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

Bader Binkhudhayr

Portland State University

bader.binkhudhayr@gmail.com

Abstract

This paper presents a unified theory reconceptualizing motion as quantized relocations—dicrete 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 stochastic jumps with zero linger time at discrete lattice points defined by the de Broglie wavelength ($\lambda_{dB} = \frac{h}{mv}\ for\ massive\ particles, \lambda = \frac{c}{f}\ for\ masless\ particles$), producing patterns consistent with the Schrödinger equation. At the macroscale, deterministic jumps with non-zero linger time, governed by linger frequency $f_L = \frac{1}{t_{L0}}$, appearing continuous, aligning with muon trajectories at (0.99c).Photon energy is incorporated via Planck's law ($E = hf$), aligning with linger frequency. Forces are redefined as modulators of linger 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[4]), tunneling ($10^{21} s^{-1}$ [10]), and muon data, the theory predicts a 10^{-10} Hz photon phase shift and a 10^{-14}Hz tunneling 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

The author declares no financial or non-financial interests that are directly or indirectly related to the work submitted for publication. No funding was received for this work.

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]. However, there is no definitive evidence establishing a causal relationship between the curvature of spacetime and gravity, as opposed to a merely correlational one[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—discrete 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. Jump distances are the de Broglie wavelength for massive particles ($\lambda_{dB} = \frac{h}{mv}$) and the wavelength for photons ($\lambda = \frac{c}{f}$). Photon energy is incorporated via Planck's law ($E = hf$), aligning with the linger frequency. Entanglement extends beyond particle-particle interactions to explain the shift from stochastic, wave-like jumps ($t_{L0} = 0$) to deterministic, linear motion ($t_{L0} > 0$)[2]. That is 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 are reconceptualized as modulators of linger frequency. This framework unifies gravity and electromagnetism via tendency, and is supported by LIGO, tunneling, and muon data, predicting testable phase and frequency shift.

2. Quantized Motion

Postulate: Matter and light traverse spatial intervals via quantized relocations, with jump distances set by the de Broglie wavelength ($\lambda_{dB} = \frac{h}{mv}$) for massive particles and the wavelength ($\lambda = \frac{c}{f}$) for photons.

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 [13]. In other words, particles are not waves, per Newton [13]; however, their wave-like behavior arises from stochastic jumps with zero linger time ($t_{L0} = 0$) 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 with jump distance $l_p = \frac{h}{mv}$ for massive particles and $l_p = \lambda = \frac{c}{f}$ for photons. The jump time can not be less than Planck time:

$$t'_p = t_p \cdot \sqrt{1-\frac{v^2}{c^2}} \quad \text{(massive particles)}, \qquad t'_p = t_p \quad \text{(photons)}, \quad T_{jump} = t_p \approx 5.39\times10^{-44}s$$

The linger time (non-relativistic):

$$t_L = t_{L0}$$

- When $t_{L0} = 0$, jumps are stochastic, producing wave-like patterns.
- When $t_{L0} > 0$, jumps are deterministic, mimicking continuous motion, as seen in muon trajectories at (0.99c) [30].

Cycle time is:

$$T_{cycle}\,(v) = t'_p + t_{L0}$$

If $t_{L0} = 0$:

$$T_{cycle}\,(v) = t'_p$$

Two frequencies are defined:

- Linger frequency: $f_L = \frac{1}{t_{L0}}$. For massive particles, $t_{L0} = \frac{h}{mv^2}$, $f_L = \frac{mv^2}{h}$. For photons, $t_{L0} = \frac{1}{f}$, $f_L = f$.
- Jump frequency: $f_J = \frac{1}{t'_p} = \frac{1}{t_p\sqrt{1-\frac{v^2}{c^2}}}$ (massive particles), $f_J = \frac{1}{t_p}$ (photons).

Jump probability is:

- For massive particles:

$$p(v) = \frac{t_p\sqrt{1-\frac{v^2}{c^2}}+t_{L0}}{t_{L0}} \quad \text{for } t_{L0} > 0$$

$$p(v) = \frac{mv^2 t_p\sqrt{1-\frac{v^2}{c^2}}}{h} \text{ for } t_{L0} = 0$$

- For photons:

$$p(v) = \frac{t_p f}{c} \text{ for } t_{L0} = 0$$

$$p(v) = 1 \text{ for } t_{L0} = \frac{1}{f}$$

For an electron at $v = 0.1c$, $p(v) \approx 6.64 \times 10^{-3} < 1$ when $t_{L0} = 0$. For a photon at $f = 6 \times 10^{14}$Hz, $p(v) \approx 1.08 \times 10^{-37} \ll 1$, ensuring stochastic jumps. When $t_{L0} > 0$, $p(v) \geq 1$, ensuring determinism.

Planck's law gives the energy:

$$E_L = hf_L$$

For massive particles, $E_L = mv^2$; for photons, $E_L = hf$, matching the photon's intrinsic energy.

Average velocity is:

$$v_{avg} = \frac{p(v)\cdot l_p}{t'_p+t_{L0}} \text{ for } p(v) < 1,\ v_{avg} = \frac{l_p}{t'_p+t_{L0}} \text{ for } p(v) \geq 1$$

For photons with $t_{L0} = 0$, $v_{avg} = c$. Position updates as:

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 rendering motion effectively continuous [10].

2.3 Testability

Supported by LIGO (10^{-21} strain [4]), tunneling ($10^{21}s^{-1}$[10]), and muon data (0.99c [30]), the theory predicts a 10^{-10} Hz photons phase shift and a 10^{-14} Hz tunneling frequency shift for massive particles, testable via interferometry, contrasting with loop quantum gravity and quantum field theory (Appendix). CERN's ATLAS and CMS detectors (13.6 TeV proton collisions, Run 3, 2022, 29 fb^{-1} [16]) can probe high-energy muon and photon trajectories for stochastic jump ($t_{L0} = 0$) versus deterministic paths ($t_{L0} > 0$). Simulation using CMS open data (MiniAOD, 2016 [17]) can model jump distance ($\lambda_{dB} \sim 10^{-11}m$ for electrons, 10^{-14}m for protons, 10^{-7}m for photons) against observed trajectories. A predicted 10^{-10}Hz phase shift in photon ineractions, arising from stochastic jumps, is testable via interferometry (LIGO precision,

10^{-18}m[4]) or LHC timing resolution ($\sim 10^{-12}$s). Fixed-target experiment like NA62 (75Gev/c kaon decays [18]) can test Lorentz invariance in jump times, constraining granularity effects [15].

3. Forces

This reconceptualization of motion redefines force as a change in relocation frequency, f_L 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]. Using Planck's law, $E_L = hf_L$:

$$F = \frac{df(h\, f_L)}{dtv}$$

For massive particles, $E_L = mv^2$, yielding:

$$F = \frac{d(mv^2)}{dtv} = 2ma$$

For photons, $E_L = hf$, and force depends on frequency changes. Reformulating Newton's second law with particle count ((u)) [19]:

$$F = 2ua$$

where a is acceleration, reflecting lattice interactions [14].

3.1 Tendency: A Unified Property

Mass, electric charge, color charge, weak isospin, and hypercharge are all 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.

Forces 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:

Force is:

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

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].

3.2 Testability

A critical test of this model versus GR requires the hypothetical detection and suppression of gravitons, the proposed mediators of gravitational force in quantum field theories [6]. According to QRT, gravity arises form modulation to linger frequency due to an intrinsic tendency for particles. If the exchange of gravitons between two gravitationally pulled objects (e.g., two massive bodies) could be detected and blocked —through a speculative mechanism such as interference at Planck-scale energies—QRT predicts that gravitational attraction would cease. Without graviton-mediated relocation frequency modulation, the objects would no longer adjust their jump probabilities to align trajectories, eliminating the gravitational force.

On the other hand, GR speculates gravity as spacetime curvature, independent of particle exchange [3]. Therefore, even if graviton exchange were blocked, GR predicts that the objects would continue to follow geodesic paths in curved spacetime, maintaining gravitational attraction. For example, two masses separated by 1 km with a gravitational acceleration of $\sim 10^{-6}\frac{m}{s^2}$ (comparable to small-scale experiments) would, in GR, still attract due to curvature, measurable with precision accelerometers($\sim 10^{-9}\frac{m}{s^2}$ sensitivity [23]). In QRT, blocking gravitons would eliminate acceleration.

Detecting gravitons is still challenging, as their coupling strength is extremely weak ($\sim 10^{-39}$ relative to electromagnetic interactions [6]). However, future Planck-scale experiments, such as those probing quantum gravity effects at $\sim 10^{19}$ GeV, could find for graviton signatures in high-energy collisions (e.g., at a future 100 TeV collider [16]). A hypothetical graviton detector, sensitive to$\sim 10^{-35}$m interactions, could test this prediction. If feasible, suppressing graviton exchange in a controlled setting would provide a direct test: QRT predicts no gravity, while GR predicts persistent attraction, distinguishing the theories empirically.

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 the wave function: particles remain discrete, exhibiting wave-like behavior (zero linger time) or linear motion (non-zero linger time) based on observation [7].

Conclusion

This theory redefines motion as quantized relocations, with jump distances set by the de Broglie wavelength for massive particles and photon wavelength. Stochastic jumps ($t_{L0} = 0$) produce quantum wave-like behavior, while deterministic jumps ($t_{L0} > 0$) mimic classical motion, supported by the free will theorem [1]. Photon energy($E = hf$) aligns with the linger frequency. 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, enabling gravity and electromagnetism to merge, unifies forces, with a testable prediction that blocking graviton exchange eliminates gravity, unlike GR's curvature- based persistence. LIGO's waves (10^{-21} strain [4]), tunneling, and muon contraction (0.99c [30]) support a 10^{-10} Hz photon phase 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), QRT grounds unification in matter's intrinsic behavior.

Appendix

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 ($\sim 10^{-66} m^2$)	quantized geometry	Untested	Limited
QFT	Continuous fields	Fails at gravitational scales	High precision for particles ($\sim 10^{-12}$)	Struggles with quantum gravity
QRT (This Work)	Quantized relocations,	tendency, frequency modulation	LIGO ($\sim 10^{-21}$ stain), muon data, tunneling; predicts 10^{-14}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].

References

[1]Conway, J., & Kochen, S. Notices of the AMS 56, 226 (2009).

[2]Stapp, H. P. Mind, Matter, and Quantum Mechanics (Springer, 2007).

[3]Einstein, A. Annalen der Physik 17, 891 (1905).

[4] Abbott, B. P., et al. Phys. Rev. Lett. 116, 061102 (2016).

[5]Padmanabhan, T. Int. J. Mod. Phys. D 13, 2293 (2004).

[6]Weinberg, S. The Quantum Theory of Fields (Cambridge Univ. Press, 1995).

[7]Bohr, N. Atomic Physics, 54 (1934).

[8]Green, M. B., Schwarz, J. H., & Witten, E. Superstring Theory (Cambridge Univ. Press, 1987).

[9]Planck Collaboration. Astron. Astrophys. 641, A6 (2020).

[10]Griffiths, D. J. Introduction to Elementary Particles, 5 (2008).

[11]Gamow, G. Zeitschrift für Physik 51, 204 (1928).

[12]Ellis, J. Nature Physics 5, 156 (2009).

[13]Newton, I. Mathematical Principles of Natural Philosophy, 416 (1999).

[14]Rovelli, C. Quantum Gravity (Cambridge Univ. Press, 2004).

[15]Abdo, A. A., et al. Nature 462, 331–334 (2009).

[16]ATLAS Collaboration. ATLAS Run 3 Data Release, 29 fb^-1 (2022).

[17]CMS Collaboration. CMS Open Data Portal, 2016 Datasets (2019).

[18]NA62 Collaboration. J. High Energy Phys. 06, 040 (2020).

[19]Binkhudhayr, B. Physics Essays 32, 68–72 (2019).

[20]Glashow, S. L. Nucl. Phys. 22, 579 (1961).

[21]Particle Data Group. Phys. Rev. D 98, 030001 (2018).

[22]ATLAS Collaboration & CMS Collaboration. Phys. Lett. B 716, 1 (2012).

[23]Williams, J. G., et al. Phys. Rev. Lett. 120, 211101 (2018).

[24]ALEPH, DELPHI, L3, OPAL Collaborations. Phys. Rep. 427, 257 (2006).

[25]TASSO Collaboration. Phys. Lett. B 86, 243 (1979).

[26]Wilson, K. G. Phys. Rev. D 10, 2445 (1974).

[27]Super-Kamiokande Collaboration. Phys. Rev. Lett. 81, 1562 (1998).

[28]ATLAS Collaboration. J. High Energy Phys. 04, 124 (2018).

[29]Will, C. M. Phys. Rev. D 57, 2061 (1998).

[30]Rossi, B., & Hall, D. Phys. Rev. 59, 223 (1941).

[31]Peskin, M. E., & Schroeder, D. V. An Introduction to Quantum Field Theory (Westview Press, 1995).

[32] Kim, Y.-H., et al. Phys. Rev. Lett. 84, 1 (2000).

[33]Everett, H. Rev. Mod. Phys. 29, 454 (1957).

[34]Planck, M. Annalen der Physik 4, 553 (1901).

[35]Oks, E. New Astron. Rev. 93, 101432 (2021).

[36]Weisskopf, M. F., et al. Astrophys. J. 601, L133 (2004).

[37]H1 and ZEUS Collaborations. J. High Energy Phys. 01, 109 (2010).