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New Concepts for Modern Physics under the Theory of Space

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ABSTRACT

This paper introduces novel conceptual frameworks for relativity, quantum mechanics, and gravity within the Theory of Space (TS) and its gravitational extension (TSG). By reinterpreting Lorentz transformations as scale changes rather than literal contractions or dilations, the author preserves absolute space occupancy, time passage, and rest mass across inertial frames, resolving paradoxes like the twin paradox and singularities at the speed of light. Quantum phenomena are modeled in a 4-dimensional realm where the fourth dimension is $\lambda = c\tau$ (energy wavelength), enabling sequential eigenstate projections into 3D space without superposition, thus addressing the measurement problem via probabilistic intermittence timed by Planck's interval τ. Gravity emerges from pulsed inward space flows during non- observable phases, leading to positive gravitational potential energy and volumetric acceleration consistent with empirical data. This unified approach reconciles special relativity, quantum mechanics, and general relativity, offering a logically coherent visualization free of conceptual inconsistencies. Empirical validations from experiments like Hafele-Keating, muon decay, and double-slit interference are discussed, alongside mathematical derivations for space-energy grids and radial free fall. Suggestions for robustness include integrating Hamiltonian dynamics in the 4D realm and testing predictions against black hole entropy and entanglement experiments.

Keywords: Time dilation, space contraction, measurement problem, radial free fall, Theory of Space, general relativity, inward space flow, gravitational potential, unification, quantum interpretation.

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1 Introduction

Modern physics has revolutionized classical physics, providing profound insights and valuable technological advancements in daily life. These developments are supported by mathematical frameworks such as the Lorentz-Einstein equations, quantum equations, and gravitational spacetime equations. However, our conceptual understanding has not kept pace, lacking consensus on the models and concepts that best describe nature.

This paper reformulates concepts in relativity, quantum mechanics, and gravitational effects within the framework of the Theory of Space (TS) [1] and its extension to gravity (TSG) [2]. It presents a comprehensive synthesis of Planck–Einstein's initial insight into the time dependence of energy in 3D—*a quanta concept!* —together with Bohr–De Broglie's undulatory nature involving the quantum interval—*an oscillatory model!* It also embraces Schrödinger's fluctuating complex numbers handling separately physical parameters by means of real and imaginary numbers. Nailed first by Heisenberg's crucial principle of noncommutativity between physical parameters, nature's sequential existence between some parameters; reinforcing existence in-and-out of 3D space—*an oscillatory presence between 3D space and an extra dimension*. Finally, it interprets the Einstein–Schwarzschild's gravitational effect *as a manifestation of wavy, flowing space*.

The framework of this proposal is outlined as follows:

I. **Energetic Presence over Physical Parameters:** In addition to the axioms of Special Relativity, the parameters of mass, time, and length undergo scale changes according to Lorentz's gamma factor and its inverse. Rest mass, the passage of time, and space occupancy remain invariant across all inertial reference frames

II. **Physical System Existence:** The state of a physical system is described by a sequence of independent eigenstates in a 4D realm, involving observable 3D coordinates **r** = (x, y, z) plus a fourth dimension λ as "cτ" (energy wavelength). States are vectors in a complex Hilbert space $\mathcal{H}$, where the wavefunction is $\overline{\psi\,(\boldsymbol{r},\lambda,t)}$. Relativistic contractions are incorporated via $\gamma = 1/\sqrt{1 - v^2/c^2}$, ensuring completeness of the 3D description.

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III. **Timing of Eigenstate Sequence:** The sequence is timed by Planck's periodic interval τ, reflecting discontinuous presence of energy (quanta). Eigenstates are selected via probabilistic amplitudes, reproducing Born's rule statistically per Kolmogorov's axiom for mutually exclusive events, with probabilities summing to 1. The 4D realm handles orthogonal eigenstates, emulating superposition in 3D as sequential projections: $\psi(\boldsymbol{r}, t) = \sum_i c_i \phi_i(\boldsymbol{r}, \lambda)$, where ϕ_i are eigenstates and P projects from 4D to 3D. Here, t is a temporal parameter for event evolution, distinct from λ.

IV. **Alternating Presence:** Each cycle of duration τ alternates between an observable 3D phase and a non-observable 4th-dimensional phase. In the 4D phase, the system retains conserved quantities (energy E, momentum **p**, charge, etc.), described by the wavefunction satisfying conservation laws. The alternation is governed by a discrete evolution: $\psi(t + \tau) = \hat{U}(\tau)\psi(t)\rangle$, where U incorporates the Hamiltonian with λ-dependent terms.

V. **Observables and Operators:** Observables are self-adjoint linear operators on the Hilbert space. When measured in 3D, an operator $\hat{A}$ acts on the projected state $P\psi$, yielding eigenvalue *a* with probability $|\langle \varphi_a | P\psi \rangle|^2$, where $|\varphi_a\rangle$ is the eigenstate.

VI. **Non-Observable Transitions:** During the 4th-dimensional phase, the system assumes a new eigenstate via a transition operator $\hat{T}$, introducing random phases while conserving quantities like E and **p**. The transition probability is $|\langle \phi_{final} | \hat{T} \phi_{initial} \rangle|^2$. Phase differences produce non-commutativity, e.g., $[\hat{X}, \hat{P}] = i\hbar$. The process follows Schrödinger's wavefunction in 4D: $i\hbar\ \partial\psi/\partial t = \hat{H}\psi$.

VII. **Spatial Splitting:** The system can split spatially in 3D (e.g., into subsystems A and B at positions $\boldsymbol{r_A}, \boldsymbol{r_b}$) without losing uniqueness, as the 4D wavefunction $\psi(\boldsymbol{r}, \lambda)$ maintains correlations via λ. Compact entities (particles or pulsed fields) transition locally in the 4th dimension, satisfying conservation laws. This enables entanglement: the reduced density matrix in 3D is $Tr_\lambda |\psi\rangle\langle\psi|$, reproducing QM tensor products.

VIII. **Time Evolution:** Eigenstates evolution follows a discrete unitary operator over τ-steps: $\psi(t + \tau) = \hat{U}(\tau)\psi(t)$, approximating the continuous Schrödinger equation i*ħ* ∂ψ/∂_t

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$=\hat{H}\psi$ for macroscopic scales. In the 4D, include λ-evolution: $i\hbar\ \partial\psi\ /\ \partial\lambda\ = \hat{H}\psi$.

IX. **Space replacement during transition:** During the oscillation, the space of state $|\varphi_i\rangle$ is displaced upon transitioning to $|\varphi_{i+1}\rangle$. Surrounding space fill this, generating pulsed volumetric acceleration $Area * a = (nQPA)\ \lambda/\tau^2$, where n is energy´s quantum number ($E = n\ h/\tau$), τ Planck´s quantum interval, QPA is a quantum package average area (an spherical shell of Planck length radius, an isotropic quantized space similar to loop quantum gravity), and λ is energy wavelength. Flow includes rotation from quantum system´s spin, aggregate macroscopically for coherent massive bodies.

X. **Post-interaction of split systems:** Interaction on one subsystem, halts replacement in others; compact entities (particles or pulsed fields) cease location and future gravity there.

In the following sections, with logic and rigor with the empirical data, some concepts of modern physics are changed under this unifying theory.

1. Relativistic effects over time, length and mass:

The Lorentz gamma factor has been extensively verified experimentally. For instance, Hafele and Keating [3] observed time dilation matching the theoretical gamma factor due to kinetic and gravitational energy. Inertial mass increase has been confirmed in accelerators like the Large Hadron Collider (LHC), where achieving ~99.99999999% of light speed requires ~6.5 TeV, corresponding to a gamma factor of 6,930 [4]. Rossi and Hall [5] detected atmospheric muons reaching Earth's surface, verifying Lorentz time dilation and length contraction. Additionally, GPS systems account for relativistic time dilation in daily operations.

There is no doubt that Lorentz-Einstein relativistic effects on space, time, and mass accurately describe nature; the challenge lies in visualization. Concepts like space shrinkage or time slowdown are counterintuitive. For a reference frame on an electromagnetic wave or photon, travel distance would be zero, collapsing 3D to 2D in the travel direction—which is incorrect. Zero time for the photon would imply simultaneity along its path, also erroneous. We observe photons from the Sun and stars at different times and positions, not simultaneously.

Singularities arise when gamma approaches infinity, leading to paradoxes such as the twin paradox [6], Ehrenfest's rotating disk paradox, and the ladder paradox [7].

The appropriate interpretation treats the Lorentz gamma factor as a scale changer. See Figure 1, illustrating this across kinetic velocities (cases A to D). Space occupancy remains constant, but physical values scale down. At speed c, space for travel persists from an external observer's view, akin to the event horizon of a black hole where speed c is achieved yet space occupancy is observed from afar. Time passage is uniform across velocities, following an absolute clock, but physical events evolve per scaled values, with conversions between systems.

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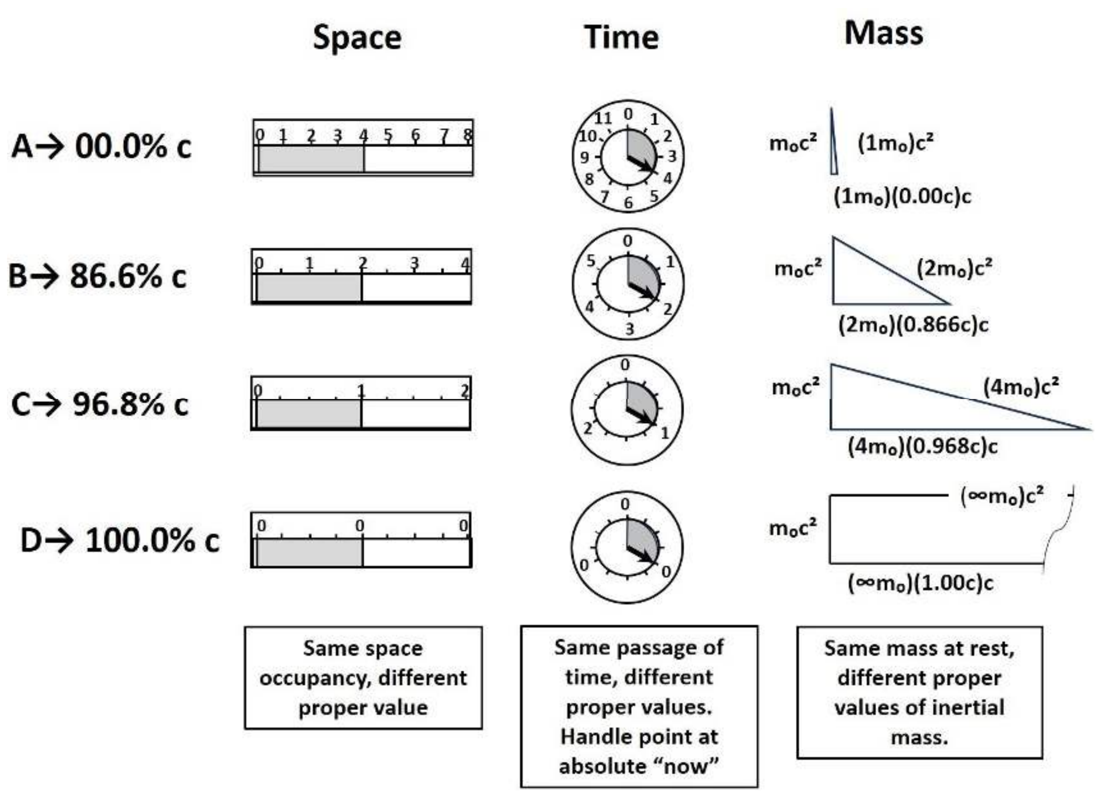
Simultaneity is preserved under absolute time passage but not under identical time values. Inertial mass increase affirms that rest mass is absolute, independent of the observer.

Figure 1: Space, time and mass under different velocities.



If rest mass were relative, energy requirements for acceleration would vary inconsistently (see Figure 2). Einstein's equivalence principle [8] and General Relativity (GR) [9] emphasize gravitational effects independent of the observer, arising solely from energy presence.

When an inertial frame of reference, different from rest, observes an object, it assigns an apparent kinetic energy due to the frame's speed; this apparent kinetic energy is compensated with an apparent mass reduction, obtaining invariant the total energy between frames. For example, in the twin paradox [6], the traveling twin sees his brother at Earth with an apparent kinetic energy increment and an apparent mass energy reduction, conserving his total energy, and consequently with no time dilation. This solves the paradox and clarifies that total energy is the one that produces physical time dilation.

No singularities occur at speed c: positional differences yield zero physical value but retain geometric distance, thus space occupancy. For example, inside black holes, longitudinal separation has zero value yet contains spatial extent (case D of Figure 1).

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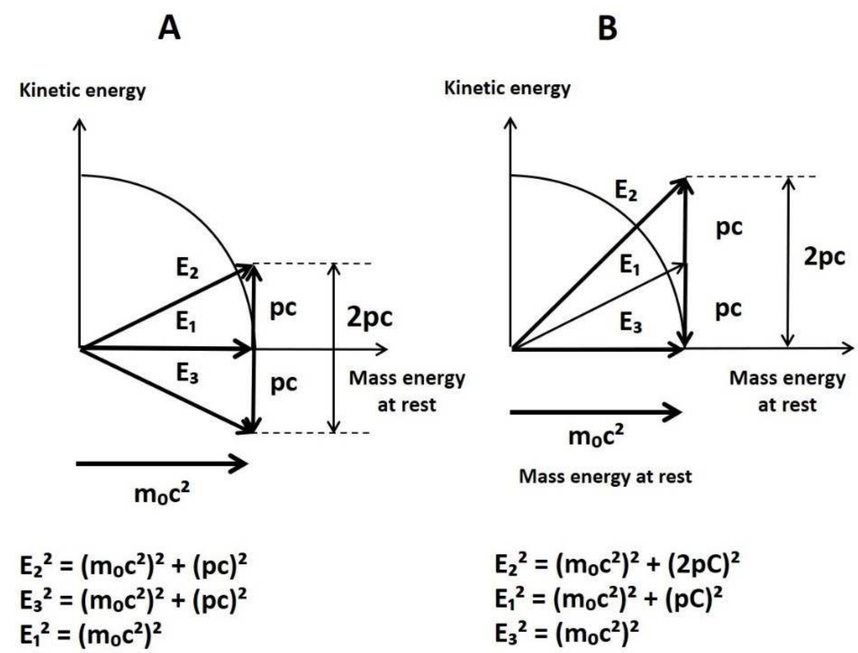
Figure 2: Energy conservation under partial increment of velocity.



In summary, relativistic changes preserve occupied space, time passage, and rest mass. Event simultaneity holds under absolute time, correlated by location and local energy—a refreshed view of relativity!

2. Space-energy grid versus spacetime:

Since space occupancy is preserved and only physical values scale per Lorentz's gamma factor, we reconstruct the 3D grid with straight axes but spaced by energy presence. Hamilton's quaternions [10] suit this: the scalar is 1/γ, and spatial vectors are standard (x, y, z)—easier to visualize than Einstein's curved spacetime.

For Schwarzschild's escape speed as kinetic energy inducing scale change 1/γ, physical distance differs from coordinate distance. From Schwarzschild radius r_s to geometric r, physical distance d is the integral over local scales:

$$d(r) = \int_{r_s}^{r} \sqrt{1 - \frac{r_s}{r}}\, dr \quad (1)$$

$$d(r) = \sqrt{r(r - r_s)} - r_s \operatorname{acosh} \sqrt{r/r_s} \tag{2}$$

As expected, the physical distance is smaller than the geometrical distance. Table 1 compares $1/d^2$ to $1/r^2$. At a geometrical distance of $1.01\ r_s$ the ratio of their inverse squared values is more than 2.3 10^6 meanwhile, at $10.0\ r_s$, its ratio is just 1.7, and almost 1 for farther distance.

Table 1: The inverse of the squared physical distance compared with the inverse squared of the geometrical distance r.

r/r_s	$r_s^2/d_{physical}^2(r)$	r_s^2/r^2	$\boldsymbol{Ratio}$: $\dfrac{1/d_{physical}^2(r)}{1/r^2}$
1.01	2,263,488.4890	0.9803	2,308,985
1.92	4.4223	0.2718	16.27
2.83	0.7401	0.1252	5.91
5.55	0.0805	0.0325	2.48
10.00	0.0170	0.0100	1.70

3. The fourth dimension as cτ:

Poincaré, Lorentz [11], Einstein, and Minkowski's inertial frames link time and space, implying a fourth-dimension ct. The issue is assigning t. Minkowski uses event time [12], creating world lines. TS notes the link involves energy, not space-time directly—kinetic in Special Relativity, mass-energy in GR. Thus, the fourth dimension should represent energy longitudinally, using Planck's interval τ: cτ = λ (energy wavelength).

This fourth dimension cτ fits with the equations: energy increase reduces τ (time dilation) and λ (space contraction). It aligns with quantum action h intermittent in 3D at τ rate. Faster h presence means higher 3D energy. A turn around to our concept of the 4th dimension, a spacetime dimension of length λ and cycle τ. The time of event is a temporal parameter, and it will accumulate a sequence of quantum intervals τ.

We appreciate the relativistic effects in 3D due to time dilation and space contraction [5] but it alone insufficiently visualizes the 4^{th} dimension; quantum measurement observations are needed (next section).

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4. The spin, an angular momentum of the oscillation:

TS posits 4D oscillation between observable 3D and non-observable 4th dimension at τ rate. Different from many theories that treat extra dimensions existing together with the observable 3D. This fluctuation involves an angular momentum perceived by Stern-Gerlach [13], where its circumference has the value of λ, travels at the speed c, and takes time τ per cycle. Euler and complex numbers manage this alternating physical reality, not a mathematical abstract tool. The energy involved in this fluctuation is known as mc^2, and its angular momentum as spin. This is the reason why 4^{th} D mass energy and spin add vectorially with their equivalent in 3D.

$$E^2 = (mc^2)^2 + (p_{3D}c)^2 \tag{3}$$

$$\vec{J} = \vec{S} + \vec{L}_{3D} \tag{4}$$

Phase emerges from dimensional fluctuation, where its value θ is handled by the intermediate Δλ, Δτ, and $\hbar$ [2]:

$$\theta = \left({}^{2\pi\Delta\lambda}/_{\lambda} - {}^{2\pi\Delta\tau}/_{\tau}\right) = {}^{(p\Delta\lambda - E\Delta t)}/_{\hbar} \tag{5}$$

Supported by double slit experiment [14][17], where a gradual destructive interference reinforces the phase between dimensional zones.

5. The presence of eigenstates in 3D space is randomly single, no superposition of states at 3D.

Quantum experiments like Stern-Gerlach [13] and double-slit [14] show multiple outcomes, leading to Hilbert space superposition. However, superposition conflicting with Aristotle's principle that A and not-A cannot coexist spatiotemporally. Aside from measurements yield one random outcome. Thus, at least one extra dimension accommodates all states, a poli deterministic reality that Hilbert space continues embracing; overcoming the measurement problem via random 3D presence of independent states.

The proposed 4th dimension supports multiple 3D states with intermittence for random 3D projection, following Kolmogorov's additive probabilities (summing to 1)—improving Born's rule for antagonistic superpositions. The wavefunction holds all states without collapse.

We observe only 3D, not 4D. Intermittence doesn't suffice; Schrödinger's equation [15] handles totals (E, p), and Heisenberg's uncertainty [16] shows phase differences—non-commutativity between some physical parameters, requiring a persistent 4D dimension evolving via temporal t. The use of complex numbers fits with this 4D realm, and Schrödinger's wavefunction can be understood as an equation related to physical presence.

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The aleatory sequential presence in 3D [2] makes impossible its identical return in time, aligning with the evidence of the arrow of time.

6. Quantum system in 3D is composed by the coexistence of two entities and not a dual role of one entity:

The 3D existence comprises wavy space coexisting with compact entity (particle/pulsed field). Compact random position is present only when space is, resolving wave-particle duality: some experiments show wave dispersion, others compact randomness.

Fluctuation implies out-of-3D moments for state aleatory changes, and when interactions occur (e.g., energy absorption, emission, particle destruction, creation). Evidence by: A) Spectroscopic data; atomic electrons that change orbitals without the prohibited 3D transition [18]. B) Entangled particles where their common oscillation phase and rate make possible to be locally at the 4^{th} D solving Clauser's experiment [19] testing Bell's inequalities [20], C) the tunneling effect observed by the nuclear decay [21].

7. 4D deterministic concept:

These ideas lead to extensive discussion about whether nature should be defined as deterministic or indeterministic. TS proposes a 4D deterministic framework, made possible by an additional and independent 4^{th} dimension that contains multiple deterministic 3D solutions or eigenstates without philosophical controversy. In this view, 3D presence emerges sequentially, as a random succession of eigenstates—not as a single deterministic 3D universe, nor as an indeterministic one. Action principle (e.g., Lagrangian, Hamiltonian, Feynman) is the framework to describe this multiple 3D scenario disqualifying detailed Newtonian mechanics.

No conscious involvement is required: the 4D realm is completely defined by the system itself and circumscribed to it alone. The universe, then, is understood as the union of all quantum systems, each with its properly scaled time, length, and mass, along with its characteristic oscillation rate and phase presence of its multiples 3D solutions. A conglomerate of 3D quantum universes seen macroscopical by their expectation values.

8. Partial Block universe concept:

TS agrees with the concept of a Block universe as a record of past events, even if they occurred randomly. The present is described for all system at the same passage of time, not the same value of time—a diffuse limit because of each system's phase. The future cannot exist because of nature's core randomness, discharging any determination of future events in each given

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3D space. Only the conglomerate of 3D eigenstates can be predicted, provided there is no interaction with other quantum systems (e.g.: Schrödinger's wavefunction time evolution).

9. Locality concept:

Einstein's great concern about nonlocality of entangled particles is overcome not by the common 3D + extra dimensions, but by the fact that physical existence fluctuates between 3D and the 4th D. This existence, independent from 3D, makes locality possible even for particles that are spatially separated in 3D. Quantum systems, through split in 3D, still behave as a unique system.

10. Planck's length as space minimum length, and not a continuous smaller one:

TSG extends to gravity: out-of-3D phase displaces quantum space, replaced by surrounding—pulsed inward flow depending in the size of the system at the rate of τ. Like a pulsed radial vortex (no rotation) or a whirlpool (with). Each cycle: discontinuous isotropic shell akin to loop quantum gravity [22]; a minimum diameter (Planck length) in a minimum time (Planck time) that contains only one action of h. An elementary black hole as nature´s limit. Its radius of λ/2 where $E = h/\tau = mc^2$ (where m is Planck mass; minimal black hole mass = $1.22\ 10^{16} TeV$). Per [2], shell part of event horizon; inward pulsed flow from 0 to c in the quantum interval.

$$4\pi\ Gh/c^3 \approx 2.06 \times 10^{\{-68\}} m^2 \tag{3}$$

For energy conglomerate containing quantum number n:

$$E = \sum_{i=1}^{l} n_i \, {}^{h}/_{\tau_i} = Mc^2 \tag{4}$$

Black hole shell area A with inward maximum speed c, will be:

$$A = 4\pi \sum_{i=1}^{l} \left({}^{n_i \lambda_i}/_{2}\right)^2 \tag{5}$$

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Shell contains the number of states linked to entropy [1]. Volume of normal quantum system are bigger than these black hole values because they contain empty space and its pulsed speed don't reach the speed c (e.g., atoms).

11. Potential energy contains a positive value and not a negative one.

From space flow, each space has an inertial frame. Impeding motion with space requires positive energy; static gravitational potential (conserved distance from the energetic source) requires an increment on particle energy, causing a time dilation [3]. Schwarzschild's escape velocity implies positive kinetic; yields time dilation, not acceleration as expected due to a negative gravitational potential energy. Lagrangian mechanics [23] uses a negative sign in the potential energy to adjust this misconception.

12. Conclusion:

This paper presents a cohesive reformulation of modern physics under TS and TSG, addressing longstanding conceptual challenges. By viewing relativistic effects as scale changes, the author eliminates paradoxes and singularities while preserving empirical accuracy. The 4D framework with $\lambda = c\tau$ resolves quantum superposition and measurement issues through sequential eigenstate projection and intermittence, aligning with experiments like double-slit and entanglement. Gravity as pulsed space replacement introduces positive potential and volumetric flow, consistent with GR but visually intuitive.

This approach unifies relativity, QM, and gravity without ad-hoc assumptions, offering a robust alternative to spacetime curvature. A falsifiable experiment is proposed [2] via time dilation under a radial free fall challenging GR and negative potential energy. Future work could enhance rigor by: (1) Deriving full Hamiltonian in 4D, incorporating λ-evolution for predictive simulations; (2) Quantitatively modeling black hole entropy via shell states; (3) Proposing tests, e.g., precision entanglement timing or gravitational wave anomalies; (4) Exploring quaternionic grids for computational efficiency in simulations. Empirical falsifiability, such as deviations in high-energy muon lifetimes or orbital jumps, would strengthen the framework.

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