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The Mechanism of Paradox in the Structures of Logic, Mathematics, and Physics

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Abstract

This paper presents a model for the structure of universal frameworks in logic, mathematics, and physics that are closed to logical conclusion by the mechanism of paradox across a dualism of elements. The prohibition takes different forms defined by the framework of observation inherent to the structure. Forms include either prohibition to conclusion on the logical relationship of internal elements or prohibition to conclusion based on the existence of an element not included in the framework of a first element. The model is applied to logical arguments in philosophy, mathematics, and physics and is initially a geometrical analysis of quantum theory and its application in experiment. Conclusion from the analysis is extended to give insight into the complexity of infinities above the two-dimensional boundary of the model.

Keywords

Hardy's Paradox, Paradox, Quantum Mechanics, Classical Relativity Theory, Gödel's Incompleteness Theorems, Cantor's Diagonal Slash Argument, Russell's Paradox, Theory of Everything, Counterfactual Structure, Shrödinger's Cat, Cosmic Background Explorer, Saturn's Hexagonal Structure

1. Introduction

In logic and mathematics, paradox is axiomatically prohibited, and studies over the centuries in philosophy, mathematics, and most recently, physics characterize it as a perplexing anomaly begging its removal through more advanced theory. Nevertheless, paradox appears to arise naturally in universal structures and truth statements in all realms of study.

In this paper, paradox is examined not as an anomaly but rather as a valid and systemic mechanism from the philosophical arguments in discussing paradox to what we observe in the fundamental structure of the physical universe. This

leads to a discussion of the formal representation of *infinities* and *dimension* in mathematics. It is argued that the formalisms of logic and mathematics hide the native form in which Nature incorporates paradox. The argument ultimately extends to the claim that it is not possible to formalize a *theory of everything* for the universe. Could paradox be a fundamental mechanism in the universe and all elements within it?

A geometric model is presented on the role of paradox and is validated based on data obtained in an experiment on Hardy's paradox. Hardy's paradox is a thought experiment proposed by Lucien Hardy in which a particle and its anti-particle may interact without annihilating each other (Wikipedia, "Hardy's Paradox", 2023). The theoretical calculation of quantum-level probabilities for the event-structure was done by Aharonov et al. (2002) (**Table 1**). An experimental demonstration of Hardy's paradox was done by Lundeen and Steinberg, experimental joint weak measurement on a photon pair as a probe of Hardy's Paradox (**Table 2**) (2008).

It is claimed that what appears to be experimental error between the theoretical calculations by Aharonov and the experimental results by Lundeen and Steinberg is not error and instead points to the mechanism of paradox discovered by applying the cosine-squared identity to the geometry of the model (**Table 3**). The mechanism of paradox is central to resolving the disparity and discovering the native functionality of paradox as a mechanism in Nature, not as an anomaly.

Table 1. Theoretical weak values from the Aharonov paper.

	N (I−)	N (O−)	
N (I+)	**0**	1	1
N (O+)	1	**−1**	0
	1	0	

I = Inner path, O = Outer path.

Table 2. Experimental weak values.

	N (I−)	N (O−)	
N (I+)	**0.245**	0.641	0.926
N (O+)	0.719	**−0.759**	−0.078
	0.924	−0.087	

(Lundeen & Steinberg, 2008).

Table 3. Application of the cosine-squared function to the data.

	N (I−)	N (O−)
N (I+)	**$\cos^2(60) = 0.25$**	Not Applied
N (O+)	Not Applied	**$-\cos^2(30) = -0.75$**

Diverse subjects are analyzed to give evidence through inductive reasoning that the role of paradox is systemic in the universe. Topics studied include a generic, comprehensive definition of paradox, a thought experiment in modelling the fundamental structure of the universe, understanding infinity, the error in logic in the thought experiment Schrödinger's Cat, Russell's paradox, examples of the transformation of paradox at the classical level, the Cosmic Background Explorer, Bell's theorem, and the hexagonal geometry on the surface of Saturn.

2. The Geometric Model

The geometric structure in Figure 1 and Figure 2 applies the cosine-squared identity to analyze theoretical and experimental data on Hardy's paradox. In the experiment, photons in quantum superposition traverse four possible paths and exit at two ports, each with two orthogonal paths. The technique of measurement is post-selection through weak measurement.

Dark Ports are analyzed that simultaneously receive quantum-entangled photons, [Both In] at ($p1$) and [Both Out] at ($p2$). The geometry represents the rotation of the entangled photons in the complex structure of the concatenated, parallel waveforms. The angle subtended to the events [Both In] and [Both Out] is $P(\theta) = \cos^2\theta$. This gives the quantum-level probabilities for the set of the two paths.

Positions $p1$ and $p2$ are rotations through simultaneous firing of both ports D. Values, as discussed in the model, are nonlinear object identities.

[Both In] (Inner paths)	[Both Out] (Outer paths)	
$\sqrt{1}/2 = 0.50$	$\sqrt{3}/2 = 0.87$	(1)
$(0.50)^2 = 0.25$	$(0.87)^2 = 0.75$	(2)
$\cos^2(60) = 0.25$	$\cos^2(30) = 0.75$	(3)

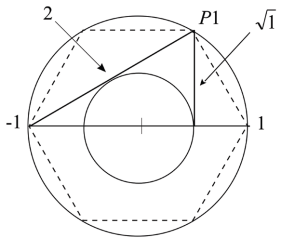

Figure 1. Waveform rotation at position $p1$ for simultaneous firing of dark ports.

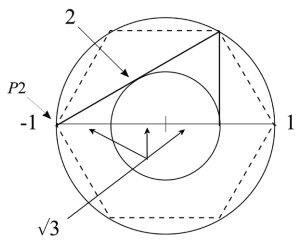

Figure 2. Waveform rotation at position $p2$ for simultaneous firing of dark ports.

Figure 1 and Figure 2 the geometric structure allows representation of the experimental data as a waveform. It is claimed this is the native format of the event-structure. Under the geometric model the sides of the triangle are assigned nonlinear object identities that cross dimensional boundaries.

3. Calculation of the Trigonometric Values

The Hexagonal Calculator calculates the values for the adjacent sides to the right triangle on the Cartesian plane (Szyk & Díez, 2023, "Hexagon Calculator."). The diameter of the circle is assigned the value 4, and the portion applied in the geometry is 3. The calculations for the sides to the 30-60-90 right triangle are 1.732, 3, 3.464. The cosine-squared values for these vectors calculated as linear elements of the right triangle match the values when calculated as object identities that cross dimensional boundaries. See equations (1), (2), and (3).

$$\text{For } p1\ (1.732/3.464)^2: \quad \text{Cos}^2(60) = 0.25 \tag{4}$$

$$\text{For } p2\ (3/3.464)^2: \quad \text{Cos}^2(30) = 0.75 \tag{5}$$

The geometric structure is a superposition of two frameworks. On the one hand, it is Cartesian. On the other hand, it has a *sub-classical* significance. It will be shown paradox is the root mechanism at work when the square root function is applied. The relationship of elements becomes nonCartesian in a quasi one-dimensional framework. As such, numerical counting and linear measurement become equal parameters for the resulting cosine-squared values.

The superposition of two dimensional levels in a single framework is analogous to the quantum entanglement of two waveforms in holographic images; two waveforms are superimposed in an image creating a three-dimensional effect (Wikipedia contributors, "Holography."). The geometric model is the reverse of that format; classical and *sub-classical* spaces are superimposed on the Cartesian plane.

For the geometric model, elements that eccentrically cross identified dimensional boundaries have the square root assigned for counting. The two segments of the hypotenuse cancel the square root by multiplication as their endpoints are on the same dimensional level, and the value is 2. The value for [Both Out] (0.75) projects from the negative side of the x-axis and takes a negative value in Table 3.

Table 3 defines the noncollapsed waveform as a function of angular rotation in the geometry. The two calculations represent the contribution when Dark Ports fire simultaneously.

4. Discussion

Three terms applied to the discussion that follows are *quantum*, *classical*, and *sub-classical*.

Quantum structure: is inherently closed to observation and conclusion on the relationship of elements contained within it. As such, it has a waveform signature. The internal structure does not obey the rules of classical relativity theory.

Classical structure: is the *everyday* basis in which we can conclude the relationship of individual objects in space and time. The format obeys the rules of relativity theory and is also the framework of analysis and conclusion for logical arguments. Classical theory does not conform to the laws of quantum theory.

Sub-classical: is the term applied in this model when a structure combines quantum and classical formats in a quasi-quantum structure. The Cartesian framework counterposes one-dimensional elements in its two-dimensional structure. The relationship of elements is simultaneously quasi-quantum and classical.

Infinities: are structures containing a boundary that prohibits conclusion. Examples are found in logical arguments, mathematics, and physics for the relationship between quantum and classical structure. Infinity takes two forms: a prohibition to the relationship of internal elements or a prohibition to reference outside its boundary for elements that have membership in the infinity.

The geometric model is a composite construction based on a *thought experiment* developed using three criteria.

1) The initial state is *null*, called a *primordial null state*, meaning that it is without internal form and is not an element of location within a larger structure.

2) Paradox creates a dynamic pressure for the structural development of dimensional complexity subsumed in successive cycles from the state of the null framework.

3) The development of dimensional complexity in stages in the model is a process in two parts, *self-organization* and *stationery* (*least*) *action*. Self-organization is a nonequilibrium process in which organized structure develops spontaneously (Wikipedia, "Self-Organization", 2023). The principle of least action mandates that the shortest path will develop from the potential of random elements (Wikipedia contributors, "Stationary-Action Principle."), (The Feynman Lectures on Physics Vol. II Ch. 19: The Principle of Least Action, n.d.).

The agreement between **Table 2** and **Table 3** strongly validates the geometric interpretation that the difference between the theoretical values in **Table 1** and the experimental results in **Table 2** is explained through the geometric model. The theoretical data in **Table 1** is a pure calculation in a consistent mathematical framework. It does not account for the mechanism of paradox as the root structure within which the concatenated waveforms of the photons reside.

The boundaries between elements in the geometry constitute *infinities* across which adjacent elements have an inconsistent and paradoxical relationship. By contrast, mathematical structure formats dimensional levels through power functions, and the elements have a common basis.

5. Paradox

Paradox is created when a statement contains circular self-contradiction and occurs in both linguistic and mathematical arguments. Conclusion for the structure's truth-property is prohibited (Wikipedia, "Paradox", 2022). There are many examples. One well-known statement in logic is: I am telling a lie. The

truth-property of whether or not it is a lie is prohibited

In mathematics, examples are Gödel's first incompleteness theorem and Cantor's diagonal slash argument. Gödel's theorem states that for any system of mathematics, there are statements that are known to be true but cannot be proven true (Wikipedia, "Gödel's Incompleteness Theorems", 2001). Cantor's diagonal slash argument openly displays the paradox of countability for a number line constructed as an infinity (Cantor Diagonal Method, "Wolfram MathWorld", n.d.). Discussions on paradox are generally limited to listing examples but without resolution.

A definition that defines the relationship of dualistic elements in paradoxical arguments can be given. The fundamental basis of paradoxical structure is that two elements have membership in a parent structure for an identified property. However, the elements do not share membership; it is not possible to distinguish the logical correlation of each to the other for the state in which they are members. Stated in reverse, the framework of the parent paradoxically *entangles* two elements.

The geometric model contains the structure identified in the definition of paradox given above. There are two mathematical frameworks for calculating the correct value of the cosine-squared identity, and they are paradoxical. In the first format, vectors have linear values, and in the second, vectors have object identities without linear values.

6. Perspective

The mathematical basis of Hardy's paradox is explained through quantum formalism, which incorporates the imaginary number i, $\sqrt{-1}$. The term imaginary is used because, in classical mathematics, the antecedents $(+1)^2$ and $(-1)^2$ should both produce the product (+1). The reverse operation taking the square root is only in the form $(\sqrt{+1})$ and not $(\sqrt{-1})$ found in quantum structure. Thus, the relationship of the classical antecedents forming the higher dimensional square has no meaning in quantum format. Instead, they are imaginary in quantum formalism in a similar way that $(\sqrt{-1})$ is imaginary in classical formalism.

Under the framework of the geometric model, the basis of classical structure is dimensionally higher than what is formatted as quantum. Consider that only the x-axis of quantum, two-dimensional structure is *real* because the value $(\sqrt{-1})$ has been attached to the y-axis. Thus, there is an underlying paradoxical dualism across quantum and classical structures. The only available mechanism of transformation is the collapse of the wave function, which is a squaring operation. The structure of the unit circle meets the definition of paradox given above. The two frameworks share a common structure but are paradoxically conjoined across a dimensional boundary.

7. The Dynamic Format of Paradox and Normalization

Paradox takes two forms. The first has a static format and is found in the logical

arguments of philosophy and mathematics. The second is a dynamic format identified in the geometric model as a composite structure formed by outward pressure in the continuation of cycle across dimensional levels that are each infinities. In both cases, normalization is not possible, and states remain incomplete. The complementary frameworks of static structure and dynamic action also meet the definition of having paradoxical relationship. The two formats are not transformable across each other.

8. Formal Modelling of the Universe: A Thought Experiment

The above sections have presented a model for the basis on which universal structure develops its complexity across dimensional boundaries. The development is a process of self-organization, stationary action, and the role of paradox as an outward force allowing growth in complexity. The representation of outward development is limited to two dimensions by the geometry of the model. However, it demonstrates the fundamental process conjectured to apply beyond a two-dimensional framework. Such a state has complexity hidden within and to still develop.

Does the universe have the same fundamental structure represented in the geometric model? That is a question without a formal answer. However, this paper presents the mathematical justification and philosophical argument that it does.

9. Understanding Infinity

The concept of infinity can be modelled in a quasi-quantum format. The structure of the half-silvered mirror experiment illustrates how this works (Penrose, 1994: pp. 261-262). An interferometer divides each photon $|A\rangle$ into two parts at 90 degrees, $|B\rangle + i|C\rangle$. Because i is the imaginary identity ($\sqrt{-1}$), the path $i|C\rangle$ is imaginary, and the two paths have parallel quantum superposition.

Following the above format for modelling infinities, we use the infinity of the natural numbers as an example. Arbitrarily, we select 1 to 10 as the real component. All naturals, not 1 to 10, are the imaginary component for the complete series. In the same context that ($\sqrt{-1}$) is imaginary, the portion of naturals grouped as imaginary cannot be listed.

This format limits what is observable in a consistent argument and meets the definition of paradox in the model. The example clarifies the distinction between what we can group as real in a first element and what cannot be grouped as real for *common property* in a second element of a universal structure.

Discussing infinity to date has involved either the myriad listing of examples or attempts to demonstrate resolution through new theories. The principle presented above takes the opposing view that paradox is a fundamental mechanism in Nature. The systemic role of paradox creates a duality for elements that do not share property but are members within an inclusive state of both. Paradox is not an anomaly in this model. Instead, it is the fundamental mechanism at work

as the limitation to knowledge in absolute terms.

10. Schrödinger's Cat (Wikipedia, "Schrödinger's Cat", 2023)

Under the geometric model, there is a fundamental flaw in the thought experiment, Schrödinger's Cat. The flaw highlights the difference between a formal mathematical representation of quantum structure and what has been proposed as its native format. The confusion created in the discussion on the *cat* is understandable because the framework of logic in classical structures is fixed by requiring mathematical consistency.

The framework of basic quantum structure is dimensionally simpler than its classical counterpart. The transformation from quantum to classical is a process of development into the more complex dimensionality of classical space. Penrose comments, "A quantum measurement has the effect of magnifying quantum events from quantum to the classical level (263)". He further states that the transformation from the quantum structure of complex numbers is the mathematical operation of forming the *squared moduli* (264).

Penrose uses the term *magnification* to describe the transformation, which fits with the generally held view of what is occurring. Magnification is a transformation from the very small to the very large in a consistent framework. That is not what occurs. It is a transformation across dimensional levels in which the mechanism of paradox forms the boundary between them. Because of the role paradox, it is not possible to correctly represent the transformation in a mathematical framework that requires consistency and categorically prohibits paradox.

The *cat* is never entangled at the lower dimensional level of the quantum structure and is always a classical *cat*. The original setup of Schrödinger's Cat uses a radioactive particle that will kill the cat when it decays. Penrose (1994: p. 334) describes a simplified version of the *cat* scenario. Instead of a radioactive particle, the quantum state used is the entangled pathways of the half-silvered mirror experiment. Although the frameworks of particle decay and the half-silvered mirror experiment are based on separate quantum phenomena, they both have a quantum basis. The difference is that when a radioactive particle will decay cannot be predicted, whereas the passage of each photon, as entangled on two quantum-level paths, is known with certainty.

In Penrose's scenario, a gun is set as a measurement device to collapse the wavefunction on one of the paths. It is set to kill the cat if a photon should transit that path on the collapse. Probabilistically this will have a 50:50 chance of occurring with each photon. The error in both scenarios is that the gun is always classically outside the quantum framework, and cannot initially exist as quantum-entangled within it. This brings up the issue of the role of observation by the scientist in the scenario. Simply hiding a quantum state in a box does not infer down-conversion of classical elements along with it. Paradox categorically divides the two frameworks across a dimensional boundary.

11. Russell's Paradox (Russell's Paradox, 2021, Stanford Encyclopedia of Philosophy/Spring 2021 Edition")

Russell's paradox, *R*, fits the definition of an infinity. *R* is the set of all sets that are not members of themselves.

The question becomes: where should the infinity *R* be placed relative to itself since it shares property with its elements? The examples of Gödel's first incompleteness theorem and Cantor's diagonal slash argument provide insight. Both structures prove that what is constructed as an infinity for a universal structure is a false infinity. It is not possible to rationally contain all elements of an infinity as a universal structure, and *R* is the collected infinity for those elements. Placing *R* as a single element within its own framework of infinity violates the mathematical proofs of Cantor and Gödel. It is not possible to construct a single state that is closed as an infinity.

The second framework for the placement of *R* is outside of its own infinity. However, since *R* shares membership for the property defined by *R*, placing it outside of its own domain means the domain is incomplete, and *R* becomes a false infinity to itself. There are only two rational alternatives for the placement of *R*, and it is eliminated from both. The conundrum for the logical placement of *R* mirrors the diverse form that paradox takes in the structure of universal frameworks.

12. Examples of Fundamental Classical States Having a Not-Relationship between Counterposed Elements

The logical operation *not* is the basis of quantum theory of computation (Deutsch, 1999, "Machines, Logic and Quantum Physics"). In the classical examples that follow, the term *not-relationship* is applied to elements robustly counterposed within a classical parent state. The mechanism of paradox takes a different form at this level of dimensional structure. Complementary, separately observable, dualistic elements display a counterposed *not-property* to each other within the parent state.

A simple example is the unit circle's *x* and *y* axes. Each axis is orthogonal to the other in defining the structure of the unit circle. However, they are *not* members of each other for their distinct identities. In other words, it is counterfactual to claim that *x* and *y* have the same identity, although they are members of the larger framework.

Examples:

1) Fungible (as numerical) and nonfungible (as linguistic) characters in the description of objects:

"There are five trees in the yard." The character *five* is a fungible symbol having universal application for identity. The word *trees* is nonfungible - having a fixed identity. The description of the scene is not complete without its fungible and nonfungible components. Fungible and nonfungible elements have paradoxical properties but, in combination, allow a more comprehensive description

than the statement "there are trees in the yard."

2) The internal relationship of elements in humor: "What did the Zen Master say to the Hotdog Vendor." Answer: "make me one with everything." The statement contains two elements that do not have a common, rational relationship but are correlated as common within a single statement, creating humor. Amusement and laughter are the reactions to the nonrational structure of paradox in humor.

The paradoxes of humor intrinsically allow the expression of what *isn't* rather than what *is* in a description. Humor draws attention to understanding the meaning of our life experience from the perspective of what it *is not*. That is why it is so successful when well-done.

3) The relationship between humor and literalism: Humor is the juxtaposition of incongruous elements in a single statement. The structure is paradoxically formatted. In contrast, literal arguments juxtapose congruous elements in a logical format. Humor and literalism are complementary, linked elements in any dialogue that contains both as a singular complex presentation.

4) The frameworks of stationary action versus Newtonian action: Both mathematical formats describe the action of a mechanical system but are paradoxical in their properties (Tributsch, 2016, "On the Fundamental Meaning of the Principle of Least Action and Consequences for a 'Dynamic' Quantum Physics."), (Wikipedia, "Classical Mechanics", 2001).

5) Color Lattice: Primary colors (red, green, blue) are the basis of additive Color mixtures such as those which create full-Color TV images. Color printing (subtractive Color process) is based on mixtures of the process colors yellow, magenta, and cyan. Both formats produce the same colors (Herbert, 1985: pp. 178-179).

6) Plot versus storyline: Storyline forms linearly from the beginning while plot is hidden. They are paradoxical for developing an event-structure but contained within it as members.

7) Male and female components in electrical connection: Two elements have counterposed structures for their properties but are singularly contained for completing circuitry.

8) Dark matter of the universe versus the observable universe: Two elements share property (the universe), and their individual properties are not transferable across them as real (Dark Energy, Dark Matter, n.d., "Science Mission Directorate").

9) Particle/wave duality: The particle form is a classical property, and the waveform is a quantum property. The two states are paradoxical in their forms but found in the description of single phenomena (Wikipedia, "Wave-Particle Duality", 2023).

10) The Möbius strip: In classical terms, when the strip is joined without a 180-degree flip, the two sides are separate as members of the structure and observationally independent. When the ribbon is cut and rejoined with a 180-

degree flip, the continuous path along the structure now has two entangled quantum-like sides as *not* members of the continuous path of the strip (Wikipedia, "Möbius Strip", 2023).

11) Electricity and Magnetism: Electric and magnetic forces have orthogonal properties and are paradoxical (incongruous) as vectors but conjoined as elements in the more fundamental description of electromagnetism (Wikipedia, "Introduction to Electromagnetism", 2022).

12) Mind-Body Dualism: (Wikipedia, "Mind–Body Dualism", 2022)

13) Logic and belief: These two elements are entangled. Logic that categorically discounts belief is the absolute and restrictive belief in the scientific method for understanding. Belief that categorically dismisses the logic of the scientific method is a conclusion formed in logical consideration of what is true. The extremes of each hide the reality contained by both.

14) Art: The last item in this list has a less obvious connection to the role of paradox but is perhaps most important for us as humans. Art is a counterfactual window to the soul.

13. Cosmic Background Explorer

We can look to circumstantial evidence for the significance of the model in the largest universal structure of all.

From the Cosmic Background Explorer: "In principle, in an infinite universe, the waves in the cosmic fireball should appear randomly around the sky at all sizes. But, according to the new map, there seems to be a limit to the size of the waves, with none extending more than 60 degrees across the sky. The effect was first noted as a puzzle in the COBE data, … and now seems confirmed… 'The fact that there appears to be an angular cutoff hints at a special distance scale in the universe,' Dr. Hinshaw said (Overbye, 2003, 'Universe as Doughnut: New Data, New Debate')".

The signature angularity in the early universe matches that of the geometric model. Speculatively, if the universe has the same framework found in the model, then dimensional boundaries apply, across which paradox is the dynamic mechanism of self-organization. If the universe has this fundamental basis, it will be impossible to formally represent it in a consistent mathematical framework because it would have to incorporate paradox as a mechanism.

14. Bell's Theorem (Bell's Theorem, 2021 (Stanford Encyclopedia of Philosophy/Fall 2021 Edition))

The basis of classical relativity theory is that all locations in the universe are local and distinct, in which the speed of light limits the connection between them. Bell's theorem tests this hypothesis by analyzing the polarization attribute between two entangled particles at separated locations in classical space.

Under the rotation of each particle, the error rate between the particles is found to be more strongly correlated than predicted by classical probability and is a single, unmediated, mixed-phase waveform. The experiment indirectly proves

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.

"As in the case of the EPR paradox, it's important to realize what Bell did not do. He did not discover an experimental situation in which non-local interactions are directly observed. Instead, he invented a simple argument based on experimental results that indirectly demonstrated the necessary existence of non-local connections." (Herbert, 1985: p. 220)

In other words, Bell did not prove that relativity theory is invalid. Instead, he demonstrated there is a problem between the two formal frameworks. The geometric model offers insight. In the framework of the geometric model, the experiment has paradoxically superimposed quantum and classical elements in a parent state of both.

The paradoxical relationship between the frameworks of the experiment is not an anomaly but rather appropriately paradoxical. The first framework is the classical separation of the particles in space and time; the speed of light limits any effects between them. The second framework is quantum, in which there is no separation in space and time for interaction between the particles, and they do not obey the limitation of relatively theory.

The generally accepted interpretation is that classical probability is invalid and begs either some integration into a quantum framework or that both require discovering some new theoretical basis. However, Bell's theorem is based on analysis within a consistent mathematical framework that axiomatically prohibits paradox. By contrast, in the geometric model, universal structures cannot be interpreted through a single consistent mathematical format.

15. A Thought Experiment on the Existence of a Primordial Universe

If our universe is a *false* universe that hides a deeper structure, what term should we assign to that deeper structure, and what are the inferences to its existence? The best term for this larger expanse is that it is a *primordial universe*.

We can describe its characteristics based on the geometric model and the examples of paradoxical structure studied above. Real and imaginary elements are counterposed in balance across a paradoxical connection of the larger state of both. It will not be possible to describe the primordial universe in a mathematically consistent theory or state that the larger collected state physically exists. The role of paradox in its construction prevents this. Nevertheless, this feature does not prevent the existence of a real universe. One of those two elements is real and forms the universe in which we exist.

The geometric model of a primordial universe can be applied to speculate on unresolved issues for the early universe. The boundary problem concerns how to formulate a universe that has no *outside* reference (Where Is the Edge of the Universe? 2016). The *Big Bang* theory states that the universe began as a single very dense point; however, there is no answer to what came before (Wikipedia,

"Big Bang", 2023). Finally, why did the universe suddenly decide to expand, and what is the mechanism by which it inflated instantaneously to its present size? There are numerous theories on these issues, but the questions remain open.

The framework of 60-degree angularity in the geometric model matches the angularity identified in the COBE data for the cutoff of the distance scale in the early universe. Could the primordial universe be defined by an ortho basis that is hexagonal rather than orthogonal? Conceivably, if such a space were to collapse to an orthogonal basis, there would be an excess of potential to be expressed as an instantaneous and inflationary form of sublimation. We suggest that the inflation mechanism could be considered an effect native to the higher dimensional platform of classical space. If so, the Big Bang is not an instantaneous inflation; it is a form of sublimation across a dimensional boundary.

The geometric model describes a process of dynamic cycle across dimensional boundaries in the development of complexity. The concept of dynamic action in time is not supported in quantum structure. Instead, the replacement for time is the relationship between elements entangled in superposition, and time is an effect only supported in the higher dimensional complexity of classical space. We can speculate how a similar effect could be represented for the early universe. If the early universe mirrors the format that time belongs to the high dimensional plane, then the event structure in the inflationary phase of the universe may not be a relic of past time. Instead, it could be a separate static framework perpetual at a sub-classical level. Its displacement as a relic would then be an effect induced at the higher dimensional level of classical space and time.

The caveat for this geometric model of the universe is that it can only be supported by inductive analysis of the myriad examples we see in Nature. The mechanism of paradox categorically prohibits deductive validation.

16. The Hexagonal Structure at Saturn's North Pole (Rayne, 2021 "What Is up with That Hexagon on Saturn? We Might Have Finally Found out")

The hexagonal feature at Saturn's north pole is permanent, and no theory exists to explain its unusual geometric shape.

"'The hexagonal flow pattern on Saturn is a striking example of turbulent self-organization. However, the mechanism of its formation and its depth remains unclear…' (Yadav & Bloxham, 2020 'Deep Rotating Convection Generates the Polar Hexagon on Saturn)."

We conjecture that the geometric model applies to shed light on the mechanism. Saturn is a very large gas giant isolated in space and, therefore, completely self-contained; the planet's gas is in continuous chaotic and turbulent motion. Saturn may be creating its demonstration of how stationary action and self-organization create order out of a null state. The vortex at the center of the hexagon is then its *primordial null*. If the geometric model is represented in the structure, it allows us to view the dimensional complexity of the geometric mod-

el in a physically observable object. This structure would represent, on the largest classical scale of a planet, the same phenomenon observed in the quantum structure of Hardy's paradox.

17. The Six Hidden Dimensions of String Theory

String theory: "… a number of string theories take place in a ten-dimensional space, adding an extra six dimensions. These extra dimensions are required by the theory, but as they cannot be observed are thought to be quite different, perhaps compactified to form a six-dimensional space with a particular geometry too small to be observable (Wikipedia, Six-Dimensional Space, 2023)".

The geometric model predicts six *sub-classical* space-defining elements hidden in classical space.

18. Conclusion

Is paradox an anomaly to reality, or is it a fundamental mechanism? Are we missing the point at the most fundamental level for what reality demonstrates on the most significant infinity of all, the universe itself? Paradox is imposed when the limit of a universal structure is constructed as a single framework, and the universe should be no exception to the rule. This imposition has two forms, and the universe appears to display both. The first form is the prohibition for countability, and the second is that universal structures are fundamentally incomplete. If the universe mirrors this format, it is composed of two parts that defy representation in any system of formal logic, and no *theory of everything* will be possible.

If the universe has a paradoxical structure at its core, there is no choice but to step back from believing that any singular, universal theory is possible. The best we can do is appreciate the beauty of its fundamental and paradoxical immensity. It is hard to accept that our understanding of universal structures will always be incomplete. Universal systems cannot be represented in single consistent framework; that is what Nature shows us. Gödel and Cantor proved this in mathematics, and we see it all around us. The analysis of the geometry in Hardy's paradox supports it.

The facture of singular universal truth has significance for what we decide as true and false. Singular universal truth is actually a *false truth* if it does not accept the element of *uncertainty* in its conclusions. The dualism at work produces a framework of opposing truths. The choice between alternatives of conclusion is the limit to what can be decided as true when a structure is universally incomplete. Beyond the fracture of dualism, the complexity of arguments grows but not with resolution.

We are creatures who can rationalize, but the universe shows us we will never have final answers when attempting to form single principles that are absolute truths. The geometric model has broad application to explain the place of paradox as a fundamental and systemic mechanism in what we think and how the

universe is constructed. The conflicts in human relationships and the relationship between science and religion are particularly interesting.

Richard Feynman

One of Richard Feynman's last thoughts, as he lay dying on his hospital bed, was, "I don't have to know an answer. I don't feel frightened by not knowing things, by being lost in a mysterious universe without any purpose, which is the way it really is, as far as I can tell. It doesn't frighten me" (Gleick, 1993: p. 438).

Conflicts of Interest

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

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