ISSN: 2639-0108

Research Article

Advances in Theoretical & Computational Physics

Establishing the Schrödinger Equation for Macroscopic Objects and Changing Human Scientific Concepts

Runsheng Tu*

Huanggang Normal University, Huanggang City, Hubei Province 438000, China

***Corresponding Author**
Runsheng Tu, Huanggang Normal University, Huanggang City, Hubei Province 438000, China.

Submitted: 2024, Nov 18; **Accepted:** 2024, Dec 23; **Published:** 2024, Dec 31

Citation: Tu, R. (2024). Establishing the Schrödinger Equation for Macroscopic Objects and Changing Human Scientific Concepts. *Adv Theo Comp Phy, 7*(4), 01-03.

Abstract
We should try to establish the Schr ö dinger equation for gravitational potential energy and use it to describe macroscopic objects. Replacing the electromagnetic potential energy in the Hamiltonian operator with gravitational potential energy can achieve the goal. The successful application of the Schr ö dinger equation for gravitational potential energy can change many existing concepts in quantum mechanics and shake the conceptual system of quantum mechanics. This can promote the development of quantum mechanics and other fields of physics.

Keywords: Gravitational Potential Energy Schrödinger Equation, Compatibility Between Classical Mechanics and Quantum Mechanics, Conceptual System of Quantum Mechanics, Description of the Wave Equation for the Earth's Revolution, Change the Concept of Physics

1. Introduction
Generally speaking, the Schrödinger equation for macroscopic objects is the Schrödinger equation for systems with masses so large that they no longer belong to the microscopic category. The Schrödinger equation for electrically neutral systems is included in it. Its representative is the Schrödinger equation for gravitational potential energy. The Schr ö dinger equation for the revolution of the Earth (the Schrödinger equation for planetary motion) belongs to this category.For convenience, we refer to this type of equation as the Schrödinger-Tu equation (STE).

A physics theory has multiple different system compositions. The two main types are mathematical logic system and conceptual system. The conceptual system of a theory represents the ideas and concepts that humans understand about it. The progress (development) of a physics theory is the development and updating of its mathematical logic system, conceptual system, and ideological concepts. The existing quantum mechanics undoubtedly has its mathematical logic system, conceptual system, and ideological concepts. Among them, there is also an explanatory system for it. The establishment of STE first shakes the existing explanatory system of quantum mechanics, or in other words, the existing ideological concepts, conceptual systems, or explanatory systems of quantum mechanics.

The idea that wave dynamics are not applicable to macroscopic systems has hindered many people's imagination. However, logically speaking, there is nothing that can prevent people from using the Schrödinger equation to describe macroscopic objects. In fact, Bohr's reverse thinking can drive him to apply the classical mechanics that macroscopic objects follow to microscopic objects. However, people denied the theoretical basis of his initial approach and referred to it as old quantum theory. Thus, his attempt to follow reverse thinking was halted. The author of this article used both classical mechanics (including classical electrodynamics) and wave dynamics to describe microsystems in, and for the first time in Ref 1, the Schödinger equation applicable to macroscopic objects was derived [1,2]. This allows macroscopic and microscopic laws to interact without obstacles caused by the size of the object's mass. The author will carefully derive the macroscopic object Schrödinger equation again in this article and analyze the significant significance of this equation. The old notion that the gap in applicability between macroscopic classical laws and microscopic modern laws cannot be eliminated will be seriously challenged. In other words, the significance of establishing the Schrödinger equation for macroscopic systems lies in changing the old notion that the applicability of wave dynamics and macroscopic classical mechanics is incompatible. The derivation or establishment of the Schrödinger equation for macroscopic objects will impact the existing interpretation system of quantum mechanics.

The method of establishing the Schrödinger equation for planetary motion is very simple. It is to replace the electromagnetic potential energy in the Hamiltonian operator applicable to microscopic systems with gravitational potential energy.

2. The Derivation of the Schrödinger Equation for Gravitational Potential Energy

Both the de Broglie hypothesis and the Ehrenfest theorem allowfor the use of wave equations in macroscopic systems [3,4]. The theoretical basis of the STE equation is the ideas and methods introduced in references [5-10]. The wave function in the original Schrödinger equation may not necessarily be the true wave function of the particle being described. It seems to be just a tool being utilized. We establish the Schrödinger equation for macroscopic objects, but it cannot change this situation (on the contrary, it supports the understanding that this wave function is just a tool).

According to the perspective of de Broglie waves, the motion of macroscopic objects such as the Earth also has corresponding de Broglie waves. This type of de Broglie wave conforms to the de Broglie relationship

$$\lambda = h / p = h / (m\upsilon). \quad (1)$$

Here, λ is the wavelength of de Broglie waves. The frequency of de Broglie waves is also represented by ν. The energy E of the de Broglie wave is also represented by hν. In the equation, υ is the group velocity of de Broglie waves, which we define as

$$\upsilon = \lambda\nu. \quad (2)$$

According to the above two relationships, $E_k = \frac{1}{2}h\nu = \frac{1}{2}m\upsilon^2$. The wave function is generally written in the following form

$$\psi = Ae^{-i2\pi(\nu t - x/\lambda)}. \quad (3)$$

There is no doubt that the Hamiltonian operator can be used for macroscopic object bound systems. If it is a non-electrodynamic system (such as the Earth in the solar system), simply replace the electromagnetic interaction potential energy function with the gravitational interaction potential energy function.

Considering equations (1), (2), (3), and $E_k = \frac{1}{2}h\nu = \frac{1}{2}m\upsilon^2$, and through specific calculations, we can obtain

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi - \frac{GMm}{R}\psi = E\psi. \quad (4)$$

and

$$-i\frac{\hbar}{2}\frac{\partial}{\partial t}\psi = -\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi - \frac{GMm}{R}\psi = E\psi. \quad (5)$$

Equations (4) and (5) are both applicable to the Schrödinger equation for macroscopic systems. They can be called Schrödinger-Tu equations.

3. Verification of the Schrödinger Equation for Gravitational Potential Energy

According to the relationship between the centripetal force of the Earth's revolution and the attractive force of the Sun on the Earth, it can be inferred that M=Rυ/G, therefore, $-\frac{GMm}{R} = -m\upsilon^2$.

Taking the Earth's revolution as an example, the correctness of the Schrödinger equation for gravitational potential energy can be verified. The simplest and most ideal scenario for the Earth's revolution is its ideal uniform circular motion around the Sun (with constant linear velocity and distance from the Sun). We use υ to represent the speed of the Earth's revolution, and r or R to represent the distance between the Earth and the Sun. By substituting the mass of the Earth m, the mass of the Sun M, and the gravitational potential energy of the Sun on the Earth into equations (4) and (5), the energy eigenvalue of the Earth's ideal revolution can be obtained as $-\frac{1}{2}h\nu = -\frac{1}{2}m\upsilon^2$. This result is consistent with the energy eigenvalues of the Earth, which are calculated using classical mechanics to orbit in an ideal manner. The kinetic energy of the Earth is calculated using the term $-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi$ Its value is $E_k = ½\, h\nu = ½ m\upsilon^2$. This result is also consistent with the kinetic energy value of the Earth's orbital motion calculated using classical mechanics.This indicates that equations (4) and (5) are correct. For describing the constraint system of macroscopic objects, if the first term of equation (5) does not have the denominator 2, it is incorrect.

This article proves that both macroscopic and microscopic systems can be described using the Schrödinger equation. In this way, the initial success of Bohr's hydrogen atom planet model is an important material to support this article.

4. Discussion on the Significance of the Schrödinger Equation for Gravitational Potential Energy

For the Schrödinger equation of a hydrogen atom similar to equation (4), which moves in infinite space outside the nucleus due to the uncertainty of the position of electrons outside the nucleus, the equation can be extended to a three-dimensional form

$$-\frac{\hbar^2}{2m}\nabla^2\psi - \frac{Ze^2}{R}\psi = E\psi. \quad (6)$$

However, for macroscopic objects, the uncertainty effect is so weak that it can be ignored. In this way, we cannot generalize equations (4) and (5) to a three-dimensional form using similar methods (i.e. no longer assuming that the position of macroscopic objects is uncertain and randomly appears in the entire space). Quantum mechanics demonstrate through diffraction experiments that microscopic particles exhibit wave like behavior and uncertainty. However, logically speaking, this method cannot prove the volatility and uncertainty of electrons in atoms (when measuring, it is uncertain. What is the situation when not measuring? The correct answer should be "I don't know". However, the answer of quantum mechanics is "also uncertain when not measuring", and the content of this answer is called uncertainty, which is ultimately elevated to the principle of uncertainty). Therefore, the reason for attributing uncertainty to physical particles is still insufficient. The reason for the uncertainty of macroscopic objects is even more insufficient. The wave equation has been proven to describe deterministic material systems. The one-dimensional Schrödinger equation of hydrogen atom and equation (4) are both one-dimensional Schrödinger equations. Can they be extended to three-dimensional form? The answer should be consistent. The current inconsistency is only due to people choosing the concept that 'microscopic particles have uncertainty'. Objects that can be described using the same equation must have the same or similar motion forms and/or characteristics. If they tend to be similar or identical in the microscopic direction, then macroscopic objects should also have uncertainty (the first case). If they tend to be similar or identical in the macroscopic direction, then microscopic objects should also not have uncertainty (the second scenario). If it is determined that there is no uncertainty in the macro object, then the first situation can be denied and the second situation can be affirmed.

In quantum mechanics, wave functions have been used as a tool. However, for microscopic objects, people believe that the moving microscopic particles are real de Broglie waves. When using the wave equation to describe macroscopic objects, it is not necessary to consider the macroscopic objects as real waves (i.e. wave functions and de Broglie waves, especially the wave functions or wave equations used, are only regarded as tools). The reason is that macroscopic objects such as the Earth cannot have observable diffraction characteristics and uncertainties.

The significance lies not in using it to obtain more accurate calculation results than Newtonian mechanics, but in changing the old notion that there is an insurmountable gap between classical mechanics that describes macroscopic objects and quantum mechanics that describes microscopic objects. Another function of STE is to prove that the concepts of "electron cloud" and "probability density" are meaningless by solving the STE equation. Because we believe in the determinacy of macroscopic objects, it is impossible to obtain the concepts of "Earth clouds" and "probability density of the Earth's center of mass in solar system space" by solvingSTE. That is to say, the establishment and successful application of STE demonstrate that the concepts of "electronic cloud" and "probability density" are derived by pre-affirming "uncertainty". It is also impossible for ecological superposition to occur between macro objects. These conclusions can have a significant impact on the explanatory system of quantum mechanics.The de Broglie waves ofthe Earth are no longer discrete real waves, but most likely virtual waves. This is due to the fact that the wave function of de Broglie waves on Earth is not the wave function of real waves (the real Earth cannot move like electromagnetic waves. In other words, de Broglie waves of the Earth cannot move or propagate in a form similar to electromagnetic waves). The old notion that the limitations of the scope of application of macroscopic classical laws and microscopic modern laws cannot be eliminated will be eliminated.

The existing interpretation system of quantum mechanics is determined by the principle of uncertainty or the uncertainty of particles. The factors that affect the uncertainty principle will ultimately affect the existing interpretation system of quantum mechanics.

In order to obtain the concepts of "Earth's center of mass cloud" and "probability density of Earth's appearance in solar system space" by solving STE, it is first necessary to assume that the motion of Earth in the solar system conforms to the "uncertainty principle" (the specific idea is to assume that the distance between Earth and Sun is uncertain and unknown, only knowing that this distance is from 0 to infinity). Otherwise, we would never have obtained these two concepts no matter what. That is to say, these two concepts originate from the uncertainty principle, rather than the solution of the wave equation. In other words, these two abnormal concepts are products of a priori theory, not mathematical logic. It can be affirmed that macroscopic objects such as the Earth cannot be stacked without interaction, that is, they do not conform to the principle of superposition of states.

In short, establishing and successfully applying STE can shake these concepts: probability waves, wave equations, uncertainty principles, and superposition of states principles.

References

1. Tu, R. (2024). A Wave-Based Model of Electron Spin: Bridging Classical and Quantum Perspectives on Magnetic Moment. *Adv Theo Comp Phy, 7*(4), 01-10.
2. Tu, R. (2024). A Review of Research Achievements and Their Applications on the Essence of Electron Spin. *Adv Theo Comp Phy, 7*(4), 01-19.
3. Yongde, Z. (2001). Quantum Mechanics (Second Edition). Beijing, Science Press, 70-79.
4. Ehrenfest, P. (1927). Bemerkung über die angenäherte Gültigkeit der klassischen Mechanik innerhalb der Quantenmechanik. *Zeitschrift für physik, 45*(7), 455-457.
5. Tu, R. (2024). Solving the Problem of Source of Electron Spin Magnetic Moment. *Physical Science International Journal, 28*(6), 105-110.
6. TuR. (2016). The principle and application of experimental method for measuring the interaction energy between electrons in atom. *Int J Sci Rep, 2*(8), 187-200.
7. Tu, R. (2019). If the wave function Collapse absolutely in the Interaction, how can the weird nature of particles be born in the interaction? A Discussion on Quantum Entanglement Experiments. *Indian Journal of Science and Technology, 12*(8), 1-10.
8. Tu, R. (2024). Progress and Review of Applied Research on New Theory of Electronic Composition and Structure. *Infinite Energy, 28*(167), 35-51.
9. Tu, R. (2018). Quantum Mechanics' Return to Local Realism. Cambridge Scholars Publishing.
10. Tu, R. (2014). Some Successful Applications for Local-Realism Quantum Mechanics: Nature of Covalent-Bond Revealed and Quantitative Analysis of Mechanical Equilibrium for Several Molecules. *Journal of Modern Physics, 5*(6).