The Unifying Theory: Bridging Quantum and Classical Physics Through Quantized Relocations

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Abstract

This paper presents a unified theory reconceptualizing motion as quantized relocations—jumps over Planck-scale time (5.39×10^{-44} s) with zero or non-zero linger time—bridging the quantum-classical divide. At the microscale, particles' wave nature arises from random jumps with zero linger time at discrete lattice points, producing patterns consistent with the Schrödinger equation. At the macroscale, relativistic muon length contraction (0.99c) reflects discrete, varying steps appearing continuous, with non-zero linger time based on object speed, governed by relocation frequency (velocity over Planck length). Forces are redefined as modulators of relocation frequency, independent of Newton's external interventions, aligning with free will theorems [1] and unifying gravity and electromagnetism via a new property, tendency, distinct from general relativity's curvature. Relocation pattern shifts align with quantum observer-driven entanglement [2]. Supported by LIGO (10^{-21} strain), tunneling, and muon data, the theory predicts a 10^{-15} Hz photon frequency shift, testable via interferometry, contrasting with loop quantum gravity and quantum field theory (Appendix).

Keywords: Classical Physics; Quantum Physics; Quantum Field Theory; Loop Quantum Gravity

Statements and Declarations

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1. Introduction:

General relativity (GR) has been, since 1915, the theory which describes gravity as spacetime curvature geodesic path guiding, accurately predicting light bending and gravitational waves (10^{-21}strain, LIGO [4]). GR likens curvature to an accelerating elevator's inertial effects, which is equated to gravitational pull [3]. If this is true, massive gravitational waves should disrupt Earth's orbit like an elevator's jolt, yet no such effect can occur, questioning spacetime curvature as gravity's cause [5]. In addition, GR fails to fit electromagnetism, strong and weak forces within a geometric framework (obstruction to unification) [6]. Quantum mechanics (QM) also reveals a separation: the double slit experiment's interference versus particle position [7] still defies classical physics, leaving the quantum-classical boundary in place after decades of work.

This paper posits motion as quantized relocations—jumps over Planck-scale time (5.39×10^{-44} s) with zero or non-zero linger time—unifying micro and macro scales. Unlike superstring theory's extra dimensions [8] or Many-Worlds' multiverse [9], it leverages QM's discreteness, linking classical motion to quantum relocations. Entanglement extends beyond particle-particle interactions to explain measurement-induced shifts from wave-like to linear relocation patterns, offering a missing link between quantum and classical realities. This novel perspective necessitates redefining Newton's second law, replacing mass with particle counts, emphasizing matter's intrinsic behavior over external forces, consistent with free will theorems [1].

Forces unify gravity and electromagnetism, relegating curvature to a background role, with measurement driving relocation patterns via observer-driven entanglement [2]. Supported by LIGO, tunneling ($10^{21}\ s^{-1}$ [10]), and muon data, the theory predicts testable frequency shifts, contrasting with loop quantum gravity (LQG) and quantum field theory (QFT) (Appendix).

2. Quantized Motion

Postulate: Matter traverses spatial intervals via quantized relocations.

2.1 Microscale Relocations

This postulate manifests at the microscale, where quantum tunneling shows particles traversing between points without crossing intervening space. In uranium-238 alpha decay (half-life 4.5 billion years [11]), alpha particles relocate across energy barriers without traversing the gap, as do electrons in hydrogen spectral lines (Lyman, 121.6 nm [12]). Scanning tunneling microscopy illustrates this, with electrons jumping between probe and surface (0.1 nm [10]) without crossing the distance. Photon behavior in Young's double-slit experiment (~500 nm light,10^{-6} m slit spacing) produces interference patterns from probabilistic relocation distributions, resembling wave-like patterns [7].

Therefore, the wave function describes quantized relocations, departing from the wave identity of particles [7]. In other words, particles are not waves, per Newton [13]; however, their wave-like behavior arises from random jumps with zero linger time at discrete lattice points, forming relocation patterns governed by the Schrödinger equation [1]. For a quantum particle in one dimension, described by wave function $\psi(x,t)$, it evolves via instantaneous transitions at discrete times $t_n = nt_p$, where $n = 0,1,2, \ldots$. At each t_n, the wave function updates stochastically, reflecting a random position jump, with probabilities set by $|\psi(x,t_n)|^2$ Between jumps, the wave function evolves unitarily per the Schrodinger equation:

$$i\,\hbar\,\frac{\partial\psi(x,t)}{\partial t} = H\,\psi(x,t)$$

where $H = -\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}$ for a free particle.

The wave function is:

$$\psi(x,t) = \sum_k c_k(t)\phi_k(x)e^{-1E_k t/\hbar}$$

Where $\phi_k(x)$ are orthonormal basis functions (e.g., Gaussian wave packets or plane waves), $C_k(t)$ are coefficients, $E_k$are energies and $\hbar$ is the reduced Planck constant. At t_nThe probability of transitioning to $\phi_k(x)$ is: $|\langle\phi_k|\psi(t_n^-)\rangle|^2$ and the updated $\psi(x,t_n) = \sum_k c_k(t_n)\,\phi_k(x)$, With $c_k(t_n) = \langle\phi_k|\psi(t_n^-)\rangle e^{i\theta_k}$, ϕ_k a random phase in $[0,2\pi)$.

in momentum space:

$$\psi(x,t) = \int_{-\infty}^{\infty} a(k,t) e^{ikx - i\omega(k)t}\, dk$$

Where $a(k,t) = \int_{-\infty}^{\infty} \psi(x, t_n^-) e^{-ikx} dx \cdot e^{i\theta_k}$ and $\omega(k) = \frac{\hbar k^2}{2m}$. A Gaussian wave packet's spreading (variance $\sigma_t^2 = \sigma_o^2 + \frac{\hbar^2 t^2}{4m^2\sigma_o^2}$) support its delocalized, wave-like nature.

2.2 Macroscale Relocations

The model extends to the macroscale, describing motion as quantized jumps at the Planck scale, where subluminal particles jump a Lorentz-contracted distance ($l'_p = l_p\sqrt{1 - \frac{v^2}{c^2}}$) , with $l_p \sim 1.616 \times 10^{-35} m$ inspired by loop quantum gravity's granular lattice [14] and supported by constraints on Planck-scale granularity [15]. The model preserves Lorentz invariance, offering frame-dependent jump distances to probe observer speed, aligning with deterministic trajectories observed in CERN's ATLAS and CMS experiments, as Planck-scale stochasticity averages out [16].

The jump time is

$$t'_p = t_p \cdot \sqrt{1 - \frac{v^2}{c^2}}$$

Where $t_p \sim 5.39 \times 10^{-44} s$ 5.39 × 10^-44 s, reflecting temporal cell contraction in the moving frame [14]. Linger time, the stationary period between jumps, contracts as:

$$t_L(v) = t_{LO} \cdot \sqrt{1 - \frac{v^2}{c^2}}$$

aligned with studies showing Planck-scale effects are macroscopically unobservable [15]. Cycle time combines jump and linger times:

$$T_{cycle}(v) = (t_p + t_{LO}) \cdot \sqrt{1 - \frac{v^2}{c^2}}$$

Or if $t_{lo} = 0$, $T_{cycle}\,(v) = t_p \cdot \sqrt{1 - \frac{v^2}{c^2}}$

Relocation frequency quantifies lattice traversals [19]:

$$f(v) = \frac{v}{l_p}$$

consistent with high-frequency dynamics (~10^43 Hz) confined to the Planck scale [15].
Jump probability is:

$$p(v) = f(v) \cdot T_{cycle}(v) = \frac{v}{l_p} \cdot (t_p + t_{LO}) \cdot \sqrt{1 - \frac{v^2}{c^2}}$$

If F $t_{lo} = 0, p(v) = \frac{v}{c} \cdot \sqrt{1 - \frac{v^2}{c^2}}$. For $t_{LO} > 0$ and $p(v) \geq 1$ jumps become deterministic. Average velocity is $v_{avg} = p(v) \cdot \frac{l_p}{t_p + t_{LO}}$ for $p(v) < 1$, or $v_{avg} = \frac{l_p}{t_p + t_{LO}}$ for $p(v) \geq 1$

Position updates as:

$$x'_{n+1} = x'_n + \xi_n l'_p \text{ where } \xi_n = +1 \text{ with probability min } (p(v), 1)$$

This aligns with quantum mechanics, as stochastic jumps mimic probability distributions, and with calculus, where discrete jumps approximate continuous motion, with spatial increments $\sim 10^{-35}$ m rendering motion effectively continuous [10].

2.3 Testability

To confirm the GSD framework, experiments at CERN's Large Hadron Collider (LHC) can analysis Planck-scale effects. ATLAS and CMS detectors, analyzing 13.6 TeV proton collisions (Run 3, 2022, 29fb^{-1} [16]), can study high-energy muon trajectories for deviations from continuous paths, potentially revealing discrete jumps (10^{-35} m). Simulations using CMS open data (e.g., MiniAOD format, 2016 [17]) can model stochastic jumps, comparing against observed trajectories. A predicted10^{-15} Hz frequency shift in particle interactions, arising from Planck-scale granularity, is testable via interferometry, leveraging LIGO's precision (10^{-18} m [4]) or LHC's timing resolution ($\sim 10^{-12}$ s). Fixed-target experiments, like NA62, can detect Lorentz invariance violations at high energies (75 GeV/c kaon decays [18]), constraining granularity effects [15]. Despite its challenges, these tests build on ATLAS/CMS capabilities and open data, offering a path to confirm or refute the model's predictions.

3. Forces

This reconceptualization of motion redefines force as a change in relocation frequency, $f(v)$, within the granular lattice [14]. Thus, The Unifying Theory reintroduce forces as modulators of relocation frequency, independent of Newton's external interventions, consistent with free will theorems [1]. It bypasses general relativity's curvature as gravity's cause, relegating spacetime to a background role [19].

Force is:

$$F = m \cdot \frac{df(v)}{dt} = m \cdot \frac{a}{l_p}$$

where a is acceleration, reflecting lattice interactions [14]. Planck-scale effects' minimal macroscopic impact supports this speculative framework [15]. Newton's second law, F = m a, is reformulated by replacing mass (m) with fundamental particle count (U) [19]:

$$F = u\,a = u\,\cdot\,\frac{df(v)}{dt} = u \cdot \frac{a}{l_p}$$

aligning with the Standard Model's particulate matter [20]. This unifies gravitational, electromagnetic, and nuclear interactions, transcending mass's gravitational bias [3].

3.1 Tendency: A Unified Property

Mass, electric charge, color charge, weak isospin, and hypercharge are intrinsic properties of particles, fixed by their internal structure within the Standard Model's quantum numbers, independent of external fields or environments [21]. Gravitational mass, determined by Higgs field interactions (e.g., muons at 105.7 MeV/c^2 [22]), remains invariant across gravitational fields, as shown by Eötvös experiments (10^{-9} precision) and lunar laser ranging (10^{-13}, 2018 [23]). Electric charge, a U(1) quantum number, is invariant under Lorentz transformations, verified by LEP experiments (10^{-18} precision [24]). Color charge, governing quark-gluon interactions via SU(3) symmetry, is validated by PETRA three-jet events (1979 [25]) and lattice QCD simulations [26]. Weak isospin and hypercharge, rooted in SU(2) × U(1) symmetry, are confirmed by neutrino oscillations (Super-Kamiokande [27]) and LHC W boson production (80 GeV [28]). Tendency unifies these intrinsic properties into a single inherent capacity to influence relocation frequency, stripping away disparate labels and providing a cohesive framework for force interactions [19].

Tendency (D) for infinite-range properties is:

$$\vec{D} = \frac{\vec{A}\,r^2}{u} + \frac{\vec{a}\,r^2}{U},$$

where A and a are accelerations of objects 1 and 2, respectively, along r, U and u are active particle counts in object 1 and 2, respectively, and r is distance [19]. Active particles exchange messenger particles (e.g., gravitons, photons), unifying forces [19].

Experimentally, U and u are quantified via particle physics experiments. For example, ATLAS/CMS jet production rates at 13.6 TeV infer quark and gluon counts through scattering events [28]. Accelerations (A, a) are derived from observed trajectories, such as muon deflections in CMS's 4 T magnetic field [16]. For two protons, U ≈ u ≈ 3 (valence quarks), with D computed from scattering angles in LHC collisions, testable against Run 3 data (29 fb^{-1} [16]). These measurements anchor tendency in empirical data, enabling validation of the unified force law.

3.2 Influence vs. Genuine Actions

Forces bifurcate into influence and genuine actions [19]. Forces of influence and genuine actions are distinguished by the presence or absence of messenger particle exchange and adherence to Newton's third law [19]. Influence modulates relocation frequency without exchanging messenger particles, thus bypassing Newton's third law of equal and opposite reactions [10]. In contrast, genuine actions involve particle exchange—gravitons, photons, gluons, or W/Z bosons—and comply with the third law, ensuring tangible interactions between material entities

[21]. Massless carriers (photons, gluons, hypothetical gravitons) travel at the speed of light (c = 3 × 10^8 m/s), while massive W/Z bosons (~80, 91 GeV/c^2) are subluminal [21]. Thus in universal attraction or repulsion phenomenon their relation is:

$$\left|\vec{F}_{influene}\right| = 2\left|\vec{F}_{genuine}\right|$$

Genuine force is:

$$\vec{F}_{genuine} = \frac{\vec{D}\ U\ u}{2r^2}$$

Where $\vec{D}$ is tendency, U and u are active particle counts in object 1 and 2, respectively, and r is distance. Unifying gravity and electromagnetism, with nuclear forces pending refinement [19]. Constants (G, k) vanish, and particle counts drive the law. LIGO's strain ($\sim 10^{-21}$ [4]) aligns with frequency shifts, sidelining curvature [29].

4. Entanglement.

A critical question arises: why is linger time (t_{lo}) zero in the absence of observation or measurement, enabling the Schrödinger wave equation's wave-like behavior? This puzzle suggests a deeper connection between quantum systems and observers. Human-particle entanglement offers a solution, positing that observation—whether by human perception or detector interaction—modulates linger time, bridging quantum and classical regimes [2].

Without observation, linger time is zero, enabling instantaneous, random jumps at Planck-scale intervals (t_p 5.39× 10^{-44} s). This activates the Schrödinger wave equation, producing wave-like behavior, as seen in double-slit interference (electrons, $\sim 10^{-10}$ m [4]). With observation, linger time becomes non-zero, causing particles to pause between jumps, aligning them linearly and mimicking classical, deterministic motion, as observed in muon trajectories (7 μs at 0.99c [30]). This shift in linger time collapses Copenhagen's duality: particles remain discrete, exhibiting wave-like behavior (zero linger time) or linear motion (non-zero linger time) based on observation [7]. Human-particle entanglement suggests observers influence linger time, could be testable via interferometry (LIGO precision, 10^{-18} m [4]), probing frequency shifts (10^{-15} Hz). Such experiments could validate this entanglement, illuminating its role in unification.

Conclusion

This theory redefines motion and the wave nature of particles as quantized relocations. It unifies quantum and classical physics through matter's inherent behavior, as supported by the free will theorem [1]. The theorem concludes that particle relocation frequency are not dictated by external factors, resolving the quantum-classical divide by linking matter's wave-like quantum or linear classical motion to linger time modulation (Sec. 4). Tendency unifies intrinsic properties (Sec. 3), enabling gravity and electromagnetism to merge. LIGO's waves (10^{-21} strain [4]), tunneling, and muon contraction (0.99c [30]) support discrete steps, with a10^{-15} Hz photon frequency shift and 10^{-14} Hz tunneling shift as novel predictions, testable by interferometry (10^{-18} m [4]) and LHC experiments ($\sim 10^{-20}$ m [12]). Contrasting with LQG and QFT (Appendix), this theory invites Planck-scale tests, grounding unification in matter's autonomy.

Appendix

Math Note: Relocation Frequency and Probability Derivation

The relocation frequency, $f(v) = \frac{v}{l_p}$, arises from the postulate that particles traverse a granular lattice with Planck length ($l_p \sim 1.616 \times 10^{-35}$ m) steps. For velocity v, the number of jumps per second is v divided by step size l_p, yielding $f(v)$. The jump probability, $p(v) = \frac{v}{l_p} \cdot (t_p + t_{lo}) \cdot \sqrt{1 - \frac{v^2}{c^2}}$, combines frequency with cycle time, $T_{cycle}(v) = (t_p + t_{lo})\sqrt{1 - \frac{v^2}{c^2}}$ where $t_p \sim 5.39 \times 10^{-44} s$ is the Planck Time and t_{lo} is the rest-frame linger time. Lorentz contraction ensures relativistic consistency, with $l'_p = l_p\sqrt{1 - \frac{v^2}{c^2}}$ and $t'_p = t_p\sqrt{1 - \frac{v^2}{c^2}}$. For $t_{lo} = 0, p(v) = (\frac{v}{c}) \cdot \sqrt{1 - \frac{v^2}{c^2}}$, mimics a probability flux, aligning with the wave function's current. Tendency (D) in $\vec{F}_g = \frac{\vec{D}\,U\,u}{2r^2}$ modulates $f(v)$, linking force to lattice interactions, unifying micro and macro dynamics.

Comparison with Other Frameworks

Loop quantum gravity (LQG) quantizes spacetime into spin networks ($10^{-66}\ m^2$), predicting discrete areas but lacking a motion mechanism, untested [14]. Quantum field theory (QFT) excels in particle interactions (10^{-12} accuracy) but fails at gravitational scales [31]. This Quantized Relocation Theory (QRT) posits quantized relocations, unifying scales with testable predictions (e.g., 10^{-15} Hz shifts, Sec. 2.3). Table 1 compares their mechanisms, gravitational approaches, empirical tests, and unification potential:

Table 1: Comparison of LQG, QFT, and QRT

Framework	Motion Mechanism	Gravitational Approach	Empirical Tests	Unification Potential
LQG	None; spacetime quantized into spin networks ($\sim 10^{-66} m^2$)	Gravity as quantized geometry	Untested; awaits cosmological signals	Limited; no motion mechanism
QFT	Continuous fields, particle excitations	Fails at gravitational scales	High precision for particles ($\sim 10^{-12}$)	Struggles with quantum gravity
QRT (This Work)	Quantized relocations, Planck-scale jumps	Gravity via tendency, frequency modulation	LIGO ($\sim 10^{-21}$ stain), muon data, tunneling; predicts 10^{-15}Hz Shift	Unifies gravity, electromagnetism

Unlike LQG's Cosmological reliance or QFT's perturbative limits, QRT grounds gravity in particle behavior, with feasible experiments via LIGO or LHC [4, 12].

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