The Premise and Result of Combining Quantum and Classical Theories: Towards Generalized Wave Mechanics

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Abstract

The explanation of quantum mechanics has never been satisfactory. The successful application of quantum mechanics is generally attributed to the mathematical system of quantum mechanics. The application research of quantum encryption communication and quantum computers using quantum entanglement is very difficult. The binary opposition between quantum and classical has hindered human scientific thinking. The widespread quest to quantize gravity mirrors humanity's enduring drive to unify quantum and macroscopic physical frameworks. This research initiates its inquiry by integrating quantum mechanics with classical mechanics, yielding novel analytical perspectives, and introduces the Schrödinger-Tu equation—a wave function that incorporates gravitational potential energy and is capable of describing macroscopic objects. Validating the practical viability of merging quantum and classical approaches, several computational cases involving atoms and molecules yield successful outcomes. Additionally, this study derives a wave-mechanical formulation of classical mechanical laws, furnishing direct empirical evidence that quantum mechanics and classical mechanics are not mutually exclusive but rather compatible and complementary. Further substantiation of their compatibility encompasses the following key points: The mass term m in the Schrödinger equation (SE) can be scaled to sufficiently large values to characterize macroscopic entities; The steady-state SE ($T\psi+V\psi=E\psi$) inherently integrates the wave function ψ with the classical energy conservation relation $T+V=E$; Potential energy functions within the SE can be derived from macroscopic force fields; Newton's second law F=ma and the SE are mutually derivable, establishing a fundamental theoretical linkage; Electron diffraction experiments concurrently demonstrate wave-particle duality, a phenomenon that bridges both mechanical frameworks. This paradigm shift—recasting the relationship between quantum mechanics and classical mechanics from one of incompatibility to compatibility—represents a pivotal theoretical advancement, with the potential to catalyze the development of a generalized wave mechanics.

Keywords: Quantum mechanics, General wave mechanics, Schrödinger-Tu equation, Anti interference electron diffraction experiment, Quantum mechanics equations of classical mechanics laws

1. Introduction

Let's begin with an analysis of the article's title, which serves as both a thematic overview and a distillation of its key contributions. **(i) Core thematic alignment**: The title directly encapsulates the paper's central focus—the integration of quantum and classical theories—while explicitly delineating the research's dual pillars: "foundations" (theoretical underpinnings and compatibility validation) and "outcomes" (practical applications and the development of a novel theoretical framework). **(ii) Clear disciplinary positioning**: By framing the research's theoretical ambition as "advancing toward generalized wave dynamics," the title echoes the "general wave mechanics" unified framework outlined in the abstract and conclusion, effectively highlighting the paper's innovative value and disciplinary significance. **(iii) Precision and academic rigor**: Adhering strictly to established terminology such as "quantum," "classical," and "wave dynamics," the title avoids ambiguity and embodies the conciseness and rigor expected of scholarly work. **(iV)**

Logical structural consistency: The title's hierarchical structure mirrors the paper's chapter progression—from theoretical derivation to experimental validation, and finally to the construction of generalized wave dynamics—accurately reflecting the research's iterative and cumulative logic.

Quantum mechanics stands as one of the most successful scientific theories, underpinning technologies from computer chips to medical imaging machines. However, the theory's successful applications do not imply its completeness—particularly regarding the interpretation of quantum probability and non-realistic concepts that deny "original existence" (objective reality independent of measurement). Notable physicists including Einstein, Schrödinger, de Broglie, and Dirac expressed dissatisfaction with quantum mechanics' interpretation[1-13], and recent reports continue to highlight the need for improvement in the field [14-32].

The biggest highlight of this article is finding the source of the "logical problem of existing quantum explanations". By deriving the quantum mechanics equations of "classical mechanics laws", the existing framework of quantum mechanics has been shaken—quantum mechanics will become a "generalized wave mechanics" that is compatible with quantum and classical mechanics. However, the existing mathematical system of quantum mechanics is still an important component of "generalized wave mechanics". The main revision is the existing interpretation system of quantum mechanics. This article presents groundbreaking evidence demonstrating that quantum mechanics and classical mechanics are fundamentally compatible and can be combined for practical applications. More specifically,Our major contributions and Highlights include:

1) The Schrödinger-Tu Equation: We derive a Schrödinger equation incorporating gravitational potential energy that can describe macroscopic objects, extending quantum mechanics' applicability beyond the microscopic realm.
2) Mathematical Equivalence: We prove that Newton's second law (F=ma) and the Schrödinger equation are mutually derivable, establishing a fundamental theoretical bridge between classical and quantum mechanics.
3) Wave Mechanics Representation of Classical Laws: We develop a systematic method to express classical mechanical laws using wave mechanics formalism, demonstrating that classical mechanics can be seamlessly integrated into the quantum framework.
4) Experimental Validation: Our electron diffraction experiments demonstrate the strong robustness of de Broglie waves, challenging the conventional interpretations of wave function collapse and quantum decoherence.
5) General Wave Mechanics: By combining quantum and classical mechanics, we establish the theoretical foundation for "general wave mechanics"—a unified framework that describes both microscopic and macroscopic systems using wave mechanics methods.
6) Practical Applications: Multiple computational examples involving atoms and molecules demonstrate successful combinations of quantum and classical methods, proving the practical viability of this unified approach.

The mathematical foundation of quantum mechanics, particularly the Schrödinger equation, inherently combines the energy relationships from Newtonian mechanics with wave functions. This suggests that quantum mechanics' mathematical structure cannot logically exclude classical mechanical laws. By replacing electromagnetic potential energy with gravitational potential energy in the Schrödinger equation, we obtain an equation that applies to both microscopic and macroscopic planetary systems, demonstrating that the Schrödinger equation cannot establish a strict boundary between quantum and classical domains [14-31].

The shift from viewing quantum and classical mechanics as incompatible to recognizing their compatibility represents a significant conceptual change with profound implications. This paradigm shift enables the quantization of Newtonian gravity and opens new pathways for developing generalized wave mechanics. Our research demonstrates that the perceived "contradiction" between quantum and classical mechanics dissolves when we abandon interpretations that deny the original existence of microscopic particles. The theoretical framework established here not only resolves longstanding interpretational issues but also provides practical computational methods that combine the strengths of both mechanical frameworks [20,24].

The dialectical thinking on the fundamental assumptions of quantum mechanics is very profound, without blindly accepting the existing framework, but starting from the point of logical contradiction to question, For example, quantum mechanics argue that the quantum states of microscopic particles (quantum entangled states, quantum superposition states) will undergo quantum decoherence or collapse upon contact with an instrument. But it also acknowledges that coherent microscopic particles can be artificially manufactured using instruments. Deny that the measured eigenstates existed before the measurement.

2. Qualitative and Quantitative Relationships Between de Broglie Waves, Wave Function Waves, and Classical Moving Particles

When describing the energy and momentum of moving particles, classical mechanics, de Broglie wave theory, and wave function-based quantum mechanics must yield consistent quantitative results—any discrepancies should not constitute irreconcilable contradictions. As a wave function inherently implies a corresponding wave phenomenon (a function cannot describe a wave without a physical or mathematical wave entity to model), the "wave of the wave function" refers to the fundamental nature of the wave function itself.

There exists ongoing debate about this nature: some argue the wave function is merely a mathematical tool in quantum mechanics, with only its squared modulus carrying physical meaning. Others posit that "wave function waves" are probability waves, analogous to monochromatic electromagnetic waves. Advanced quantum mechanics frameworks further specify that these waves exist in configuration space, not in the real physical space we observe. Notably, prior to this work, no published studies have systematically explored the quantitative relationships between the wave-like and particle-like properties of moving particles.

The Schrödinger equation for a hydrogen atom is expressed as:

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi+V\psi=E\psi. \qquad (1)$$

Substituting the potential energy term V with the gravitational potential $V=-\frac{GMm}{r}$, Equation (1) transforms into:

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi-\frac{GMm}{r}\psi=E\psi. \qquad (2)$$

From a purely mathematical standpoint, Equation (2) is formally applicable to both microscopic systems (like hydrogen atoms) and macroscopic planetary systems. However, macroscopic planetary systems adhere strictly to classical mechanics (governed by $F=ma$) and do not exhibit quantum phenomena such as uncertainty, probabilistic interpretation, or state superposition.

This creates a logical tension: proponents of quantum mechanics who argue $F=ma$ does not apply to microscopic systems must reject the universality of Equation (2)—at least its applicability to microscopic systems. Yet, from a rigorous logical perspective, Equation (2) itself provides no inherent basis for distinguishing between macroscopic and microscopic domains; the Schrödinger equation alone cannot establish a clear demarcation between classical and quantum regimes.

The wave function employed by Schrödinger is

$$\psi=\psi_0 e^{-\frac{i}{\hbar}(Et-px)}=\psi_0 e^{-i2\pi(\nu t-x/\lambda)}. \qquad (3)$$

Calculate the first term of Eq. (1) based on the two equivalent exponential functions on the left and right sides of the equal sign in Eq. (3). We can obtain $\frac{p^2}{2m}\psi=\frac{mv^2}{2}\psi=T\psi$ and $\frac{\hbar^2}{2m}(\frac{2\pi}{\lambda})^2\psi=\frac{(h\nu)^2}{2mv^2}\psi$, respectively. When using the exponential function on the left side of the equal sign in Eq. (3), we intentionally use classical mechanics laws. When using the exponential function on the right side of the equal sign, the relationship between $\lambda=h/mv$ and $v=\lambda\nu$ in the fluctuation law was employed. Since the equations $\frac{mv^2}{2}\psi$ and $\frac{(hv)^2}{2mv^2}\psi$ are derived from two completely equivalent wave function expressions and the same term in Eq. (1), the equation $\frac{mv^2}{2} = \frac{(hv)^2}{2mv^2}$ must hold, and the result is $(mv^2)^2=(hv)^2$. If the square roots are all positive, then, we have

$$\left.\begin{aligned} mv^2 &= hv \\ T &= \frac{1}{2}hv \end{aligned}\right\}. \qquad (4)$$

This reveals that in the two accepted energy representations inherent to the Schrödinger equation for hydrogen atoms, the kinetic energy accounts for only half the energy value described by wave mechanics. Concurrently, it demonstrates that the wave associated with the wave function (the essence of the wave function) does not align with de Broglie waves.

The equivalence of $\frac{1}{2}mv^2$ and $\frac{1}{2}hv$ can be used to verify the phase velocity of de Broglie waves: $v = \frac{E}{p} = \frac{hv}{p} = \frac{mv^2}{mv}$. The relationship between phase velocity, wave energy, and momentum adheres to the universal wave laws $E=hv=mv^2$. Equation (4) indicates that the wave energy described by the wave function is twice the kinetic energy of a moving particle or a de Broglie wave. When calculating the energy of the system using the time-dependent Schrödinger equation, it is easy to misinterpret the wave energy of the wave function's essence as the energy of the system itself. In reality, this merely shows that the wave energy defined by quantum mechanics for the wave function does not correspond to the kinetic energy of the moving particle.

This again confirms that in the two implicit energy representations of the hydrogen atom Schrödinger equation, kinetic energy constitutes only half the energy value depicted by wave theory. It further reiterates that the wave of the wave function (its fundamental nature) is inconsistent with de Broglie waves.

When a particle is free (with zero potential energy), the Virial theorem no longer applies (as evidenced by the changed sign of E in Equation (1)). Equation (1) simplifies to: $-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi = E\psi$. Excluding the internal energy mc^2, the total energy of a moving particle equals its kinetic energy. From the perspective of energy conservation, this kinetic energy can also be expressed via wave theory as khv, which must equal $\frac{1}{2}mv^2$, leading to Equation (4). Here, E in the simplified Schrödinger equation corresponds to $\frac{1}{2}hv$. If we use the time partial derivative of the wave function $\frac{\partial}{\partial t}\psi$ to represent its operator, we require $f(i,\hbar)\frac{\partial}{\partial t}\psi = \frac{1}{2}hv\psi$. Solving this yields the relationship \(f(i,\hbar) = -\frac{i\hbar}{2} \), and thus the kinetic energy operator $f(i,\hbar)=-\frac{i\hbar}{2}$ and $\widehat{E}_k=\widehat{T}=-\frac{i\hbar}{2}\frac{\partial}{\partial t}$. Combining this with Equation (4), we derive:

$$\frac{\hbar^2}{m}\frac{\partial^2}{\partial x^2}\psi = i\hbar\frac{\partial}{\partial t}\psi. \qquad (5)$$

This is the free-particle wave equation, namely the wave equation describing the de Broglie wave of a one-dimensional free particle. Derived from the Schrödinger equation of the hydrogen atom, it is specifically suited for characterizing free particles, making it more applicable to de Broglie waves. To derive the partial derivatives in the free-particle wave equation, Equation (4) must be obtained; otherwise, either Equation (4) or (5) will not hold true. Section 8: Deriving the Correct Schrödinger Equation via the Unitary Operator of Hilbert Space – Equation (1).

Equation (5) also serves as the wave mechanics equation for kinetic energy. The equivalence between the energy of a moving particle's de Broglie wave and the wave energy of its wave function constitutes an alternative form of Equation (4). By utilizing Equation (5)—along with relations such as $E=-T$ or $p=mv$ and $v=\lambda v$—we can achieve mutual conversion between the time-dependent Schrödinger equation and the steady-state Schrödinger equation, which is applicable to planetary model systems.

As demonstrated above, we have realized a high degree of unification between de Broglie waves and wave function descriptions. No fundamental contradictions exist between the classical mechanical depiction of moving particles and their descriptions via de Broglie waves or wave functions. For a moving particle: Classical mechanics framework: Concepts such as mass points, mass, velocity, momentum $p=m\upsilon$, kinetic energy $T=(1/2)\ m\upsilon^2$, and Newton's laws of motion can be employed.

Traveling wave description: Parameters including wavelength $\lambda=h/p$), momentum \(p=m\upsilon\), wave velocity $\upsilon=\lambda\nu$, wave energy $E=h\nu=m\upsilon^2$ are applicable. Wave function formalism: Key expressions include wavelength$\lambda=h/p$, momentum $p=m\upsilon$, wave velocity $\upsilon=\lambda\nu$, and wave energy $E=h\nu=m\upsilon^2$.

References [14–20] indicate that a Schrödinger equation incorporating gravitational potential energy can be formulated to describe macroscopic objects, meaning wave mechanics is no longer exclusive to the microscopic world. If the objective outlined in this section's title is fully achieved, quantum mechanics and classical mechanics could share a unified set of physical axioms (theoretical postulates).

3. The Unshakable Status of the Aspect Experiment in Quantum Mechanics: A Re-examination

The interpretive framework of quantum mechanics has long been a source of profound confusion [31]. At the core of this framework lies the denial that microscopic particles possess stable, independent, and complete eigenstates (DSICE). This concept emerged from attempts to explain the double-slit diffraction experiment, and it later evolved into the Copenhagen interpretation—with the Aspect experiment serving as its iconic empirical validation. Together, these ideas form a seemingly progressive chain: the interpretation of double-slit diffraction → the DSICE proposition → the Copenhagen interpretation and its validation via the Aspect experiment.

A closer analysis, however, reveals a critical logical flaw in the traditional explanation of the double-slit experiment. The claim that "dark fringes arise from wave interference" has never been rigorously verified, and alternative explanations remain plausible. For the term "interference" to be scientifically valid, experimental evidence must confirm that particles indeed reach the dark fringe regions without triggering any photosensitive response—a condition that has not yet been met.

Following Thomas Young's double-slit experiment, Geoffrey Taylor carried out a single-photon double-slit diffraction experiment—in which photons were fired through the slits one at a time (the Taylor experiment). The results mirrored those of Young's original experiment, with distinct interference fringes appearing (see Figure 1). This challenges the classical assumption that microscopic particles behave as independent, well-defined entities.

Both the Copenhagen interpretation and the interpretation of Alain Aspect's experiments rely on the **Discrete Stochastic Interference of Corpuscular Entities (DSICE)** framework. Proponents of DSICE have also established a mathematical foundation for their perspective: they introduced the concepts of probability waves and probability amplitudes to describe the behavior of microscopic particles, embedding DSICE's core tenets into formal mathematical language.

However, a critical experimental prediction of this interpretation remains unobserved: when a single microscopic particle passes through a double slit, the receiving screen should occasionally display two distinct bright spots. This follows from the DSICE premise that dark fringes arise from the interference of two simultaneously existing components of the particle. By extension, in regions corresponding to bright fringes, these two components would fail to interfere with each other—and if they do not overlap, they should trigger two separate photosensitive points on the screen.

Conversely, if each particle fired through the slits consistently produces only one bright spot, this strongly suggests the particle behaves as a stationary point-like or spherical entity both before and after passing through the slits, rather than existing in a discrete probability wave state. For single-particle double-slit experiments, the observation that interference fringes emerge as the accumulation of individual points further undermines the claim that fringes result from the superposition of discrete probability waves (the assertion that discrete waves can only form small, isolated bright spots is inherently inconsistent with the observed pattern).

In short, while the dark fringes on the receiving screen closely resemble diffraction patterns, their formation could stem from two distinct mechanisms: (a) The microscopic particles simply do not reach those regions of the screen, or (b) The particles that doreach those regions undergo destructive interference.

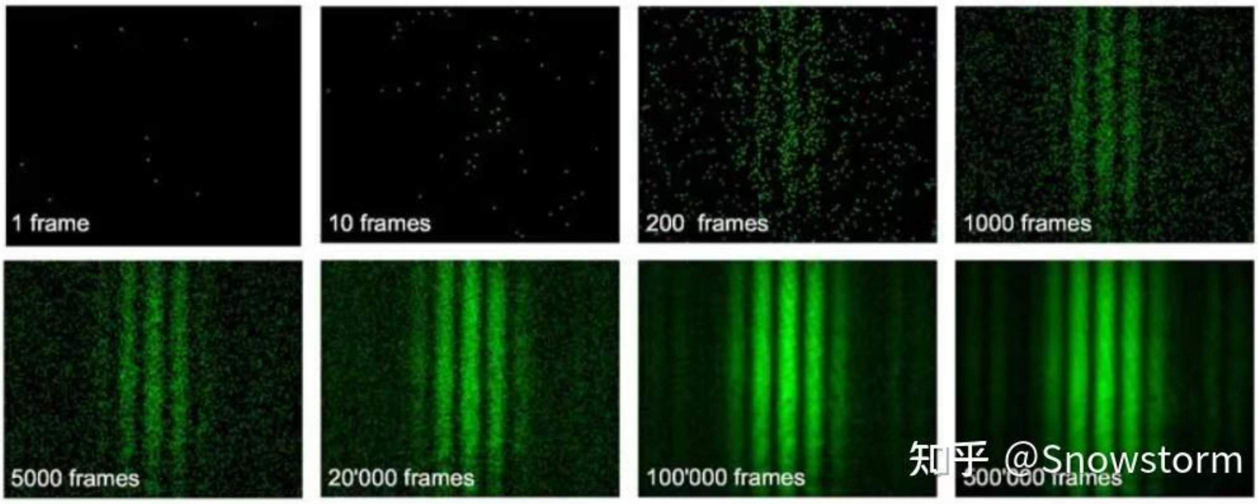

Figure 1. The photosensitive results of Taylor's single photon double slit diffraction experiment. It can be explained using Huygens' principle.

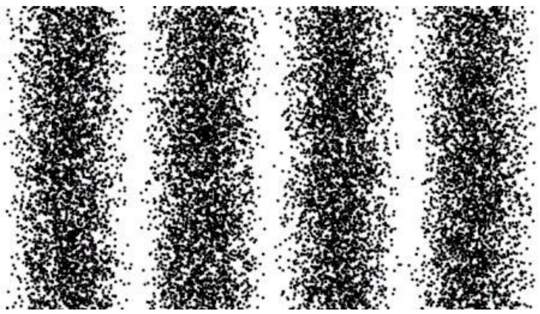

Figure 2. Photosensitive results of electrons passing through a double slit one by one. When an electron passes through the double slit and strikes the detection screen, it leaves only a tiny bright spot. Describing this phenomenon as a "discrete wave-screen photosensitive reaction" is imprecise and misleading.

In diffraction experiments, particles are inevitably perturbed by collimating lenses or electromagnetic fields used for focusing—conditions that trigger quantum decoherence and superposition collapse. The Tu experiment further introduces post-slit interference, meaning particles are subjected to disturbances throughout the entire diffraction process, providing even stronger evidence that quantum decoherence and superposition collapse occur [30].

The Copenhagen interpretation of quantum mechanics is founded on the core premise that "any perturbation of a particle will induce quantum decoherence or superposition collapse, transitioning the particle to a macroscopic classical state." By this logic, microscopic particles in diffraction experiments—both before and after passing through the slit—are highly likely to exist in a decohered, classical state. For the Tu experiment, which includes post-slit interference (detailed in Section 6), the case for electrons remaining in a macroscopic classical state during diffraction is even more compelling. Yet proponents of the established quantum interpretation system deny that particles in diffraction processes occupy classical states, directly contradicting their own foundational premise.

Whether particles reach the dark fringe regions can be experimentally verified using a second-order diffractometer. Here’s how: Modify a first-order detection screen to include a movable slit, and place a second-order detection screen behind it. Direct single test particles through the front double slit, followed by the movable slit on the first-order screen. Locate the dark fringes on the first-order screen, align the movable slit with a dark fringe, and observe the pattern on the second-order screen.

If particles reach the dark fringe area on the first-order screen, secondary diffraction fringes will appear on the second-order screen; if not, it confirms no particles arrive at the first-order dark fringes. Even if fewer particles reach dark fringes than bright fringes, it would still refute the claim that dark fringes arise from interference. Notably, single-particle diffraction experiments (Figures 1 and 2) already show far fewer particles reaching dark fringes. This second-order diffraction experiment is technically straightforward to implement, making it a missed opportunity not to pursue it.

The possible reason why particles that have already passed through the slit did not reach the dark stripe is that "the slit particles have direction quantization" [28]. There are atoms at the edge of the slit. These atoms (especially their nuclear charges) have an impact on the particles passing through the gap. The diffraction experiment of photons can be explained using Huygens' principle. For non photons, it is possible that particles pass over different main energy level regions of atoms, and the quantization of orbital angular momentum may have an impact on the passing particles. Later on, we will also talk about the slit and the front ray, which are directly focused and have a sufficient effect on the reference diffraction particles to cause quantum decoherence. The single particle experiment also showed that a particle passing through a slit can only form a bright spot on the screen, rather than forming extremely light and dark stripes. This can only be achieved when the particles involved in diffraction are in a quantum decoherence state. The Tu’ experiment deepened this conclusion.

Whether particles have reached the dark areas can be verified through experimental methods. One specific method is to manufacture a second-order diffractometer—that is, to cut a slit on a movable first-order receiving screen, and then install a second-order receiving screen behind it. The operation of the instrument is to allow some test particles to pass through the front and rear slits. After starting the instrument, locate the location of the dark fringes, move the slit on the primary receiving screen to a dark fringe, and observe the diffraction patterns on the secondary receiving screen. If particles reach the shadow on the primary receiving screen, secondary diffraction fringes will appear on the secondary receiving screen. Otherwise, it indicates that no particles have reached the dark stripes of the primary receiving screen. This type of second-order diffraction experiment is easy to implement. It would be a pity if we didn't do it.

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As mentioned above, as long as the second-order diffraction experiment proves that no particles reach the dark fringes of the double slit diffraction pattern, it shakes the super position of the Aspect experiment in quantum mechanics. The mechanism of directional quantization can be gradually explored.

Finding the problem of aspect experiment explanation is equivalent to shaking the foundation of existing quantum mechanics explanations. The quantum mechanics equations derived from classical mechanics laws are equivalent to shaking the existing framework of quantum mechanics.

One plausible explanation for why particles passing through a slit fail to reach the dark fringes in diffraction patterns lies in the "directional quantization of slit-interacting particles" [28]. Atoms lining the slit edges—particularly their nuclear charges—exert an influence on traversing particles. While photon diffraction can be accounted for by Huygens' principle, non-photonic particles may interact with distinct atomic energy level regions, where the quantization of orbital angular momentum alters their trajectory. Additionally, we will discuss how direct, focused rays preceding the slit induce quantum decoherence in diffracting particles, a critical factor in pattern formation.

Single-particle diffraction experiments demonstrate that an individual particle only forms a single bright spot on the screen, rather than faint, dispersed fringes. This observation confirms that diffraction patterns require particles to be in a quantum decoherent state, a conclusion further reinforced by Tu's experiment.

To verify whether particles actually reach the dark fringe regions, a second-order diffraction experiment offers a feasible approach. This setup involves a movable primary receiving screen with a slit, paired with a secondary receiving screen positioned behind it. The procedure entails directing test particles through both the initial slit and the aperture on the primary screen. By aligning the primary screen's slit with a dark fringe location and observing the secondary screen, we can draw definitive conclusions: the appearance of secondary diffraction fringes would indicate particles reach the dark areas of the primary screen, while their absence would confirm no particles arrive at these dark fringe regions. This experiment is technically straightforward, making its execution highly worthwhile.

As previously hypothesized, the "directional quantization of slit-interacting particles" [32] provides a framework for understanding this phenomenon. Slit-edge atoms, via their nuclear charges, affect passing particles. For non-photonic particles, interactions with atomic energy level regions and orbital angular momentum quantization may dictate their trajectories, complementing Huygens' principle for photon diffraction.

If the second-order diffraction experiment confirms that no particles reach the dark fringes of double-slit patterns, it would undermine the superposition principle underlying Aspect's experiment—a cornerstone of quantum mechanics. This would open avenues to systematically explore the mechanisms of directional quantization.

Identifying flaws in the interpretation of Aspect's experiment would shake the foundations of mainstream quantum mechanics explanations. Moreover, deriving quantum mechanical equations from classical mechanical principles would fundamentally challenge the existing framework of quantum theory.

There has also been controversy over this issue in history. The controversy surrounding the formation of double slit interference dark patterns Traditional wave theory suggests that dark streaks are caused by destructive interference of waves, but particle theorists propose an alternative explanation: dark streak regions may be areas where particles are deflected by Coulomb forces at the edge of the slit and do not reach, rather than interference cancellation. This viewpoint can be referred to as: Einstein, A. (1927). "Quantum theory and reality." Nature, 119(2998), 802-804. The "single spot" phenomenon in single particle double slit experiments: Modern high-precision experiments (such as the 1989 electron double slit experiment) show that a single electron only produces one spot on the detection screen after passing through the double slit, rather than the theoretically predicted "double spot". The experimental data can be cited from:Tonomura, A., Endo, J., Matsuda, T., Kawasaki, T., & Ezawa, H. (1989). "Demonstration of single-electron buildup of an interference pattern." American Journal of Physics, 57(2), 117-120. Controversy over the mathematical basis of the concept of probability waves: Although Bohr's interpretation of probability waves (1926) became mainstream, scholars such as Einstein have always questioned its completeness, believing that probability waves only describe the statistical behavior of particles, rather than the real physical state. Related literature:Born, M. (1926). "Zur Quantenmechanik der Stoßvorgänge." Zeitschrift für Physik, 37(12), 863-867.

4. Wave Equation of Classical Mechanics and Universal Operators of Fundamental Physical Quantities

Quantum mechanics, alternatively referred to as wave mechanics, is mathematically grounded in wave equations. A critical step toward establishing a unified theoretical framework that integrates classical mechanics and wave mechanics lies in deriving wave equations that can reproduce core laws of classical mechanics. Since this framework seeks to unify the two theories rather than replace them, the existing mathematical foundations and formalisms of quantum mechanics can be retained.

Dissatisfaction with current quantum mechanics primarily stems from its interpretive framework, not its mathematical structure. Conflicts between quantum mechanics and classical mechanics also originate from these established interpretations. Central to the contentious interpretive system are explanations of quantum probability and the stance of "denying the inherent reality of microscopic systems"—a form of anti-realism.

For planetary models, the relationship between potential energy V and force F is given by $F=V/r$. In Bohr's hydrogen atom model, the total energy E of an electron relates to its kinetic energy in the planetary model as

$$E=\frac{1}{2}V=-\frac{1}{2}mv^2=-\frac{1}{2}rF.$$

Equations (32) and (40) demonstrate how the relation $T+V=E$ can be derived from the Schrödinger equation (1) for hydrogen atoms. In the classical planetary model, this relation simplifies to $E=-T$. Dividing both sides of this equation by the orbital radius r and substituting $F=V/r$, we derive the connection between kinetic energy and force: $2T/r=F$. Substituting $T=mv^2/2$ and accounting for the centripetal acceleration $a=v^2/r$ in uniform circular motion, we arrive at Newton's second law: $ma=F$.

The formula for kinetic energy in classical mechanics is $T=\frac{p^2}{2m}$. For an object in uniform circular motion, $2T/r=F$ can be written as $F=mv^2/r$. Multiplying both sides of $F=mv^2/r$ by $\frac{1}{2}r$, we can obtain $\frac{1}{2}Fr=\frac{1}{2}mv^2=T$. Substituting $\frac{1}{2}mv^2=T$ into Eq. (4) $\frac{1}{2}mv^2+V=E$, or $(1/2)mv^2+Fr=E$. We write the classical mechanical formula $(1/2)mv^2+Fr=E$ *as*

$$\frac{p^2}{2m}+V=E. \qquad (6)$$

If all terms of Eq. (6) are multiplied by ψ, we can obtain

$$\frac{p^2}{2m}\psi+V\psi=E\psi.$$

The operator of force is also a wave mechanics representation of force (a method of calculating force using wave mechanics). Considering that $F=\mathrm{d}V/\mathrm{d}r=-\mathrm{d}p/\mathrm{d}t$, by dividing both sides of $F=ma$ by the interaction distance r, we can obtain

$$F=\frac{mv^2}{r} \text{ or } F=-\frac{Ze^2}{r^2}.$$

For the uniform circular motion of electrons (Planetary model), $pr=\frac{1}{2}\hbar$. Considering $p=mv$, and $F=V/r$, we can obtain

$$F=-2p^3/m\hbar. \qquad (7)$$

The operator of p^3 is

$$\hat{p}^3=i\hbar^3\frac{\partial^3}{\partial x^3}. \qquad (8)``$$

By replacing p^3 in Eq. (7) with the operator the operator represented by Eq. (8), we can obtain

$$\hat{F}=\frac{2i\hbar^2}{m}\frac{\partial^3}{\partial x^3}. \qquad (9)$$

Multiply both sides of $F=ma$ by ψ to obtain the relationship between $F\psi=ma\psi$. Replace F with the force operator shown in Eq. (8), and obtain the wave mechanics Eq. (10) for the final force. We can also directly write Eq. (10) based on Eq. (9).

$$\hat{F}\psi = 2\frac{i\hbar^2}{m}\frac{\partial^3}{\partial x^3}\psi. \qquad (10)$$

In a bound state equilibrium system, the force acting on electrons conforms to this equation.

Considering mv^2=$2T$, substituting $r=\frac{\hbar^2}{2p}$ into $F=-k\frac{Ze^2}{r^2}$, we can obtain $-\frac{4kZe^2}{\hbar^2}p^2=F$. By replacing the kinetic energy T with the kinetic energy operator $\hat{T}=-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}$, we can obtain

$$\hat{F}=\frac{4kZe^2}{\hbar^2}\frac{\partial^2}{\partial x^2}. \qquad (11)$$

Here. $k=\frac{1}{4\pi\varepsilon_0}$. Eqs. (11) and (9) are equivalent when Z=1, the operator of force and the wave equation containing force are completely new research results that were not available before. For the hydrogen atom in the planetary model, Newton's second law takes the form of

$$\hat{F}\psi=\frac{4kZe^2}{\hbar^2}\frac{\partial^2}{\partial x^2}\psi.$$

The expression for the law of conservation of momentum is m_1v_1=m_2v_2, or p_1=p_2. Replace the momentum p with the operator $\hat{p}$=$-i\hbar\frac{\partial}{\partial x}$, resulting in $\hat{p}_1$=$-\hbar\frac{\partial}{\partial x_1}$ and $\hat{p}_2=-i\hbar\frac{\partial}{\partial x_2}$. Multiplying both sides of this equation by both $\psi_1\times\psi_2$, we can obtain

$$-\frac{i\hbar}{\psi_1}\frac{\partial}{\partial x_1}\psi_1=-\frac{i\hbar}{\psi_2}\frac{\partial}{\partial x_2}\psi_2. \qquad (12)$$

Here, $\psi_1=A_1e^{-\frac{i}{\hbar}(E_1t_1-p_1x_1)}$, $\psi_2=A_2e^{-\frac{i}{\hbar}(E_2t_2-p_2x_2)}$, $E_1=h\nu_1$, $E_2=h\nu_2$. Eq. (12) is the law of conservation of momentum expressed using wave mechanics methods. It indicates that wave mechanics allow the law of conservation of momentum to apply.

Calculate the first term in Eq. (1) and move some terms to become $\frac{p^2}{2m}\psi-E\psi$=$-V\psi$. Considering E=$-T$, we have

$$-\frac{p^2}{m}\psi=V\psi. \qquad (13)$$

By replacing p^2 in Eq. (13) with an operator form, the potential energy operator $\hat{V}=\frac{\hbar^2}{m}\frac{\partial^2}{\partial x^2}$ can be obtained (note: potential energy V is a negative value).

$$\frac{p^2}{mr}\psi=F\psi=\frac{p}{v}\frac{v^2}{r}\psi. \qquad (14)$$

By substituting a=v^2/r into Eq. (14), we can obtain $F\psi=a[\frac{p}{v}]\psi$. By replacing the momentum p with the operator $\hat{p}$=$-i\hbar\frac{\partial}{\partial x}$ and using the relationship of v=$c\alpha$ for the ground state Bohr hydrogen atom, we can obtain

$$\hat{F}\psi=-a\frac{i\hbar}{c\alpha}\frac{\partial}{\partial x}\psi. \qquad (15)$$

Eq. (15) is Newton's second law expressed using the wave mechanics method (applicable to Bohr's planetary model). According to the Schrödinger equation. It indicates that wave mechanics allows Newton's second law to apply under certain conditions.

Using $\lambda=h/mv=h/p$, $v=\lambda v$, $a=v^2/r$ and Eq. (4), the first equation in Eq. (14) can be transformed into a $a\left[\frac{p^2}{hv}\right]\psi = F\psi$. Using Eq. (4), $a\left[\frac{p^2}{hv}\right]\psi = F\psi$ can be transformed into $a\left[\frac{p^2}{2T}\right]\psi = F\psi$. By replacing p^2 with the corresponding operator $\hat{p}^2 =-\hbar^2\frac{\partial^2}{\partial x^2}$, we can obtain

$$F\psi =-\frac{a\hbar^2}{2T}\frac{\partial^2}{\partial x^2}\psi. \qquad (16)$$

Eq. (16) is applicable to both macroscopic and microscopic planetary models, unlike Eq. (15) which is only applicable to ground state hydrogen atoms. From the derivation process of Eq. (16), it can be seen that the operator of the force with a wider range of applicability is $\hat{F} =-\frac{a\hbar^2}{2T}\frac{\partial^2}{\partial x^2}$.

From Eq. (16), it can be seen that the mass operator of a moving object is related to its kinetic energy

$$\hat{m} =-\frac{\hbar^2}{2T}\frac{\partial^2}{\partial x^2}. \qquad (17)$$

This operator is applicable to moving objects in bound state systems, such as Planetary Model System. According to Eqs. (15) and (16), T+V=E can be transformed into a much more widely applicable form.

$$a\left[-\frac{\hbar^2}{4T}\frac{\partial^2}{\partial x^2}\right]\psi+\frac{E}{r}\psi =F\psi. \qquad (18)$$

However, the applicability of Eq. (18) is limited and only applies to planetary model systems where the Huang Weili law holds. According to $\hat{T} =-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}$, $\hat{V}=\frac{\hbar^2}{m}\frac{\partial^2}{\partial x^2}$, $E=-T=-\frac{p^2}{2m}$, $\hat{E}=-\hat{T}=\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}=-i\frac{\hbar}{2}\frac{\partial}{\partial t}$ (the last equation can be found in Refs. 15-16), the wave mechanics expression of Viry's theorem can be obtained: $-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi + \frac{\hbar^2}{m}\frac{\partial^2}{\partial x^2}\psi=-i\frac{\hbar}{2}\frac{\partial}{\partial t}\psi$ or

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi + V\psi=-i\frac{\hbar}{2}\frac{\partial}{\partial t}\psi. \qquad (19)$$

The concise form of the classical expression for Viry's theorem is $V=-2T$. Considering $\hat{T} =-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}$, we have

$$V\psi = \frac{\hbar^2}{m}\frac{\partial^2}{\partial x^2}\psi.$$

According to the momentum operator $\hat{p} =-i\hbar\frac{\partial}{\partial x}$, the velocity operator, velocity squared operator, and acceleration operator can be obtained.

$$\hat{v}=\hat{\dot{r}}=-\frac{i\hbar}{m}\frac{\partial}{\partial x}, \qquad (20)$$

$$\hat{v}^2=-\frac{\hbar^2}{m^2}\frac{\partial^2}{\partial x^2}. \qquad (21)$$

$$\hat{a} = \hat{\dot{v}} =-\frac{\partial}{\partial t}\left[\frac{i\hbar}{m}\frac{\partial}{\partial x}\right]. \qquad (22)$$

The equation describing the motion of a particle is $s=vt$. Considering Eq. (20), $\hat{s} =-i\hbar\frac{t}{m}\frac{\partial}{\partial x}$ and $s =-i\hbar\frac{t}{m}\frac{\partial}{\partial x}\psi$. When we use Eq. (22), we must use the relationship of $p=mv$. Based on the derivative of the wave function of kinetic energy with respect to t, and considering $m=2T/v^2$, the quality operator is $\hat{m}=-i\hbar\frac{\partial}{\partial t} \div \left[-\frac{\hbar^2}{m^2}\frac{\partial^2}{\partial x^2}\right]$, that is

$$\hat{m} = i\frac{m^2}{\hbar}\left[\frac{\partial}{\partial t}\Big/\frac{\partial^2}{\partial x^2}\right]. \qquad (23)$$

This quality operator is universal, while Eq. (17) only applies to systems where the "Viry theorem applies". If the operator forms of various physical quantities are written, then classical physics formulas have corresponding operator expressions, which can be written as wave mechanics equations. For example, the operator formula for Newton's second law of $F=ma$ is $\hat{F}=m\hat{a}$. According to the multiplication operation of $m\hat{a}$, Eq. (24) can be obtained.

$$\hat{F}=-i\hbar\frac{\partial^2}{\partial t\partial x}. \qquad (24)$$

According to $F=\partial p/\partial t$ and $\hat{p}=-i\hbar\frac{\partial}{\partial x}$, Eq. (24) can also be obtained. Eq. (24) is applicable to planetary models and object in linear motion. Considering $F=mv^2/r$, Eqs. (21) and (24), the "wave mechanics equation with force" applicable to all planetary models is

$$F\psi=-i\hbar\frac{\partial^2}{\partial t\partial x}\psi. \qquad (25)$$

Eq. (24) is the wave-mechanical form of the universal Newton's second law, whch is universal.

Eq. (25) is the wave mechanics expression of Newton's second law and is universal and is universal. The wave mechanics representations of various classical mechanical concepts and laws can form a complete system. With such a system of mechanical equations, it can no longer be denied that classical mechanics can be combined with wave mechanics.

The above discussion has already covered the four operations of operators. Eq. (22) and $m\hat{a}$ involve multiplication of "heavy partial derivatives" or/and operators, while Eq. (23) involves division of operators. The multiplication rule of operators is reflected in Eq. (25) (belonging to the rule of multiple derivatives). Please note that the value of ψ must be written in parentheses to indicate that $\frac{\partial}{\partial t}$ no longer directly acts on ψ. This is different from the high-order partial derivative rule. Especially the heavy partial derivatives with different independent variables. This is different from the high-order partial derivative rule. Especially for the heavy partial derivatives with different independent variables. The division rule of operators is to take the derivatives of the numerator and denominator separately, and then divide them. The relationship between Eqs. (20) and (21) reflects the operation rule of the square of the operator. As for the square root of operators, the situation is quite complex. The rules are left to mathematicians to formulate. This section has constituted a true wave mechanics that does not distinguish between "quantum" and "classical".

Using equation (3), we can obtain $\frac{p^2}{2m}\psi=-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi=T\psi$. For the electromagnetic potential energy function, $V=E/r$. We will first learn from Bohr and start by using the planetary model. Then transition to the Schrödinger method. In the planetary model of hydrogen atoms, the orbital angular momentum of electrons is $pvr=\hbar$. The orbital velocity of the first main layer electrons is $v=\alpha c$. Dividing all terms of Eq. (2) by the radius r, and considering the electron orbital angular momentum formula and orbital velocity formula here, we can obtain

$$c\alpha\hbar\frac{\partial^2}{\partial x^2}\psi-\frac{E}{r}\psi=F\psi. \qquad (26)$$

Among them, α is the fine structure constant.

In Eq. (1), the relationship between E and V is $V=2E$. In this way, $E/r=V/2r$. The three-dimensional form of Eq. (6) is

$$c\alpha\hbar\nabla^2\psi+\frac{V}{2r}\psi=F\psi. \qquad (27)$$

It is applicable to the 1s electron of hydrogen atom [See Eq. (24) in Section 6 for the shape applicable to all planetary models]. Due to the energy eigenvalue of hydrogen atoms being $E=-\frac{Ze^2}{2r}$, the equation becomes

$$c\alpha\hbar\nabla^2\psi - \frac{Ze^2}{2r^2}\psi = F\psi. \qquad (28)$$

The establishment of Eq. (26) is like Bohr's successful use of old quantum theory to describe the hydrogen atom, which is a preliminary success in the effort to "give wings of force" to wave mechanics. It can intuitively demonstrate that wave mechanics itself does not exclude classical mechanics. Reference [32] introduces a more concise export method.

5. Exploring the Physical Mechanism and Conditions of Quantization: Integrating Newtonian Gravity into the Quantum Mechanics Framework

After deriving a wave equation that incorporates force, solving this equation yields quantized force values—meaning wave mechanics equations that include force enable the quantization of "force" itself. The force in question can be either the Coulomb force or Newtonian gravity, indicating we have identified a mathematical approach to quantize Newtonian gravity. Notably, our method involves introducing force into the framework of "quantum" systems. Prior to this work, existing approaches focused on quantizing "force" as a standalone quantity, a strategy that required building entirely new theoretical systems. In contrast, our research strategy of embedding "force" into "quantum" systems focuses on incorporating force within the existing quantum mechanics framework, eliminating the need to construct an entirely new theoretical foundation.

The quantization derived from the Schrödinger equation is mathematically valid but provides no insight into the physical factors that determine quantization. Our goal in this section is to explore these underlying physical causes.

Equation (26) represents a wave equation that, to our knowledge, appears here for the first time in the scientific literature and can be used to calculate the force between electrons and atomic nuclei. Readers can conduct a simple verification: substitute the wave function from Equation (3) into Equation (26), select an arbitrary value for r, and compute the corresponding force F. For a more in-depth exercise, readers can solve Equation (28) using methods analogous to those employed for the hydrogen atom Schrödinger equation to calculate the quantized forces within a hydrogen atom.

When describing a Newtonian gravitational system, the potential energy is given by $V=-G\frac{Mm}{2r}$. Substituting this into Equation (27) yields:

$$-\frac{i\hbar}{m}\frac{\partial^2}{\partial t\partial x}\psi - \frac{G}{2}\frac{Mm}{r^2}\psi=F\psi. \qquad (29)$$

The derivation of the first term in Equation (29) proceeds as follows: Starting from Equation (1), the term is $-\frac{\hbar^2}{2mr}\frac{\partial^2}{\partial x^2}\psi$.

Using the classical centripetal force relation $mv^2/r=F$, we derive $r=mv^2/F$ with the operator $\hat{F}=-i\hbar\frac{\partial}{\partial t}\left[\frac{\partial}{\partial x}\right]$ and v^2 with the operator $\hat{v}^2=-\frac{\hbar^2}{m^2}\frac{\partial^2}{\partial x^2}$. Substituting these into the expression for $\hat{r}=-m\frac{\hbar^2}{m^2}\frac{\partial^2}{\partial x^2}\div\frac{\partial}{\partial t}\left[-i\hbar\frac{\partial}{\partial x}\right]$.

Solving Equation (26) yields quantized Newtonian gravity. While Equation (29) significantly expands the applicability of the wave equation, it also increases the complexity of finding solutions. Similar to the hydrogen atom Schrödinger equation, solving Equation (29) produces a $1/n^2$ coefficient, a result that mathematically permits quantization. However, the physical validity of this quantization depends on whether the system meets specific conditions. Crucially, this is not the Sommerfeld quantization condition; instead, quantization occurs strictly and realistically only when the described object is a particle with the smallest unit charge or the smallest unit mass.

Eq. (26) incorporates a wave function and bears striking resemblance to the Schrödinger equation for hydrogen atoms. Notably, it constitutes a force-inclusive wave equation, demonstrating that wave formalisms do not preclude the applicability of Newton's second law $F=ma$. This allows for a dual description of particle motion using both wave equations and classical mechanical frameworks, opening avenues for collaborative exploration of additional applications.

The Schrödinger equation for hydrogen atoms can alternatively be derived via calculus from the planetary model, leveraging the total energy relation $T+V=E$ (refer to Section 4). Building on this, the Wigner-Stone theorem—utilizing unitary operators $U(\alpha)$ in Hilbert space and the principle of energy conservation—extends the hydrogen atom Schrödinger equation to all atomic and molecular systems. This generalizable approach is also applicable to force-containing wave mechanics equations: for the hydrogen atom Schrödinger equation, dividing all terms in the energy conservation relation by the force distance r yields a force equilibrium equation. In this sense, the derivation of Eq. (26) establishes quantum mechanics as a truly mechanical framework.

The classical impulse theorem is expressed as $Ft=\Delta p$, where $\Delta p = mv_2 - mv_1$. Combining this with Eq. (12), we derive:

$$I = Ft = -\frac{i\hbar}{m}\frac{\partial}{\partial x_1}\psi_1 + \frac{i\hbar}{m}\frac{\partial}{\partial x_2}\psi_2. \qquad (30)$$

Eqs. (30) and (12) collectively confirm that Newton's third law can be formulated within the wave mechanics paradigm. Subsequently, we will analyze the factors influencing quantization (i.e., the physical conditions necessary for quantization) and endeavor to develop a quantum formalism for Newtonian gravity.

Eq. (1) is the single particle stationary Schrödinger equation and cannot describe macroscopic circuit quantum effects. If j atomic nuclei are arranged in a charged parallel plate (or equivalent to a sphere), theoretically, the potential energy of an electron far away from it is $\frac{\sum_1^i Z_i e_i e}{4\pi\varepsilon_0 r}$. The idealized Schrödinger equation is

$$-\frac{\hbar^2}{2\sum_1^i m_i}\frac{\partial^2}{\partial x^2}\psi - \frac{e\sum_1^i Z_i e_i}{4\pi\varepsilon_0 r}\psi = \mathrm{E}\psi.$$

The actual situation is even more complex (the shielding of inner layer electrons must be considered). Taking metals as an example, only the collective of free electrons in the energy band can be used for approximate calculations. The nuclear charge shielded by the inner layer electrons needs to be reduced. If the total number of inner electrons is i, the total potential energy of free electrons in the band is $\frac{(\sum_i^j e_k)(\sum_1^j Z_j e - \sum_1^i e_i)}{4\pi\varepsilon_0 r}$. The sum of the masses of $j-i$ free electrons in the metal band is $\sum_i^j m_k$, (k=i-j). For macroscopic systems, r is a macroscopic distance that can ignore the distance between electrons in different energy levels and an infinitely charged parallel plate (or a positively charged metal sphere). In this way, the approximate Schrödinger equation for the group of free electrons in the metal band is

$$-\frac{\hbar^2}{2\sum_i^j m_k}\frac{\partial^2}{\partial x^2}\psi - \frac{(\sum_i^j e_k)(\sum_1^j Z_j e - \sum_1^i e_i)}{4\pi\varepsilon_0 r}\psi = E\psi. \qquad (31)$$

This is the case for elemental metals. The situation is slightly more complex for non elemental mixed metals, but similar equations can still be used. But this approximate equation still has the following solution

$$E_n = -\frac{\left[(\sum_i^j e_k)(\sum_1^j Z_j e - \sum_1^i e_i)\right]^2}{(4\pi\varepsilon_0)^2}\frac{\sum_i^j m_k}{2\hbar^2}\frac{1}{n^2}. \qquad (32)$$

The energy quantization solution derived in Equation (32) can be extended to the macroscopic scale. When the term $2\times 1836\sum_1^i m_i$ reaches a macroscopic mass magnitude, Equation (32) describes the energy quantization of collective electrons within the energy bands of macroscopic conductors. This demonstrates that Equation (32) can at least approximately account for the 2025 Nobel Prize in Physics-winning discovery: energy quantization in macroscopic circuits. This is a macroscopic quantum phenomenon arising under conditions where atomic nuclei or electrons are neatly arranged in the "energy band" regions of metals, relatively far from their parent nuclei. The requirements for macroscopic energy quantization are highly stringent, involving specific material properties, ultra-low temperatures, and minimal dissipation.

Equations (31) and (32) hold practical significance: they not only characterize the macroscopic quantization observed in the 2025 Nobel Prize-winning work but also provide a framework to explore the quantization of Newtonian gravity. Notably, Equation (31) offers a simpler, more pragmatic alternative to second quantization methods, provided multiple particles meet the synchronized transition criteria.

The energy eigenvalues of the Schrödinger equation for hydrogen atoms are given by:

$$E_n = -\frac{Z^2 e^4}{(4\pi\varepsilon_0)^2}\frac{m}{2\hbar^2}\frac{1}{n^2}. \qquad (33)$$

While this solution yields the mathematical form of energy quantization, it does not explicitly reveal the physical mechanisms driving quantization. From a physical realism perspective, the quantization of electromagnetic interaction energy is fundamentally determined by the existence of a minimal charge unit—most commonly the electron. Stepwise electron transitions lead to discrete changes in energy, representing one form of energy quantization. Extending this quantization from individual electrons to macroscopic electromagnetic interactions requires the strict condition of synchronized collective electron transitions.

Energy quantization for photons differs from that of electrons. Unlike electrons, photons do not require a "minimum existence" condition (only that fractional or incomplete photons of any given type are absent). As long as photons are added or removed as discrete, whole units (e.g., no half-photons or third-photons), the resulting energy changes are inherently quantized. From Equation (33), we can identify the key determinants of energy: nuclear charge number, electron charge magnitude, electron mass, and the principal quantum number *n*).

When matter reaches a macroscopic state of disordered atomic distribution—where electrons and nuclei are randomly arranged—the nuclear constraints on individual electrons become extremely complex. Electrons close to inner electron shells will also be influenced by these randomly distributed particles. This makes precise calculation of the term $(\sum_i^j e_k)(\sum_1^j Z_j e - \sum_1^i e_i)$ infeasible, as the system cannot be accurately described by the standard Schrödinger equation. In such cases, whether considering a single electron or a collective of billions, does clear energy quantization still emerge? (Notably, quantization defined by the principal quantum number is disrupted, as observed in the molecular spectra of complex molecules.)

This indicates that energy quantization in a system of numerous atoms depends on three key factors: the arrangement of atomic nuclei, the concentration of "relatively free electrons," and their distance from the nuclei. A fundamental prerequisite for quantization—both in physical reality and theoretical frameworks—is the existence of a minimum energy unit (i.e., a particle carrying the smallest possible energy). Such particles (often bosons) ensure that energy increases incrementally, one particle at a time, giving rise to quantization. This logic extends to gravitational quantization, which would require the existence of a minimum mass unit particle—a key insight derived from this analysis of energy quantization conditions.

Theoretically, the solution to Eq. (29) can reflect the quantization of electromagnetic force. However, practical validity demands that the smallest charge unit corresponds to a single elementary charge. If we strictly control conditions to create a scenario where "multiple electrons detach from a relatively concentrated atom," a state analogous to that described by Eq. (32) could emerge, enabling macroscopic electromagnetic quantization.

Rewriting the solutions of Eqs. (28) and (29) in a form similar to Eqs. (32) and (33) could theoretically describe the quantization of Newtonian gravity. While solving Eq. (29) allows for "mathematical consistency of Newtonian gravity quantization," the microscopic realization of gravitational quantization appears to require gravitons (the hypothetical smallest carriers of gravitational force) or a fundamental minimum mass unit. To express macroscopic gravitational quantization using the solution of Eq. (29), interacting objects must exchange discrete collections of mass units or gravitons, propagating gravitational interactions in quantized "waves."

Evidently, force quantization in classical systems includes at least two forms: gravitational quantization within Newtonian mechanics and electromagnetic quantization within electrodynamics. This discussion does not encompass gravitational quantization as framed by quantum field theory or general relativity.

If the electron is not the fundamental unit of mass, then applying Eqs. (28) and (29) requires identifying a particle with the smallest possible mass. This is essential to ensure the quantized, step-like variation of mass and gravity—without such a fundamental unit, explaining discrete changes in these properties becomes theoretically inconsistent.

According to quantum field theory, the current candidate for this minimal mass unit is the graviton, whose mass can be derived from its equivalent energy. If a sufficiently large ensemble of these gravitons could be made to oscillate in a coherent, synchronized manner, macroscopic manifestations of quantized Newtonian gravity might occasionally be observable.

As noted earlier, quantizing gravity in principle follows the same logic as microscopic energy quantization via the Schrödinger equation: by solving wave-mechanical equations that incorporate gravitational interactions. However, practical realization of quantized Newtonian gravity demands specific, rarely achievable conditions. As a result, this concept remains largely a mathematical possibility with little tangible relevance to real-world physics. From a physical realism perspective, a critical prerequisite for gravitational quantization is the existence of a fundamental particle that mediates gravity—such as the graviton. This parallels the role of the elementary charge in explaining the quantization of electron energy, a well-established concept in quantum mechanics.

6. Results of Disturbed Electron Diffraction Experiments

Experimental Report

Experiment Name

Electron Diffraction Under Magnetic and Optical Interference (Electron Diffraction Robustness Experiment). For brevity, this experiment is hereafter referred to as the Tu Electron Diffraction Experiment.

Experimental Objective

The experiment aims to observe how electron diffraction patterns change under the influence of visible light and magnetic fields, thereby probing the motion characteristics and behavioral laws of electrons.

In photon double-slit diffraction experiments, a well-documented phenomenon occurs: activating a detector to measure which slit a photon passes through destroys the interference fringes. This is typically interpreted as observation-induced quantum decoherence or wavefunction collapse, a model predicated on the assumption that quantum properties are extremely fragile and lack robustness. While the origins of this experiment are known, no analogous studies have been conducted using electrons. Existing research on delayed-choice quantum erasure (e.g., Ref. [24]) relies solely on photons and only indirectly validates the impact of observation on diffraction. To address this gap, we designed and executed a direct experiment to test the robustness of electron diffraction—and by extension, the validity of the quantum decoherence framework.

Our approach stems from a reluctance to uncritically accept mainstream viewpoints that conflict with intuitive physical reasoning. Thus, we developed an unambiguous experimental protocol to rigorously verify this widely accepted but untested hypothesis.

Experimental Instruments and Tools

Electron diffractometer, high-strength permanent magnet, flashlight.

Experimental Procedures

(1) Power on the electron diffractometer and adjust it to the optimal state for observing diffraction patterns.

(2) Scenario A: Manipulate a high-strength permanent magnet near the electron beam exit to interfere with diffraction, and record changes in the diffraction pattern.

(3) Scenario B: Illuminate the electron beam path with visible light and observe any potential changes to the diffraction pattern.

Experimental Phenomena

Scenario A: As the permanent magnet interacts with the electron beam, the diffraction fringes undergo overall deformation and lateral displacement along the direction of the magnetic force, but the diffraction pattern itself does not disappear (see Fig. 3).

Scenario B: Visible light irradiation has no observable effect on the electron diffraction pattern.

Phenomenological Inferences

(i) Correspondence with Classical Electrodynamics: Similar to J.J. Thomson's cathode ray deflection experiment, where electron beams follow the Newtonian mechanics law $F=ma$, the lateral displacement of diffraction fringes in this experiment confirms that electrons also experience force-induced deflection consistent with classical dynamics. This experiment can be analogized to a cathode ray tube with a built-in slit, where the observed deflection aligns with the force-bias mechanism illustrated in Fig. 4.

(ii) Quantum Coherence Preservation: The persistence of the diffraction pattern despite magnetic interference indicates that quantum decoherence does not occur during the experiment. Electrons remain in a quantum-mechanical state, retaining their wave-particle duality.

(iii) Simultaneous Wave-Particle Manifestation: The observation that electrons undergo longitudinal force-induced motion while still producing diffraction patterns demonstrates that particles with wave-particle duality can exhibit both particle-like (force response) and wave-like (diffraction) properties simultaneously.

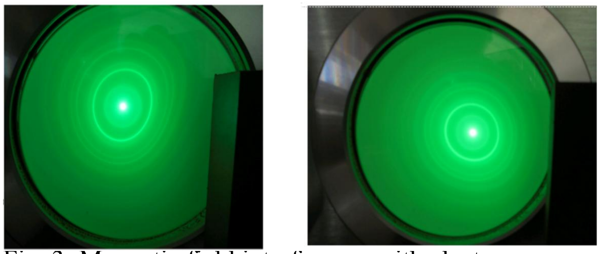

Fig. 3: Magnetic field interference with electron diffraction. The electron beam undergoes lateral displacement along the force direction, causing overall deformation and movement of diffraction fringes without pattern disappearance. This confirms the simultaneous manifestation of particle characteristics and wave behavior during electron diffraction.

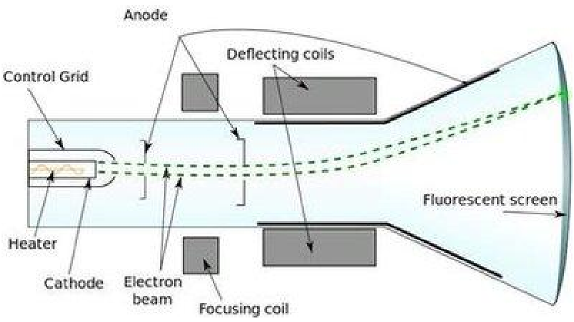

Fig. 4: Schematic diagram of J.J. Thomson's cathode ray deflection experiment principle. Image source: https://p0.ssl.qhimgs1.com/sdr/400/t0136f39cb9fcded8d0.jpg

Tu’s electron diffraction experiment provides unambiguous evidence that electron diffraction exhibits strong anti-interference robustness—a quantum property of electrons. Since supervised interference failed to disrupt this quantum behavior, it follows that such interference does not induce quantum decoherence (or superposition collapse). This finding suggests that measurements of microscopic particles may not always result in collapsed states; at least a significant portion of these states reflect the particles’ "original existence."

These conclusions compel a reevaluation of the double-slit diffraction experiment involving photons with monitoring devices. One plausible alternative explanation is that unmonitored light passing through a slit generates secondary wavelets in accordance with Huygens' principle, which then interfere to produce diffraction patterns. However, when monitored (e.g., via photon detection), Huygens' principle is disrupted, eliminating observable diffraction.

Extending this logic, Tu's experiment implies that neither quantum superposition nor superposition collapse may occur—or even exist—during electron penetration. This calls into question fundamental quantum mechanics constructs, including the processes of quantum superposition, superposition collapse, and decoherence, as well as Bohr's principle of complementarity between the wave and particle properties of moving particles. Importantly, this reexamination does not reject the mathematical framework of quantum mechanics; rather, it highlights that moving particles can simultaneously exhibit classical particle characteristics (e.g., conforming to F=ma) and wave characteristics (*e.g.*, obeying diffraction laws) in simple, stable, and unambiguous diffraction experiments.

Tu's experiment directly demonstrates that moving particles can manifest both particle size and wave behavior concurrently, alongside classical particle traits such as orbital displacement and adherence to Newtonian mechanics. By experimentally verifying the simultaneous coexistence of classical and wave properties in moving particles, this work provides empirical proof of the compatibility of wave mechanics and classical mechanics—a conclusion previously supported by both theoretical and practical analyses.

The phenomena depicted in Figures 1 and 2 can be observed concurrently in a single experiment using identical instrumentation. Specifically, the classical particle-like behavior of electron beams—their deflection in a magnetic field—and the quantum wave-like behavior of electron diffraction through a slit can be demonstrated simultaneously. This coexistence of classical and quantum properties within the same system provides direct evidence for the compatibility of classical mechanics and quantum mechanics, showing that the laws governing both frameworks can operate in tandem on the same physical object.

Tu's electron diffraction experiment reveals an exceptional robustness in the diffraction characteristics of electrons against environmental interference. This outcome carries two profound implications: either measurements or observations do not induce the decoherence of electrons' quantum properties into classical behavior, or the various collapse processes posited in interpretations of quantum mechanics are not physically real. Instead, the results support the notion that electron diffraction is an intrinsic property of the particles themselves, rather than a consequence of wave function collapse. Furthermore, the experiment challenges the idea that microscopic particles exhibit "non-real" behavior during diffraction; instead, it suggests that no collapse occurs as a result of observation, and the observed state corresponds to the objective physical reality of the particles. These findings strongly reinforce the perspective that macroscopic objects described by classical mechanics possess tangible reality, and that quantum mechanics is fundamentally compatible with classical mechanics.

Based on this paper's theoretical conclusion that quantum mechanics and classical mechanics are compatible, along with experimental evidence from magnetic-field single-slit electron diffraction and photon interference, we assert that wavefunction collapse and quantum decoherence are not physical realities. From this foundation, we derive the following testable predictions:

Prediction 1

A magnetic-field double-slit superposition experiment will yield two key results:

The deflection of electron beams carrying diffraction information strictly follows the laws of classical electrodynamics and Newton's second law.

The electron diffraction pattern will undergo positional shift and deformation, but will not vanish due to interference effects. This prediction directly validates two core claims: (1) "non-reality" and "quantum superposition phenomena" do not exist; (2) moving particles can exhibit both particle-like and wave-like properties simultaneously.

The experimental protocol for this magnetic-field double-slit superposition test must include four defining features:

Conduct the electron diffraction experiment within a magnetic field (integrating Thomson's cathode ray deflection experiment and electron diffraction into a single magnetic-field apparatus);

Use two side-by-side slits as the diffraction aperture;

Employ two electron emission modes: sequential single-electron passage through the slits, and simultaneous multi-electron passage;

First perform single-slit experiments by covering one slit at a time, accumulating electron impacts on the same screen, then conduct the double-slit experiment. The resulting diffraction fringes represent a combination of particle accumulation and wave interference effects. These four characteristics constitute both the experimental design and the observable outcomes of Prediction 1.

Prediction 2

Secondary diffraction patterns can be obtained in a double-stage electron diffraction experiment. This experiment involves drilling a small aperture or slit at the center of the receiving screen from the first diffraction, which then serves as the aperture for the second diffraction stage.

Prediction 3

Electron beams deflected by a magnetic field will still produce diffraction patterns after passing through a slit. This integrated experiment combines Thomson's cathode ray deflection with electron diffraction, demonstrating that magnetic deflection does not eliminate the wave nature of electrons.

Prediction 4

When a cathode ray tube is modified into a compact cyclotron, the emitted electron beam—presumed to undergo quantum decoherence—will still produce diffraction patterns after passing through a slit, and will exhibit quantum tunneling behavior when encountering a potential barrier.

If experiments can validate the four aforementioned predictions, then these verifications, combined with the results of Tu's electron diffraction experiment, will demonstrate that we cannot dismiss the "intrinsic existence" of microscopic particles. Moreover, they will refute the claim that "all experiments confirm the validity of quantum mechanics interpretations." It is thus evident that experiments to test these predictions are of critical importance.

The experiment in question is Tu's electron diffraction study under magnetic field interference. Its results revealed that magnetic field interference applied after the slit did not eliminate the diffraction fringes, but merely altered their shape. Diffraction patterns of microscopic particles arise from the slits' influence on particle motion—this is confirmed by the absence of fringes when slits are removed. The fact that magnetic field interference behind the slit did not erase the fringes clearly indicates that the slits' impact on the particles persists.

Tu's experiment proved that interfering with electrons after they passed through the slit (functionally equivalent to post-slit monitoring) did not negate the slits' effect on the electrons' propagation. This holds true for single-slit diffraction, and double-slit diffraction would not differ in principle. Notably, there exists no formal, citable experimental report to support the assertion that "monitoring (interfering with) particles either before or after the slit will cause diffraction fringes to disappear." AI systems cannot locate such reports, suggesting no successful experiments of this kind have ever been conducted. This casts doubt on the validity of the assertion, which also directly violates the causal principle that "the present shapes the future." Placing a "monitoring" device behind the slit means the electron has already traversed the slit; if interference from instruments or fields downstream could erase the fringes, it would imply that "current actions can alter the historical trajectory of electrons passing through the slit in the past."

7. Conclusion and Discussion

The composition, structure, and functional logic of the Schrödinger equation underpin the integration of quantum mechanics and classical mechanics. This integration gives rise to a wave mechanical framework that incorporates force, a suite of mechanical quantities, and a wave-mechanical representation of classical mechanical laws. In turn, this framework establishes a novel theoretical system: general wave mechanics.

How does general wave mechanics describe the hydrogen atom? And if we adopt a planetary model, how can we resolve its long-standing stability issue? After all, resolving this stability problem would reopen the door for applying planetary models in the microscopic realm. Notably, the planetary model effectively describes the 1s electrons of hydrogen and over a hundred other elements—a consistency too pervasive to dismiss as mere coincidence.

Our approach begins with a foundational acknowledgment: electrons in hydrogen atoms do not emit electromagnetic radiation outward. In scientific inquiry, observed facts can be directly leveraged even when their underlying mechanisms remain unclear. For instance, the origins of electron spin and its associated magnetic moment are not fully understood, yet this phenomenon is universally utilized as an established fact. The next step is to explain this observed stability. Invoking "unknown exotic mechanisms" or "unidentified motion patterns" amounts to no explanation at all—making agnostic frameworks that reject planetary models no more compelling than the models they seek to replace. Thus, we start by accepting and utilizing the observed stability of hydrogen atoms; ideally, we can also provide a theoretical explanation for it.

From the perspective of a novel theory of electronic structure, we propose an account of the origin of the electron spin magnetic moment while circumventing the stability paradox inherent in the planetary model. Turning to "quantization" and the "tunneling effect," we argue that both phenomena emerge as amplified characteristics when the scale of microscopic particles shrinks. For example, because electrons are the smallest charged elementary particles, the incremental addition of electrons leads to discrete, stepwise increases in energy—a process that inherently exhibits quantization as long as electrons retain their status as the smallest charged entities. Similarly, all materials contain substantial gaps between their constituent atoms. Electrons, being far smaller than these gaps, can traverse them with ease, whereas larger macroscopic objects cannot. The tunneling effect is therefore not a violation of macroscopic rules but an accentuation of them: as particles diminish in size, their ability to pass through relatively large gaps becomes pronounced, adhering to the fundamental principle that small objects can traverse gaps inaccessible to larger ones.

Classical mechanics and quantum mechanics are compatible, laying the foundation for the establishment of a general wave mechanics framework. Two core questions inevitably arise in this context: first, how to resolve the apparent contradiction between quantum probability and the stability and determinism inherent in classical mechanics; second, how to achieve coordination or unification of quantization principles across both "classical" and "quantum" domains. These questions are not only worthy of in-depth exploration but also unavoidable for advancing our understanding of the physical world.

To address the first question, we begin by examining the composition, structure, and functional significance of Equation (1), the steady-state Schrödinger equation, along with its connections to fundamental laws of classical mechanics. By computing the partial derivatives of each term in Equation (1), we derive the form: $\frac{p^2}{2m}\frac{\partial^2}{\partial x^2}\psi+V\psi=E\psi$.

Substituting $\frac{p^2}{2m}=T$ (where T represents kinetic energy), this simplifies to:

$$T\psi+V\psi=E\psi. \qquad (34)$$

Canceling the wave function ψ from both sides yields $T + V = E$, a well-known expression of the Virial theorem. Notably, the Virial theorem applies to both microscopic and macroscopic systems. According to the principle of least action, in macroscopic systems, steady-state systems satisfying the Virial theorem correspond to planetary model systems—constrained systems where orbiting objects undergo uniform circular motion. There is no compelling theoretical basis to argue that "the principle of least action fails in the microscopic world, or that the validity of the Virial theorem does not depend on the planetary model structure." Logically, therefore, it is difficult to reject the applicability of the planetary model in the context of the steady-state Schrödinger equation.

Supplementary Material A outlines the derivation of the Schrödinger equation from classical mechanical principles. Combined with the above analysis, this demonstrates that the Schrödinger equation can be transformed into both the classical force equation $F=ma$ and the Virial theorem. This provides a key theoretical proof that "quantum" and "classical" frameworks are compatible and integrable.

Tu’s electron diffraction experiment further supports this compatibility by demonstrating the strong robustness of electron diffraction characteristics. This result challenges core quantum concepts such as quantum state superposition, uncertainty, and quantum decoherence (including wave function collapse or wave packet spreading). Importantly, direct experimental verification for these concepts remains lacking, while counterevidence—such as Tu’s experiment—has emerged. The ability to express classical mechanical laws using wave mechanics, and the potential to build a general wave mechanics system upon this foundation, positions Tu’s experiment as a critical link in the "theoretical-practical-experimental evidence chain" supporting the unification of quantum and classical mechanics. If researchers with the necessary resources can verify our predictions (1–4), the conclusions presented here will be further validated and strengthened.

The compatibility of quantum mechanics and classical mechanics is poised to give rise to a generalized wave mechanics framework, though several lingering issues require resolution. These include the applicability of particle concepts; the utility of speed and acceleration descriptors; and the maintenance of spacetime symmetry—specifically, the invariance of physical laws under Lorentz transformations.

Quantum mechanics does not outright reject classical notions of center of mass and point particles. For instance, the electron cloud can be interpreted as a distribution of spatial points where the center of mass (or "particle" locus) of an extranuclear electron has manifested or is likely to manifest. In this sense, the concepts of electron cloud and probability density inherently incorporate classical center-of-mass and particle frameworks. Quantum mechanics also retains velocity-related concepts, such as the phase and group velocities of de Broglie waves, and particle momentum, which explicitly depends on velocity.

Given the simultaneous use of velocity and particle concepts, a realist perspective demands that particle motion conform to the fundamental relation $s=vt$—assuming extranuclear electrons do not teleport discretely between points, implying continuous physical displacement. The second derivative of $s=vt$ with respect to time yields a non-zero acceleration. While this acceleration may not require a force-induced cause, its mathematical and physical existence cannot be arbitrarily negated.

In essence, unifying Newtonian mechanics with quantum mechanics would require two key adjustments: Newtonian mechanics must adapt to the quantization of physical reality, while quantum mechanics must revise its rejection of inherent microscopic particle properties. A compelling proof of their compatibility lies in successful practical applications that already integrate both frameworks [23-26]. The fruitful combination of quantum mechanics and special relativity (exemplified by Dirac's theory) further suggests that unifying quantum mechanics with Newtonian principles is not an insurmountable challenge.

We will now explore how this interpretation of the Aspect experiment impacts the foundational premises and core concepts of quantum mechanical explanation.

We first need to clarify the definition of "original existence": The "Original Being" essentially refers to "Primordial Existence," a philosophical concept denoting the starting point or fundamental state of existence itself. It represents an objective reality that existed prior to human observation, or an objective, tangible, and relatively stable entity that emerged before being subjected to destructive interference. It is independent of environmental or external influences and cannot be altered by human consciousness. Entities at the starting point of a specific stage can be termed "relative primordial existence" or "stage-specific primordial existence."

Below is an analysis of why the double-slit diffraction experiment and the Aspect experiment cannot conclusively refute local realism:

The core premise of the existing quantum mechanics interpretation system hinges on the denial of the "Original Existence of Microscopic Particles" (DOEMP). While DOEMP serves as a foundational assumption for quantum mechanics' explanatory framework, the mathematical structure of quantum mechanics does not rely on this premise. The mathematical system of quantum mechanics is built upon the Schrödinger equation and the Dirac equation. Although contemporary discourse often frames it as rooted in Hilbert spaces and group theory, the early development of quantum mechanics by Schrödinger, Heisenberg, and Dirac did not directly employ these mathematical tools. The theoretical framework of quantum mechanics was established through logical deduction, meaning its logical structure does not require DOEMP. This is also reflected in quantum mechanics textbooks, which focus on the logical framework and rarely mention DOEMP.

DOEMP only comes into play when interpreting quantum mechanical phenomena, yet it is never explicitly identified as a fundamental premise of the theory. Over generations of knowledge transmission, few quantum mechanics students or researchers are aware that DOEMP was once a foundational assumption of the field—even those who know of it do not recognize its foundational role, instead embracing the principle of superposition. In short, quantum scholars rarely consciously articulate or reflect on DOEMP (it often remains in the realm of subconscious assumption). During his debates with Bohr, Einstein even occasionally overlooked DOEMP and required reminders from Bohr. Today, proponents of non-local realist quantum mechanics intentionally avoid discussing DOEMP, largely because it cannot be directly experimentally verified, and repeated scrutiny would undermine the coherence of quantum mechanics.

Notably, interpreting the results of the Aspect experiment also relies on DOEMP. Since DOEMP itself lacks experimental validation, this constitutes a critical logical flaw in the Aspect experiment's ability to refute local realism.

The Definitive Observer Effect Measurement Premise (DOEMP) only operates when interpreting quantum mechanical phenomena, yet it is never explicitly designated as a foundational premise of the theory. Across generations of knowledge transmission, few students or researchers of quantum mechanics are aware that DOEMP once served as a bedrock assumption of the field—even those who have heard of it fail to recognize its foundational role, instead prioritizing the principle of superposition. In short, quantum scholars rarely consciously articulate or reflect on DOEMP, which often lingers as an unspoken, subconscious assumption. Even Einstein, during his famous debates with Bohr, occasionally overlooked DOEMP and required reminders from his counterpart. Today, proponents of non-local realist quantum mechanics intentionally avoid discussing DOEMP, largely because it cannot be directly experimentally verified; repeated scrutiny would threaten the internal coherence of quantum mechanics as currently formulated.

Notably, interpreting the results of the Aspect experiment also relies on DOEMP. Since DOEMP itself lacks experimental validation, this creates a critical logical flaw in the experiment's purported ability to refute local realism.

Curiously, this unvalidated DOEMP is almost always employed implicitly, never cited as a fundamental premise when explaining quantum mechanics. Advocates of non-local realist quantum mechanics may argue that while DOEMP has not been directly confirmed by experiments, practical applications and extensive experimental work have indirectly validated quantum mechanics as a whole, thereby indirectly supporting DOEMP. However, this line of reasoning is flawed. The reality is that all quantum mechanics experiments are interpreted through the lens of DOEMP, as exemplified by the Aspect experiment.

The claim that "engineering applications or production practices have proven the correctness of quantum mechanics" is also not rigorous. Even without the formal development of quantum mechanics theory, modern electronic devices and communication technologies would likely have evolved along similar paths. Engineering applications only reflect the observable outcomes of quantum superposition collapse; they cannot capture the dual processes of state superposition and collapse themselves. These paired, opposing processes exist only in subjective interpretation—one might even argue they do not exist at all. It is entirely plausible that the postulated collapse process was constructed to compensate for the hypothetical nature of superposition, especially since neither process can be directly verified. If the superposition process is fundamentally invalid, the collapse mechanism becomes a necessary ad hoc fix to align theoretical predictions with measured reality.

Furthermore, engineering designs are guided by the mathematical framework of quantum mechanics, not its interpretive system. Even so-called "quantum communication" relies on photon transmission, not the purported characteristics of quantum entanglement. Taken together, these observations demonstrate that the claim DOEMP has been "indirectly proven" is deeply unsubstantiated.

Some might argue that Einstein lost his famous debates with Bohr. A closer analysis, however, reveals that Einstein did not lose—he fell into a trap. Influenced by the prevailing intellectual climate, he accepted the DOEMP (Distinctly Observable Experimental Measurement Premise) framework, and thus debated Bohr on shared DOEMP assumptions. Their core disagreement centered on whether the "spooky action at a distance" entanglement effect relies on logical connections: Einstein insisted such connections must exist (otherwise quantum mechanics would be incomplete), while Bohr argued they did not.

Logically, however, if one accepts DOEMP, there is no need for logical underpinnings to explain long-range entanglement. Within the DOEMP framework, Einstein's concerns were therefore unfounded. Notably, the Aspect experiment was irrelevant to their debate and cannot resolve who was right. In essence, Einstein sought to refine quantum mechanics into a more complete theory by using rigorous reasoning to validate the flawed DOEMP premise—but his effort failed, leaving him marginalized. Bohr, by contrast, embraced DOEMP unconditionally and was celebrated for it.

The DOEMP-based framework is rife with misleading and deceptive practices:

● It claims that before measurement, microscopic particles have uncertain composition, structure, spin, and motion, with some properties existing in a "superposition state."

●It refuses to acknowledge that localized, deterministic measurement results reflect the inherent reality of microscopic systems, instead asserting that measurement itself "collapses" the particle's objective state.

●It rejects classical interpretations even when physical quantities are measured precisely: for example, while it accepts the magnetic moment caused by particle spin, it denies that this spin involves classical rotational motion.

Such paradoxical reasoning is unprecedented in the history of scientific inquiry—unique to quantum mechanics. The superposition-collapse construct further blocks experimental verification of these claims, meaning the DOEMP premise itself and the practices it entails have never been directly validated. This makes them highly susceptible to charges of sophistry and deception.

Next, we turn to the double-slit diffraction experiment. The Copenhagen interpretation is not the only explanation for the double-slit diffraction phenomenon. There are four prominent interpretations that acknowledge or support the reality of particle diffraction (**see table 1**).

Table 1. Realistic Explanation of Double slit Diffraction Experiment

No	**Explanation method**	**Objective substantiality**	**Core mechanism**	**Answer to 'Which seam does the particle pass through'**
1	De Broglie Bohm	Both particles and guided waves are reality	Quantum potential guidance	There is a definite path, but it is affected by guided waves
2	Many worlds	All branches are reality	Cosmic wave function splitting	In all branches, each branch only passes through one seam
3	Decoherence	Decoherent states are classical states	Environmental entanglement leads to information leakage	Dependent on specific measurements and environmental factors

4	Ensemble	The statistical results are accurate	Collective statistical behavior	A single particle only passes through one, but the ensemble distribution shows interference

Next, we will explore the advantages of unifying classical and quantum frameworks to establish a generalized wave mechanics.

For a long time prior to the present paradigm, quantum mechanics and classical mechanics were regarded as incompatible and mutually exclusive. However, by demonstrating the compatibility between quantum and classical systems, we have proven that they can be integrated to describe both macroscopic and microscopic phenomena coherently. The resulting generalized wave mechanics, which reconciles classical and quantum principles, eliminates the false dichotomy between the two frameworks and aligns with the iterative evolution of scientific cognition. The progression from classical mechanics to quantum mechanics, and finally to a unified generalized wave mechanics, represents a profound advancement in our understanding of physical systems.

Crucially, this framework allows classical mechanical laws and additional classical physical quantities to be formulated within a wave equation formalism. This developmental process thus incorporates the validated achievements of both classical and quantum mechanics, while resolving (and in many cases eliminating) longstanding contradictions in contemporary quantum theory. In doing so, it enables a more comprehensive and profound understanding of both the macroscopic and microscopic worlds. Furthermore, by proposing a macroscopic quantization scheme for Newtonian gravity, this approach provides novel insights for advancing Einstein's program of gravitational quantization. These constitute the core advantages of the generalized wave mechanics presented in this work.**

The intrinsic state of microscopic particles is undefined (lacking a definite eigenstate) and is presumed to exist in an uncharacterized quantum coherent state—encompassing both quantum superposition and entanglement.

Coherent states are inherently fragile: any external interaction triggers quantum decoherence, a process where superposed or entangled states "collapse" into macroscopic states that align with classical mechanics. This parallels how a small flame is easily extinguished by strong winds in everyday experience.

Auxiliary Requirements (Validated by Aspect-Type Bell Inequality Experiments)

For experiments testing Bell's inequality (such as Aspect's landmark study) to hold meaning, three conditions must be satisfied:

Rejection of the notion that microscopic particles possess predefined intrinsic states (a philosophical restatement of Core Premise 1);

Acceptance that free microscopic particles exhibit quantum coherence and superposition states of entirely unknown nature;

Confirmation that quantum entanglement and coherence can be artificially engineered.

Notably, these premises and requirements are not directly observable through experimental methods. What experiments actually detect are the definite eigenstates of microscopic particles. The processes of decoherence, entanglement collapse, and superposition collapse—posited to bridge Core Premise 1 with observed deterministic states—remain theoretical constructs rather than empirical facts.

Crucially, the entire edifice of quantum mechanics' existing interpretive framework hinges on the validity of Core Premise 1. Should this premise be disproven, the framework would unravel entirely. Significantly, evidence and reasoning have emerged to suggest that Core Premise 1 does not reflect physical reality.

We have identified a critical oversight in the analysis of microscopic particle diffraction experiments: the impacts of particle beam formation, focusing, collimation, and slit-induced interference on particle states. Notably, all microscopic particle diffraction experiments involve at least two of these influencing processes.

Take electron diffraction as an example. The experiment begins with a strong electric field extracting electrons from a metal cathode to form an electron beam, which is then collimated via an electromagnetic field. Importantly, electrons interact with intense electromagnetic fields before reaching the diffraction slit. Based on Premise 2, electrons must remain in a state of quantum decoherence—exhibiting properties analogous to macroscopic objects—throughout the entire process. Rejecting this conclusion would directly contradict Premise 2, and selectively applying scientific principles based on self-interest violates the fundamental spirit of science.

The Tu experiment introduces an additional layer of complexity by applying strong magnetic field interference after the slit. This makes it even more likely that electrons maintained a quantum decoherent, macroscopic-like state throughout the entire experimental procedure.

Results from single-particle double-slit diffraction experiments further reinforce this conclusion: after passing through the slit, a single particle produces only one bright spot on the fluorescent screen, not multiple spots. To argue otherwise would require assuming that the slit splits a single electron into two halves, which then spontaneously recombine after passing through the slit—a hypothesis that defies both particle physics fundamentals and basic common sense. This observation strongly supports the claim that "particles remain in a classical, quantum-decoherent state throughout diffraction experiments."

In Yang's double-slit diffraction experiment, the emergence of diffraction fringes is taken as evidence of diffraction itself. Following this line of reasoning, attempts have been made to uncover the mechanism behind single-particle double-slit diffraction. Yet, counter to conventional intuition, no plausible physical mechanism has been identified despite extensive efforts. This has led to a highly counterintuitive proposition: a single particle can split as it passes through a slit (or a single electron can traverse both slits simultaneously).

Further, it is argued that this apparent "cloning" of a single particle stems from the notion that microscopic particles lack a definite inherent state—meaning they do not occupy a defined eigenstate prior to measurement, but instead exist in an indeterminate state. Here, the reasoning conflates "unknown" with "non-existent," forming the basis for Premise 1 and its associated requirements. This line of argument carries excessive subjective bias, and the core issue cannot be adequately resolved within the existing theoretical framework.

This impasse arises because Premise 2 dictates that quantum coherent states (encompassing quantum superposition and quantum entanglement, as outlined in Premise 1) cannot be directly verified experimentally. Experiments such as the Aspect experiment, designed to test Bell's theorem, rely on instruments to produce particles in quantum coherent states. In other words, these experiments artificially generate quantum entangled particles and/or particles in quantum superposition. However, this creates a fundamental contradiction: Premise 2 holds that quantum coherent states are fragile and easily disrupted by measurement instruments, yet the same instruments are purported to create such states. The assertion that "entangled photons can maintain quantum entanglement after passing through a beam splitter" directly exemplifies this contradiction.

To illustrate this inconsistency more clearly, consider a matchstick analogy:

Premise 2 is akin to a small flame being extinguished by strong winds—just as it is nearly impossible to light a match by striking its phosphorus head in gale-force winds, artificially creating quantum coherent particles using instruments should be equally unfeasible.

Is Premise 1 a reflection of physical reality? Do particles with the hypothesized quantum coherent states and "quantum superposition" actually exist? The answer is that no direct experimental confirmation exists. Even if such particles did exist, they could not be artificially produced.

For over a century, the prevailing interpretations of quantum mechanics have remained a source of profound confusion. This is rooted in inherent contradictions within the existing theoretical framework—such as the conflict between Requirement (3) and Premise 2—and the shaky foundations of its core assumptions, which fail to persuade critical thinkers. When combined, Premises 1–2 and Requirements (1)–(3) resemble a logically flawed construct, lacking solid grounding. Consequently, the standard explanations for experiments like Aspect's, which purport to validate Bell's inequality, are built on fragile experimental and theoretical underpinnings.

These Bell test experiments have long served as the last bastion of conventional quantum mechanics, and their interpretation has been the "super weapon" wielded by orthodox proponents to silence skeptics. This paper dismantles this final refuge and neutralizes the Copenhagen School’s most formidable defense against questioning. Specifically, the logical flaws in the Aspect experiment’s foundational assumptions, when paired with findings from single-particle diffraction experiments and the Tu experiment (detailed in Sections 2, 4, 6, and 7), form a devastating critique that undermines the mainstream interpretation of Bell test results.

8. The Significance of "Quantum-Classical Compatibility and General Wave Mechanics: Unifying Quantum and Classical Mechanics"

The outdated dogma that "quantum and classical mechanics are irreconcilable" is replaced by a new paradigm: the two frameworks are not only compatible but can be integrated into a cohesive "general wave mechanics" (with a well-defined mathematical foundation). This shift in perspective is as transformative as Copernicus’s heliocentric theory, which redefined humanity’s understanding of the cosmos. It redirects our worldview back to the intuitive, experience-aligned principles of realism, determinism, and certainty—values consistent with millennia of human common sense.

Rather than rejecting either framework outright, this approach achieves a dialectical synthesis of quantum and classical thought, offering intellectual reassurance by aligning theory with lived experience. The establishment of general wave mechanics necessitates a reexpression of quantum mechanics itself, regardless of lingering beliefs about incompatibility. Beyond resolving conceptual contradictions, this new framework simplifies quantum calculations and paves the way for a potential surge in research into the "wave-element theory of material structure."

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Supplementary Material A: Derive the Schrödinger equation from the principle of minimum action

The mathematical expression for the principle of small quantity and action can be written as

$\mathrm{S} = \int_{t_1}^{t_2} L dt\psi.$ (A1)

Take L as

L=T+V=$\frac{1}{2}\mathrm{m}\dot{q}^2 + V(q).$ (A2)

$m\ddot{q}$=$\frac{\partial V}{\partial q} = F.$ (A3)

Here, q is the distance r. Eq. (A3) is the expression for Newton's second law. Write Eq. (3) in the most familiar form, which is F=ma.

Since L is the energy E here, take the first equation of Eq. (A2).

E=T+V. (A4)

Multiplying both sides of F=ma by the interaction distance r, and considering a = $\frac{dv}{dt}$ = $\frac{v^2}{r}$, Fr=mar can be transformed into V=mv^2 or

V=2T.   (A5)

Eqs. (4) and (5) are both expressions of the Viry theorem. Comparing them, it can be concluded that, E=$-T$.

Multiplying both sides of equation (A4) by ψ,we can obtain $E\psi$=$T\psi+V\psi$. Considering that $\psi=\psi_0 e^{-\frac{i}{\hbar}(Et-px)}$, $f(i, \hbar)\frac{\partial^2}{\partial x^2}\psi$=$T$=$\frac{p^2}{2m}$, and we can obtain $f(i, \hbar)$=$-\frac{\hbar^2}{2m}$ or $\widehat{T}=\frac{\hat{p}^2}{2m}$=$-\hbar^2\frac{\partial^2}{\partial x^2}$. Substituting $\widehat{T}$=$-\hbar^2\frac{\partial^2}{\partial x^2}$ into $E\psi$=$T\psi+V\psi$, we can obtaain

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi+V\psi=E\psi. \qquad \text{(A6)}$$

Eq. (A6) is the steady-state Schrödinger equation. For the planetary model system, considering Eq (A4) in the main text, E in Eq. (A6) is the energy eigenvalue of the system E=$-T$=$-\frac{1}{2}mv^2$=$-\frac{1}{2}h\nu$.