Open Journal of Philosophy, 2023, 13, 586-597
https://www.scirp.org/journal/ojpp
ISSN Online: 2163-9442
ISSN Print: 2163-9434

The Limit to Rationalism in the Immaculately Nonordered Universe

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How to cite this paper: Gill, D. C. (2023). The Limit to Rationalism in the Immaculately Nonordered Universe. *Open Journal of Philosophy, 13,* 586-597.
https://doi.org/10.4236/ojpp.2023.133038

Received: July 6, 2023
Accepted: August 5, 2023
Published: August 8, 2023

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Abstract

We claim that the Universe's fundamental structure is not discoverable through rationalism. The various frameworks studied are logic, mathematics, their application through theories in physics, and finally, the pivotally separate application of logic to historical evidence in formal religious belief. The basis of the prohibition is that rational structure has a limit for consistency that falls short of completeness in absolute terms. The limit of observability reaches only a framework in which correlated elements are formed paradoxically within a parent structure. Apart from our advanced ability in human reasoning, we have the same fundamental sentience possessed by other living creatures. Beyond that limit of awareness, the Universe in its native form is immaculately nonordered. We examine the dimensional relationship between quantum and classical frameworks to justify the theory. Mathematics requires operational consistency across its elements. In contrast, the Universe incorporates a feature of inconsistency in its native form. The companion paper to this document examines in detail how complexity develops from a null condition across dimensional levels. The argument's foundation applies a general framework of stationary action and self-organization principles to the theory and experimental data on Hardy's paradox. The complementary format to the dichotomy of paradoxical elements is its sliding scale of uncertainty between their extremes. The argument extends that the root source of societal biases, conflicts, and bigotries is the fundamental and systemic mechanism of paradox.

Keywords

Paradox, Theory of Everything, Quantum Mechanics, Hardy's Paradox, Bell's Inequality, Social Dysfunction, Value-Judgements

1. Introduction

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).

Feynman's insights are legendary, and his last statement hints at a possible area of research. *The mechanism of paradox in logic*, *mathematics*, *and physics* and this companion paper examine a novel approach to the issue Feynman pondered (Gill, 2023a). His intuition is formally analyzed by examining the role of paradox in universal structures.

The companion paper first focuses on the discrepancy between the theoretical representation of Hardy's paradox in quantum formalism and the experimental data obtained by Lundeen and Steinberg (Lundeen & Steinberg, 2008). A geometric model is constructed explaining that what appears to be experimental error, instead points to a new principle on how universal structure evolves dynamically in a process of self-organization across dimensional boundaries (Wikipedia, "Self-organization", 2023). The relationship of elements across such boundaries is paradoxical.

In all logical frameworks, the elements and the operations that link them must have consistency in forming truth statements. The geometric model demonstrates that the root structure of universal systems has an internal inconsistency that introduces an error for any conclusion intended as a universal truth. The limit to rationalism in the immaculately nonordered universe is a further discussion of how paradox is a universal mechanism and not an anomaly in both our rational structures and the dynamic basis of the Universe (Wikipedia, "Paradox", 2023).

2. The Geometric Representation of Universal Structure in the Model

The geometric model, illustrated in Section 3, has a universal structure in its native format in which it develops complexity dynamically across dimensional boundaries. The figure has an inner and outer circumference, and the right triangle is superimposed within it. The companion paper discusses in detail the wavefunction rotation of the mixed phase two-particle quantum state in Hardy's paradox and Bell's inequality (Wikipedia, "Hardy's Paradox", 2023; Bell's Theorem, Stanford Encyclopedia of Philosophy).

The right triangle geometrically locates the two pure phases on the circumference using the cosine squared identity. The rationale for the geometry is based on a *thought experiment* employing the general concepts of *stationary action* and *self-organization* (Wikipedia, "Thought Experiment", 2023).

Self-organization is a non-equilibrium process in which organized structure develops spontaneously (Wikipedia, "Self-Organization"). The principle of least or stationary action mandates that the shortest path will develop from the potential of random elements (Wikipedia, "Stationary-Action Principle").

The boundaries at the limit to each segment are dimensional separations, and absolute. This means that each is contained as an infinity. The geometry develops sequentially outward from the origin which is a *null state*. In dynamic sys-

tems, the mechanism of paradox forms the separation and the force of development across the segment levels. The full rationale for the development is explained below. We claim that the geometry describes the root structure in which a universal state develops complexity.

A universal state is defined as one that is closed in absolute terms; therefore, it has no extension of property beyond its boundary. The two categorically separate perspectives of *observation* are within and from the outside.

As an example, the regions inside and outside the boundary of the unit circle do not have common properties defined by the circumference. However, they do share membership in a larger state that is not singularly observable as rational. It is the state defined as the set of two sets of elements that are not members of themselves for the unit circle and has a Russell-set-like construction for rationality ("Russell's Paradox", Stanford Encyclopedia of Philosophy).

Universal structures are unitary in the absolute sense. In logic, mathematics, and experiments in physics, paradox is the mechanism that closes the elements that form them prohibiting rational conclusion. A dualism spontaneously arises, in which paradox forms the boundary between the two parts.

3. Calculation of the Trigonometric Values

In **Figure 1** and **Figure 2**, the sides to the right triangle contain elements crossing boundaries established by the inner and outer circumferences. The rationale of the model is discussed in the companion paper and justified in the arguments that follow. The geometry, counterintuitively, combines classical and nonclassical frameworks, and the identified segments are one-dimensional. As such, for the calculations, we assign the square root function to each segment and the numerical value (1) despite their different lengths. This format counterintuitively *entangles*

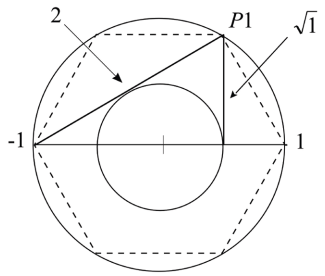

Figure 1. Cosine squared identity for the 60-degree angle.

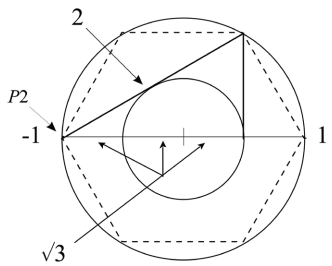

Figure 2. Cosine squared identity for the 30-degree angle.

the two fundamentally distinct properties of fungible numerical value and non-fungible object identity.

Calculation of the cosine squared identity, on this basis, gives the same result as in the standard format's calculation in which the sides have correct linear values. The one-dimensional framework is a *compacted* space of elements to the more complex classical framework of structure in formal calculations.

The Hexagonal Calculator calculates the values for the adjacent sides to the right triangle on the Cartesian plane (Szyk & Díez, 2023). The diameter of the geometry for the outer circumference 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 then 1.732, 3, 3.464.

3.1. Calculation under Standard Mathematical Formalism

For the linear values (1.732, 3, 3.464):

$$P1-\cos^2(60)=(1.732/3.464)^2=0.25 \tag{1}$$

$$P2-\cos^2(30)=(3/3.464)^2=0.75 \tag{2}$$

3.2. Calculation in Which Numerical and Object Identities Are Entangled

The geometric structure entangles the classical, Cartesian, two-dimensional plane, and a one-dimensional space. The hypotenuse combines two segments that begin and end on the same dimensional level of the outer circumference and, for those segments, the square root cancels.

$$P1-\cos^2(60)=\left(\sqrt{1}/2\right)^2=0.25 \tag{3}$$

$$P2-\cos^2(30)=\left(\sqrt{3}/2\right)^2=0.75 \tag{4}$$

The geometry counterintuitively (paradoxically) opens dimensional boundaries in an inconsistent framework to formal mathematical representation. Each element is an *infinity* within its upper and lower dimensional boundaries, and the geometry downconverts the space to a quasi-one-dimensional state. The agreement between the two methods for calculating the cosine squared identity strongly validates the rationale.

4. The Imaginary Structure of the Quantum State and the Introduction of Time

Quantum states do not contain the dimensional structure of *time* and are *time-symmetric* or *stationary* for *time* (Wikipedia, "T-symmetry"). The result is that when a quantum state is transformed by *collapse* to its correlated classical form, *time begins*. *Time* replaces the *imaginary*, lower-dimensional framework of the quantum state. The *square root of minus one*, with the symbol *i*, encapsulates the fundamental basis of such *collapse*. Specifically, the classical operation of forming the square produces only a positive valued number; therefore, reversing the

operation, taking the square root within the function, can only be performed on a positive number. The equality $(\sqrt{-1}) = (-1)$ produces a paradoxical exception to the rule.

Operations in the equations for all mathematical formalism, formal logic, and the informal logic of our daily lives rely on consistency if conclusions are possible. In other words, paradox is not allowed, other than as a question begging for future clarification and elimination of the paradox. However, suppose paradox across dimensional boundaries is a natural feature of the Universe. In that case, from the outset, it is impossible to represent Nature without introducing the element of error in some form. All the evidence points to the fact that paradox is the operative mechanism ultimately prohibiting consistency for universal frameworks.

The role of paradox extends systemically far beyond its place in the relationship between classical and quantum structures. The linguistic composition of Russell's paradox and the Liar paradox are examples (Wikipedia, "Liar paradox"). Another linguistic format with the same structural framework is humor, juxtaposing incongruous elements in a single statement.

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 rational relationship but are correlated as common creating humor. All humor has the basic form found in a Russell-set-like construction. Amusement and laughter are the reactions to the non-rational, paradoxical linkage between the elements of the statement. Still, nothing is trivial about the relationship between the elements of humor and the relationship of classical reality to quantum mechanics.

The geometric model goes deeply into the basis of quantum formalism and explains its fundamental limit and flaw to the root representation of Nature. The universe is not formed in a structure of consistent relationships. Nature builds complexity across dimensional boundaries that are each absolute infinities incorporating paradox at their boundaries. Are we in denial of this natural feature of the Universe in our attempts to understand it completely?

5. The Thought Experiment of the Geometric Model

The companion paper does not include the detailed basis of the thought experiment in creating the geometric model. The initial state is *null*, called a *primordial null state*, meaning, in simple terms, that it does not exist. It does not have a framework of preexisting structure within and is not a location in a larger state outside.

There is a second hypothetical framework for the state that satisfies its property. It can contain two elements that do not share a common property. The parent then remains internally null. This basis for constructing a primordial state might seem contrived; however, the theoretical formalisms of logic and mathematics and the representation of Nature in physics contain numerous real examples. The companion paper discusses a diverse collection of these in which the two elements within the parent have no basis for a relationship. Yet, they do form membership to each other in the parent state.

Suppose a dynamic form for such a relationship were to exist. In that case, an accumulation of complexity occurs in a cascading cycle as elements negate their proximity relationship. If such a mechanism applies to the Universe, the largest of all universal structures, then it describes how our Universe and its companion Universe came into existence, each having a paradoxical relationship to the other, and with a parent that cannot be stated to exist in rational terms.

In this definition, an *infinity* is the point at which a common structural basis is broken at its upper and lower terminations. To the above schema, the *thought experiment* applies a general framework of *self-organization* and *stationary action* principles, described above, in determining the shape of the development.

The sequences of development within each dimensional level are:

1) Curvature develops from the point of origin of the *null state* and forms a semi-circumference.

2) A second, opposing semi-circumference returns the outward projection to the origin of the *null* location, and the two semi-circumferences successfully enclose the *null state* as a *null area*.

3) The curvature development is complete in step 2, and the state now projects linearly, without curvature, from the point of termination in the closure of the *null area*.

4) The linear projection terminates with the introduction of angularity at 60 degrees.

5) Projections in the sequenced angularity of 60 degrees return the outward development to the first point of linear projection and create closure of the structure as a hexagon.

6) To illustrate the waveform rotation in the experiment, the entire structure is enclosed by a circumference.

In the development across dimensional boundaries, the above sequences are the hidden precursors to expressing a *dimensionless* point in classical space. The process hides all *future* angularity, location, and structure for outside complexity (classical-like) and simultaneously all inside complexity (quantum-like).

It is essential to understand that the illustration for the growth of the complex structure in the model is strictly from the perspective of classical *time-sequencing* and is a mathematical and geometric simulation based in logic. The root process does not have a logical time-sequenced basis, and although such representations can be accurate interpretations, they are purely limited simulations. As a process of sequential organization, the description is a device borrowed from our concept of time in our classical sense of reality. The technique works in a limited sense for logic-based understanding, but it is just a technique removed from the root basis of what is neither a classical reality nor a quantum structure.

6. The Cosine Squared Identity in Bell's Inequality and Hardy's Paradox

6.1. Hardy's Paradox

Hardy's paradox is a thought experiment proposed by Lucien Hardy in which a

particle and its antiparticle may interact without annihilating each other (Wikipedia, "Hardy's Paradox"). The theoretical calculation of the quantum-level probabilities for the event-structure was done by Aharonov et al. (2001). The experimental demonstration applies the technique of weak measurement. If a quantum state is measured weakly, data can be collected that reveals the quantum structure of the state without causing its collapse, which would otherwise occur if the state were observed by direct classical interference (Wikipedia, "Weak measurement").

Lundeen and Steinberg conducted the experimental demonstration of Hardy's paradox discussed in the companion paper, Experimental joint weak measurement on a photon pair as a probe of Hardy's paradox (Lundeen & Steinberg, 2008). The experiment measures the waveform of entangled particles across separate classical paths at the two dark ports. The geometric model analyzes the joint quantum habitation of the two inner and outer paths using the cosine squared identity.

Quantum theory predicts that the probability of the waveform when the two inner paths are taken simultaneously is (0), and separately for the two outer paths is (−1). However, experimentally, the data recorded was (0.25) for the inner paths and (−0.75) for the outer paths. The data conform to the rationale of the geometric model on the role of self-organization in the structure.

6.2. Bell's Inequality

The Cosine squared identity applies to the two-particle systems of both Hardy's paradox, and Bell's inequality (Wikipedia, "Bell's theorem", 2023). 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 separate locations. John Clauser performed the experiment on Bell's inequality at Berkeley University (Herbert, 1985).

Error rates found for rotation between the particles at 60 and 30 degrees:

$$\cos^2(60) = 0.25 \tag{5}$$

$$\cos^2(30) = 0.75 \tag{6}$$

The frame of reference in the experiments is reversed since for Hardy's paradox joint habitation is measured and in Bell's inequality error rates are measured. However, both experiments point to the same phenomenon predicted in the geometric model.

For Bell's inequality, the error rate between the entangled particles is more strongly correlated than predicted by classical probability. Consequently, the quantum correlation between the two particles having separation in classical space violates the limitation for communication at the speed of light, and 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 (Herbert, 1985).

6.3. A General Principle

Hardy's paradox and Bell's inequality demonstrate a general principle. Measurement in the native framework of the experiments produces inconsistency to a conjoined interpretation that remains valid in its own basis.

1) For Hardy's paradox: calculation in formal quantum theory requiring mathematical consistency is in error for data obtained in the native experimental root of its universal structure, and

2) For Bell's inequality: calculation in classical statistical theory is in error for the data obtained in the measurement of the system in a quantum framework.

7. The Expression of Paradox across Correlated Frameworks

There are two forms for the expression of paradoxical structure between elements joined in a parent universal state of both:

1) Elements having joint membership in a parent structure for a given property display a paradoxical boundary between themselves that is absolute. In the case of logical arguments, the elements have a Russell-set-like construction with an infinite regression to resolve the correlation between the elements as members of the parent state and the parent state as a member of the domain of the elements.

2) A sliding scale of uncertainty for observability is found between the two pure elements of the state. The pure states have a Heisenberg-uncertainty-like construction for observation between their extremes (Wikipedia, "Uncertainty principle").

8. Conclusion—A Philosophical Perspective

8.1. The Term Paradox

The geometric model combines fungible and non-fungible properties in the values used to calculate the cosine squared identity. The values are categorically incorrect for a standard calculation, yet they yield the correct result. The rationale of the model demonstrates a new principle that the native format of the Universe incorporates paradoxical boundaries between dimensional levels. Each boundary is a limit as an infinity and points to a general limitation applying to all forms of rationalism when attempting to form conclusions of absolute truth. The basis of the Universe is fundamentally inconsistent across its elements. Rationalism requires consistency for its arguments and cannot be applied within such a structure without also retaining paradox as a mechanism of separation across correlated elements. Rationalism has a limit that falls short of the ability to form conclusions as statements of absolute truth.

The geometric model defines the imbalance for two degrees of freedom on the flat plane. The projection is equally one forming to the outside as to the inside,

and neither framework is resolvable. The force of the *null state* continues to develop more structure, resulting in an infinite regression as internal complexity builds in cycles. Another interesting framework also applies entirely within the two pivotal descriptions of our Universe. Is the inward structure its quantum framework, and is the outward development its expansion described as the beginning of *time* in the *Big Bang* (Wikipedia, "Quantum mechanics"; Wikipedia, "Big Bang")?

8.2. The Inconsistent Frameworks of Universal Structures

Rationalism in all its forms, from formal logic and mathematics to everyday reasoning consists of systems of symbols linked by operations in the creation of conclusions. The arguments constructed require internal consistency or they become false, paradoxical arguments for truth.

If the Universe has at its root an inconsistent structure of relationships, then arguments constructed within rational frameworks must still account for the underlying inconsistency. In other words, an element of failure by incompleteness will apply to all arguments. The formative basis of the Universe is the source of the systemic presence of paradox in all rational-based conclusions.

For each perspective taken as an absolute truth, there is a second framework of truth hidden and a *sliding scale of uncertainty* between them. In other words, there is no such thing as a *theory of everything* in any version of the Universe's form.

There is no path to resolving absolute truth, and change is a fundamental feature of the Universe. However, the knowledge of the underlying framework that is its basis can help navigate the conflicting elements of reality in building an understanding of what is not observable in any single perspective of truth.

8.3. Application of Rationalism in Value-Judgements and Our Sense of Morality

The fundamental distinction between us as humans and other living creatures is that we have an advanced form of intellect, allowing the creation of theoretical principles. It is a particular category of sentience involved in the development of meaning from individual concepts to the theoretical aspects of logic, mathematics, and science, and finally to our value judgments and sense of morality for each person.

For these diverse forms of reasoning, is there a limit to the function of rationalism? The only source of information is from observation of the Universe in all its immensity. Our curiosity and discoveries have led to the *belief* that greater understanding is always possible.

However, suppose the Universe has at its core a fundamental paradoxical structure. In that case, there are absolute limits to rationalism that fall short of ultimate truth and certainty. If so, all our judgments on the *absolute* would mirror the structure of the Universe that it contains at its core, a mechanism of inconsistency and a nonresolvable cycle.

As humans, we want finality for truth to be a guide, and the only way to achieve that is to arbitrarily stop what is not resolvable. The problem with that approach is that it contains a systemic error of judgment. Understanding is then *locked down* and arbitrary in a smaller space than in the larger framework of reality. This can have negative consequences on two levels.

Not understanding the process and what exists beyond any given understanding can lead to intolerance of what is unknown in its *locked-down* perspective. In the second and worst incarnation, it is the pattern of ignorance, bias, and hatred. What is outside that view of reality is then seen as an untruth. The term for that is bigotry.

Dimensional Boundaries is a novel written from an artistic perspective to capture the concepts in this and its companion paper. A term the protagonist, Jack Bennett, who is a physicist, uses to describe the Universe is that it is *immaculately nonordered* (Gill, 2023b). He distinguishes this nonorder from disorder with no internal, hidden structure other than randomness.

It is not rationally possible to have direct and infinite access to the rule of a Universe with the property of *immaculate nonorder.* However, an order to the structure can be observed in which elements are paradoxically conjoined. Paradox is the mechanism and limit that allows a dualism of elements to have a relationship as ordered; however, it is a *paradoxical order*. Paradox creates an order that is one level removed from absolute certainty for observation. Additionally, the property of *immaculate nonorder* can be observed as the process of change that is not statically resolvable.

The fracture of universal truth has significance for what we decide as true and false. Any truth constructed and considered universal is false within a larger framework than directly observable. The element of *uncertainty* is a necessary component of framing any absolute truth.

Beyond the fracture in the study of dualism, the complexity of arguments grows but not with resolution. The structure of the Universe points to a principle that there are no final answers when attempting to form single principles that are fundamental and absolute.

The logical role of paradox in the Universe cannot be argued for proof by deductive logic. Deductive proofs prohibit paradox from the outset. However, inductive reasoning does not have that restriction. Then, proof relies on the absence of a counterexample, and that is the situation we find based on the extensive collection of supporting examples in the companion paper. Of course, deductive and inductive logic are subject to falsification in future discovery. So far, that does not appear to be the case for the examples cited.

8.4. On the Roles of Science and Religion

The ultimate question we have is understanding the fundamental basis of the Universe, and there are two paradoxical frameworks, the logic of science and the faith in a religion. The study of paradox gives insight into the nature of the con-

flicting perspectives that can arise between science and religion and the distinction between religious forms of faith. There are no answers to discovering a *final truth*, but a mystery remains. The perspectives of science as logic and religion as faith are *immaculately* separate in their frameworks but *entangled* in their conclusions. Both have a place in our human perspective and logic does not apply between them.

Einstein stated, "Science without religion is lame, and religion without science is blind" (Jammer 1999). Hidden in Einstein's comment is the significance of the role of paradox in the Universe.

Conflicts of Interest

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

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