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The Emergence of Dimensional Complexity out of the Null State Universe

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Abstract

The standard interpretation of a null state, or empty state, posits it as devoid of structure. This paper introduces a geometric model (named the 1-*D* geometric model) proposing that the null or empty state contains hidden structure in the emergent development of dimensional complexity. The model's argument analyzes two formats of the right triangle within the unit circle. The first format adheres to standard geometric principles. In contrast, the second adopts a novel framework of dimensional structure by assigning a counter-rational and formally nonsensical unitary value of "1" to its vectors. Although the two geometries have a null relationship due to their fundamental geometric inconsistency, the cosine squared calculations for both triangles agree. The relationship framework is leveraged to propose a generic definition of infinity, in which the inherent paradoxes found in its study are justified as a native and essential feature of the Universe's structure. This reinterpretation is applied to study the paradoxical relationship found between correlated quantum and classical states.

Keywords

Quantum Foundations, Paradox, Emergent Organization, Nonlocality, Universality, Null State, Empty State, Infinity, the Qubit, Double-Slit Experiment, Bell's Inequality, Measurement Problem, General Relativity

1. Introduction

Previous papers in this series have focused on the role of the "not" function in quantum structure [1]-[4]. For clarification, it is now termed the "quantum-not" function to distinguish it from the operator "not" of formal logic. The "not" operation in formal logic is used to negate or reverse a value from true to false. For example, in the structure of two correlated values such as 0 and 1, "not 0" becomes

"1".

The distinction between the "not" of formal logic and the "quantum-not" of the 1-*D* geometric model is that in formal logic, the "not" function operates on a single element, falsifying its value. Instead, the "quantum-not" function falsifies the discrete, classical relationship between two components, entangling and transforming their discrete identities from a classical to a quantum basis.

Two segments having a "quantum-not" relationship share a property on a unitary basis; however, paradoxically, they do not share membership with each other. A new term is applied to describe their entangled relationship, that they are "not/members" of each other.

2. The 1-*D* Geometric Model

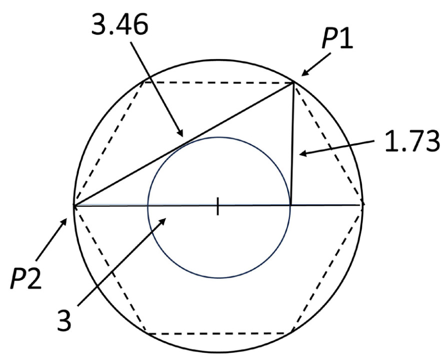

Figure 1. Formal.

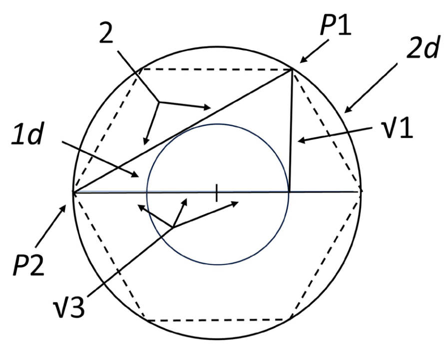

Figure 2. Formally inconsistent.

In **Figure 1**, the diameter of the outer circumference is assigned a value of 4, while the relevant portion for calculating the cosine squared value is 3. The sides of the 30-60-90 triangle measure 3, 1.732, and 3.464 [5]. In **Figure 2**, each vector segment is a unitary state with an identity value of "1".

The dimensional structure in **Figure 2** increases outwardly from a one-dimensional level (on the inner circumference) to a two-dimensional level (on the outer circumference). Vectors that eccentrically cross the dimensional structure of inner and outer circumferences carry the square root. The hypotenuse consists of two vectors that start and end concentrically on the outer circumference, and together, the square roots cancel.

3. Calculating the Cosine Squared Function in the Two Geometries

The 1-D geometry calculates the formal cosine squared value based on **Figure 1** and the nonformal (rationally nonsensical) value based on **Figure 2**.

3.1. Formal Calculations

$$P1-\text{Cos}^2(60)=(1.73205/3.4641)^2=0.25 \quad (1)$$

$$P2-\text{Cos}^2(30)=(3/3.4641)^2=0.75 \quad (2)$$

3.2. Calculations in the Emergent Basis

$$P1-\text{Cos}^2(60)=(\surd 1/2)^2=0.25 \quad (3)$$

$$P2-\text{Cos}^2(30)=(\surd 3/2)^2=0.75 \quad (4)$$

3.3. Interpreting the Results of 3.1 and 3.2

Any structure that contains an incomplete or inconsistent listing of its elements is, by definition, null for the conclusion on its fundamental structure. By this definition, the fundamental format of a null domain (in its lowest basis) is a structure that is devoid of internal structure in the absolute sense.

Geometrically, **Figure 1** and **Figure 2** have a null relationship. However, because they generate the same cosine squared values, rather than being meaningless, the inference is that their relationship is hidden on a nonformal basis.

The new term, defined in Section 1, the "quantum-not" function, is the operator in the relationship between the two geometries. Correlated segments exhibit an entangled, hidden relationship that cannot be defined on a formal basis, due to the role of paradox in their structure. They are "not/members" of each other.

4. Infinity

Mathematical infinities are described as structures without a discrete limit to their boundary, and in a logical framework, they will have different sizes. For example, the infinity of the natural numbers (1, 2, 3 …) will appear to be smaller than that of the real number line, which includes fractions.

Listing examples of infinity does not lead to an understanding of its root nature. Instead, the 1-D model argues through its geometric model that infinities are "unitary states," containing complex structure but prohibiting its discrete representation.

The minimum format of modelling, which is the basis of the 1-D model, is a structure containing two segments. There are two categories to the above prohibition:

1) The interior structure of the infinity prohibits the delineation of its interior structure as a collection of mutually discrete elements.

2) An exterior segment to the infinity exists that shares a given property but is excluded from membership.

5. Dimensional Emergence from the Argand to the Cartesian Plane

The Argand plane's quantum structure has the coordinate axes (x, iy), where i is the square root of minus one [6]. The square root of minus one ($\sqrt{\ } - 1$) is an "imaginary" term in the classical basis of mathematics since the square on which the square root operates is either (1^2 = 1) or (−1^2 = 1) and not (+1x − 1 = −1). In contrast, the Cartesian plane's axes have classical coordinates (x, y).

Although both the Argand and Cartesian planes share the two-dimensional basis of the unit circle, the attachment of the imaginary number (i) to the y-axis of the Argand plane means that its vertical axis (iy) does not contribute to the creation of a two-dimensional structure on a "real" basis. The structure contains only one "real" (classical) dimension.

The conversion of a complex number on the Argand plane to a two-dimensional "classical" basis requires forming the square of the modulus (z) (the hypotenuse) using the Pythagorean theorem ([7]: p. 264). The squaring operation is a dimensional transformation across the boundary between a one-dimensional and a two-dimensional framework.

For the distance of the x and iy axes from the origin:

$$|z|^2 = x^2 + y^2 \tag{5}$$

In the transformation, $x + iy$ (having a real and an imaginary part) becomes a "single" real value $|z|^2$ at the classical level. The process is analogous to the dimensional transformation that occurs from the lower one-dimensional inner circumference to the higher two-dimensional outer circumference of **Figure 2**. The one-dimensional circumference is subsumed into the outer circumference's complexity.

Going back to the definition of a null state in Section 3.3, any structure that contains an incomplete or inconsistent listing of its elements is, by definition, null for the conclusion on its fundamental structure. The Argand plane has a null structure because, on its two-dimensional platform (the unit circle), the orthogonal axes do not share membership on a common basis. The two axes are "not/members" of each other, which conserves the fundamental null structure in the framework of the Argand plane.

6. The Entanglement Mechanism in the Qubit

The paper by David Deutsch *et al.* identifies the quantum structure created by entangling two logic machines in series. Their output, in combination, produces a single "not" value, and the randomness of a 50:50 distribution disappears, which violates the axiom of additivity in logic [8].

"**Figure 2**: Concatenation of the two identical machines mapping {0, 1} to itself. Each machine, when tested separately, behaves as a random switch, however, when the two machines are concatenated the randomness disappears—the net effect is the logical operation not. This is in clear contradiction with the axiom of additivity in probability theory!

This is a very counter-intuitive claim—the machine alone outputs 0 or 1 with equal probability and independently of the input, but the two machines, one after another, acting independently, implement the logical operation not. That is why we call this machine √not. It may seem reasonable to argue that since there is no such operation in logic, the √not machine cannot exist. But it does exist! Physicists studying single-particle interference routinely construct them, and some of them are as simple as a half-silvered mirror *i.e.* a mirror which with probability 50% reflects a photon which impinges upon it and with probability 50% allows it to pass through. Thus the two concatenated machines are realised as a sequence of two half-silvered mirrors with a photon in each denoting 0 if it is on one of the two possible paths and 1 if it is on the other."

The analysis of the qubit structure in David Deutsch's paper serves as an excellent comparative example to the structure of correlated quantum and classical states. In the half-silvered mirror experiment studied in Section 7, two half-silvered mirrors are similarly concatenated in a quantum structure.

In the quantum operation of the experiment, the second half-silvered mirror transmits photons only on one of its two orthogonal axes. Similarly to the output generated by the qubit, this is a violation of what should be a random 50:50 distribution on both axes.

7. The Half-Silvered Mirror Experiment

In the half-silvered mirror experiment, a photon beam is directed at the first half-silvered mirror, which splits (quantum entangles) the wavefunction across two orthogonal paths, (x, iy). Two fully silvered mirrors, positioned one on each path, redirect the entangled paths of the wavefunction to a second half-silvered mirror at the apparatus's exit ([7]: pp. 264-265). The final half-silvered mirror has a detection device on each of its two orthogonal paths of exit.

If there is no detection (classical interference) along the interior paths of the apparatus, the second half-silvered mirror recloses the wavefunction, after which the photon projects on the same axis that it entered the apparatus, and the other axis does not contribute to the probability structure.

However, if interference by any form of detection, at the classical level, occurs within the apparatus, the wavefunction collapses to the higher-dimensional structure of the classical basis, and each photon (as a classical particle) is randomly found on one of the two orthogonal paths of exit with a 50:50 distribution.

For both the qubit structure and the half-silvered mirror experiment, entangling two classical-level devices results in the creation of a unitarily contained and closed state (a localized infinity as defined in the 1-D model). The interiors are "null" for concluding the contribution of the paths to the outcome. The "quantum-not" function in the complex frameworks of the two structures conserves their null property.

8. The Double-Slit Experiment

In the double-slit experiment, instead of half-silvered mirrors dividing the photon wavefunction onto orthogonal paths, it is divided across two slits [9]. A screen is positioned beyond the slits, and correlated quantum and classical effects are observed, depending on whether the photon beam is disturbed before passing through the slits.

For comparison, in the half-silvered mirror experiment, the concatenation of the two mirrors creates two degrees of freedom (on a quantum basis), with one axis being "real" (in a one-dimensional format) and the other axis being imaginary. The double slit structure also has two degrees of freedom (on a quantum basis), but prohibits distinguishing the contribution of each slit, equally conserving the state as null.

If the wavefunction is interfered with before the slits, then its collapse occurs at that point. The quantum basis is destroyed, and the phenomenon transforms to a classical structure in which each slit contributes one degree of freedom on a classical basis. There is then a 50:50 probability for which slit each photon will go through, and the photon distribution on the screen is without an interference pattern.

At the classical level, the "unitary" state in which the photon passes across both slits is sequenced in "imaginary" time. This means that the null basis of the classical format is conserved because the events (as a unitary state) are imaginary to each other. Each event is incomplete for the expression of the unitary state that requires a probabilistic 50:50 distribution.

9. Bell's Inequality Theorem

Bell's inequality theorem tests the hypothesis in relativity theory that all locations in the Universe are local and distinct, in which the speed of light limits the connection between them ([10]: pp. 211-227). The theorem examines the polarization correlation between quantum entangled photons when measured from separate locations in classical space.

If the measuring devices are set at the same angle, the polarizations (up or down) will always agree (UU, DD…). If one device is set at 30 degrees, quantum theory predicts that the disagreement on polarization between the particles will be one in four. If the device measuring the second photon is also rotated by 30 degrees (for a total of 60 degrees), quantum theory predicts that the disagreement will occur in three out of four cases.

However, for the same rotations (to 60 degrees), classical probability predicts differently, that the disagreement can be no more than two in four misses.

In the experimental demonstration of Bell's inequality by Alain Aspect, disagreement between the polarizations was found in three out of four cases [11], validating that the particles remain in a robust quantum relationship, which violates the limitation for communication at the speed of light.

Thus, the experiment indirectly demonstrated that, despite the unquestioned accuracy of relativity theory in its realm, classical relativity can never explain any system that obeys the laws of quantum mechanics ([10]: pp. 220-221).

9.1. The Active Quantum and the Passive Classical Background in Bell's Inequality

In Bell's inequality, the violation of classical probability occurs because the disagreement ratio between the two particles is too strongly correlated to be generated in a classical relationship. Nevertheless, the particles must still fly apart, obeying the limitation of the speed of light. Consequently, the classical space is a "passive" background in the quantum relationship of the two photons.

9.2. Frameworks of the Null State Conserved in Bell's Inequality

In its most general form, a conservation principle conserves the content of a given state when it is transformed into a new basis.

Going back to the definition of the null condition in Section 3.3, any unitary structural framework that contains an incomplete or inconsistent listing of its elements is, by definition, null for the conclusion on its fundamental nature.

The null or empty state structure, in Bell's inequality, is conserved in two formats:

1) The polarization value of the photons is hidden before measurement, meaning that it is "not" possible to have knowledge of the values until the state is raised to the classical level. The null state is conserved in its lowest fundamental state, which contains no degrees of freedom.

2) The relationship between the robust quantum state and the classical background is fundamentally inconsistent, which means that they are "not/members" of each other, and their relationship is null.

10. Discussion

The 1-D geometric model studies the unit circle, on the two-dimensional platform, as the most general framework in which to analyze infinity as a domain of absolute self-reference. Although the circumference is not an infinity in the larger space of the flat plane, its circumference absolutely confines the structure qualifying for membership within it on a local basis. The cosine squared calculation for the right triangle is one of the parameters that measure the membership structure of the space.

The 1-D model constructs two geometries within the unit circle. The second geometry, in **Figure 2**, is formally nonsensical; yet it qualifies for membership in the unit circle based on the cosine squared calculation.

The 1-D model conjectures that its proof holds significance as a general principle demonstrating how unitary (infinitely bound) states incorporate paradoxical inconsistency in their dimensional structure. The argument has two parts.

Part One: On a formal basis, the geometry in **Figure 2** is nonsensical, and there is no basis on which to establish that it has a common link with **Figure 1** in the unit circle. However, the cosine squared calculation demonstrates that a relationship does exist in which the two geometries are conjoined in a complex null state of both. The quantum-not function establishes their relationship as not/members of each other.

Part Two: **Figure 1** and **Figure 2** examine the relationship between the fixed formal basis of dimensional complexity, which is essential for mathematical consistency, and a process that develops across boundaries that cannot be grouped in a consistent framework.

In **Figure 1**, the dimensional structure is geometrically and mathematically fixed. In **Figure 2**, the inner and outer circumferences represent separate infinitely bound states across which their relationship is formally inconsistent. Complexity grows outward, with the inner one-dimensional circumference subsumed into the canopy of the two-dimensional outer circumference.

10.1. The Measurement Problem

As discussed in the above experiments, the measurement problem concerns the instantaneous collapse of a quantum state to its correlated classical basis when disturbed by any form of measurement [12]. There would be no proof of such relationship without the apparatuses capable of opening classical structures in a lower-dimensional framework. A lower-dimensional space lacks the dimensional complexity to support discrete locations, particles, and classical objects, and is counterintuitive to our classical experience.

Our tools of rationalism for interpreting reality (logic, mathematics, and experiment) are fundamentally grounded in a classical framework that requires consistency for its formulations. Necessarily, dimensional structure is placed on a fixed mathematical plane, wherein dimensional levels are grouped by applying the power function.

There is no law in Nature to prove the concept that dimensional structure has a fixed format. If, as argued in the 1-D geometric model, dimensional complexity develops across boundaries that are infinities, then mathematics, although completely valid within its realm, also has a boundary beyond which the Universe's basis is fundamentally inconsistent with formal representation.

If so, the measurement problem is a natural consequence of the relationship between correlated quantum and classical frameworks established by the "quantum-not" function. At each level of dimensional complexity, the "quantum-not" function incorporates a different format of the null state, which prohibits conclusion on an absolute basis.

10.2. The Imaginary Component of Dimensional Structure from the Purely Null to Its Classical Basis

The term imaginary, in the most general sense, means that a structure has no "real" form, and is another way of stating that the structure is empty or null. Accordingly, when an imaginary and real component are conjoined, the unitary state of both becomes incomplete for conclusion.

The 1-*D* model identifies the format of incompleteness that is contained at each level of dimensional complexity.

The Pure Null State: The definition of a null state is that it contains no content. The pure null state is the primordial precursor to the development of complex dimensional structure, characterized by a "quantum-not" relationship.

Quantum Structure: Quantum structure elevates the pure framework of the null state by one level of dimensional complexity and correspondingly, to one degree of freedom. It lacks sufficient complexity to support the existence of structure on a classical basis.

Classical Structure in Two Dimensions: The classical structure of the Cartesian plane introduces an additional level of dimensional complexity, allowing both orthogonal directions in space (x and y) to be real. The null component is incorporated on a more complex basis. The separation distance between locations on the plane is time-like imaginary.

Classical Structure in Three Dimensions: In classical structure, with three orthogonal directions (x, y, z), the imaginary null component of the space is transformed into the fourth dimension of imaginary time. The structure remains incomplete because the element of time extends to infinity and cannot be limited.

In conclusion, the 1-*D* model argues that understanding the role of the empty or null state at each level of dimensional complexity resolves the issue of the measurement problem. The two frameworks (quantum and classical) are "not/members" in the null state's fundamental structure, which incorporates a prohibition to final conclusions.

The "quantum-not" function prohibits the discrete delineation of the quantum/classical relationship, and instead, it is paradoxical. Although this is not a satisfactory solution that demonstrates a unitary theory conjoining both frameworks, it clarifies the role of the null state in their relationship.

10.3. What Can a Two-Dimensional Model Reveal of the Immense Complexity of the Universe?

The experimentally validated mathematical theories that provide insight into the fundamental structure of the universe are Einstein's general relativity theory and quantum field theory (the Standard Model). The mathematical structures of these theories are incredibly complex [13].

Currently, there is no theoretical basis for unifying the above theories. Discovering such a link would finally quantify the structure of the Universe in a unitary framework, at least between these competing theories.

Classical and quantum theory are as paradoxical to each other as the geometries in the 1-*D* model. Quantum theory cannot account for time and gravity, and the theory of relativity cannot account for the quantum structure of the Standard Model.

The 1-*D* model adopts a philosophical perspective of inductive reasoning in analyzing its proof and the implications for formulating a theory of everything. Examples are used to demonstrate the generic mechanism of paradox that applies in logic, mathematics, and the physical structure of the Universe.

The 1-*D* geometric model presents two arguments that inherently include the null state, as defined in the 1-*D* model, in their structures. The first describes the Universe in a format that prohibits discrete knowledge of its internal structure. For example, that would be the case for string theory, which would theoretically describe the Universe but so far has been untestable [14].

The second contains more than one entirely successful theory, which are "not/members" of each other. The relationship between quantum theory and general relativity exemplifies this.

Are the laws of Nature discovered through mathematics and physics hinting at a larger basis of reality than can be singularly contained in a unitary principle? Is the native structure of the Universe hidden in the format of a null state that is not directly observable through rationalism? If so, there is no such thing as a Theory of Everything.

Conflicts of Interest

The author declares no conflicts of interest in the publication of this paper.

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