually her conception. At that point the DNA bifurcates with 23 chromosomes going into each parent. If Bob chooses to follow any particular chromosome, he will arrive at the site of gametogenesis in one of Alice's parents. In similar fashion, Bob can fully explore the complex spacetime network of DNA that is Alice's close family and complete society.

Recent work has shown DNA is held together by entanglement [7]. In terms of continued fractions on the golden spiral, DNA is held together by the observer. Each person's worldline is a double helix of DNA. The flatness of the observed universe fixes the orientation of the self with respect to the 3-sphere: self worldlines are parallels [3]. When we require that men are hypermeridians and women are meridians, on the event that a man and woman join together at a vertex, a new strand of DNA emerges as a self. Each intersection in figure 5 is an orthogonal intersection of three circles: one parallel, one meridian, and one hypermeridian. This interpretation strongly agrees with what is known about observers from biology.

POINCARÉ DODECAHEDRAL SPACE

The 3-sphere in figure 6 initially entered the MCM as a description of 10D string theory [3]. In that case, each timelike line foliates a 3-sphere. Parallels are the radial coordinate of a flat 4D spacetime, meridians are hyperbolic, and hypermeridians are spherical. On the other hand, the vector spaces $\{\aleph, \mathcal{H}, \Omega\}$ live on the objects $\{H^3, E^3, S^3\}$ [5]. Now that the Poincaré conjecture is the sphere theorem, we can say with certainty that H^3 and E^3 are conformally S^3: the 3-sphere. In that case, figure 6 equally describes a network of spacelike cosmic strings in 4D spacetime.

The freedom to change perspective between 3+1D cosmic strings and 9+1D modern strings is the freedom to change levels of $\aleph$. Via Yangian symmetry and the method outlined above, each spatial dimension is resolved into three temporal dimensions. Through computation, each of those can be further resolved into three spatial dimensions and so on.

The nesting spine and the foliation always have opposite metric signature. When the cosmos is described by tiled Minkowski diagrams as per figure 1, time is either vertical or horizontal on alternating tiles. Since there are always two spirals, there will always be two universes U and $\bar{U}$ with respective metric signatures $\{\mp \pm \pm\pm\}$ [3].

Consider the following short excerpt from reference [3]. (Minor edits for consistency.)

> "We have assigned a spatial 3-sphere $\{x, y, z\}$ to each dimension of the temporal sphere $\{\xi_+, \xi_-, t\}$. Space serves as the radial coordinate of the temporal ball just as time serves as the radial coordinate in the 3+1 dimensional

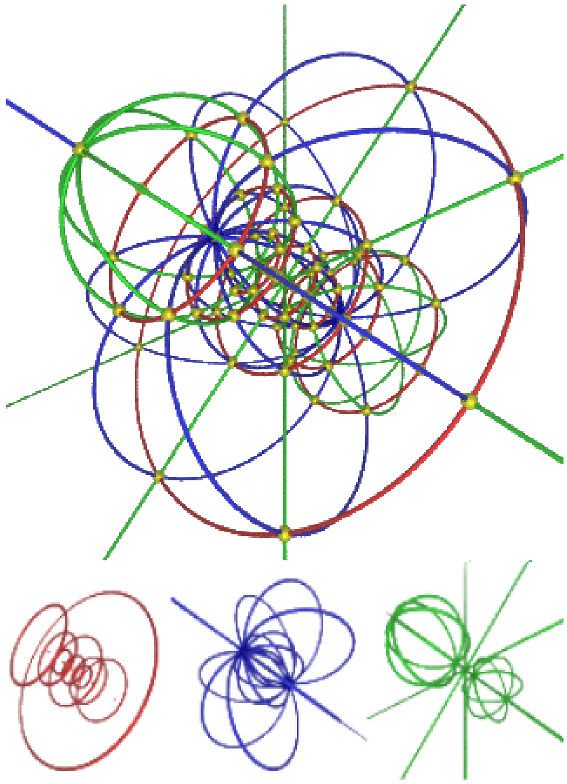

FIG. 6: *Stereographic projection of the 3-sphere [8]. The geometry is made of three types of circles: parallels, meridians and hypermeridians.*

> space of general relativity. The distinction of temporal and spatial spheres is mirrored in the spacelike and timelike regions of the Minkowski diagram.
>
> "By alternating temporal and spatial spheres, diameters are mapped to circumferences and it is clear that the MCM is a fractal matrix theory of infinite complexity."

On radial coordinates, consider any possible smooth transition from cosmic strings to modern strings. For cosmic strings, the parallels, meridians, and hypermeridians are spacelike. In 10D, strings are timelike but foliate 3-space. The foliation is a bifurcation on the worldline at the symplectic intersection of worldlines. The worldline is a fractal. Spacelikeness and timelikeness oscillate as each bifurcation inverts the metric. The updated ADM result [2] puts a symplectic element at spacelike infinity so we have good reason to invoke metric signature inversion as a property of the cosmos' inherent periodicity. The functionality of $\hat{M}^3$ is described in references [1, 3].

Diameters mapped to circumferences allude to removal and injection of units of π. The duality between a 3-ball and its great circles is that seen in equations (32) and (33). Keeping in mind the method of AdS/CFT duality derived in reference [2], consider what Weeks has written in reference [5].

> "It is straightforward to calculate how a 3-manifold's modes restrict to 2-dimensional modes of the horizon sphere, ultimately allowing direct comparison to observations. [*sic*] We now have a way to transfer symmetries from the 2-sphere to the 3-sphere."

Weeks specifically points out that such a calculation is useful for comparing calculated future trajectories to real observations [1]. The 3-modes restrict to 2-modes at the intersection of chronos and chiros. Likewise, when chronos and chiros inevitably intersect at infinity, their symmetries transfer to the 3-sphere Ω.

Strings are double helical worldlines so we have reason to calculate the spectrum of CMB fluctuations when a network of double helices spans the 3-sphere. The electrodynamics of twisted wire pairs is distinct from untwisted or single wires so we can expect a distinct result from previous attempts to correlate cosmic strings with the CMB.

A founding principle in this study was that a cosmological solution on the 3-sphere should be the real solution up to a perturbation [3]. Consider the empty solution on Φ^2. Dynamics there are characterized by Einstein's equations and the fine structure constant [1]. The dodecahedron is the smallest logical matrix needed to carry $\{H^3, E^3, S^3\}$ and its symmetry group is the binary icosahedral group [5]. Let that group be represented by the Star of David and the pentagram in figure 7.

The symmetry of the pentagram can be associated quantum mechanics and the five canonical bosonic spin polarizations. The Star of David is what connects each matrix so let that be the observer. In the sense that quantum mechanics is a subset of Nature, the pentagram is a subset of the observer. The Flower of Life in figure 8 also contains the icosahedral symmetry group; it is spanned by five circles.

Consider the cosmos as a quasicrystalline substance or glassy metal. The pentagram describes the short range order of quantum mechanics. The Flower of Life shall be the medium range order $\hat{\pi}$ sites. This is a sound assumption because it is known that medium range order in quasicrystals and metallic glasses is characterized by icosahedral symmetries.

To partially define figure 7 in G-space, let the 7-matrices be the left and right coset of Φ^2 with a dodecahedron and an icosahedron. When the observer occupies one vertex in each, the informatic remainder is 20 by 13. This is another symmetry with the 20x13 Tzolkin of Mayan astrology [2, 9].

To resolve the Ford paradox [10], establish an information current from one 7-matrix to the other. The observer is an information sink as entropy in the universe

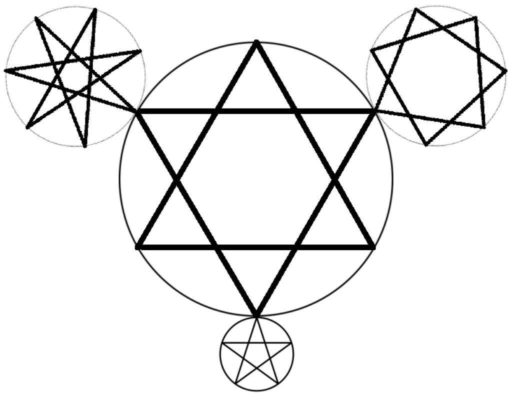

FIG. 7: *The symmetries of the dodecahedron belong to an icosahedron at the null intersection of two 7-matrices.*

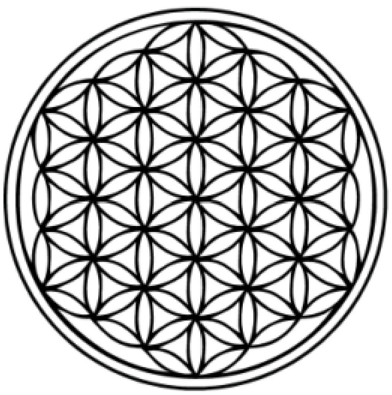

FIG. 8: *The Flower of Life contains all Platonic symmetries.*

increases. The observer and the universe are indistinguishable. The information current does not affect quantum mechanics.

The observer is a Star of David at the center of the Flower of Life. This is another astonishing positive result because the merkaba is a ditetrahedral energy matrix representing the human soul [11]. Both the Star of David and the Flower of Life are a Poincaré sections of the merkaba. It is reported males and females will generally have stronger energy centers in opposing tetrahedra. Just as males and females are spherical and hyperbolic, let males and females be opposing triangles in the Star of David. One is connected to the exterior matrices and the other is not. Thus symmetry is broken. Weeks identifies the symmetry group of the merkaba as follows [5].

> "...the group G has twice as many elements as the original group [*sic*] with the original group being [*sic*] the binary tetrahedral group."

DISCUSSION

The unlimited complexity of infinity may seem daunting but consider what can be seen at the surface. Our lemmas are that the identity is Φ^2 and information is encoded on powers of π.

$$\pi = 3 + \cfrac{1^2}{6 + \cfrac{3^2}{6 + \cfrac{5^2}{6 + \cfrac{7^2}{6 + \cfrac{9^2}{6 + \cfrac{11^2}{6 + \cfrac{13^2}{6\ldots}}}}}}} \tag{35}$$

The 3 enjoys a special top level status. It can be related to broken symmetry in the merkaba and also, interestingly, to the normal three dimensions of space. The infinite 6-string represents medium range cosmological order. Long range order is unknown and not represented in π. Self-similarity at $\hat{\pi}$ sites gives us fair reason to assume a unique top level algebraic status as a starting point for making calculations. "Here" is 3 and all other levels of $\aleph$ are 6.

The logical program of the MCM is three-fold so consider what happens when one drills down three levels into π. Referring to equation (35), we see a logical progression from 1·1 to 7·7. One level beyond 7·7 is 3·3·3·3. Each of those 3's can be associated with a top level on one some other harmonic of π. Due to entropic arguments, further considerations must be accounted for when going beyond 7·7.

Let the us examine the case when the fractal algebra is the simplest, most intuitive one. In that case, for obvious reasons, the number wau $\digamma$ should be related to bifurcations of icosahedral symmetries [12].

$$\digamma = \frac{5}{6} + \cfrac{\frac{5}{6} + \cfrac{\frac{5}{6} + \cfrac{\frac{5}{6} + \cfrac{\frac{5}{6} + \cfrac{\frac{5}{6} + \frac{\ldots}{6}}{6}}{6}}{6}}{6}}{6} \tag{36}$$

The complexity of these objects is minimal. The structure is an array. Inner and outer products can handle any operation between arrays. For example, take the inner product $\hat{\digamma} \cdot \hat{\pi}$ of one 6-array from $\digamma$ with the one in π. After the operation, the top level of π remains as an unpaired term. Continuing with maximal simplicity the following number might have direct application to the physics of fermions.

$$\mathcal{M} = 7 + \cfrac{\frac{6}{2} + \cfrac{\frac{6}{2} + \cfrac{\frac{6}{2} + \cfrac{\frac{6}{2} + \cfrac{\frac{6}{2} + \frac{\ldots}{3}}{3}}{3}}{3}}{3}}{3} \tag{37}$$

There is a well-known phenomenon in which patterns emerge from pure noise. As some parameter is smoothly

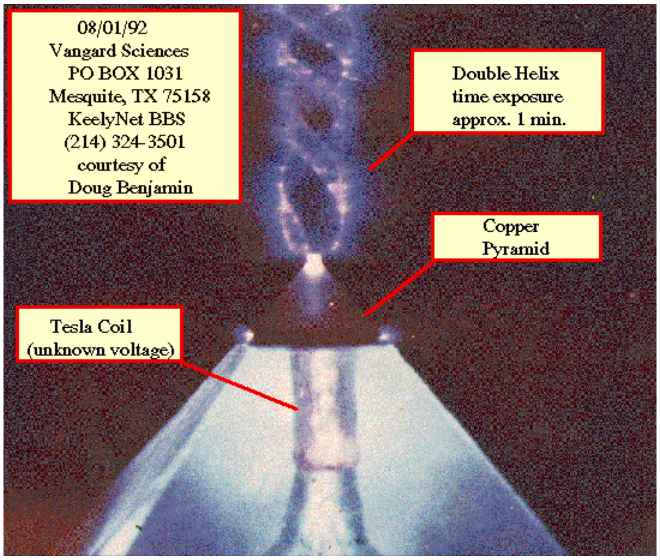

FIG. 9: *Double helical electrical discharge.*

varied past a critical value, a bifurcation occurs and patterns appear. This implies a discontinuous jump from noise to patterns at the critical value. However, the mathematical framework does not allow discontinuous jumps. This is a paradox. There must be a second number line somewhere, intersecting the first number line at the critical value.

The jump from noise to patterns is an interesting problem in the early universe. Consider physics when the wavefunction of the universe found in reference [1] goes as $\sin(\Phi^{\Delta}\pi m\xi)$. Since Δ is a measure of displacement from the present, this function has a remarkable asymmetry. Its odd limits may describe physics in the early and late universe.

Through experience, Alice casts a net in observer space and catches terms in the present. As chaos unfolds around her, there is a flux of terms that factor in from infinity due to chance. These contributions are always finite and increase or decrease according to Δ. Alice will preferentially accumulate such terms from the dodecahedron or the icosahedron due to an imbalance in information pressure. We find an arrow of time.

As Alice accumulates information, she carries more algebraic structure which may in turn accept a larger flux of random unpaired terms. Alice's net expands like a sail on the winds of time. Let the qubit wind be a flux of particles tunneling into Alice's universe. If a tunneling particle's frequency is unaffected by the shift to her $\hat{\pi}$ site, that may account for the anomalous flux of ultra-high energy cosmic rays. Given that the characteristic length scale for chiros is 10^{-4} meters, the random qubit flux may also be related to such things as dust and soil. Without speculation, full turbulence can be attributed to an anomalous Cantor set of unknown terms.

Cosmic ray tunneling is more likely to occur between clustered $\hat{\pi}$ sites. If the infinite potential complexity of fractal branching is restricted to elementary structures such as Φ^2, π, and $\digamma$, it should be possible to calculate the location of nexus points where the anomalous particle flux is high. If Alice or Bob can go there and harvest particles at large Δ, that should have useful energy applications.

Figure 9 shows a double helical electrical discharge from a cusped piece of metal. The electrodynamic action does not predict this behavior. The normal prediction is that the potential V at the pyramid's apex A should be infinite. This gives us good reason to assign a symplectic point to the location of the apex. The interesting behavior occurs when the Tesla coil induces chaotic potential matching on the metal pyramid. Perhaps when A has a chaotic background, V is able to fall through the symplectic point to a hidden region of the phase space where the strange behavior is an extremum of the action.

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