THE FRAMEWORK OF EVERYTHING (FOE)

The Laws of Existence and the Structure of Our Universe

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ABSTRACT

This article provides a rigorous mathematical definition of existence and establishes laws and geometric constraints that govern it. It establishes that the Dirac delta function must be continuous and non-zero over some $\varepsilon > 0$ of its domain rendering it logically incompatible for use with point particles (defeating its purpose). Consequently, point particles, strings, 0-branes, 1-branes, and 2-branes cannot have properties that make them indistinguishable from non-existence. Assuming the validity of all well-established experimental outcomes in physics, this work formulates logical propositions to deduce a coherent, paradox-free structure of the universe. By applying mathematical principles to this structure, a theory is developed that is both scientifically accurate and logically sound. This article explains phenomena such as superposition, entanglement, wave-particle duality, gravitational and Lorentz time dilation, and gravitational lensing in a manner consistent with formal logic, thereby uniting metaphysics and physics. It also reveals that Einstein's formulation of general relativity (GTR) involved an erroneous assumption about the vacuum of space, which, while not affecting observational predictions, led to problematic explanations. By correcting this assumption (while retaining Einstein's principles), the same predictions are achieved, but in a manner that explains features of quantum mechanics (QM).

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1. INTRODUCTION AND INTENT

While many physicists may contend that QM violates several of the axioms proposed in this model, this article argues that such perceived violations arise from a fundamental misunderstanding of the universe's structure and the nature of what appears to be empty space. To ensure transparency, it is argued herein that both GTR and QM share an underlying assumption about the vacuum of space that, while not affecting their scientific predictions, profoundly alters our understanding of the underlying cause. This will be explained in more detail momentarily.

A comprehensive set of axioms and assumptions for this work is outlined in Section 2. It is therefore assumed that all scientific observations presented there are accurate, and these observations are then used to formulate a series of logical propositions. Formal logic is then applied to these propositions to derive specific conclusions about the vacuum of space, and the structure of the universe, that are necessary to prevent paradoxes. Mathematics, and established principles from modern physics, are subsequently applied to this structure, yielding a theory that is both scientifically accurate and logically sound. The methodology employed in this process is as follows:

1. Evidence: $\beta = \{$***Gravitational lensing, gravitational time dilation, Lorentz time dilation, invariance in the measurement of c, cosmic expansion, gravitational waves, quantization, superposition, entanglement, tunneling, wave-particle duality, and uncertainty***$\}$
2. Structure: $[Framework \wedge Formal\ Logic \wedge \beta] \rightarrow Structure$
3. Theory: $[Math \wedge Principles\ of\ Modern\ Physics \wedge Structure] \rightarrow Theory.$

To clarify this, each statement in β provides details about the structure of our universe, and only after "putting all of the pieces to the puzzle together", does it become apparent exactly what it is that Einstein erroneously assumed about the vacuum of space and the structure of our universe. If we therefore apply the same principles and thought processes that Einstein developed but without said assumption in place, the resulting theory makes the same observational predictions as that of GTR, but in a way that is compatible with both QM and formal logic. To be very precise, this work establishes a set of equations that make the same predictions as GTR, such that the proposed structure of our universe allows all quantum processes to be explained in terms of formal logic.

It should be made clear that this work departs significantly from the established theories and postulates of modern physics, while still explaining the same predictions and observations. Therefore, unless one is prepared to accept that a theory only needs to explain scientific observations (logically), without necessarily aligning with other related theories, there is little reason to proceed further. To clarify, consider an object O with a measurable quantity (u), such as mass or charge. The true value of (u) is given by $Val(u) = M(u) + Err(u)$, where $M(u)$ is the measured value and $Err(u)$ represents the measurement error. Since every measurement includes some error, $|Val(u) - M(u)| = |Err(u)| > 0$. Now we can say that the speed of light is known to be constant, the laws of physics are invariant, or that point particles are known to exist, but this contradicts the fact that $|Err(u)| > 0$ (logically: $|Err(u)| < 10^{-k}$ doesn't imply that $|Err(u)| < 10^{-k-1}$ for some $0 \leq k < \infty$). Thus, no assumptions are made beyond that which is stated in section 2.

With that said, mathematics is fundamentally built upon the principles of formal logic. For instance, foundational concepts like $A = A$ and $A \vee \neg A$ are essential for constructing proofs by contradiction. Consequently, if a theory in physics is developed based on assumptions that contradict the axioms of the mathematics it employs, it inevitably leads to a paradox. That is:

$$[Formal\ logic \rightarrow (some)\ Math \rightarrow (Some)\ Theories \rightarrow \neg Formal\ Logic] \rightarrow \perp$$

Thus, while physicists may tend to try and separate logic from physics, such a separation isn't feasible for a theory to remain coherent throughout. Although there are various forms of logic, to ensure consistency with the logic underlying the mathematics listed in Section 2, this work adheres strictly to that of formal logic. This maintains a cohesive argument where logic, math, and scientific explanations share a common set of assumptions.

Consider the system of equations $\{2x + \pi = 3ey,\ \pi x = y + Ln(4)\}$. In this analogy, physics resembles solving the system by guessing values for (x) and (y), while logic is akin to using mathematics to solve it algebraically. To clarify, although physics is extensively developed mathematically, it often involves educated guesses without first logically establishing the underlying structure in which these equations are applied. This article starts by defining certain logical properties of our universe, and then mathematics and scientific methods are applied to this established structure eliminating guesses. Thus, while this article makes bold claims, there is a solid logical foundation for these assertions. Just as algebra can streamline decades of guesswork, applying formal logic can refine and correct decades of research.

This article provides formal proofs for you to analyze and assess. If no errors are found, since the assumptions presented are consistent with the principles of logic, mathematics, and β, there is no reason to reject its conclusions. This article demonstrates the following:

A. Limits and the Dirac delta function produce logical contradictions when modeling anything as being point-like (yes this negates the main purpose of the Dirac delta).
B. Logical contradictions do not exist, and thus everything that exists can be said to follow the rules of logic. This allows one to establish the Laws of Existence (Framework) below.
C. While not all theories propose point-like particles, this work establishes that point-particles, strings, 0-1-2 branes do not have means of possessing a property that would allow them to be distinguished from non-existence.

D. Empty space (distinct from spacetime) is isomorphic to $\mathbb{R}^n$ for some $n \geq 3$.

It is important to explicitly acknowledge that this work challenges several theories in physics, but these theories have been essential steppingstones in shaping this approach. Without their contributions, the insights gained here might not have been possible. With that said, it is not the intention of this article to discard equations of modern physics, but rather to refine, or "tweak", them until they align with this Framework. This approach enables us to build upon the valuable work of others.

2. *AXIOMS AND OTHER ASSUMPTIONS*

The following are assumed true in developing this work.

Formal Logic [4]:

1. Law of Identity ($A \equiv A$)
2. The law of Non-Contradiction ($\neg(p \land \neg p)$).
3. The Transitive law ($(A \to B) \land (B \to C) \to (A \to C)$)
4. The law of Excluded Middle ($(p \lor \neg p)$)
5. The law of Contraposition ($(p \to q) \leftrightarrow (\neg q \to \neg p)$)
6. De Morgan's laws ($\neg(p \land q) \leftrightarrow \neg p \lor \neg q$ and $\neg(p \lor q) \leftrightarrow \neg p \land \neg q$)
7. The axioms on which the mathematics used herein are based.

Applied Mathematics (<u>These are all based on the axioms of formal logic</u>):

1. Local Homeomorphism Theorem.
2. Whitney Embedding Theorem [5].
3. The principles and methodologies of general mathematics, particularly calculus, differential geometry, real analysis, and calculus of variations.
4. The Finite Precision Theorem (Infinite precision is not obtainable on a continuous spectrum).

Scientifically verified experimental results and observations:

Gravitational lensing, gravitational time dilation, Lorentz time dilation, invariance in the measurement of c, cosmic expansion, gravitational waves, quantization, superposition, entanglement, quantum tunneling, wave-particle duality, uncertainty

Scientific Principles:

1. The Principle of Least Action.

3. THE DIRAC DELTA FUNCTION,
LIMITS, AND THE GAUSSIAN DISTRIBUTION

The Dirac delta function is a rigorously defined distribution used extensively in both mathematics and physics. However, its application has sometimes enabled one to obscure mathematical errors and logical contradictions within an integral. In this section, formal proofs concerning certain properties of limits, the Dirac delta function, and the Gaussian distribution are established demonstrating that many common uses of these tools in physics lead to inherent paradoxes. These proofs serve a very specific purpose in the following sections.

With that said, particles are typically associated with a field. If one argues that the field is part of the particle itself, then the particle cannot be considered point-like. Conversely, if the field is asserted to be separate from the particle, what is being modeled is the field, not the particle directly. Similarly, if the field is said to consist of virtual photons being exchanged, those photons are distinct from the particle. Therefore, a particle cannot possess any non-zero property, such as mass or charge, outside of itself (this is therefore true even if the particle is a wave). To clarify this, in quantum field theory particles are excitations of fields and thus one measures the field, not the particle.

3.1 The Zero-Infinity Limit Theorem

Infinity is not a number but a concept representing something that is unbounded or without limits. That is, $\forall x \in \mathbb{R}, x \neq \infty$. For example, if we are to pick $x = 10^{1000}$, we would see that x is not unbounded and thus does not satisfy the definition of being infinite. For this reason, statements like $0 \cdot \infty = 0$ are undefined or in an indeterminate form. To resolve this issue, mathematicians have adopted the notation $\lim_{x \to \infty} 0 \cdot x = 0$, meaning that as x becomes arbitrarily large, $0 \cdot x = 0$. This can be established as follows.

Statement: $\forall x \in \mathbb{R}, 0 \cdot x = 0$.

Proof:

$$0 \cdot x = (0 + 0) \cdot x$$
$$0 = 0 \cdot x$$

QED

By replacing x with $g(x)$, this can thus be generalized as the following.

$$\forall\ g(x) \in C^k \ for\ some\ k \geq 0 \text{ where} \lim_{x \to \infty} g(x) \to \infty \text{, then } \lim_{x \to \infty} 0 \cdot g(x) = 0$$

3.2 The Point-Particle Limit Theorem

Statement: 1) Limits cannot be applied to non-point particles to model them as being point-like, and 2) Limits cannot be applied to point particles to yield a non-zero value.

Proof: Let $f(x), g(x) \in C^k$ $for\ some\ k \geq 0\ |\lim_{x\to\infty} f(x) \to 0\ and\ \lim_{x\to\infty} g(x) \to \infty$.
Suppose that:

$$\lim_{x\to\infty} f(x)g(x) \neq 0$$

By the Zero-Infinity Limit Theorem, it follows that:

$$\lim_{x\to\infty} f(x)g(x) \neq \lim_{x\to\infty} 0 \cdot g(x)$$
$$\lim_{x\to\infty} f(x) \neq 0$$

Therefore, $f(x)$ can be made arbitrarily close to being point-like, but never identical to it, thus proving the statement.

To clarify this, $\forall\ x \in \mathbb{R}, \frac{1}{x} \neq 0$ as demonstrated by the fact that $1 \neq 0x$. Thus, while $\lim_{x\to\infty} \frac{1}{x}$ is said to be zero when such nuances are not relevant, when analyzing limits of the form $0 \cdot \infty$, such details must be preserved.

QED

3.3 The Point-Particle Delta Function Theorem

Informal Definition: Consider the Dirac delta function $\delta(x-\alpha)$ informally defined as [2]:

$$\delta(x-\alpha) = 0 \text{ when } x \neq \alpha$$
$$\delta(x-\alpha) = \infty \text{ when } x = \alpha$$
$$\int_{\alpha^-}^{\alpha^+} \delta(x-\alpha)dx = 1$$

Clarification: $\int_{-\infty}^{\infty} \delta(x-\alpha)\,dx = \int_{-\infty}^{\alpha^-} \delta(x-\alpha)\,dx + \int_{\alpha^-}^{\alpha^+} \delta(x-\alpha)\,dx + \int_{\alpha^+}^{\infty} \delta(x-\alpha)\,dx$

$$= 0 + \int_{\alpha^-}^{\alpha^+} \delta(x-\alpha)\,dx + 0$$
$$= \int_{\alpha^-}^{\alpha^+} \delta(x-\alpha)\,dx$$

In this case the width of the spike or impulse is identically $\Delta x = 0$, thus by the Zero-Infinity Limit Theorem, the area is 0 not 1. That is:

$$\left[\int_{\alpha^-}^{\alpha^+} \delta(x-\alpha)\,dx = 1\right] \wedge [\delta(x-\alpha) = 0\ when\ x \neq \alpha] \to \perp$$

And thus

$$\int_{-\infty}^{\infty} \delta(x-\alpha)\,dx = 0\ not\ 1$$

It follows that this informal definition of the Dirac delta function is a logical contradiction, and simply defining it in this manner doesn't make it logically possible.

Formal Definition: The main purpose of the delta function is to sift out the value of a function at a point, so its formal definition is just that $\delta(x-\alpha)$ satisfies the property [2]:

$$\int_{-\infty}^{\infty} \delta(x-\alpha) f(x)\, dx = f(\alpha)$$

In this case, the delta function is a distribution that picks out specific value(s) of $f(x)$ such that the property holds. This leads us to the following proof.

Statement: 1) The Dirac delta function introduces a contradiction when used to model a non-point particle as being point-like, and 2) the Dirac delta function cannot be applied to a point particle to produce a non-zero value.

Proof: Typically, we don't care specifically what the shape of the distribution is, but in this case, it is necessary to analyze it. Suppose that the Dirac delta function is non-zero only at specific points. That is: $\delta(x-\alpha) = 0$ except at $x = \{\alpha_1, \alpha_2, \dots\}$. In this case, the formal definition of the Dirac delta function reduces to the informal definition above as follows:

$$\begin{aligned}\int_{-\infty}^{\infty} \delta(x-\alpha) f(x)\, dx &= \int_{\alpha_1^-}^{\alpha_1^+} [\delta(x-\alpha_1) f(x)]\, dx + \int_{\alpha_2^-}^{\alpha_2^+} [\delta(x-\alpha_2) f(x)]\, dx \dots \\ &= f(\alpha_1) \int_{\alpha_1^-}^{\alpha_1^+} \delta(x-\alpha_1)\, dx + f(\alpha_2) \int_{\alpha_2^-}^{\alpha_2^+} \delta(x-\alpha_2)\, dx \dots \\ &= f(\alpha_1) \cdot 0 + f(\alpha_2) \cdot 0 \dots \\ &= 0\end{aligned}$$

Likewise, if $f(x) = 0$ except at $x = \{\alpha_1, \alpha_2, \dots\}$, then the same result occurs. Thus, by contradiction $\exists\, D_{\delta f} \subset D_\delta \cap D_f \mid D_{\delta f}$ is continuous and in which $\delta(x-\alpha)$ and $f(x)$ are both non-zero over $D_{\delta f}$. Since $D_{\delta f}$ cannot be made point-like, this proves the statement. QED

3.4 The Gaussian Distribution

Now consider the Gaussian distribution defined as $G(x,\beta) = |\beta| e^{-(x\beta)^2}$ in which $\int_{-\infty}^{\infty} G(x,\beta)\, dx = \int_{-\infty}^{\infty} [f(x) = e^{-(x\beta)^2}][g(x) = |\beta|]\, dx = \sqrt{\pi}\ \ \forall\, |\beta| > 0$. It follows that $\lim_{\beta\to\infty} [f(x) = e^{-(x\beta)^2}][g(x) = \beta] \neq 0$, and thus, by the Point-Particle Limit Theorem, the Gaussian distribution doesn't apply to anything point-like.

With this said, it is important to explain why the Dirac delta function, and the Gaussian distribution can produce the correct results in physics for the wrong reason. By l'Hôpital's Rule, $\forall\ x \neq 0\ \lim_{\beta\to\infty} |\beta| e^{-(x\beta)^2} = \lim_{\beta\to\infty} 1/(2\beta x^2 e^{(x\beta)^2}) = 0$. Thus:

$$G(x \neq 0, \beta \to \infty) = 0$$

At the point $x = 0$, $G(0,\beta) = |\beta| e^{-(0\beta)^2}/\sqrt{\pi} = |\beta|/\sqrt{\pi}$, and thus:

$$G(0,\beta \to \infty) \to \infty$$

That is, $G(x, \beta \to \infty)$ models the first two conditions of the informal definition of the delta function, but by the Point-Particle Limit Theorem it never actually matches it perfectly since $f(x)$ is never identical to zero. Notice that $\int_{-\infty}^{\infty} G(x, |\beta| < \infty) / \sqrt{\pi} dx = \int_{-\infty}^{\infty} \delta(x)\, dx = 1$, thus the delta function produces the correct value by assuming non-point particles to have the geometry of a point.

3.5 Discussion

Since neither $f(x)$, nor $D_{\delta f}$ can be made point-like, limits and the Dirac delta function cannot logically model point particles, nor can they logically be used to treat non-point particles as being point-like. As demonstrated above, doing so effectively assumes that $0 = 1$, introducing a paradox and implying that the Law of Identity is false. However, these tools may still be used for computational purposes, if it is understood that such equations do not support the existence of point-like particles.

4. DEFINITIONS

These definitions are philosophically based, allowing for a purely conceptual understanding. Building on these foundations, equations are introduced in the following sections to refine these concepts, making them scientifically rigorous.

Formal Logic is a system for reasoning that deals with propositions (true/false statements), logical operators (AND ($\wedge$), OR ($\vee$), NOT ($\neg$), IMPLIES ($\rightarrow$) [except when used with limits], etc.), mathematics, and truth tables. It allows for constructing valid deductive arguments where the conclusion necessarily follows from true premises. As used herein, it does not include multivalued, fuzzy, or quantum logic.

A **property** is an intrinsic, non-trivial attribute of an entity independent of subjective perception or geometrical characteristics (i.e. a square has the property of being square but that is a geometrical characteristic and thus does not satisfy the specific definition. Likewise, an imagined entity can have the property of change within the mind, but this is subjective and thus also does not satisfy the intended definition.).

Existence refers to the state or condition of possessing at least one property that distinguishes an entity from non-existence. It implies the actuality or reality of an entity, independent of subjective perception or mental constructs (in this context, existence refers to ontological existence). The word existence, or **existences**, is used to reference an entity that possesses a property and thus therefore exists.

An **entity** is an object or concept that either exists or it doesn't. Entities can possess properties that contribute to their existence and define their identity (i.e. an imagined sphere is an entity, but it does not possess a property, thus it cannot exist. An electron can exist because it has the property of charge.).

Property density is the quantified magnitude of a property possessed by an entity divided by the entity's length, area, or volume as specified by the context.

Binding Property is any property that binds an existing entity together. A binding property, like all properties, must have an internal flux.

Flux is the measure of how much of a property of an entity passes through a boundary. It indicates the flow, transfer, or influence of the property across or through the specified area or region, regardless of whether the property physically moves or not.

A **transition** involves altering an entity's property or spatial extent.

A **volumetric** geometry occupies empty space and excludes regions that are strictly a point, area, or length (i.e. Two spheres connected by a line is not a volumetric geometry, whereas the two spheres sharing some volume is.).

Space is the expanse that contains the universe's matter and energy, in addition to the matter and energy itself. If dimensionality is defined beyond the universe, space includes that as well. **Empty Space** references the same but without the presence of any existence.

To **constrain** means to impose limits or conditions.

Information is a quantifiable and interpretable representation of the state or properties of a system, whether physical or logical.

Causality is the principle that specifies a cause-effect relationship between events such that the state of a system at one point determines its state at another point, consistent with the governing laws of the system.

A **Causal Loop** is a sequence of events in which each event is both a cause and an effect of another event in the sequence, forming a closed loop.

5. *FRAMEWORK - THE LAWS OF EXISTENCE*

According to the axioms outlined above, an entity with contradictory properties cannot exist; thus, everything that exists must be logically consistent. If scientific observations appear contradictory, it is only because the correct explanation has yet to be found, not because such an explanation is inherently impossible. Therefore, even if there are other universes with different physical laws, logic remains the fundamental principle governing all. This Framework can thus be used to assess the feasibility and consistency of theories in physics.

5.1 The general concept of existence

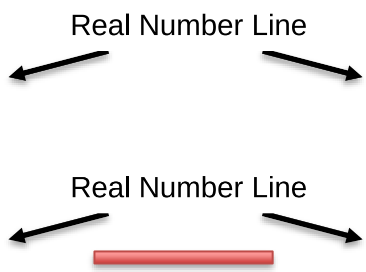


Fig 1 illustrates the difference between an entity that exists by having a property and one that does not exist due to lacking such a property. At the top, entity L lacks any property that distinguishes it from the real number line, so it represents a non-existent entity. At the bottom, the entity has a distinguishing property, in this case causing it to appear red, which marks it as existing.

Imagine the real number line $\mathbb{R}$ positioned in space, with L representing the imagined line segment [0,1]. In **Fig. 1** (top), both $\mathbb{R}$ and L are depicted as transparent, indicating that they are only in the mind. While they have an imagined geometry, they lack any distinguishing property that separates them from non-existence. In the bottom portion of **Fig. 1**, the same imagined number line is shown, but L is replaced by an object of similar length. This object possesses a property that distinguishes it from non-existence, which, in this case, causes it to appear red.

Thus, $\mathbb{R}$, L, and the object all share geometric qualities, but only the object possesses a property, such as mass or charge, that grants it existence. For this reason, the term "property" excludes any geometric features. Additionally, the ability to change is not considered a property, as transforming one imagined shape into another does not imply existence. In the following theorems, I intend to demonstrate that existence requires both a specific type of geometry (as seen in the object) and a property (such as the one that makes the object appear red) that distinguishes it from non-existence. These theorems establish the foundational laws of existence.

5.2 The Laws of Existence

Define the following for an entity Z:
$P(Z)$: The entity Z has a property.
$S(Z)$: Z has the property of self-causation, suggesting Z can cause its own existence.
$C(Z)$: Z has the property of constraining.
$E(Z)$: The existence of Z can arise from non-existence.
$B(Z)$: Z began to exist indicating a transition into existence.
$O(Z)$: Z was formed from at least one already existing entity.
$I(Z)$: Z possesses the property of having information.

5.2.1 Property Law

By the definition of existence, if Z exists then it has a property, and if Z has a property, then it exists. Thus:

$$[Def.of\ Existence] \rightarrow [P(Z) \leftrightarrow Z]$$

5.2.2 Self-Causation Negation

By the definition of S(Z), $S(Z) \rightarrow P(Z)$; and by the Definition of Existence, $P(Z) \rightarrow Z$. Thus, by the transitive law $S(Z) \rightarrow Z$, and by its contrapositive $\neg Z \rightarrow \neg S(Z)$. Thus, if Z doesn't exist, it cannot cause itself to exist. Thus:

$$\neg S(Z) \quad \text{(Self Causation Negation)}$$

Therefore, Z cannot be self-causing. To clarify, if two pre-existing entities combine to form Z, it is the interaction between these two entities that results in the formation of Z, rather than Z causing its own existence.

5.2.3 Constraint Law

By the definition of C(Z), $C(Z) \rightarrow P(Z)$. Combined with the Definition of Existence, the antecedent of the transitive law is $[C(Z) \rightarrow P(Z)] \wedge [P(Z) \rightarrow Z]$. Thus:

$$C(Z) \rightarrow Z \quad \text{(Constraint Law)}$$

Thus, for Z to be constrained, Z must first exist. By the contrapositive of the Constraint Law, if Z does not exist, it cannot be constrained to begin existing (from non-existence). It should be clarified that the converse of the Constraint Law is not necessarily true. That is:

$$\Diamond(Z \nrightarrow C(Z)) \quad \text{(Non-Biconditional Constraint Law)}$$

Thus, it is possible that two entities exist that cannot constrain each other and are thus able to occupy the same spatial coordinates. It should be noted that the Non-Biconditional Constraint Law is used as a reference for clarity, not as part of the logical argument.

5.2.4 Law of Ontological Continuity

By the Self Causation Negation, Z cannot cause itself to exist; and by the contrapositive of the Constraint Law, Z cannot be constrained to exist (out of non-existence). That is $\neg S(Z) \wedge [\neg Z \rightarrow \neg C(Z)] \rightarrow \neg E(Z)$, thus:

$$\neg E(Z) \quad \text{(Law of Ontological Continuity)}$$

Therefore, Z cannot be produced from non-existence. This implies that if Z began to exist, it must have formed from pre-existing entities. Conversely, if Z was formed from such entities, then Z transitioned into existence. Thus:

$$B(Z) \leftrightarrow O(Z) \quad \text{(Existence Law)}$$

5.2.5 Information Law

If Z possesses information, then Z exists. That is:

$$I(Z) \to Z \quad \text{(Information law)}$$

Thus, consider two existences, Z_1 and Z_2, in an otherwise empty space, separated by a distance $\varepsilon > 0$. By the contrapositive of the Information Law ($\neg Z \to \neg I(Z)$), regardless of how small ε is made, neither entity can have any information about the other unless an existence is transferred (or shared) between them. Thus, suppose that existence γ is transferred from Z_1 to Z_2. Consequently, Z_2 can have information about Z_1, but Z_1 cannot have information about Z_2.

5.2.6 Law of Fields and Waves

Particles are often associated with a field, and since these fields contain information about the particle, by the Information Law, the field must exist. If one argues that the field is part of the particle itself, then the particle cannot be considered point-like. Conversely, if the field is asserted to be separate from the particle, what is being modeled is the existence of the field, not the particle directly. Similarly, if the field is said to consist of virtual photons, those photons are distinct from the particle. Therefore, a particle cannot possess any non-zero property outside of itself.

5.2.7 Time-Existence Relation

According to the Information Law, time can only be conveyed through the presence of an existence. In the absence of an existence, there would be nothing to measure with a clock or to move through time, rendering the concept of time as undefined. Thus:

$$Time \to Existence \quad \text{(Time-Existence Relation)}$$

5.2.8 Mathematics

While numbers and equations can be conceived in specific geometric forms within the mind, they lack properties that differentiate them from non-existence. When equations are inscribed on paper, the physical materials (lead and paper) are real, but the symbols themselves are representations of mathematical concepts rather than entities that exist. Similarly, creating a drawing of a unicorn does not bring unicorns into existence. Thus, mathematics functions as a descriptive framework for reality, rather than an entity that exists.

5.2.9 The Isomorphism Theorem of Space

Statement: Space is isomorphic to the vector space $\mathbb{R}^n$, for some $n \geq 3$. In the context where points in space are represented as vectors, empty space is isomorphic to the vector space $(\mathbb{R}^n, \mathbb{R}, +, \cdot)$ for some $n \geq 3$, where $\mathbb{R}^n$ denotes an n-dimensional Euclidean space over the field of real numbers $\mathbb{R}$, and + and · denote vector addition and scalar multiplication, respectively.

Proof: Let S represent points in space, and $\mathbb{R}^n$ be the n-dimensional Euclidean space for some $n \geq 3$. Define $\phi: \mathbb{R}^n \rightarrow S$ by $\phi(< v >) = (v)$, where each vector $< v > \in \mathbb{R}^n$ is mapped to a corresponding point $(v) \in S$.

By the Local Homeomorphism Theorem, for any manifold M of dimension m, any point (v_{origin}) locally resembles $\mathbb{R}^m$. Therefore, it is established that for M, representing the geometry of space, $(v_{origin}) = (0,0,0\ldots) \in S$, and $< 0,0,0\ldots > \in \mathbb{R}^n$, and thus at least one point in S corresponds to a vector in $\mathbb{R}^n$.

By the Law of Excluded Middle, existence either exists at (v), or it doesn't. If existence exists at (v), then (v) must first be well-defined. If existence doesn't exist at (v), then by the contrapositive of the Constraint Law, nothing exists at (v) to prevent existence from moving to (v). Therefore, $\forall < v > \in \mathbb{R}^n$, (v) is well-defined.

Let $< v_1 >, < v_2 > \in \mathbb{R}^n$:

1. **Injective:** Suppose that $\phi(< v_1 >) = \phi(< v_2 >)$. It follows that $(v_1) = (v_2)$, and thus $< v_1 > = < v_2 >$. Therefore ϕ is injective.
2. **Surjective:** For any point $(v_i) \in S \ \exists\ \phi^{-1}(v_i) = < v_i > \in \mathbb{R}^n$. Thus ϕ is also surjective.
3. **Linear:** $\phi(< v_1 + v_2 >) = (v_1 + v_2) = \phi(< v_1 >) + \phi(< v_2 >)$, and $\phi(c < v_1 >) = c(v_1) = c\phi(< v_1 >)$ and thus ϕ preserves vector addition and scalar multiplication.

Since ϕ is bijective and preserves vector operations, it is an isomorphism between $\mathbb{R}^n$ and S.
QED

<u>Considerations regarding the ITS:</u> According to the Isomorphism Theorem of Space, space is smooth, continuous and infinite in all its defined dimensions with a Euclidean metric. Every point in space either contains existence or nothing exists there to prevent existence from existing there. Thus, space itself cannot be quantized or discrete. Therefore, for any manifold M representing the real structure of the universe, each point on M can be described as a point in $\mathbb{R}^n$ for some $n \geq 3$. This is very similar to the Whitney Embedding Theorem (WET) stating that a smooth manifold of dimension n/2 can be embedded into $\mathbb{R}^n$ [5], but the WET doesn't guarantee that there will not be deformations whereas the ITS does (for space).

Now that a metric has been defined for space, it can be used to represent additional geometries of any entity existing within it. This leads to the following theorems.

5.2.10 The Point Entity Theorem

Statement: A point entity can't exist.

Proof: Let Z be a point entity. Define the following:

$V(Z)$: Length, area, or volume of Z.

$\rho(Z)$: Corresponding (to $V(Z)$) average linear, area, or volume property density of Z.
$Point(Z)$: Denotes that Z is a point entity.

1. By the Law of Fields and Waves, $V(Z)$ is identically zero.
$$Law\ of\ Fields\ and\ Waves \land Point(Z) \rightarrow V(Z) \equiv 0$$
2. By the Point-Particle Limit Theorem (PPLT), limits cannot be applied to a point particle to produce a non-zero value. According to the Point-Particle Delta Function Theorem (PPDFT), the Dirac delta function cannot be applied to a point particle to produce a non-zero value. By the Zero-Infinity Limit Theorem (ZILT), even if the property density is infinite at a point, the product of the property density and volume is zero.
$$1. \land PPLT \land PPDFT \land ZILT \rightarrow \rho(Z)V(Z) \equiv 0$$
3. The product of the volume and the property density being identically zero, implies that Z doesn't have a property.
$$2. \rightarrow \neg P(Z)$$
4. Without a property, by the definition of existence, Z cannot exist.
$$3. \land [Def. of\ Existence] \rightarrow \neg Z$$

QED

Considerations regarding the Point Entity Theorem: In quantum mechanics, fundamental particles are often considered point-like, and high energy experimentation affirms that no (currently) detectable structure exists [1]. However, the Point Entity Theorem shows that such particles cannot exist. This conflict between Formal Logic and observation will be addressed later in the article.

5.2.11 The 1-D Entity Theorem

Statement: A 1-dimensional entity cannot exist.

Proof: Let Z be a 1-dimensional entity in space.

1. Let x be a point on Z such that x is not an endpoint:
$$x \in Z \land x \notin endpoints(Z)$$
2. By the Isomorphism Theorem of Space, each point x on Z is well-defined:
$$[ITS] \rightarrow \forall x \in Z, \textit{well-defined}(x)$$
3. Since x is not an endpoint, x divides Z:
$$1. \rightarrow x\ divides\ Z$$
4. Since x divides Z, and x is a point, flux does not pass through x.
$$3. \land Point(x) \rightarrow \neg flux\ through(x)$$
5. Without flux, there isn't a binding property holding Z together at x.
$$4. \rightarrow \neg(binding\ property(x))$$
6. Since x is arbitrary, this applies to all internal points on Z:
$$5. \land x\ is\ arbitrary \rightarrow \forall x \in Z, \neg(binding\ property(x))$$
7. Without a binding property, Z cannot exist:
$$6. \rightarrow \neg Z$$

Since each point x on Z divides Z, and x is a point entity, flux cannot pass through x to bind Z together. Therefore, Z lacks any property that could bind its segments together. Consequently, Z cannot exist.

As a clarification, suppose that the flux of Z goes around the point x, to bind Z together. In this case, such flux is either 1 dimensional and thus bound by this theorem, or such flux is higher dimensional in which the following theorems apply.
QED

<u>Considerations regarding the 1-D Entity Theorem:</u> In string theory, a string is theorized as a one-dimensional entity propagating in spacetime. These strings are hypothesized to be the fundamental constituents of the universe, replacing point-like particles of the Standard Model [1]. However, even if you consider a string as collectively being fundamental, by the 1-D Entity Theorem, there isn't a means for such entities to possess a property, and thus they do not exist. This is independent of the number of dimensions, presumably 10 or 11, in which the string would propagate. This leads to the following Theorem:

5.2.12 The 2-D Entity Theorem

Statement: A 2-dimensional entity cannot exist.

Proof: Let Z be a 2-dimensional entity in space.

1. Let x be a 1-d entity on Z such that x divides Z into two sections:
$$x \ divides \ Z$$
2. By the Isomorphism Theorem of Space, each point y on Z is well-defined:
$$[ITS] \rightarrow \forall y \in Z, \textit{well-defined(y)}$$
3. Since x divides Z, and x is 1-d, flux does not pass through x.
$$\textit{1.} \wedge [x \ is \ 1d] \rightarrow \neg flux \ through(x)$$
4. Without flux, there isn't a binding property holding Z together at x.
$$\textit{3.} \rightarrow \neg(binding \ property(x))$$
5. Since x is arbitrary, this applies to all 1-d entities on Z:
$$\textit{4.} \wedge x \ is \ arbitrary \rightarrow \forall x \in Z, \neg(binding \ property(x))$$
6. Without a binding property, Z cannot exist:
$$\textit{5.} \rightarrow \neg Z$$

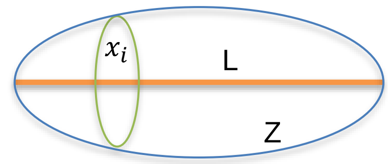
QED

<u>Considerations regarding the 2-D Entity Theorem:</u> In the context of M-Theory, a 0-brane, 1-brane, and 2-brane cannot exist. This leads us to the 3-D Entity Theorem.

5.2.13 The 3-D Entity Theorem

Statement: It is possible that a 3-D entity exists.

Fig 2 represents a 3-d entity Z, with the longest possible line segment L positioned inside such that both ends of L are on L. The cross-section x_i is perpendicular to L, and divides Z.



Proof: To establish the existence of a 3-d entity, it is necessary to first demonstrate that the same logic preventing the existence of lower-dimensional entities does not prevent the existence of a 3-d entity. Define the following in relation to the **Fig 2**:

Z: A 3-d entity.
L: The longest possible line segment through Z.
|L|: The length of L.
x_i: A cross-section of Z perpendicular to L.

1. By the 2-D Entity Theorem, x_i does not exist (DNE).
$$[2\text{-}D\ Entity\ Theorem] \rightarrow \forall x_i \in Z, DNE(x_i)$$
2. By the Constraint Law, x_i cannot prevent flux from passing through it.
$$[Constraint\ Law] \wedge DNE(x_i) \rightarrow \neg Prevent\ Flux(x_i)$$
3. x_i has an area, x_i cannot prevent flux from passing through it, thus a binding property can pass through x_i.
$$Area(x_i) \wedge 2. \rightarrow Z\ can\ have\ binding\ property(x_i)$$
4. Since x_i is arbitrary, this applies for all $x_i \in Z$.
$$3. \wedge x_i\ is\ arbitrary \rightarrow \forall x_i \in Z, Z\ can\ have\ binding\ property(x_i)$$

Therefore, the same logic that prevents a 1-d, or 2-d entity from existing, doesn't apply to a 3-d entity.

It is necessary to establish that, although a 3-dimensional entity can be considered a set of points, lines, or areas representing entities that do not individually exist, this does not prevent the existence of the 3-dimensional entity itself. That is. $\forall x_i \in Z, x_i$ does not exist, yet Z can exist. To prove this, consider $y: [0, \infty] \rightarrow [0, |L|]$, defined as $y(x_i) = |L|/(1 + x_i)$. For each x_i, the thickness l_i is zero, but the total length of Z is $|L| > 0$. Therefore, by tying the property of Z to the thickness l_i, such that $P_i = \beta x_i l_i$ for some $\beta \neq 0$, a property of Z can be recovered with |L|. Thus $\sum_{i=0}^{\infty} P_i = \beta \sum_{i=0}^{\infty} x_i l_i = \beta V(Z)$, and therefore, a 3-D entity can exist, even though the individual point, length and area entities comprising it do not exist.
QED

5.2.14 The Missing Geometry Theorem

By the Point, 1-D, and 2-D entity theorems, if an entity has a geometry in which any portion is not volumetric, that portion does not exist. Consequently, enclosing an existing entity within a larger entity does not confer existence to the larger entity. Therefore, if two entities are not connected volumetrically, or such volume doesn't have a property, the two entities exist independently.

5.2.15 The Mathematical Definition of Existence

The Point Entity, 1-D Entity, 2-D Entity, and 3-D Entity Theorems establish the criteria for an entity Z to exist. Such criteria can be explicitly defined using the following sets:

$$G = \{g | g \text{ is volumetric}\}$$
$$P = \{p | p \text{ is a property}\}$$

In which the existence of Z is established as:

$$Z = (g, p) \quad \text{(Mathematical definition of existence)}$$

Therefore, the set ξ comprising the entirety of everything that exists is defined as:

$$\xi = \{Z\} \quad \text{(Set of everything that exists)}$$

This formulation encapsulates the idea that an existing entity Z is characterized by a volumetric geometry g, and at least one property p. By the law of Excluded Middle, anything that doesn't satisfy the definition of existence does not exist. Therefore, the set N of everything that does not exist is defined below. It should be clarified that neither N nor ξ exist, and thus to avoid Russell's Paradox, they are excluded from N. That is:

$$N = \{Y |\ g \ \notin \ G \ \vee p \ \notin \ P\} \setminus N, \xi \quad \text{(Set of everything that doesn't exist)}$$

It follows that an entity that has spatial extent but lacks a property belongs to N. Therefore space, despite its spatial nature, does not exist. That is:

$$Space \in N$$

This makes sense intuitively because an existence can move without constraint within empty space. Everything that exists, exists in infinite space. That is:

$$\forall\ Z \in \xi, Z \text{ exists in infinite space} \quad \text{(Law of Spatial Existence)}$$

Now that the geometry g for existence is established, this leads to the following theorem regarding the potential for infinite divisibility.

5.2.16 The Existence Divisibility Theorem

Statement: Any existing entity can be infinitely divided into multiple existing entities, provided that a property doesn't prevent such division.

Proof: Let Z be an existing entity. By the Finite Precision Theorem, any process external to Z cannot divide or compress Z with perfect precision to produce $Z_i \subset Z \mid Z_i$ has the geometry of a point, line, or area. Thus, $\forall\ Z_i \subset Z$, the volume $V(Z_i) > 0$. Therefore, let L_i be the longest possible line segment such that both endpoints are positioned on Z_i. Now suppose that Z_i is divided into k equal-length segments sliced perpendicular to L_i

such that $|L_i| = k(\frac{|L_i|}{k})$ for some $k \in \mathbb{N}$. If for some k, $\frac{|L_i|}{k} = 0$, then $|L_i| = 0k$ contradicting the premise that $|L_i| > 0$. It follows by contradiction that, $\frac{|L_i|}{k} > 0 \, \forall \, k$, and thus Z is infinitely divisible unless a property prevents it.

QED

5.2.17 The total existence in space

It follows from the Existence Divisibility Theorem that if Z exists, a subset of Z cannot be reduced to non-existence; and according to the Law of Ontological Continuity, Z cannot be produced from non-existence. Therefore, although Z may be added to another existing entity, divided into multiple entities, or permuted:

$$The\ total\ existence\ |\xi|\ in\ space\ is\ constant\ and\ has\ [always]\ existed$$

5.2.18 States of existence and interactions

Assume that the total existence of Z is fixed. According to the Existence Divisibility Theorem, each point on Z can be sheared, allowing Z to deform and "vibrate" like elements of String Theory. Now, suppose Z exists in the S_z^i state. Since Z is assumed to be vibrating, there is some other state S_z^{i-1} in which Z has existed. If Z were to become non-existent temporarily between the states of $S_z^{i-1}$and S_z^i, then by the Law of Ontological Continuity, Z could not begin existing again contradicting the premise. Therefore, the state function S_z of Z is continuous, and can thus be expressed as $S_z = S_z(\chi)$ for some parameter χ. Since the total existence of Z is fixed, by the contrapositive of the Existence Law, Z did not have a beginning. Thus, the domain of $S_z(\chi)$ can be represented as the entirety of the real number line.

Since causality presumably always holds, $S_z(\chi)$ is necessarily a causal loop in which each state of Z causes the next. It follows that if two existences Z_1 and Z_2 interact, their interaction $\tilde{I}(Z_1, Z_2)$ results in a state that is determined by the applicable laws and the respective states during interaction to not violate causality.

5.2.19 Physical Laws and Free-Will

Physical laws are information, and thus only an existence can have the property of a law. That is, a law is intrinsic to an existence. Therefore, suppose that Z has a law that determines each preceding state $S_z(\chi)$ such that causality is never violated. In this case it follows that Z is deterministic. Now suppose that Z does not have an intrinsic law other than that which requires it to change states. In this case, Z is required to change states, but there isn't an intrinsic law that establishes which state Z must transition into. It follows that at each transition, Z has a choice introducing the notion of free-will. That is:

$$[Z\ is\ required\ to\ change\ states] \wedge [Z\ doesn't\ have\ a\ deterministic\ law] \rightarrow [Free\ will]$$

5.2.20 Spacetime, and the meaning of time

By the Constraint Law, for spacetime to be deformed by the presence of mass and energy, spacetime must first exist. This is consistent with the Time-Existence Relation, necessitating that for time to be defined at each point in spacetime, each point must have an existence. By the mathematical definition of existence, spacetime must therefore have a geometry g and a property p. Spacetime is a 4-d manifold and thus it has a hyper-volumetric geometry g, and since each point in spacetime is represented by the coordinates (x_0, y_0, z_0, t_0) a property is necessarily that of time. That is, at each point in spacetime, time must be defined. By the Isomorphism Theorem of Space, spacetime exists in infinite space that is isomorphic to $\mathbb{R}^n$ for some integer $n \geq 3$. Since spacetime is not isomorphic to $\mathbb{R}^n$, there is infinite space beyond the bounds of spacetime producing problems related to Olber's Paradox. Now this paper doesn't argue in favor of spacetime, so these are just requirements for those in support of it.

By the Isomorphism Theorem of Space, space is isomorphic to $\mathbb{R}^n$ for some integer $n \geq 3$, and by the contrapositive of the Constraint Law, nothing exists in empty space to constrain an existence from freely moving. Therefore, an existence Z existing in open space is free to move indefinitely in all defined dimensions without the need for a temporal one. That is, since Z exists, it automatically has the ability for change that we associate with the concept of time. Therefore:

The ability for change is a property of existence

Assuming spacetime, everything within our observable universe moves through the temporal dimension. Consequently, there must be a mechanism within spacetime that ensures uniform movement through time. It is not entirely clear if advocates of spacetime have a definitive understanding of what this mechanism is. In the proposed model, there is a similar mechanism referred to as the FE, but rather than ensuring everything moves through time uniformly, such a mechanism ensures that the distances traveled by each existence within the observable universe are linked together. That is, rather than dealing with time, we deal with distances.

To explain this, consider two existences Z_1 and Z_2 moving towards a third existence Z_3 in otherwise empty space. Time doesn't exist, so the only way to relate the 3 existences is through the concept of distances. Therefore, we can say that the distances that Z_1 and Z_2 move respectively (relative to Z_3) are d_1 and d_2, and they are related by some equation such as $d_1 = 4d_2$. In the context of time, this means that d_1 is traveling 4x faster than d_2. Now, rather than directly relating d_1 to d_2, a fourth existence Z_4 can be introduced, and $d_4$can then be compared separately to d_1 and d_2. As an example, $d_4 = 12d_2$, and $d_4 = 3d_1$.

In this context, d_4 represents our concept of time. To explain this, imagine Z_4 as a photon, and d_4 is the distance that the photon moves between two events occurring. Since the distance d_4 is typically very large, we have invented devices called light clocks that allow us to instead measure the number of passes from mirror to mirror. If we now use the light clock to measure the "speed of light", the light in both the clock and the experiment change proportionally so the measurement is a geometry relation resulting in all reference frames measuring the same value. That is, the "speed" of light is measured as constant independent of it being constant, and the distance that light travels in one reference frame relative to another is interpreted as time dilation. Now one might argue that light requires time to propagate, but this is not true: Light propagates due to its causal loop $S_\gamma(\chi)$, and we measure time based on the distance that it travels.

This concept of time being a relationship between events, and the distance that light travels between them needs further clarification. Suppose that you have an atomic clock. For the existences making up the atom to function cohesively, by the Information Law, existences need to be exchanged between the components. Such existences represent the force carriers of the standard model. With that said, the same FE that causes the photon to move less distance in one area of space than another, also causes all force carriers to do essentially the same. Thus, the atomic clock time dilates like the light clock (even without the presence of a photon).

With that said, take a 3-d slice of spacetime. Now again, we are not advocating for spacetime, so this is merely exemplary. Since that slice is volumetric, by the Missing Geometry Theorem, for spacetime to exist that slice must also exist. If we now say that everything that we observe in that slice is free to move independent of a temporal dimension, then there must exist a mechanism that ensures consistency throughout such that everything that we observe moves as if transitioning through time. That mechanism is the FE. To clarify, everything that we observe exists within the FE, and moves independent of a temporal dimension. The FE regulates how far each object in the universe moves in relation to others giving the illusion of moving through time. Since the FE exists, it can deform under the influence of mass and energy as objects move producing the results attributed to GTR. Thus, only a slice of spacetime would need to exist, implying that spacetime itself would simply be a plot of its worldlines.

Now, although the slice of spacetime is 3-d, it occupies a higher dimensional space. Since there isn't any indication that higher dimensional space is possible, we want to restrict the metric to that of Euclidean 3-space such that black holes, gravitational waves, etc. still occur. We shall therefore loosely define the FE as being an existence, or set of existences, that can deform under the presence of mass and energy to produce the results of GTR, such that the FE is a subset of space isomorphic to $\mathbb{R}^3$.

Putting this all together, everything that we observe within the universe exists within the FE. Without the FE present, an existence Z transitions through its causal loop $S_z(\chi)$ freely moving indefinitely in any direction. With the FE present, the interactions $\tilde{I}(CE, Z)$ regulate the distance traveled by Z. Thus, the FE merely regulates how far objects move within it relative to each other giving the illusion of time. As matter moves through the FE, the FE deforms producing the results attributed to GTR.

6. THE STRUCTURE OF THE UNIVERSE

Based on the axioms, assumptions, and Framework outlined above, it is essential to derive a structure for our universe that ensures the scientific observations listed in Section 2 are free from contradictions. By treating these scientific observations as propositions, each statement builds upon the others, collectively contributing to our understanding of the universe's structure. In the following sections, mathematics and principles of modern physics are then applied to this structure, to produce a viable theory.

6.1 The deduction of the universe's general Structure

Define the following:

FE(M): This is the universe's structure represented by the manifold M. Within the context of GTR, M serves as the spacetime manifold that models the universe, but M is not the universe itself. For the sake of completeness, if FE(M) is composed of distinct existences that perhaps interact like a lattice, then by the Missing Geometry Theorem, FE(M) references those distinct existences.

Deform(FE): FE(M) is constrained to deform by the presence of mass and energy.

Exists(FE): FE(M) exists.

FE_AE: FE(M) has either always existed, or it is composed of entities that have.

FE_DirUnmeas: FE(M) is an existence, or is composed of existences, that have a property that is not directly measurable by current standards.

1. By the Constraint Law, an entity must first exist before it can be constrained. FE(M) is constrained to deform under the presence of mass and energy to produce the results of GTR and thus FE(M) exists. That is:

$$[Constraint\ Law] \wedge Deform(FE) \rightarrow Exists(FE)$$

2. $FE(M)$ exists, yet we can only measure it indirectly through gravitational waves, gravitational lensing, quantum processes, etc.

$$1. \wedge [Can't\ directly\ measure\ FE(M)] \rightarrow FE\_DirUnmeas$$

3. The existence of FE(M) implies that it is an element in the set of everything that exists. Thus:

$$1. \rightarrow FE(M) \in \xi$$

4. By the Law of Spatial Existence, and the Isomorphism Theorem of Space:

FE(M) exists in Space and Space is isomorphic to $\mathbb{R}^n$ for some $n \geq 3$

5. By the Law of Ontological Continuity, FE(M) has either always existed, or it is composed of entities that have. Thus:

$$1. \wedge [Law\ of\ Ontological\ Continuity] \rightarrow FE\_AE$$

Thus, it is established that FE(M) exists in infinite space, and its property is not directly measurable. By additionally incorporating experimental results from QM, further improvements to the theory can be made as follows.

In the vacuum of space, before the emergence of any virtual particles, the only existence is the existence of the FE(M) that we cannot directly measure. By the Law of Ontological Continuity, it follows that any virtual particles that emerge in the vacuum of space must therefore be formed/created out of the FE(M) itself. The only way this is possible is if the components of FE(M) that form a particle, have individual properties that are not directly measurable, but when combined their properties superimpose to produce a property that is. Thus:

VPE: Virtual particles emerge in the vacuum of space.

OEIV: The only existence in the vacuum of space, prior to the emergence of virtual particles, is that which composes FE(M).

QP: The quantum process of virtual particle pair production and annihilation models an exchange in which existences composing FE(M), superimpose to produce measurable particles and vice versa.

$$OEIV \wedge VPE \wedge [Existence\ Law] \rightarrow QP$$

FE_MP: FE(M) is composed of multiple existences (think of a uniform lattice), with a variety of unmeasurable properties. When combinations of such existences interact, their properties superimpose, sometimes producing a net property that we can measure, thus forming what we call a particle.

$$QP \rightarrow FE\_MP$$

FP_NF: The particles of the standard model are not fundamental.

$$FE\_MP \wedge QP \rightarrow FP\_NF$$

QuantAndMult_Lattice: The multiple existences from FE_MP are discrete and quantized forming a uniform lattice-like structure. Thus FE(M) is lattice-like.

$$FE\_MP \wedge [QM\ is\ quantized] \rightarrow QuantAndMult\_Lattice$$

ApproxZeroVol: The volume of the individual existences in QuantAndMult_Lattice cannot be zero, but they can be smaller than detectable range.

$$Point\ Entity\ Theorem \wedge [Existence\ Divisibility\ Theorem] \rightarrow ApproxZeroVol$$

Since particles are formed from combinations of existences that do not individually have measurable properties, it follows that the existences composing FE(M) need not individually be bound by our physical laws. Thus, there isn't a reason to assume that they are restricted by the speed of light, resulting in a logical explanation for entanglement and the expansion of our universe. Thus:

> **FEisNotBound:** The individual existences u_i composing FE(M) are not necessarily bound by our physical laws until they superimpose producing a particle that can be measured. Thus, such existences should not be assumed to be bound by the speed of light or constrained by any other known law other than those of logic.

$$Existences\ in\ FE\_MP\ are\ not\ measurable \rightarrow FEisNotBound$$

> **Entanglement:** There is an existence that is not directly measurable, that propagates the information between some particles at a speed that is not bound by c.

$$[Information\ Law] \wedge [FEisNotBound] \wedge [Entanglement\ occurs] \rightarrow Entanglement$$

> **Tunneling:** There is a non-zero probability that a particle dissociates into its respective existences (each a respective u_i), and can thus bypass a potential well, recombining on the exterior potentially faster than c.

$$FEisNotBound \wedge [Tunneling\ Occurs] \rightarrow Tunneling$$

By the Law of Ontological Continuity, the total existence of a particle cannot be produced from non-existence, and thus a particle cannot exist in multiple states at once. According to this model, two forms of superposition are allowed:

> **ExistencesInteract:** The individual existences u_i composing a particle can dissociate such that their individual states $S(\chi)$ superimpose.

> **WavesPropFE:** The particle produces a series of waves that propagate through FE(M) and those waves give the illusion of the particle being in a superposition of states.

> **WaveParticleDuality:** The existences making up a particle can collectively act as both a wave and a particle.

$$([Existence\ Law] \wedge [Superposition]) \rightarrow (ExistencesInteract \vee WavesPropFE)$$

Now, if WavesPropFE is true, then there doesn't appear to be any means for there to be a distinction between when a particle is observed and when it is not. If ExistencesInteract is true, then the particle can dissociate when not observed, and remain as a particle otherwise. Thus:

$$ExistencesInteract \rightarrow WaveParticleDuality$$

It is thus established that this framework is consistent with observations in quantum mechanics, including quantum tunneling, superposition, and entanglement. When a particle is observed, the fundamental existences constituting the particle remain intact, causing it to exhibit particle-like behavior. When a particle is not observed, one could say that it "partially dissociates” into its constituent existences u_i, and as each u_i moves through its causal loop, the interactions produce wave-like effects, thus explaining wave-particle duality within the confines of section 2. Consequently, while everything adheres to Formal Logic, uncertainty arises due to the lack of a complete knowledge about the state function $S_z(\chi)$. It should be clarified that this article does not provide an explanation for why wave-particle duality occurs, nor does it propose a new theory of quantum mechanics. Rather, it simply establishes a logical means for their feasibility.

6.2 The mathematical definition of the Field Ether

QuantAndMult_Lattice posits that the universe is structured as a lattice of quantized entities, while FE_MP suggests that these existences possess properties that are not directly measurable individually. However, when they are superimposed, their combined properties can manifest as measurable particles. Therefore, loosely define the Field Ether (FE) as the lattice that pervades the universe, consisting of the particles described by QuantAndMult_Lattice and FE_MP. Every existence Z_i within the universe exists within the FE, and transitions through its own causal loop $S_Z(\chi)$, thereby replacing the concept of time as a real dimension. Interactions $\tilde{I}(Z_i, FE)$ regulate the causal loop giving the illusion that everything in the universe is passing through time uniformly. It should be clarified that, according to the Missing Geometry Theorem, objects such as stars and planets do not exist as distinct entities: what exists are the individual existences that constitute these objects.

It is thus necessary to establish that the FE is also conceptually able to produce the observations attributed to GTR such as black holes, time dilation, and gravitational lensing. To do this, define an existence density **ϱ**, of the existences making up the FE per unit volume. It is also necessary to define a weak interaction $\tilde{I}(\gamma, FE)$ between the FE, and a photon (γ) that is traversing through it. Said interaction must be weak so that over small distances the total interaction is not detectable thus resulting in the speed of light being the same in all directions (within detectible means), yet over vast distances these interactions result in gravitational lensing/redshifting.

With that said, as speed increases through the FE, the number of interactions $\tilde{I}(\gamma, FE)$ also increases. Thus, increasing speed through the FE is like being stationary in a region of the FE that has a higher **ϱ**. Therefore, for Lorentz time dilation to be compatible with that of gravitational time dilation:

The presence of mass and energy increases **ϱ**, *and velocity increases* $\tilde{I}(\gamma, FE)$

With that said, it is necessary to establish a light clock K positioned at a point in the FE that has the smallest existence density **ϱ**, and interactions $\tilde{I}(\gamma, FE)$. It follows that K measures time to be equal to or faster than any other point within the FE, therefore acting as an upper limit for the rate at which time can be measured. It should be noted that when the time in another location of the FE is compared to K, it is not implied that a measurement is possible, but rather it is being established that there is a relationship with or without a measurement being feasible.

When a photon is produced near K, the net property necessarily includes the photon moving in the direction of emission. That is, the state function $S_{\gamma}(\chi)$ of the photon results in its motion. Time is then measured, based on the distance the light travels inside of a light clock. As the number of interactions $\tilde{I}(\gamma, FE)$ increases, the slower the local speed of light relative to K, and thus time dilation occurs within such a clock. However, since time is based on the distance that light travels, all reference frames measure the speed of light to be the same. That is, using a light clock to measure the speed of light implies that such measurement will produce the same results in all reference frames. Therefore:

The speed of light is not constant universally (relative to k)
but in each reference frame it is measured to be c.

Time is a function of the distance light travels.

Since **ϱ** increases in the presence of mass and energy, the number of interactions $\tilde{I}(\gamma, FE)$ increases near massive objects resulting in a slower speed of light relative to K. However, as stated above, such a reference frame still measures the same value for c locally. Likewise, when speed through the FE increases, the same result occurs. Thus, this model is compatible with both gravitational and Lorentz time dilation, and the invariance in the *measurement* of the speed of light.

Since the speed of light decreases near a massive object, two things are implied: there can exist a point in which the speed of light becomes zero accounting for the concept of black holes; and the FE has a varying index of refraction accounting for the concept of gravitational lensing.

By FEisNotBound, the FE is not bound by our physical laws, and thus it is not limited by the speed of light. This therefore produces a means in which the FE can drive the expansion of the universe faster than c in accordance with Hubble's Law. Since the FE exists, it is conceivable that gravitational waves can propagate through it and in doing so, they alter the interactions $\tilde{I}(\gamma, FE)$ locally producing a detectable shift in the interferometer at LIGO [6].

By the Isomorphism Theorem of Space, space is isomorphic to the vector space $\mathbb{R}^n$, for some $n \geq 3$. Thus, define a Euclidean Coordinate System in otherwise empty space, and define a geometry S in relation to it such that:

$$S = \{(x, y, z) | x^2 + y^2 + z^2 \leq R^2, R \in \mathbb{R}\}$$

$$U \subseteq \xi \mid \forall\, u_i \in U, P(u_i)\ is\ directly\ undetectable\ and\ u_i\ is\ quantized$$

$$FE = \{u_i | u_i \subseteq U, u_i \exists \in S, U\ is\ uniformly\ distributed\} \quad \textbf{(Definition of the FE)}$$

This definition provides a means in which the information pertaining to a particle can be distributed through the elements of the FE producing fields that can interact with other particles.

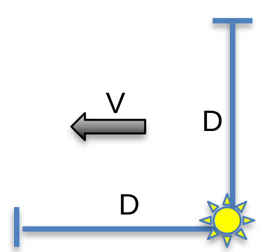
7. THE FIELD ETHER (FE) - A THEORY BASED ON THE ABOVE FRAMEWORK AND STRUCTURE

It is necessary to take the structure derived in the previous section and apply the principles of modern physics and mathematics to it to produce a scientific theory that is both compatible with the axioms and assumptions of section 2, and logically meaningful. This theory is only developed to the point of establishing that this structure provides a means for all the predictions of GTR and QM to be compatible with formal logic. While this work does not produce a new theory of QM, one should begin to see that the FE provides a means for all quantum processes to be logically explained.

7.1 The Field Ether Theory

As derived in Section 6, the FE can be compared to a lattice where the nodes represent quantized existences, each with properties that are individually undetectable to us. This FE extends throughout our universe, encompassing everything that we observe. As these quantized existences move through their own causal loops, $S_{ui}(\chi)$, interactions $\tilde{I}(u_i, FE)$ occur between them. Occasionally these interactions result in the superposition of their properties, producing a net property that we can detect and interact with, thus producing what we call a particle. Quantum mechanics models these exchanges between the FE and observable particles. Since we can only interact with these quantized existences when they superimpose to manifest as particles, we cannot assume they are individually bound by the known physical laws. It is therefore plausible that each individual existence is not constrained by the speed of light, offering a logical explanation for phenomena such as superposition, entanglement, the expansion of the universe, gravitational waves, etc. As one reads this section it should become apparent that the assumption that Einstein made was that the interactions $\tilde{I}(u_i, FE)$ don't occur (and understandably so).

Fig 3 illustrates the Michelson-Morley Experiment (MME) apparatus moving through empty space.



With that said, suppose that the Michelson-Morley Experiment (MME) apparatus is placed in otherwise empty space as depicted in **Fig 3**. Since nothing else exists, by the contrapositive of the Constraint Law, nothing exists to interact with the photons. Additionally, there isn't any reference frame to establish the velocity v. Hence, the velocity of the photons relative to the apparatus is always c in all directions. That is, the equations of motion for the photons in both directions of each arm is just $D = ct$.

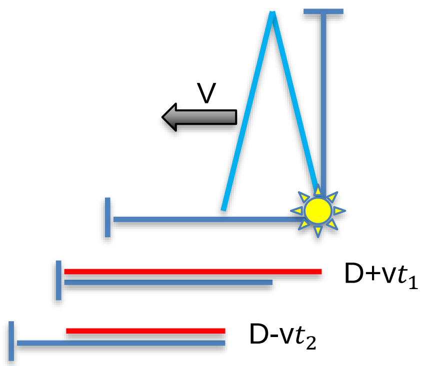


Fig 4 illustrates the Michelson-Morley Experiment (MME) apparatus moving to the left through a Medium. The three stages depicted correspond to photon emission, photon reflection, and photon return. The total path length traveled by each photon is shown in red and blue, respectively.

Now suppose that, like the sound wave, a photon needed a medium to propagate as shown in **Fig 4**. As the apparatus moves through such medium at velocity v, the equation of motion for the first horizontal photon is:

$$D_{\leftarrow} = (c - v)t_1$$

Therefore, if the photon doesn't require a medium the equation of motion is $D = ct$, and if it does require a medium the equation is $D_{\leftarrow} = (c - v)t_1$. It follows that if the photon doesn't need a medium, but instead has a weak interaction $\tilde{I}(\gamma, FE)$ as it propagates through the FE, then the equation of motion must be $D_{\leftarrow} = (c - \alpha v)t_1$, where $|\alpha| << 1$ establishes that the interaction is weak. That is, αv just changes the speed of light slightly. The equations are as follows for some $\alpha_h = \alpha_h(v)$ and $\alpha_v = \alpha_v(v)$:

$D = (c - \alpha_h v)t_1 = (c + \alpha_h v)t_2$ (Time components)

$\Rightarrow t_1 = D/(c - \alpha_h v)$ and $t_2 = D/(c + \alpha_h v)$

$\Rightarrow T = t_1 + t_2$

$= 2Dc/(c^2 - \alpha_h^2 v^2)$ (Total time (horizontal photon), 1)

So, the total distance traveled by the horizontal photon is:

$$D_h = (D + \alpha_h v t_1) + (D - \alpha_h v t_2)$$

$= 2D + \alpha_h v(t_1 - t_2)$

$= 2D + \alpha_h v(D/(c - \alpha_h v) - D/(c + \alpha_h v))$

$= 2D + \alpha_h v D(\,(c + \alpha_h v) - (c - \alpha_h v)\,)/(\,(c - \alpha_h v)(c + \alpha_h v)\,)$

$= 2D + 2\alpha_h^2 v^2 D/(c^2 - \alpha_h^2 v^2)$

$= (2Dc^2 - 2D\alpha_h^2 v^2 + 2D\alpha_h^2 v^2)/(c^2 - \alpha_h^2 v^2)$

$= 2Dc^2/(c^2 - \alpha_h^2 v^2)$ (2)

And the total distance traveled by the vertical photon (blue) is:

$$D_v = 2\,[\,D^2 + (\alpha_v vT/2)^2]^{1/2}$$

$= 2\,[\,D^2 + (\alpha_v vDc/(c^2 - \alpha_h^2 v^2))^2]^{1/2}$

$= 2[D^2(c^4 - 2c^2\alpha_h^2 v^2 + \alpha_h^4 v^4) + \alpha_v^2 v^2 D^2 c^2]^{1/2}/(c^2 - \alpha_h^2 v^2)$

$= 2D[(c^4 - c^2 v^2(2\alpha_h^2 - \alpha_v^2) + \alpha_h^4 v^4)]^{1/2}/(c^2 - \alpha_h^2 v^2)$

$= (\,2Dc^2/(c^2 - \alpha_h^2 v^2)\,)[1 - v^2(2\alpha_h^2 - \alpha_v^2)/c^2 + \alpha_h^4 v^4/c^4]^{1/2}$

$= D_h[1 - v^2(2\alpha_h^2 - \alpha_v^2)/c^2 + \alpha_h^4 v^4/c^4]^{1/2}$ (3)

Notice that $\lim_{\alpha_h \to 0} D_h = \lim_{(\alpha_h,\alpha_v)\to(0,0)} D_v = 2D$, so the weaker the interaction $\tilde{I}(\gamma, FE)$, the closer the result gets to that of GTR. Also notice that if D is made large enough, then for $\alpha \neq 0$, and $v \neq 0$, the error becomes measurable. Thus, the speed of light is very close to being invariant over small distances, but over vast distances, such as those between earth and the sun, its variance will become apparent.

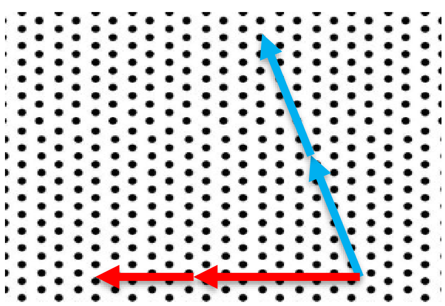


Fig 5 is a diagram that represents the total path length of each photon respectively through the FE.

Assuming a uniform density **ϱ** as shown in **Fig 5**, the number of interactions $\tilde{I}(\gamma, CE)$ is proportional to the path length traversed by each photon, not the length of each arm. With that said, the total time of travel for each photon is not T above, but rather:

$$T_h = D_h/c + nt_{int} = 2D/c_h \quad \text{(horizontal photon, 4)}$$
$$T_v = D_v/c + nt_{int} = 2D/c_v \quad \text{(vertical photon, 5)}$$

where (n) is the number of interactions $\tilde{I}(\gamma, FE)$, t_{int} is the time each interaction takes to occur, 2D is the distance traveled by the photon relative to the clocks reference frame, and c_h and c_v are the speed of light in the horizontal and vertical directions respectively, relative to K. Solving equation 4 for c_h yields:

$$D_h/c + nt_{int} = 2D/c_h$$

$c_h(D_h + nt_{int}c) = 2Dc$

$c_h = 2Dc/(D_h + [n]t_{int}c)$

$c_h = 2Dc/(D_h + [\varrho D_h]t_{int}c)$

$c_h = 2Dc/[D_h(1 + [\varrho]t_{int}c)]$

$$c_h = 2Dc/[\{2Dc^2/(c^2 - \alpha_h^2 v^2)\}(1 + [\varrho]t_{int}c)]$$

$$c_h = \frac{c(1-\alpha_h^2 v^2/c^2)}{(1+[\varrho]t_{int}c)} \quad \text{(Horizontal Light Dilation, 6)}$$

Likewise, solving equation 5 for c_v yields:

$$D_v/c + nt_{int} = 2D/c_v$$

$$c_v(D_v + nt_{int}c) = 2Dc$$

$$c_v = 2Dc/(D_v + [n]t_{int}c)$$

$$c_v = 2Dc/(D_v + [\varrho D_v]t_{int}c)$$

$$c_v = 2Dc/[D_v(1 + [\varrho]t_{int}c)]$$

$$c_v = 2Dc/[\{D_h[1 - v^2(2\alpha_h^2 - \alpha_v^2)/c^2 + \alpha_h^4 v^4/c^4]^{1/2}\}(1 + [\varrho]t_{int}c)]$$

$$c_v = 2Dc(c^2 - \alpha_h^2 v^2)/[\{2Dc^2[1 - v^2(2\alpha_h^2 - \alpha_v^2)/c^2 + \alpha_h^4 v^4/c^4]^{1/2}\}(1 + [\varrho]t_{int}c)]$$

$$c_v = c_h/[1 - v^2(2\alpha_h^2 - \alpha_v^2)/c^2 + \alpha_h^4 v^4/c^4]^{1/2} \quad \text{(Vertical Light Dilation, 7)}$$

From equations 4 and 5:

$$c_v T_v = c_h T_h$$

$$T_v = c_h T_h / c_v$$

$$= T_h[1 - v^2(2\alpha_h^2 - \alpha_v^2)/c^2 + \alpha_h^4 v^4/c^4]^{1/2} \quad (8)$$

Equations for D_h, D_v, c_h, c_v, T_h, and T_v have therefore been established, but it is also necessary to derive equations for α_h, α_v, and ϱ. To do this, let's go back to the MME apparatus moving through otherwise empty space. Each photon travels through its causal loop $S_\gamma(\chi)$ at speed c relative to the apparatus.

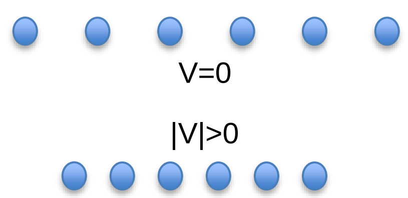


Fig 6 illustrates the existence of the FE as perceived by a photon. At the top, the MME apparatus is stationary relative to the FE resulting in an emitted photon perceiving the FE as spread out. As the velocity of the apparatus increases, the FE appears bunched up resulting in a change of α.

If the FE is now introduced, the photon is still emitted at speed c, but the interactions $\tilde{I}(\gamma, FE)$ change the average speed. As shown at the top of **Fig 6**, when the velocity of the MME apparatus is zero through the FE, from the photons perspective the existences making up the FE are spread out maximally. As the apparatus increases in speed relative to the FE, from the photon's perspective, the existences making up the FE appear bunched as shown at the bottom of **Fig 6**. Hence why $\alpha = \alpha(v)$.

We shall now derive the equations for α_h and α_v in which $\varrho = 0$ (corresponding to no other mass present). As claimed above, time is a function of the distance that light travels through its causal loop. Therefore, for this theory to produce the results of Lorentz time dilation, the speed of light (relative to K) must dilate like how time dilates in special relativity.

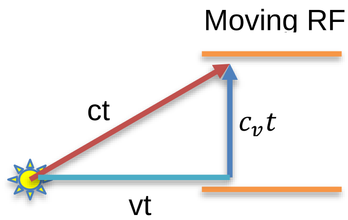


Fig 7 represents the conventional setup for the time dilation equation of special relativity except where the speed of light dilates instead of time.

Consider a light source that is stationary relative to the FE as shown in **Fig 7**. At the moment a moving reference frame reaches the light source, a flash occurs (same setup as that in special relativity). Since time doesn't exist, by the contrapositive of the Constraint Law, it cannot dilate and thus c_h dilates instead. Thus:

$$c_h^2 + v^2 = c^2$$
$$c_h^2 = c^2 - v^2$$
$$c_h = c\sqrt{1-(v/c)^2} \quad (9)$$

Comparing this result to equation 6 (with $\varrho = 0$) yields:

$$c\sqrt{1-(v/c)^2} = c(1 - \alpha^2 v^2/c^2)$$
$$\alpha_h^2 v^2/c^2 = (1 - \sqrt{1-(v/c)^2})$$
$$\alpha_h(v) = [(1 - \sqrt{1-(v/c)^2})c^2/v^2]^{1/2} \quad (|v| << c, 10)$$

With that said, notice that equations 3, 7, and 8 have the same coefficient function of $[1 - v^2(2\alpha_h^2 - \alpha_v^2)/c^2 + \alpha_h^4 v^4/c^4]^{1/2}$. That is, if $1 - v^2(2\alpha_h^2 - \alpha_v^2)/c^2 + \alpha_h^4 v^4/c^4 = 1$ then $D_v = D_h$, $T_v = T_h$, and $c_v = c_h$ meaning that both the horizontal and vertical photons travel the same distance in the same time, resulting in them staying in phase. This is only possible because the weak interaction $\tilde{I}(\gamma, FE)$ causes the vertical photons path to curve such that $D_v = D_h$, and this curve is modeled herein as a delay. That is, rather than having to model the curve of the vertical photon's path due to the interactions $\tilde{I}(\gamma, FE)$, its path is modeled as straight with a time delay at each interaction. Equations 2 and 3 ensure that the path lengths and time are the same in a constant density $\varrho = 0$, and equation 7 ensures that this remains true with gravitational effects accounted for ($\varrho \neq 0$). Thus:

$$1 - v^2(2\alpha_h^2 - \alpha_v^2)/c^2 + \alpha_h^4 v^4/c^4 = 1$$
$$-(2\alpha_h^2 - \alpha_v^2)c^2 + \alpha_h^4 v^2 = 0$$
$$\alpha_v^2 c^2 = 2\alpha_h^2 c^2 - \alpha_h^4 v^2$$
$$\alpha_v^2 c^2 = (2c^2 - \alpha_h^2 v^2)\alpha_h^2$$
$$\alpha_v^2 c^2 = (2c^2 - [(1 - \sqrt{1-(v/c)^2})c^2/v^2]v^2)[(1 - \sqrt{1-(v/c)^2})c^2/v^2]$$
$$\alpha_v^2 c^2 = c^2(2 - (1 - \sqrt{1-(v/c)^2}))[(1 - \sqrt{1-(v/c)^2})c^2/v^2]$$
$$\alpha_v^2 = (1 + \sqrt{1-(v/c)^2})[(1 - \sqrt{1-(v/c)^2})c^2/v^2]$$

$$\alpha_v^2 = (1 - (1 - (v/c)^2))c^2/v^2$$
$$\alpha_v^2 = (v/c)^2 c^2/v^2$$
$$\alpha_v = 1 \quad (11)$$

Equations 2-7 are simplified below with the appropriate substitutions for α_v and α_h:

$$D_h = D_v = \frac{2D}{\sqrt{1-(v/c)^2}} \quad (12)$$

$$T_h = T_v = \frac{2D(1+[\varrho]t_{int}c)}{c\sqrt{1-(v/c)^2}} \quad (13)$$

$$c_h = c_v = \frac{c\sqrt{1-(v/c)^2}}{(1+[\varrho]t_{int}c)} \quad \text{(Light and Time dilation, 14)}$$

It should be specified that c_h and c_v are the average speeds of light in the horizontal and vertical directions respectively, not the speed of light along the curved paths. It is therefore possible that the speed of light is invariant in some respects since it moves on a curved path not the straight one modeled by equation 14. In this case, both an increase in velocity and an increase in gravitational field strength (explained below) cause a longer path length for the light to propagate (like GTR). Thus, equations 12-14, with $\varrho = 0$, will produce the exact same results as the MME, with the exact same time dilation of special relativity, all within 3-space Euclidean. By producing an equation for ϱ, gravitational effects can also be incorporated. Now, it should be clarified that nothing states that the speed of light is perfectly invariant since $|Err(c)| > 0$.

Notice that there isn't a need for length contraction in this scenario, even though equation 12 may resemble the length contraction equation from special relativity. To clarify, imagine a muon emerging at the Earth's horizon and traveling at relativistic speeds toward the surface. Normally, one would argue that in the muon's reference frame, time dilates and length contracts. However, in this model, the speed of light in the muon's reference frame dilates along with all fundamental forces as explained earlier. This slowing down of the fundamental forces leads to a longer decay process. Length contraction is unnecessary because there is no violation if the muon perceives itself as moving faster than the speed of light (c) due to its slower clock. If the muon's speed, relative to clock K, does not exceed c, it can perceive its own speed as infinite without any known violations. Therefore, length contraction is not required (but is still possible to implement within the FE). One might argue that a moving charge generates a force due to length contraction, but that is not the case herein. The force carriers of the moving charges are slowed down producing the effect attributed to length contraction.

Now consider the existence Z placed in the FE. By the 3-D entity theorem Z must therefore occupy some volume $V > 0$. We can therefore say that the amount of information (I) that Z has is proportional to its volume such that $I = kV$ for some $k \in \mathbb{R}$. Now, just as a magnet placed near a ferromagnetic material aligns the dipoles of the material producing a stronger field, the information that Z contains aligns the properties of the existences that make up the FE to produce what we call fields. That is, the information that Z has gets spread out over the FE, and therefore any secondary existence placed in that field obtains information about Z often resulting in a force.

With that said, wrap Z in a spherical shell of area $4\pi r^2$, and weigh the distribution of the information from Z at each radius as $W(r)$. It therefore follows that:

$$kV = 4\pi \int_{a>0}^{\infty} W(r) \cdot r^2 dr \quad \text{(Information Distribution Law, 15)}$$

Now, if we restrict $W(r)$ to the form A/r^q, for equation 15 to converge, $q > 3$ for some $q \in \mathbb{R}$. Thus:

$$kV = 4\pi A \int_{a>0}^{\infty} \frac{1}{r^{q-2}} dr \quad \text{(Assuming } W(r) = A/r^q\text{, 16)}$$

It follows that the information pertaining to a field F at any distance (r) is simply the integrand in equation 16, and the total information throughout the FE due to Z is kV. Thus:

$$F = \frac{4\pi A}{r^{q-2}} \quad \text{(Field equation when } W(r) = A/r^q\text{, 17)}$$

Notice that for $A = Gm_1/(4\pi)$, and $q = 4$, equation 17 reduces to Newton's gravitational field. In general, all fields in physics are represented as:

$$F = 4\pi W(r) r^2 \quad \text{(All fields, 18)}$$

Now suppose that there is a massive object O placed within the FE. By equation 15, the information that O has is distributed over the existences making up the FE producing a field described in equation 18. When a photon then propagates over that field, it obtains information about O that is proportional to the field strength at that point. It follows that:

$$\varrho = 4\pi W(r) r^2 \quad (19)$$

By QuantAndMult_Lattice, the FE is a quantized lattice. This means that all of the subatomic particles making up objects such as stars and planets can exist between the elements of the FE, rather than occupying their same spatial coordinates. That is, subatomic particles can “fill the gap” between the existences composing the FE eliminating the need for the possibility of the Non-Biconditional Constraint Law. Now it should be clarified that by the 3-D Entity Theorem, an existence Z has a non-zero volume and thus it is impossible for singularities to exist. Since the Non-Biconditional Constraint Law is not necessary in this model, and singularities cannot exist, it is reasonable to assume that existences cannot occupy the same spatial coordinates. Thus, everything that exists in our universe has a type of boundary, and you can compress these existences together, but you can’t ever reduce the total volume of existence. Eventually, after compressing enough existences together, the influence that the object has on the

FE prevents light from escaping nearby. If we therefore confine a black hole to a spherical shape, the amount of information is $I = kV = 4\pi k r_{EH}^3/3$ where r_{EH} is the radius of the event horizon. It follows that:

$$r_{EH} = [3I/(4\pi k)]^{1/3} \quad \text{(Radius of a spherical black hole, 20)}$$

Thus, information is never lost resolving the Black Hole Information Paradox, and singularities do not exist resolving the Singularity Problem. With that said, it would be desirable to produce a theory of gravity in which inside the event horizon an existence experiences zero force, while its presence still contributes to the field produced in the FE.

With the index of refraction (n) defined as $c = nc_0$, using equation 6, $c = n\frac{c\sqrt{1-(v/c)^2}}{(1+[\varrho]t_{int}c)}$. Thus:

$$n = \frac{(1+[\varrho]t_{int}c)}{\sqrt{1-(v/c)^2}} \quad \text{(Index of refraction of the FE, 21)}$$

Using Fermat's Principle, the action $S = \int_a^b n\sqrt{r^2 + (r')^2}\, d\theta$ where $r = r(\theta)$ is the path that light takes when modeled in polar coordinates. Assuming that $n = n(r, v)$, the integrand is not explicitly dependent on θ, thus we can use the Beltrami Identity resulting in:

$$n\sqrt{r^2 + (r')^2} - r'\frac{\partial}{\partial r'}(n\sqrt{r^2 + (r')^2}) = const$$

$$n\sqrt{r^2 + (r')^2} - r'(nr'/\sqrt{r^2 + (r')^2}) = const$$

$$nr^2 + n(r')^2 - n(r')^2 = const\sqrt{r^2 + (r')^2}$$

$$nr^2 = const\sqrt{r^2 + (r')^2}$$

$$n^2r^4 = const^2r^2 + const^2(r')^2$$

$$\sqrt{n^2r^4 - const^2r^2}/|const| = \frac{dr}{d\theta}$$

$$\theta = \int_a^b \frac{|const|}{\sqrt{n^2r^4 - const^2r^2}}\, dr + B \quad \text{(Gravitational Lensing, 22)}$$

7.2 FE and GTR comparison

In GTR the metric equation is $cdt_0 = \sqrt{g_{\mu\nu}dx^{\mu}dx^{\nu}}$. As explained above, the speed of light herein dilates like time in GTR, and therefore $c_h dt = c\, dt_0$. It follows that:

$$c_h dt = \sqrt{g_{\mu\nu}dx^{\mu}dx^{\nu}} \quad \text{(GTR analog)}$$

To explain this, in GTR there is a dimension of time that dilates. In this proposed theory, a photon transitions through its own causal loop $S_\gamma(\chi)$ and the interactions $\tilde{I}(\gamma, FE)$ slow it down resulting in what we perceive as time dilation. As claimed herein, we measure time based on the distance that light travels, and the interactions that cause light to slow down also cause the other fundamental forces to slow down, resulting in even atomic clocks undergoing time dilation. In the GTR analog, the time component is in relation to the parameter χ which is not a universal dimension and does not exist. By slowing down the speed of light (relative to χ), the illusion of time dilation occurs. By dividing the GTR analog by dt yields:

$$c_h = \sqrt{g_{\mu\nu}\frac{dx^{\mu}}{dt}\frac{dx^{\nu}}{dt}} \quad \text{(GTR analog)}$$

Using the Schwarzschild metric in the GTR analog without rotational velocities yields:

$$c_h = \sqrt{\frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}\left(\frac{dr}{dt}\right)^2} \quad \text{(GTR-SM analog)}$$

If we set $\frac{dr}{dt} = 0$, $c_h = \sqrt{\frac{r-r_s}{r}}\, c$ meaning that the speed of light slows down in a gravitational field, and this results in time also slowing down. Compare this to the gravitational time dilation of GTR-SM: $dt_0 = \sqrt{\frac{r-r_s}{r}}\, dt$.

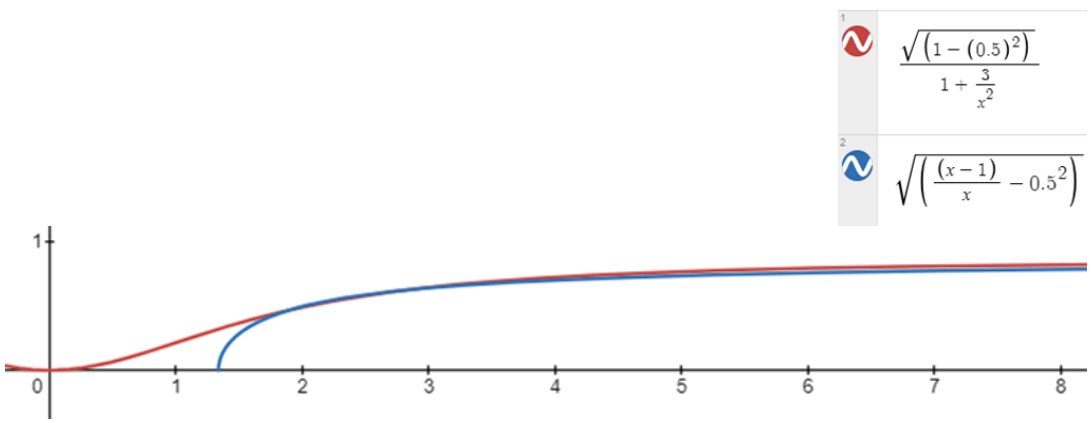


Fig 8 shows a comparison between equation 23 and the GTR-SM analog.

We are now ready to compare the FE theory to the GTR analog. Using $3/r^2$ as an approximation (described above), $\varrho = 3/r^2$. Equation 6 becomes:

$$c_h \approx c\sqrt{1-(v/c)^2}/(1+[3/r^2]t_{int}c) \quad (23)$$

Fig 8 is a comparison between the GTR analog and equation 23 with $v = 0.5c$. Now ϱ is just being approximated: with a more precise equation for ϱ, the results of GTR can be perfectly aligned with the FE theory.

8. MAXWELL'S EQUATIONS AND GRAVITATIONAL REDSHIFT

Based on the derivations of Maxwell's Equations, the general structure of such equations should remain the same if $\mu = \mu(x, y, z)$, and $\varepsilon = \varepsilon(x, y, z)$. Thus they are simply:

$$\nabla \cdot E = \rho/\varepsilon$$
$$\nabla \cdot B = 0$$
$$\nabla \times E = -\frac{\partial B}{\partial t}$$
$$\nabla \times B = \mu\left(J + \varepsilon\frac{\partial E}{\partial t}\right)$$

From equation 14, $c_v(r, v) = \frac{c\sqrt{1-(v/c)^2}}{(1+[\varrho]t_{int}c)}$, and thus $\mu\varepsilon = \frac{(1+[\varrho]t_{int}c)^2}{c^2-v^2}$. Therefore, when the free-charge and current density are zero, the electric field for a vertically oriented photon is:

$$\nabla \times (\nabla \times E) = \nabla \times \left(-\frac{\partial B}{\partial t}\right)$$
$$\nabla(\nabla \cdot E) - \nabla^2 E = -\frac{\partial}{\partial t}(\nabla \times B)$$
$$-\nabla^2 E = -\frac{\partial}{\partial t}\left(\mu\varepsilon\frac{\partial E}{\partial t}\right)$$
$$\nabla^2 E = \frac{(1+[\varrho]t_{int}c)^2}{c^2-v^2}\frac{\partial^2 E}{\partial t^2}$$
$$T\frac{\partial^2 R}{\partial r^2} = \frac{(1+[\varrho]t_{int}c)^2}{c^2-v^2}R\frac{\partial^2 T}{\partial t^2} \quad (E = RT)$$

Thus:

$$\frac{c^2-v^2}{R(1+[\varrho]t_{int}c)^2}\frac{\partial^2 R}{\partial r^2} = \frac{1}{T}\frac{\partial^2 T}{\partial t^2} = -k^2$$
$$\frac{\partial^2 R}{\partial r^2} = -k^2\frac{(1+[\varrho]t_{int}c)^2}{c^2-v^2}R^2 \quad \text{and} \quad \frac{\partial^2 T}{\partial t^2} = -k^2 \mathrm{T}$$

It follows that:

$$k\frac{(1+[\varrho]t_{int}c)}{c\sqrt{1-(v/c)^2}} = \frac{2\pi}{\lambda}$$
$$\lambda = \frac{2\pi}{k}\frac{c\sqrt{1-(v/c)^2}}{(1+[\varrho]t_{int}c)}$$
$$\lambda = \lambda_\infty\frac{c\sqrt{1-(v/c)^2}}{(1+[\varrho]t_{int}c)} \quad \text{(Gravitational Redshift)}$$

Compare this to the gravitational redshift equation of GTR in which $\lambda = \lambda_\infty\sqrt{\frac{r-r_s}{r}}$ [8]. With $\varrho = A/r^2$, and $v = 0$, the results are very similar to that in **Fig 8**.

9. AUTHORS COMMENTS

Formal logic, mathematics, and physics are the most essential tools for comprehending the universe, in that order. This work demonstrates that many prevailing theories in physics are logically impossible. However, my hope is that those who have developed such theories can be steered toward a more viable path, fostering a unified effort among physicists to advance science more efficiently and cohesively.

By the Transitive Law, $[(G \vee \neg G) \rightarrow H] \wedge [H \rightarrow I] \rightarrow [(G \vee \neg G) \rightarrow I]$. In this analogy, H represents the physical properties of the universe that are described by our laws of physics, I represents all scientific observations, and G represents God. Thus, all scientific observations remain true if God gave the universe its physical properties that cause it to organize itself.

When a simulation is produced it is based on equations that determine how everything in the simulation is to be displayed. While the equations of physics are descriptive not prescriptive, everything in the universe follows mathematical principles as if it were a simulation, making it consistent with intelligent design (ID). A universe that doesn't have laws would perhaps be unlikely to harbor life, but it would also not be consistent with an intelligent design process since it would not be possible to "declare the end from the beginning". Thus, the fact that our universe is deterministic is a necessity for it to be consistent with ID. Imagine if we could produce a set of laws causing everything that we need to create itself: this would be the ultimate in engineering.

Since existence cannot be produced from non-existence, existence has always existed, and thus if it is possible for God to exist, then statistically it is guaranteed that He does somewhere in infinite space. With that said, if it is true that God gave the universe its physical properties that cause it to create itself, then it follows that everything that is dependent on these laws is evidence of ID, including science. ID therefore encapsulates all of science and allows for personal experiences rendering ID far superior. ID eliminates any complications associated with Olber's Paradox.

CONCLUSION

This article presents a rigorously defined framework for existence, establishing fundamental laws and geometric constraints that govern its properties. By examining the Dirac delta function, it has been demonstrated that it must be continuous and non-zero over a non-zero interval of its domain rendering it logically incompatible for use with point particles. Likewise, it has been established that strings, 0-branes, 1-branes, and 2-branes cannot possess properties that make them indistinguishable from non-existence.

Building upon these insights and assuming the validity of established experimental results, a coherent and paradox-free structure of the universe has been developed. This structure is grounded in mathematical principles, allowing for the formulation of a theory that is both scientifically accurate and logically sound. This approach provides explanations for phenomena such as superposition, entanglement, wave-particle duality, gravitational and Lorentz time dilation, and gravitational lensing that are consistent with formal logic.

Furthermore, an erroneous assumption in Einstein's formulation of general relativity (GTR) regarding the vacuum of space has been identified. While this assumption did not affect observational predictions, it led to problematic explanations. By correcting this assumption while preserving Einstein's core principles, the same predictions can be achieved but in a manner that is consistent with quantum mechanics (QM) and formal logic.

This work offers a framework that bridges the gap between metaphysics and physics, providing a coherent and logically sound understanding of the universe. By addressing fundamental questions about existence and applying rigorous mathematical principles, a theory has been developed that is both scientifically accurate and philosophically meaningful.

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