

# A Review of Research Achievements and Their Applications on the Essence of Electron Spin

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, Oct 16; **Accepted:** 2024, Nov 08; **Published:** 2024, Nov 18

**Citation:** 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.

## Abstract

*A model of the electronic internal structure has been developed, revealing the specific movement mode of electrons outside the nucleus. Building on this, the Bohr's planetary model of the hydrogen atom has been adapted into the Saturn model, suitable for describing multi-center and multi-electron bound systems. It has been discovered that the mathematical formalism of Bohr's old quantum theory and wave mechanics are compatible. A quantum chemistry method has been established to implement this compatibility (where the Saturn model and wave mechanics can complement each other), using this method, the energy eigenvalues of s electrons in atoms and the binding energies and bond lengths of four diatomic molecules such as hydrogen molecules have been successfully calculated. This provides new insights into material structure theory. The aforementioned compatibility could lead to the birth of local realism quantum mechanics.*

**Keywords:** The Essence of Electron Spin, Wave Element Electronic Structure Model, Quantum Mechanics, Compatibility, Applications

## 1. Introduction

The existing quantum mechanics are very successful, but there are also many problems. The voice questioning it has never been interrupted [1-5]. Therefore, efforts to improve or develop it are always necessary. Quantum electrodynamics has also been questioned [6]. There is also considerable evidence of certainty in microsystems. For example, if the quantum state is uncertain, then the Pauli exclusion principle cannot be established. The reason is that the spin state of electrons is one of the quantum states of electrons, and if it is uncertain, the four quantum numbers of an electron in an atom cannot be exactly the same without any obstacles. In addition, if particles in the microscopic system cannot have a definite momentum and position at the same time, molecules such as graphite and diamond cannot have a definite bond length, bond angle, and bond energy. If the product of energy and time cannot be determined simultaneously, then measuring bond energy or photon energy must take an infinite amount of time. This is impossible.

Is Bohr's planetary model absolutely limited to hydrogen atoms? When someone developed Bohr's planetary model into the Saturn rings model (Saturn model for short. The motion of s electrons outside the nucleus is similar to that of Saturn's rings. Both the Saturn model and Bohr's planetary model belong to the category of

the old quantum theory), and successfully extended its application to hydrogen molecules, the results were consistent with the experimental facts, what would readers think? If the calculation process adheres to the unified operating principle, and there are four calculation examples of diatomic molecules, and the calculation examples of atomic s electrons include all atoms, can it be considered as coupling?

The reason why Bohr's planetary model cannot be used for microsystems other than hydrogen atoms is precisely because of the point electron scattering model or the solid spherical electronic structure model. Once the electronic structure model is developed from the planetary model of the solar system to the Saturn model in the Saturn system (non-point or non-solid sphere structure model), the Bohr model can immediately apply multi center and multi electron bound systems. I have done the work led out by the several "if" above and completed the following work. Under the common premise (hypothesis), we can give the specific form of the motion of the electron spin, and derive the electron spin magnetic moment operator and the electron spin angular momentum operator. The common premise is that the free electron is also annular, which is formed by the wave propagating along a closed path. It is called the light knot electronic structure model (or the wave element electronic structure model). According to this model, the electron

spin angular momentum and the electron spin magnetic moment can be calculated, which are completely consistent with the experimental values. Whether the old quantum theory and wave mechanics are contradictory or not, the mathematical form system of the two theories can be used at the same time (that is, we can ignore the contradictory established understanding of the two theories and use their mathematical formal system at the same time). That is to say, we can use practical actions to show that the mathematical formal systems of the two theories are compatible. The unified operational principle mentioned above is the program of "practical action" mentioned in the previous sentence. A series of related calculation results under the unified principle and operation principle constitute the evidence network of Tu's theory and method (evidence network is a stronger evidence system than evidence chain). Since quantum field theory cannot give the specific structure and internal motion mode of electrons, it has no ability and qualification to judge the specific internal structure given by other theories. In fact, the electronic internal structure model of light knot does not deny the main content of the mathematical form system of quantum field theory. In view of the above facts, do we have sufficient reason to believe that the calculated results that conform to the experimental facts are coincidence?



**Figure 1:** Saturn Model

The old quantum theory, represented by Bohr, belongs to the category of localized realism and determinism, that is, classical theory. In philosophy, its mathematical form system and interpretation system are consistent. The interpretation of the phenomenon is always inseparable from subjective judgment, and there is a great risk to accept the conclusion of subjective judgment. If the interpretation system of wave mechanics is separated from the mathematical formal system, the mathematical formal system is purely objective and can be expressed in the form of localized realism and determinism. In this way, the old quantum theory and the mathematical form system of wave mechanics do not necessarily have very sharp contradictions. On the contrary, the two mathematical formal systems are consistent with mathematical logic (belonging to mathematical logic system), and there is no logic barrier for their compatibility. As long as you change your mind, the old quantum theory can be compatible with the formal system of wave mechanics rather than contradictory to the interpretive system of wave mechanics. In the second section, the author will explain theoretically "why it is possible to use both wave mechanics and Saturn model" [see the author's joint description of Eqs. (3), (7), (8), (9), (16) and (18) after Eq. (18)]. The specific method is that as long as  $x$  is a circle

composed of arc lengths and its radius is fixed, the wave function and corresponding de Broglie waves can be both real matter waves and just tools. As long as the de Broglie wavelength can be written as  $\lambda = h / p$ , such a bound system (whether macroscopic or microscopic) can be described using the Schrödinger equation. In the process of describing the same object, a definite circular orbit motion is recognized, the Saturn model (or planetary model) is used to indicate the use of classical mechanics that is "applicable to the macroscopic field", and the Schrödinger equation is used to calculate physical quantities such as energy eigenvalues using wave dynamics. Together, we can use both classical mechanics and wave dynamics to describe macroscopic objects simultaneously. Together, we can use both classical mechanics and wave dynamics to describe macroscopic objects simultaneously.

The core concept of existing quantum mechanics is the spin of microscopic particles and the principle of superposition of states. Unfortunately, how is the spin magnetic moment generated? Quantum mechanics cannot answer this question (without detailed theoretical discussion). It is only a physical property inherent in the spin of particles that is forcibly defined. People subjectively believe that it, like the mass and charge properties of particles, is innate (i.e. has intrinsic properties), and through subjective quantum mechanical rules, they are divided into various spin forms such as 0, 1, 2, 1/2, 2/3, etc. This is a flaw in the theory of quantum mechanics! The principle of superposition of states is also a subjective assumption that has many logical loopholes (see Appendix A: Logic loopholes and other issues of the principle of superposition of states). The purpose of the state superposition principle established in a hypothetical way is to find reasons for denying the existence of detected eigenstates and eigenvalues before measurement. If there are insufficient reasons to deny that the measurement results (especially non projection measurement results) reflect the original objective existence, physics research will be difficult to move forward. Moreover, the probability theory used to maintain the superposition principle of states must modify traditional probability theory (i.e., not in line with previous classical probability theory). The principle of superposition of states assumes a dual risk of errors in physics and mathematics. The new viewpoint of using the principle of superposition of states to deny the problem of avoidable superposition of states is not appropriate. The author of this article breaks free from the constraints of the basic particle structure models of point particles and solid spheres and establishes the wave element material architecture theory, providing a specific way for electron spin. The author of this article breaks free from the constraints of the basic particle structure models of point particles and solid spheres and establishes the wave element material architecture theory, providing a specific way for electron spin. The principle of superposition of states has therefore shifted from the core and foundation of quantum mechanics to the mathematical formal system of quantum mechanics, and has become a secondary knowledge point (no longer the core and foundation of quantum mechanics).

In the next natural section, I will introduce the developing process

---

of theories and methods.

At the end of 1985, I suddenly wanted to try whether the hydrogen molecule with two electrons between two hydrogen nuclei could reach mechanical equilibrium. To achieve such a mechanical equilibrium, the electron between the two nuclei must be an elastic ring-shaped entity. This is the old way of Bohr planetary model. No matter what the obstacles are or what the principle of the method is, it is necessary to find out the skeleton system that meets the requirements. As a result, the mechanical equilibrium equation was solved, and the skeleton structure of hydrogen molecule meeting the requirements was found. Then I tried to calculate the dissociation energy and bond length of hydrogen molecule. The biggest difficulty encountered at that time was that it was impossible to calculate the interaction energy between two paired electrons. So I decided to calculate hydrogen molecular ions first, and achieved success. The method is to combine Bohr's hydrogen atom theory with the mathematical formal system of wave mechanics.

In 1987, I adopted an empirical constant to solve the problem of calculating the interaction energy between two paired bound electrons. Later, the empirical constant was improved by using ionization energy data [7,8]. Then the dissociation energies and bond lengths of hydrogen, lithium, sodium and HCl molecules were calculated by using the Saturn model framework, classical electrodynamics and wave mechanics [9-12]. The calculated results are close to the experimental results. The ionization energy and atomic radius of helium, beryllium and other elements are also calculated [9]. The calculated results are also in agreement with the experimental values or recognized values. Each calculation case in reference has a significant feature, that is, the Saturn model method and the wave mechanics method can be used separately or at the same time (simultaneous use means mixed use) [9-12].

These results obviously promote the application of Bohr's planetary model to the calculation of small molecules and multi electron atoms. It is difficult to deny the above results by using rigorous logical methods. The theory used by the author is neither completely the old quantum theory (after all, Schrödinger equation is used) nor completely wave mechanics (after all, the interpretation system of wave mechanics is abandoned). We not only do not exclude the mathematical formal systems of the old and new quantum theories, but also make them compatible (mixing their advantages). The source of the theory and method is the assumption of the electronic structure of wave elements (the term "light-knot electronic structure" was once used). However, both authoritative readers and ordinary readers may have two doubts: first, is it the calculation result made up by the author? Second, is it a coincidence? Since there are many calculation cases (the evidence network has been formed), the doubt of coincidence seems to be dispelled (if all 10 calculation cases are coincidence, the probability of coincidence seems too high). As long as many calculation examples are successfully obtained according to the unified principle and method, the first doubt can also be eliminated. We can also try to find a reasonable explanation for

the phenomenon of "that successful computing cases are relatively many". If the existing theories and methods cannot explain it, some new hypotheses or theories will inevitably arise (Planck's explanation of blackbody radiation phenomenon is the case).

As we all know, Bohr's theory and method of planetary model belong to the category of localized realism and determinism in philosophy. The existing interpretation system of wave mechanics belongs to the category of nonlocal realism and indeterminism. From a large perspective, the fact that "multiple calculation results obtained by using Bohr method and wave mechanics method can be mixed with facts" in reference shows that the old quantum theory established by Bohr and the wave mechanics established by Schrödinger are compatible in terms of mathematical formal system, although they are contradictory in philosophy [9-12]. The planetary model and wave mechanics are mixed to describe the same microscopic system. Wave mechanics can solve the problems of system stability and quantization that have not been solved by the planetary model, and the planetary model method can provide great convenience for the establishment of potential energy function in wave mechanics. This is undoubtedly an important conclusion that can add points for the author.

"As mentioned above, the following sentence is generally included or acquiesced in the textbooks of quantum mechanics and quantum chemistry": the Schrödinger equation of a simple system can be solved accurately, such as the Schrödinger equation of electrons in a hydrogen atom. For complex systems, it can only be solved approximately. According to the existing quantum mechanics, we can not give the specific structure and the specific movement mode of the electron in the microscopic system. These are the shortcomings of wave mechanics.

The deficiencies of the old quantum theory (including Bohr's planetary model hydrogen atom theory) are more obvious. It is also helpless for the multi electron system other than the hydrogen atom, and the stability and quantization of the micro bound system is only a hypothesis. However, the author's research work breaks this situation by combining the mathematical formal system of the old quantum theory with the mathematical formal system of wave mechanics, thus expanding the application scope of quantum chemistry or quantum mechanics methods to the calculation of multi center microscopic systems and multi electron atoms. The principle of the method is derived from the assumption of the electronic structure of the optical junction, which extends Bohr's planetary atomic model in the solar system to the Saturn model in the Saturn system; The mathematical formal system of wave mechanics and the interpretation system can be separated, so that the old quantum theory and the mathematical formal system of wave mechanics are compatible with each other (this compatibility can be realized through successful calculation cases). The highlight of the research results of the title reference in this paper also lies in the development of the planetary model theory and the combination of the old and new mathematical formal system of quantum theory, and has achieved many successful calculation cases. It points out a new possible development direction for the theory of material

structure and the interpretation system of quantum mechanics.

Although the accuracy of the calculation results of the new method is not high enough, it can reflect the great revolution of theory and methods. The calculation results of Copernicus's heliocentric theory are not as accurate as those of Ptolemy's repaired geocentric theory. This also did not affect the revolutionary nature of Copernicus's heliocentric theory.

The new theory established by the author of this article meets the three basic conditions of "the new theory has communicative value": The problems that can be solved by old theories can be solved by new theories; Some problems that cannot be solved by old theories can also be solved by new theories; New theories can make some predictions that old theories cannot make. Here are the details:

Fact 1: The problem that existing physics theories have solved is that various calculations can be performed on microscopic systems using the Schrödinger equation and Dirac equation.

Fact 2: The problem that existing physics theories cannot solve is the inability to clarify the specific form of spin of microscopic particles such as electrons, and the lack of knowledge about the source of electron spin magnetic moments.

Fact 3: The author of this article can also achieve practical results And it can be done better. Because the author of this article achieved fact 1 through compatibility between wave dynamics and classical electrodynamics. And the method is simpler and the result is more accurate when completing fact 1. This belongs to the category of "as long as the existing theory can solve the problem, the author of this paper can also solve it".

Fact 4: Fact 2 expresses the flaws or shortcomings of existing physics theories (it is a dark cloud floating over physics). In this paper, the author puts forward a specific electronic internal structure model and electron spin mode (electromagnetic wave runs in ferris wheel mode), and accurately calculates the electron spin angular momentum and spin magnetic moment according to this spin mode, thus dispersing this dark cloud. This belongs to the category of "the author of this paper has solved the problem that the existing theory can't solve".

Fact 5: The author of this article predicted a phenomenon that existing theories cannot predict - the electron beam can be continuously split when passing through multiple non-uniform magnetic fields; The Schrödinger equation can be used to describe planetary motion. The first prophecy is also a verification experiment designed to validate the basic hypothesis proposed by the author of this article. It does not support the principle of state superposition. So, existing physics theories cannot make this prediction. The second prophecy is made based on the belief that there is no insurmountable gap between the laws followed by the microsystem and the laws followed by the macrocosm. According to existing quantum mechanics, such a second prediction cannot

be made. The Schrödinger equation for planetary motion has been established in this article and can be validated using known data from planets. This situation also belongs to the transformation and expansion of the application scope of existing quantum mechanics. The third prophecy is that conducting electron diffraction experiments in a cloud chamber can also yield diffraction fringes. This prophecy was made based on the first prophecy and the second prophecy. It also does not support the principle of state superposition.

Next, we will take the quantum chemical calculation of micro systems such as hydrogen molecule and lithium atom as an example to explain the principle and/or operation rules of the calculation method in detail.

## 2. The Principle and Operation Rules of Quantum Chemical Calculation Method Based on the Mutual Length of Classical Planetary Model and Wave Mechanics

The hypothesis put forward by the author is not completed in one step, but has gone through the process from coarse to fine. At first, the author regarded the hydrogen atom as a structure similar to the Saturn system. The motion of electrons outside the core around the core is similar to the motion of Saturn's ring moon around Saturn. In this way, hydrogen molecular ions and hydrogen molecules are an electron ring of appropriate size, which rotates between two hydrogen nuclei like Saturn's annular moon. The electron ring is elastic or has centrifugal force caused by rotation. Since then, the original atomic and molecular models (especially the internal structure model of electrons) have been continuously improved in the process of applying this model. We retain the existing understanding that the bound state electron ring is similar to the de Broglie wave. According to the calculated results, it is fitted that the electron ring is composed of completely basic circularly polarized photons. Whether it is an extranuclear bound state electron or a free electron, the 1s electron propagates along a closed circular phase trajectory by a fundamental circularly polarized photon. Electronic pairing refers to the complete coincidence of two fundamentally circularly polarized photons in the opposite direction.

### 2.1. Structural Skeleton of Hydrogen Molecule and Solution of Mechanical Equilibrium Equation

The ground state hydrogen molecular ion is an electrodynamic equilibrium system with a single electron ring between two hydrogen nuclei. The schematic diagram of hydrogen molecular structure is similar to this, except that between the two nuclei is a double electron ring composed of two paired electrons (see Figure 2).

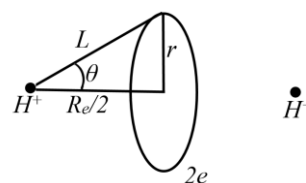


Figure 2: Hydrogen Molecule H<sub>2</sub>

These two molecules are very much like the wheels of a unicycle spinning in the air. Only there is a very dense ball at both ends of the axle. The wheel axle is virtual, so is the spoke. It is called the unicycle skeleton of diatomic molecules. This structure can reach the classical electrodynamic equilibrium state. After the system reaches mechanical equilibrium, the relationship between bond length  $R$  and bevel  $L$  is  $R=2L\cos\theta$ . The attraction between electron and nucleus is  $(Ze^2 \times 2/L^2) \cos\theta$  in the direction of the line between nuclei. The repulsive force between nuclei is  $(Ze)^2 / (Ze)^2/R^2$ . So, we get the mechanical equilibrium equations as

$$\begin{cases} R = 2L \cos \theta \\ \frac{2e^2}{L^2} \cos \theta = \frac{(Ze)^2}{R^2} \end{cases} \quad (1)$$

The general solution of this equation is

$$\theta = \arccos\left(\sqrt[3]{Z^2/8}\right). \quad (2)$$

If  $Z$  is the effective nuclear charge number  $Z^*$ , Eq. (2) also holds. If the two atoms that make up a diatomic molecule are different, the solution of the mechanical equilibrium equation of state can also be obtained p.204, but the situation is much more complicated [11]. In hydrogen molecule,  $Z = 1$ , according to Eq. (2), we can get  $\theta = 60^\circ$ .

It is not difficult to see that where Figure 2 and Eq. (1) of mechanical equilibrium are directly and indirectly used, the thinking methods of local realism and determinism are used.

## 2.2. The Relationship Between “The Solution of Energy Eigenvalue of Schrödinger Equation in A Polycentric and Or Multi Electron Microscopic System” and the Solution of Hydrogen Atom

In this paper, the energy eigenvalues obtained by establishing and solving the Schrödinger equation are "without considering the interaction energy between the two electrons in the bonding electron pair". For a diatomic molecular system, the difference between the energy eigenvalue solution of the Schrödinger equation when considering "the interaction energy between two atomic nuclei (or two atomic reals)" and not considering it is considered to be the interaction energy between nuclei (or the interaction energy between atomic reals).

As you know, the potential energy function and the steady-state Schrödinger equation of the hydrogen atom are  $V=-Ze^2/r$  and Eq. (3), respectively.

$$\left[-\frac{\hbar^2}{2m} \nabla^2 - \frac{Ze^2}{r}\right] \psi = E\psi. \quad (3)$$

The energy eigenvalue solution of this equation is

$$E_n = -\frac{Z^2 e^2}{n^2 2a_0} = -\frac{Z^2}{n^2} \times 1312.0\text{kJ/mol}. \quad (4)$$

Before this paper, the exact solution of the Schrödinger equation of hydrogen molecule is difficult to obtain. Now, we have obtained the structural skeleton of hydrogen molecule based on the Saturn model (belonging to the category of localized realism). It is much easier to establish the potential energy function of hydrogen molecule than before (the potential energy of the interaction between two bonding electrons is not considered temporarily. This is the benefit of the old quantum theory based on the Saturn model to wave mechanics). This potential energy function is

$$V = -\frac{(2Ze)(2e)}{r} \sin \theta = -\frac{4Ze^2}{r} \sin \theta. \quad (5)$$

We can also find the relationship between the solution of the Schrödinger equation of hydrogen molecule and the solution of the Schrödinger equation of hydrogen atom. The solution of the energy eigenvalue of Schrödinger equation on the first main layer is only related to the number of nuclear charges and the mass of electrons. If other conditions remain unchanged, but the number of nuclear charges attracting electrons changes, the energy eigenvalue solution is  $Z^2$  times that of the ground state hydrogen atom. If the electrons in the target system are in the  $n^{\text{th}}$  layer, then,

$$E_n = [Z^2 E_{H(n=1)}] \frac{1}{n^2} = -1312.0 \times \frac{Z^2}{n^2}. \quad (6)$$

Where  $Z$  is the virtual effective nuclear charge number and  $E_{H(n=1)}$  is the energy eigenvalue solution of the ground state hydrogen atom. There are two ways to find  $Z$ . Method 1 (scheme 1) is to convert the single electron potential energy function of the target system into a multiple of the potential energy function ( $e=r$ ) of the ground state hydrogen atom ":  $Z = |V \times \frac{r}{e^2}|$  (here,  $V$  is the potential energy function of the target system). Scheme 2 directly uses the potential energy function of two electrons as  $V$ . This relationship can provide great convenience for the solution of Schrödinger equation of polycentric microscopic system and single center multi electron microscopic system. Most of the following examples for solving Schrödinger equation meet the conditions for using Eq. (6).

Attention! If the energy eigenvalue of the double electron ring is calculated, the potential energy functions of the two electrons must be respectively substituted into the Schrödinger equation for calculation and then sum (or the energy eigenvalue of an electron is calculated and multiplied by 2 as the energy eigenvalue of the two electrons when the interaction energy between the two electrons is not calculated for the time being), but we cannot include double the number of electron charges in  $Z$ . As long as we use equation (6), neither  $Z$  nor  $Z$  can be related to the number of electronic charges. The reason is, as long as we use equation (6), neither  $Z$  nor  $Z$  can be related to the number of electronic charges. In other words, there is only one electron in the hydrogen atom. The energy eigenvalue is only proportional to the square of the effective nuclear charge number. When the number of electrons increases from 1 to 2, the energy eigenvalue increases to twice the original value instead of the square of 2. Let's stress it again. If the energy eigenvalue of two electrons is calculated, scheme 1 is

to convert the system into two single electron systems, substitute them into Schrödinger equation for calculation, and then sum them. The mathematical law of " $1^2+1^2=2^2/2$ " determines that there is an equivalent calculation method (which can be called scheme 2). That is, if the bonding electron is a double electron, determine the total potential energy function of the two paired electrons first, and then divide by 2 after solving their energy eigenvalues. For a diatomic molecule (or molecular ion) with only one bonding electron, such as the excited state of a hydrogen molecule or a hydrogen molecule, the operation of "dividing the last one by 2" is not required (for scheme 1, the operation of "converting a molecule into two molecules" is not required).

### 2.3. Some Principles and Rules in the Calculation of Dissociation Energy and Bond Length of Hydrogen Molecule

The bonding double electrons of the ground state hydrogen molecule are only relative to the potential energy function of the nucleus (write the function of  $r$  shown in Fig. 2)  $V=-4(\sin\theta)e^2/r$ . Obviously,  $Z=4\sin\theta$ . The steady-state Schrödinger equation of the potential energy function in the form of  $V=-Z^2e^2/r$  is established, and the energy eigenvalue solution is obtained by using Eq. (6).

$$\left[-\frac{\hbar^2}{2m}\nabla^2 - \frac{Ze^2}{r}\right]\psi = E\psi. \quad (7)$$

We generally use scheme 2 for calculation. For hydrogen molecules,  $Z=4\sin\theta=3.4650$ . In this way, the corresponding energy eigenvalue can be calculated using Eq. (6). When  $n=1$ , the contribution of "the energy required to keep the two bonding electrons in coincidence and pulled to infinity" to the dissociation energy of hydrogen molecule is

$$E_{\text{bonding electron}} = -Z^2 \times 1312.0/2 = -12.000 \times 1312.0/2 = -7872.0 \text{ (kJ/mol)}.$$

Here, we add the subscript 'bonding electron' to  $E$  in Eq. (7).

Under suitable conditions, it is also possible to write the potential energy as a function of  $L$  as shown in Fig. 2 ("quantum chemists often do this"). The potential energy of hydrogen molecule considering the interaction between nucleus and electron and the interaction between nuclei is selected in this way. Without considering the interaction energy between nuclei, we choose the potential energy function with  $r$  as the independent variable. Both of these options are within the range allowed by the existing quantum chemical methods. This is the unified operation rule we adopt, which is very practical. The key is that for the quantum chemical calculation of diatomic molecules, we have fixed this choice (the principle of choice is to write the potential energy function as a function of  $r$  as shown in Fig. 2 when ignoring the potential energy of the interaction between nuclei; when not ignoring the potential energy of the interaction between nuclei, write the potential energy function as a function of  $L$  as shown in Fig. 2). The significance of this operation rule increases. "According to its successful calculation cases reached 4 cases", which further increased its significance [8-11]. If we consider the interaction between nuclei and ignore the interaction between two bonding electrons temporarily, the Schrödinger equation of hydrogen molecule is

$$\left[-\frac{\hbar^2}{2m}\nabla^2 - \frac{4e^2}{L} + \frac{e^2}{R}\right]\psi = E\psi. \quad (8)$$

Equation (8) is the Schrödinger equation which regards the bonding electron pair as a whole. According to Fig. 2,  $L=R$ . Substitute the known values into, merge the items of the same kind, and the above formula becomes

$$\left[-\frac{\hbar^2}{2m}\nabla^2 - \frac{Ze^2}{R}\right]\psi = E\psi. \quad (9)$$

From Eq. (8), it can be seen that  $Z=3.0000$  in Eq. (9) [writing  $V$  as  $Ze^2/R$  meets the condition of using Eq. (6)]. The result that the energy eigenvalue of Schrödinger equation in the form of Eq. (9) is released to 2 is the contribution to the dissociation energy of hydrogen molecules (except for the interaction energy between bonded electrons that have been paired). Using "the relationship between the solution of the Schrödinger equation of the microscopic system and the solution of the hydrogen atom", we can solve Eq. (9). The result is  $E = -3.0000^2 \times 1312.0/2 = -5904.0$  (kJ/mol). The method of verifying scheme 1 is to select  $Z=1.5000$ . The answer to " $1.5000^2 \times 1312.0 \times 2$ " is obviously 5904.0. Verification completed.

For convenience, we call the method and principle used in the establishment and solution of Eqs. (6) - (9) as Tu's operation rule.

Because the results of 5904.0 kJ/mol consider the nuclear interaction, while the results of 7872.0 kJ/mol ignore the interaction between the two nuclei, the difference between 5904.0 kJ/mol and 7872.0 kJ/mol ( $\Delta E=1968.0$  kJ/mol) is the eigenvalue of the interaction energy between two nuclei:  $V = -(Z^2e^2/R) \times 1968.0$  kJ/mol. If diatomic molecules are asymmetric ( $Z_a \neq Z_b$ ),  $Z^2$  should be replaced by  $Z_a \times Z_b$ . Using  $e^2/a_0 = 2624.0$  kJ/mol, the bond length formula of diatomic molecules with asymmetric nuclei (or ions) on both sides can be obtained

$$R = \frac{Z_a^* \times Z_b^*}{|\Delta E|} \times 2624.0 a_0. \quad (10)$$

In this case,  $\Delta E=1968.0$  kJ/mol. Thus, the distance between nuclei  $R=1.33333a_0 \approx 0.71 \times 10^{-10}$  m. It is 5% different from the experimental value of  $0.74 \times 10^{-10}$  m. In references, the author used Eq. (10) to calculate the bond length and dissociation energy of HCl [9-12].

### 2.4. An Empirical Method for Calculating the Interaction Energy Between Two Paired Bound Electrons

The calculation of the dissociation energy  $D_e$  of hydrogen molecule is still short of the interaction energy between two paired electrons. If each micro system uses its own unique empirical value, such calculation is meaningless. We must find the basic law of the energy of this interaction. Even if we cannot find a pure theoretical calculation method, we should also find a general empirical method.

In 1987, I realized that in an atom, the interaction energy between

two electrons that have been matched into a pair is related to the difference between their electron ionization energies. Thus, according to the ionization energy of elements, the empirical formula of the interaction energy between two electrons that have been matched into a pair can be concluded. The thinking process is as follows.

According to the planetary model and the assumption that the two electron pairs are completely coincident (the two electron rings are inversely coincident), the operating environment of the two s electrons is exactly the same. After one electron is ionized, the motion state of the remaining electron, the radius of the electron ring and the energy relative to the nucleus remain unchanged. In this case, the difference in ionization energy between two electrons inside the  $s^2$  electron pair is the interaction energy  $E_{ns^2}$  between them. Taking helium atoms as an example, the difference between the first ionization energy and the second ionization energy of helium is exactly the difference in ionization energy between electron 1 and electron 2 in a given environment (the ionization of the second electron only needs to overcome the attraction of the helium nucleus, while the ionization of the first electron requires overcoming the attraction of the helium nucleus and its interaction with another 1s electron). As long as this is the case for the atoms of each element, we can conclude the relationship between the interaction energy between the two s electrons in the  $s^2$  electron pair and the number of nuclear charges (that is, calculate the corresponding regression curve) according to the difference of ionization energy between the two 1s electrons of the atoms of each element. The author found that the relationship between the interaction energy between the paired two ns electrons in the other main electron layer and the atomic reality is very regular, and it is  $1/n^2$  times of the interaction energy between the two electrons in  $1s^2$  [8-11]. When  $Z=0$ , it may correspond to the pairing energy of free electrons  $\Delta=-275.9$  kJ/mol. For the case of the first periodic element and the second periodic element ( $n \geq 1$  of the outer electron), the regression equation obtained is

$$E_{ns^2} = (1.1699Z^2 + 1632.8Z - 392.02)/n^2 \quad (11)$$

Where, the coefficient  $1/n^2$  is obtained from the relationship between the energy eigenvalue and the principal quantum number and a large number of ionization energy data.

The correlation coefficient of this regression equation is equal to 1 within five significant figures. It is proved that the law is very strict. See references for the solution of regression equation [9-11]. If the ionization energy difference of the elements in the second period and the third period is summed up together, the regression equation (fitting curve) of  $E_{ns^2} = (3.0595Z^2 + 1599.2Z - 275.90)/n^2$  can be obtained (for relatively long periods, it is more accurate to calculate the regression equation once per cycle).

If two electrons with opposite spin directions pair, they completely overlap and form a structure and state similar to a standing wave. So, equation (11) means that when the distance between these two electrons is zero, the interaction force and energy between

them are not infinite. In the case of zero distance, electromagnetic interactions do not conform to classical electrodynamic laws [equation (11) provides indirect experimental evidence for this conclusion]. Equation (11) describes the pairing energy of electrons, and the intercept  $\Delta$  value in the equation may be the pairing energy of free electrons. Cooper pairs have also appeared in superconductivity theory. A Cooper pair is an electron pair, where the distance between two electrons, even if not zero, is extremely small. Superconductivity phenomenon indicates that directional moving electrons pass through the ocean of electrons at high speed without resistance. This makes people have to consider that the applicability of Coulomb's law may be limited. In fact, Coulomb's law is based on the assumption that the basic charged particle is a point particle or a solid sphere (classical electrodynamic uses the central force field model). Once charged elementary particles such as electrons are neither point particles nor solid spheres, Coulomb's law is inevitably challenged. "Electron phonon interaction" is also an explanation of the abnormal interaction between charges discovered in practice, without abandoning the point particle model.

Next, we use the planetary model (or Saturn model) in the classical electrodynamic category to calculate the total ionization energy of helium atom. In order to directly verify whether the operation of the relationship between the energy eigenvalue solution of other microscopic systems and the energy eigenvalue solution of the ground state hydrogen atom is reliable. This can also verify whether Eq. (11) of the interaction energy between two electrons in the electron pair is practical. The significance is that Bohr hydrogen atom theory can be extended to multi electron systems; Bohr theory and wave mechanics can be used together, mutual confirmation.

On the premise that "the Saturn model and the electron pairing are two electrons with opposite spins that completely coincide", the two electrons in the ground state helium atom have been paired, and the radius of the electron ring is  $r$ . Taking the  $1s^2$  electron of the ground state helium atom as a whole, the potential energy function is  $V_{He}(1s^2) = -(2e)(Ze)/r = -4e^2/r$ . According to scheme 2 of Tu's operation rules, result in  $Z=4$ . Substituting it into Eq. (6), the corresponding energy eigenvalue is  $-4^2 \times 1312.0/2 = -10496.0$  kJ/mol. Substituting  $Z=2, n=1$  into Eq. (11), we get  $E_{ns^2} = -2878.26$  kJ/mol. The inverse sign of " $-10496.0$  kJ/mol +  $2878.26$  kJ/mol -  $7617.7$  kJ/mol" is the ionization energy of He. The energy eigenvalues of high-speed moving electrons calculated using the Schrödinger equation do not take into account relativistic effects, while the ionization energy obtained by experimental methods already includes relativistic effects. The experimental value of the second ionization energy of helium is  $-5250.5$  kJ/mol. The energy eigenvalue of this electron calculated using wave mechanics method is  $-5248.0$  kJ/mol. The difference 2.5 between 5250.5 and 5248.0 reflects the magnitude of relativistic effects.  $[(2.5/5248.0) \times 100\% \approx 0.048\%$ , which is the proportion of relativistic effects in the ionization energy or energy eigenvalues of helium atoms in the ground state]. The correction value for the relativistic effect of two such electrons is  $10496.0 \times 0.048\% \approx 5.0$  (kJ/mol),

7617.7+5.0=7622.7 (kJ/mol). It can be seen that after relativistic correction, the calculation results of helium atoms in this article are consistent with the experimental results.

This shows that the Tu's operation rules introduced and uniformly used in this paper are desirable. The calculation results of lithium molecule and hydrogen chloride molecule in references strengthen this conclusion. The two  $1s^1$  electrons of helium atoms have already paired (completely overlapping). When they overlap, the radius of the electron ring remains unchanged (*i.e.*, for helium atoms, the radius of the  $1s^1$  single electron ring is equal to the radius of the  $1s^2$  double electron ring). We can calculate the radius of the electron ring based on the energy eigenvalue of the double electron ring in helium atoms (temporarily ignoring the interaction energy between two electrons), or we can calculate the radius of the single electron ring based on the energy eigenvalue of the single electron in helium ions ( $\text{He}^{1+}$ ). The potential energy function of electrons in a single electron ring in helium ions is  $V_{\text{He}}(1s^1) = -(e)(Ze)/r = -2e^2/r$  (where  $Z$  is the effective charge of the helium atom,  $Z=2$ ). The corresponding energy eigenvalue solution is  $2^2$  times that of the  $1s$  electron in the hydrogen atom, *i.e.*,  $-5248.0$  kJ/mol. The corresponding potential energy is 2 times the energy eigenvalue, *i.e.*,  $10496.0$  kJ/mol. According to the Saturn model,  $10496.0 = 2e^2/r_{1s}$ . The second ionization of helium is  $5250.5$  kJ/mol (this is the experimental value). The difference between the calculated value of  $5248.0$  and the experimental value of  $5250.5$  is also caused by the fact that the relativistic effect is not considered in this paper. After finishing  $10496.0 = 2e^2/r_{1s}$ ,  $r_{1s} = (2 \times 2624.0 / 10496.0) a_0 = 0.49976 a_0 = 2.6446 \times 10^{-11} \text{m}$  can be obtained. If the second ionization energy data is used, the radius of helium atoms are  $0.5 a_0$ .

The above has calculated the energy eigenvalue of one of the two paired electrons in the helium atom as a solid whole as  $-5248.0$  kJ/mol (the energy eigenvalue of two such electrons is  $10496.0$  kJ/mol). The corresponding potential energy is twice as large as this value. In this way, we also have such a relationship:  $10496.0 \times 2 = 4e^2/r_{1s}$ . Its solution is also  $r_{1s} = 0.50000 a_0$ . The above two calculation results can be fully understood as that there is no obstacle to the conclusion that "the pairing of two electrons outside the helium nucleus is the complete coincidence of two electron rings" [Eq. (11) can remove the obstacle of energy divergence]. After calculating the radius of  $1s^2$  double electron ring, we can characterize the classical electrodynamic equilibrium structure of helium atom in the framework of planetary model, and accurately calculate the total ionization energy of helium atom in the ground state. Ionization energy of two electrons of helium atom in ground state = potential energy of two electrons relative to helium nucleus - kinetic energy of these two electrons - interaction energy between these two electrons =  $4e^2/0.5 a_0 - 10496.0 - 2878.2 = 7617.8$  (kJ/mol). The final total ionization energy of the helium atom in the ground state is calculated from the Saturn structure model. The Saturn structure of helium atoms is clear — there is a double electron ring outside the helium nucleus, which is moving along the circular impact, similar to the standing wave.

Let's go back to the calculation of the hydrogen molecule. On the premise that the distance between two electrons and two hydrogen nuclei is equal, there is no more suitable hydrogen molecular skeleton that meets this premise, except for the skeleton where these two electrons form a ring and stay in a ring between the two nuclei. Bohr lacks the ability to imagine the planetary model structure skeleton of hydrogen molecules, while wave mechanics denies that hydrogen molecules have a definite and clear structural skeleton using the principle of uncertainty. Readers can try the classic structure where two point like electrons are located between two nuclei to see if it is stable or not. The author has tried it, but it is very unstable [The mechanical equilibrium equation (1) of the system cannot be established]. It is only a thermodynamic assumption that the partial charge of these two electrons is always between the two nuclei, which is not possible from a kinetic perspective. In addition, it is difficult to achieve a clear and stable mechanical equilibrium state when only a small portion of the charges of the two bonded electrons are distributed between the two nuclei (previously referred to as partially overlapping electron clouds distributed between the two nuclei). For example, if both electrons run far from the nucleus or run to the same side of both nuclei, the system becomes unstable. Existing quantum mechanics and quantum chemists can only guarantee from a thermodynamic perspective that hydrogen molecular systems do not self-release heat and dissociate. The combination of Saturn's model and wave mechanics has great advantages in analyzing hydrogen molecules (both kinetic and thermodynamic aspects can ensure the stability of the system).

Replace  $Z$  with the total effective nuclear charge ( $Z^+ + Z^*$ ) of the two atomic nuclei perceived by the bonding electron, and Eq. (11) also holds. Substituting  $Z=2$  and  $n=1$  into Eq. (11) result in  $E_{1s^2} = 2878.26$  kJ/mol =  $29.849$  eV. Clearly visible, we used both classical electrodynamics and wave mechanics methods [Note: Eq. (9) used both methods, Eq. (1) used classical electrodynamics, and Eqs. (3) and (7)-(9) used wave mechanics]. The dissociation energy of hydrogen molecules is the algebraic sum of the following: The energy eigenvalues of two bonded electrons (treating the already paired electrons as a whole) and the electron pairing energy, the interaction energy between two atomic nuclei, and twice the ionization energy of hydrogen element. The first item has been calculated based on Eqs. (6) and (7), and it is  $-7872.0$  kJ/mol. The sum of the effective nuclear charges received by these two bonded electrons is also 2, so the proportion of the relativistic effect of their energy eigenvalues can also be chosen as  $0.048\%$ . The relativistic correction value is  $-7872.0 \times 0.048\% = 3.8$  kJ/mol  $\approx -0.4$  eV. Considering the relativistic effect, the dissociation energy of hydrogen molecules is

$$D_e = (-7872.0 - 3.8) + 1968.0 + 2878.26 + 1312.0 \times 2 = -405.5 \text{ (kJ/mol)} \approx -4.6 \text{ eV.} \quad (12)$$

We have already used equation (11) to calculate the value of  $E_{1s^2}$  (which is  $2878.26$  kJ/mol). The two nuclei are relatively stationary, and the interaction between nuclei does not require relativistic correction. The relativistic correction values of the energy eigenvalues of the two bonded electrons are the same as those used



in equation (12).

So, we have

$$D_e = -5904.0 - 3.8 + 2878.26 + 1312.0 \times 2 = -405.5 \text{ (kJ/mol)} \approx -4.6 \text{ eV.} \quad (13)$$

The charge state of hydrogen molecules is the same as that of helium atoms. Therefore, we use the experimental value of the interaction energy between two electrons in a hydrogen atom  $E_{ns^2} = 5250.5 - 2372.3 = 2878.2 \text{ (kJ/mol)}$  as a reference and simple validation (The relativistic correction value is still  $-3.8 \text{ kJ/mol}$ ).

$$D_e = -5904.0 - 3.8 + 2878.2 + 1312.0 \times 2 = -405.6 \text{ (kJ/mol)} \approx -4.6 \text{ eV.} \quad (14)$$

The corresponding experimental value is  $-0.4 \text{ eV}$ . The  $1312.0 \times 2$  in the equation is the energy released by recombining two free electrons and two hydrogen nuclei into two ground state hydrogen atoms after splitting the hydrogen molecule into four independent individuals: electrons and hydrogen nuclei. According to the calculation result of Eq. (11), there is an uncertainty component of  $0.3 \text{ eV}$ . The spin magnetic moment coupling between the nucleus and electrons has another uncertain component that has not been taken into account. Although there is a significant error in the calculation results, we know where the error lies. Therefore, the calculation here can achieve the main purpose of demonstrating the feasibility of new theories and methods.

The most accurate method for calculating the interaction energy between two paired electrons is the ionization energy difference method, and the ideal regression equation is a regression equation that is fitted based on ionization energy data of the same period.

Since the determined relative static skeleton of hydrogen atoms is known, the classical electrokinetic method can be used to calculate the dissociation energy of hydrogen atoms. If the results calculated based on the hydrogen molecular skeleton in a relatively stationary state are consistent with Eqs. (12)-(14) (similar to experimental facts), it would be exciting. From Fig. 2, it can be seen that since  $R = 0.7053 \times 10^{-10} \text{ m} = 1.33333a_0$ ,  $\theta = (1/3)\pi$ .  $L$  and  $r$  can be calculated based on trigonometric functions or trigonometric corner relationships.  $L = (R/2)\cos\theta = 0.7053 \times 10^{-10} \text{ m} = 1.33333a_0$ ,  $r = L\sin\theta = 1.15465a_0 = 0.61081 \times 10^{-10} \text{ meters}$ . The potential energy between hydrogen nuclei and electrons is  $V_{N-e} = -4e^2/L = -7872.02 \text{ kJ/mol} = -81.6362 \text{ eV}$ . The interaction energy between two hydrogen nuclei is  $V_{N-N} = -e^2/R = -1968.0 \text{ kJ/mol} = -20.409 \text{ eV}$ . The dissociation energy of a hydrogen molecule is equal to the algebraic sum of the interaction energy between nuclei and electrons, the interaction energy between nuclei, the interaction energy between bonding charge pairs, and the ionization energy of two hydrogen atoms. The interaction energy between internal electrons in bonded double electrons can be calculated using a value of  $2878.2 \text{ kJ/mol}$ . Given  $L = R = 1.333333a_0$ , the potential energy of electrons relative to the nucleus is  $-4e^2/L = -(4/1.33333)(e^2/a_0) = -7872.00 \text{ kJ/mol}$ . In wave mechanics, the result calculated by the Schrödinger equation is  $-7872.02 \text{ kJ/mol}$  (The relativistic correction value is still  $-3.8 \text{ kJ/mol}$ ). So, we can calculate the dissociation energy of hydrogen

molecules based on the determined static skeleton.

$$\left. \begin{aligned} D_e &= -4e^2/L + E_{(1s^2)} + e^2/R - 2I_H \\ &= -7872.02 - 3.8 + 2878.2 + 1968.0 + 1312.0 \times 2 \\ &= -405.6 \text{ (kJ/mol)} \approx 4.6 \text{ eV} \end{aligned} \right\} \quad (15)$$

It is easy to see that the Eq. (15) adopts a relatively static hydrogen molecular structure model calculation method. If the intrinsic motion and vibration of electrons and atomic nuclei are not considered, the structural model is a stationary structural model (stationary structure of virtual axle wheels of unicycles). It is worth discussing why it can calculate results close to experimental values. However, using this set of rules to calculate hydrogen molecule ions ( $H_2^+$ ), lithium molecules ( $Li_2$ ), and sodium molecules ( $Na_2$ ), the calculated bond lengths and dissociation energies are close to the experimental results. We have demonstrated the effectiveness of this set of operating rules in this way.

The above calculation process indicates that the Saturn model brings great convenience to quantum chemical calculations. An important source of error is the neglect of the coupling effect between nuclear magnetic moment and electron magnetic moment. Using the same method to calculate hydrogen molecular ions, the error in the calculation of dissociation energy is greater than that of hydrogen molecules, The reason is that the interaction between nuclear magnetic moment and electron magnetic moment leads to structural asymmetry of hydrogen molecular ions (Calculated based on completely symmetrical molecules, the error will definitely be larger). Although using the author's method to calculate the relative wave mechanics of hydrogen molecular ions does not have an absolute advantage, the problems explained by the author's calculation results are interesting and valuable.

In the author's calculation process and results, the momentum and position of each particle in the hydrogen molecule remain unchanged (the most obvious being the positional and momentum determinacy reflected in the schematic diagram of the hydrogen molecule structure and the mechanical equilibrium state equation of the hydrogen molecule system). This is in line with local realism, deterministic theory (determinism), and methods. All the calculation results mentioned above are based on the ideas, theories, and methods of local realism and determinism, or both of these determinist methods and wave dynamics. The constant bond length of hydrogen atoms and the constant bond angle in molecules such as carbon dioxide are both experimental results. This is experimental evidence that the position and momentum of atoms in microscopic systems have a certain degree of certainty. There is no direct evidence to prove that the bond length, bond angle, and bond energy in molecules such as hydrogen, carbon dioxide, and silica are uncertain when not measured (they are not determined by human selection). The molecular spectrum is also deterministic or invariant. If it is believed that this "spectral invariance" is caused by measurement (which causes superposition collapse and stabilizes the intrinsic value), it must be acknowledged that "current measurements determine past history", and the law of causality

does not apply. The reasonable calculation result based on Eq. (15) is a direct evidence of the certainty of the molecular system. Even if the values of bond length, bond angle, and bond energy in molecules such as hydrogen, carbon dioxide, and graphene are obtained by measuring the collapse of the superposition state, the same value is always obtained for the same point in the second measurement (for identical measurements, measuring the same physical quantity no matter how many times it is measured, most of the time only the same value can be obtained), which indicates that the randomness of collapse does not exist. The randomness of collapse does not exist, and the existence of state superposition is questionable.

### 3. Some Computational Examples Suggest Electronic Structure

As we all know, the meaning of the wave function used in the steady-state Schrödinger equation has always been unclear. Schrödinger was indeed just borrowing a wave function at the time. The most commonly used wave function is the plane wave solution of the electromagnetic wave motion equation.

$$\psi = Ae^{-i2\pi(vt-x/\lambda)}. \quad (16)$$

Schrödinger established the Schrödinger equation in 1926, and it was not until 1927 that Davidson confirmed the existence of the de Broglie wave (Actually, he only verified the de Broglie relationship  $p=h/\lambda$ , and without understanding the specific form of the de Broglie wave. However, until now, people still have not confirmed that the wave equation or wave function of de Broglie matter waves is Eq. (16). Even though Schrödinger had long accepted the concept of matter waves, he did not know the specific wave form of the de Broglie wave. People think that wave mechanics uses the concept of matter waves, but the wave function in the Schrödinger equation is not the wave function of de Broglie waves (the specific form of de Broglie waves is unknown. Wave mechanics only uses the  $p=h/\lambda$  relationship recognized by de Broglie waves). The particles in motion are considered to be material waves, but the Schrödinger equation in wave mechanics uses a wave function of electromagnetic waves instead of a de Broglie wave function. This is a limitation of wave mechanics. Not further exploration is not a scientific attitude.

According to historical data on technology, the Schrödinger equation was written by him based on intuition. This indicates that Schrödinger did not know the source of the wave function, and the wave function in the form of Eq. (16) was a tool used by Schrödinger to establish wave mechanics. Schrödinger's use of de Broglie waves is consist of two aspects: firstly, the use of the concept of de Broglie matter waves; Secondly, use the de Broglie relationship  $p=h/\lambda$ . As long as we think carefully, it is not difficult to find that the wave corresponding to the wave function in the Schrödinger equation has three possible meanings: first, it is electromagnetic wave; Secondly, it is a matter wave (determined by the wave particle duality of particles, but the specific form is not considered); Thirdly, it is purely a tool used in wave mechanics. The first possibility supports the theory of wave element material structure (a special case is that electrons can be

considered to be composed of specific electromagnetic waves). The second possibility does not reject the suggestion given by the first possibility. After all, the essence of objects composed of many waves is still waves.

As long as we have the idea that the wave function and its corresponding de Broglie matter waves can be both real waves and just tools for utilization, there is no obstacle to using the Schrödinger equation to calculate the classical mechanical eigenvalues of bound state macroscopic objects. In the steady-state Schrödinger equation, there is a Hamiltonian operator (including a classical potential energy function and a kinetic energy operator). There is no reason to believe that this potential energy function can only be an electromagnetic force potential energy function and not a gravitational potential energy function. There is no problem retaining the Hamiltonian operator when describing macroscopic objects (the Hamiltonian operator has always been considered a kinetic energy operator, and the motion of macroscopic objects also has kinetic energy). We use  $M$  as the mass of the sun and  $m_{\text{earth}}$  as the mass of the earth. So, the Schrödinger equation that describes the Earth's revolution is

$$-\frac{\hbar^2}{2m_{\text{earth}}}\frac{\partial^2}{\partial x^2}\psi - \frac{GMm_{\text{earth}}}{r}\psi = E_{\text{escape}}\psi. \quad (17)$$

As with the previous discussion of hydrogen atoms, the  $0 \rightarrow x$  in the above equation can be an arc length (or  $x$  can be viewed as a one-dimensional coordinate in Riemannian geometry, i.e. the distance on the spherical surface). Newton's theory can fully describe this situation. The establishment of the Eq. (17) laid the theoretical foundation for the joint use of classical mechanics and wave dynamics. The energy eigenvalue solution of Eq. (17) is the energy required for the Earth to escape from the solar system from its orbit  $r$  away from the Sun (referred to as "escape energy"). Referring to the treatment of the Schrödinger equation for microscopic systems, Eq. (17) can also be extended to a three-dimensional form (the equation obtained by replacing  $\frac{\partial^2}{\partial x^2}$  with  $\nabla^2$  in the above equation).

In the solar system, the Earth moves along a circle (this article ignores the case of ellipses), and  $r$  is on this circular plane (i.e.,  $r$  is only a distance on a plane rather than in three-dimensional space). The three-dimensional Schrödinger equation in this Euclidean space always has a coordinate value of zero in one dimension. Therefore, this three-dimensional Schrödinger equation is actually only two-dimensional. The radius  $r$  can be selected within a range of zero to infinity. However, this does not mean that the position and linear velocity of the Earth on this plane cannot have a definite value at the same time. This is just like the situation where an elderly person is lost that will be discussed below. After an elderly dementia patient is lost in Beijing, his range of activity is the entire city of Beijing. That is to say, the probability of his appearance throughout the urban area of Beijing is not zero, but it does not mean that his position and speed cannot have a definite value at the same time. Only when we choose an uncertain value of  $r$  can we conclude that the position of the Earth in the solar system is uncertain. When  $r$  is a constant value, Eq. (17) still has a solution. When the value of  $r$  is determined, the value of wavelength  $\lambda$  is

also determined, and we can solve Eq. (17) like Eqs. (18)-(22). To put it another way, when the Earth revolution, its orbit can be fixed. The meaning of "the selection range of radius  $r$  is  $0 \rightarrow \infty$ " is only to acknowledge that its orbital radius can change from  $r=0$  to infinity, rather than to acknowledge that the earth sun distance and the direction of extension of the line representing this distance are both random. Although the selection range of radius  $r$  for the Earth's orbit is  $0 \rightarrow \infty$ , it indicates that there are an infinite number of the Earth's revolution orbit. However, the radius of each orbit is determined. Although choosing which one is random. As long as one is selected, the radius of the orbit is fixed (no longer changing, it is fixed).

The quantization of the Earth's escape energy obtained from the three-dimensional Schrödinger equation can be understood as an augment of root of equation in mathematics. Equation (17) intuitively demonstrates that Newtonian mechanics can be combined with wave mechanics. However, it is still not possible to calculate the magnitude of the force and can only calculate some physical quantities other than the force. The quantization condition can be obtained. However, even if quantization occurs, it is definitely not the quantization of gravitation. For wave mechanics, there is no insurmountable gap between macroscopic and microscopic systems themselves.  $E_{escape}$  can be obtained by substituting the known orbital radius  $r$  value into the classical mechanical relationship equation  $E_{escape} = (1/2)mv^2 = GMm^2/(2r)$ , which can also be obtained by solving the Schrödinger equation. It is the magnitude of the Earth's rotational kinetic energy. Note: In the process of solving the three-dimensional form of Eq. (17), it is possible to use the classical mechanical formula, such as  $p = h/\lambda = vm_{earth}$ ,  $v^2 = GMm/r$ . The solution of the three-dimensional form of the Eq. (17) is the same as the solution of the steady-state Schrödinger equation for hydrogen atoms.

The Schrödinger equation of the Earth's revolution and its solutions can be associated with the handling of hydrogen atoms in wave mechanics. The uncertainty of the position of extranuclear electrons was originally assumed artificially when solving the Schrödinger equation. That is, the conclusion that "electrons randomly appear in space outside the hydrogen nucleus" is not a result obtained by solving Schrödinger, but a hypothesis made by the person solving the Schrödinger equation. Many people have already recognized this and believe that there is no reliable source of probability in quantum mechanics.

The above analysis indicates that the wave function can be a real equation of motion for waves, but it can also be a real wave or just a tool. For describing planetary motion, it is a tool. In this case, the de Broglie wave is just a concept. It can be seen that there is no irreconcilable contradiction (or insurmountable gap) between the mathematical formal system describing microscopic systems and the mathematical formal system describing macroscopic objects themselves. If the described object is a complete wave, then the Hamiltonian operator acting on the wave function result in "the energy increase of the wave due to the action of the potential field" rather than the kinetic energy of the described object. If

the object being described is not a wave, the energy obtained by the Hamiltonian operator acting on the wave function is kinetic energy, rather than the energy increment caused by the law that the energy of the wave changes while the form of the wave remains unchanged in the potential field.

As long as we believe that the wave corresponding to the wave function in the Schrödinger equation is a complete electromagnetic wave, even without taking into account the calculation results introduced in this article, we still have reason to admit that electrons are composed of complete electromagnetic waves. In this way, within the framework of the Bohr hydrogen atom planetary model, taking into account the series of calculation results introduced in Section 2, it is possible to choose that the extranuclear electron is also a ring (ring entity). The origin of the electromagnetic field in hydrogen atoms is a planar structure, and the motion of electrons outside the nucleus is the rotation of the outer electron ring in the plane (similar to the motion of Saturn's circular satellites relative to Saturn). At least, in describing the structure and motion of bound state  $s$  electrons, it is possible to achieve unity between wave dynamics description and planetary model description. In this way, the Schrödinger equation for hydrogen atoms can be written in the following simplified form

$$-\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} \psi - \frac{Ze^2}{r} \psi = E\psi. \quad (18)$$

When  $r$  is a known constant  $a_0$ ,  $x$  is a closed curve on a sphere with a radius of  $r$  (i.e., a closed line in Riemannian space). This is determined by the author's free electron structure model and extranuclear electron motion model. In Euclidean space, this circle is drawn using this radius  $r$ . When waves propagate along the circumference of this circle, Eq. (18) can simultaneously use planetary models and wave mechanics to describe hydrogen atoms. It is obvious that the hydrogen atom in the Saturn model can also be described using Eq. (18) (because the electron charge distribution is on a circle surrounding the atomic nucleus's transport, and the potential energy function is the same as the electron charge distribution on an  $i$ -ball rotating around the nucleus). If the binding force in a bound system originates from gravitation, then the corresponding Schrödinger equation is Eq. (17). Only by artificially selecting  $r$  with uncertainty (the size can only be randomly selected within the range of 0 to infinity, and direction can only randomly point from zero to one of all points in three-dimensional space), can Eq. (18) be extended to a three-dimensional form of equation (3). From this perspective, at least a considerable part of the uncertainty in quantum mechanics is artificially selected (when the size and direction of  $r$  both are determined, there is only one definite orbital. When the size and direction of  $r$  both are uncertain, it can be said that a bound solid outside the center of attraction has no definite motion orbit).

When the electrons outside the nucleus of the ground state hydrogen atom resemble a circular satellite of Saturn, it is easy to know according to the Virial theorem that the value of the first term on the left side of equation (18) is exactly half of the value of the second term. According to the meaning of the Hamiltonian operator, the

first term on the left of equation (18) is the kinetic energy of a particle in a bound state. For wave functions, wave dynamics has always borrowed the form of Eq. (16), or an equivalent form. If this wave is an electromagnetic wave, it has a definite propagation path and non-zero linear momentum. However, it has no stationary mass. Therefore, it does not have kinetic energy corresponding to linear momentum. In this case, the eigenvalues obtained using the first term on the left of Eq. (18) are not kinetic energy, but the energy added by the wave entering the potential field. The reason is that "in a potential field, the energy of the wave changes, but the form of the wave remains unchanged".

The Eq. (18) is a one-dimensional steady-state Schrödinger equation, and solving it is not much more difficult than solving a one-dimensional potential well, but it is much simpler than solving a three-dimensional Schrödinger equation. If  $r$  and wavelength  $\lambda$  are all constant values, then the partial differential in Eq. (18) can be directly calculated to obtain Eq. (19), and finally the energy eigenvalue can be obtained. The establishment and solution process of Eqs. (8) and (18) indicate that the planetary model and wave dynamics model can achieve complementary advantages. According to Fig. 2, convert  $R$  in Eq. (8) to  $L$ , and then merge the potential energy terms. Using pure wave dynamics methods, its solution can be obtained. If both  $R$  (or  $L$ ) and  $\lambda$  are fixed values, and Eq. (8) can also be reduced to a one-dimensional steady state Schrödinger equation to obtain the corresponding energy eigenvalues. This is calculated based on the stationary skeleton. Equation (15) is this type of completely static calculation method (belonging to the category of local realism and determinism, without completely rejecting the existing mathematical form system of wave mechanics).

By calculating the partial derivative in Eq. (18), it can be obtained that

$$\left. \begin{aligned} -\frac{\hbar^2}{2m\lambda^2}\psi - \frac{Ze^2}{r}\psi &= E\psi \\ -\frac{\hbar^2}{2m\lambda^2} - \frac{Ze^2}{r} &= E \end{aligned} \right\} \quad (19)$$

We know that the kinetic energy operator  $-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}$  can be obtained from the momentum operator  $\hat{p} = -i\hbar\frac{\partial}{\partial x}$  according to the operator operation rules. It is an energy operator corresponding to momentum. If it is an electromagnetic wave without a stationary mass, the Hamiltonian operator  $\hat{H} = -\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}$  obtained from its momentum operator  $\hat{p} = -i\hbar\frac{\partial}{\partial x}$  is definitely not the kinetic energy of the electromagnetic wave.

We have once again explained that the first term of the second equation in Eq. (19), even if viewed as kinetic energy, can only be virtual kinetic energy (in the case of particles being complete waves). For complete waves, energy with values equal to kinetic energy belongs to the energy that the wave is lifted by the potential field, rather than the true kinetic energy. The two electrons that have already been paired completely overlap in opposite directions of propagation. According to wave theory, the two overlapping waves have formed a standing wave with zero overall (or center of

gravity) displacement. The overall unidirectional linear momentum of the standing wave is zero, and the corresponding kinetic energy is also zero. It can be certain that when there is a small error in the framework structure of hydrogen molecules, it will inevitably cause a large dissociation energy error. This indicates that the calculation process and results of the dissociation energy of hydrogen molecules in this article cannot be completely denied for the validation of the theoretical model. The extensive application of localized realism quantum mechanics is still in its early stages. The spin coupling effect between nuclei and electrons has not been considered, and the regression equation in the calculation method of the interaction energy between bonded electrons and internal electrons is not yet very accurate. In this case, having such application results is still relatively ideal. The calculation results based on equation (15) and equations (12) - (14) can mutually confirm each other.

For hydrogen atoms, Eqs. (3) and (18) can be used simultaneously. Equation (3) can describe the classical equilibrium system of bound state mechanics. This in principle determines that the rotation state of planets in the solar system can also be described using the Schrödinger equation. In fact, the Schrödinger equation for the rotation of planets in the solar system has been established, with only the properties and forms of potential energy different from those in the Schrödinger equation for microscopic systems.

The content of this section is one of the theoretical foundations for combining planetary model theory and wave dynamics. We have provided multiple successful application examples of the mixed use of wave dynamics and planetary model methods. This leads to the inference that the explanatory system of quantum mechanics can be separated from the mathematical formal system, and the mathematical methods of planetary models can be compatible with the mathematical methods of wave dynamics.

As long as the radius of the calculated electron ring is known and constant  $a_0$ , the second term on the left side of equation (18) does not need to be solved using complex methods, but can be directly calculated using  $-Ze^2/a_0$ . Its value is  $-2624$  kJ/mol. If the 1s electrons outside the nucleus of a hydrogen atom resemble a Saturn ring with uniformly distributed charges, there is no doubt that the first term on the left of Eq. (17) is the kinetic energy of the Saturn ring electrons (previously expressed as  $E_k$ ). Its absolute value is half of the absolute value of the potential energy  $V$  of the second electron  $V = -Ze^2/a_0$  [i.e., in accordance with the Virial theorem. See Eq. (20) for details]. If the electrons outside the nucleus of a hydrogen atom are completely electromagnetic waves without a stationary mass, the first term on the left in the stationary Schrödinger [Eq. (19)] is the energy that the electromagnetic wave increases after entering the potential field (not kinetic energy, its relationship with the immediately following term conforms to the Virial theorem. We can all use  $E_f$  to represent it, indicating that its properties are undetermined), rather than "the kinetic energy of an electromagnetic wave that has always been without a stationary mass."

The specific form of the wave function is unknown. However, people have always borrowed the form of Eq. (16), or an equivalent form. In this case, both gravitational and electric potentials have

$$E_f = \frac{h^2}{2m\lambda^2}. \quad (20)$$

And in terms of form, they all conform to the principle of dimensional theorem. Regardless of whether the wave function and the "de Broglie wave corresponding to it" belong to real waves or are only tools used, Eq. (20) can be used to calculate the true kinetic energy or the energy increment of pure waves in a potential field.

$$\frac{h^2}{2m_e\lambda^2} = \frac{Ze^2}{2a_0} = 1312.0. \quad (21)$$

The Planck constant  $h$  has a dimension of  $\text{J}\cdot\text{s}$ , and to convert it to  $\text{kJ}\cdot\text{s}$ , it must be divided by  $10^3$ . The unit of 1312.0 is  $\text{kJ}\cdot\text{mol}^{-1}$ , The dimension of  $\lambda$  is  $\text{m}$  (i.e., the unit of  $\lambda$  measurement is meters. To prevent confusion, the electronic mass in the above equation is represented by  $m_e$ , and its unit is  $\text{kg}$ . In other areas that are not easily confused, ignore the subscript of mass  $m$ ).

One difficulty in the dimensional operation in the above equation is that the dimension on the left side of Eq. (21) will contain a dimensional sub item of  $\text{s}^2\cdot(\text{kg}\cdot\text{m}^2)^{-1}$ . It is the reciprocal of  $\text{kg}\cdot\text{m}^2\cdot\text{s}^{-2}$ , the unit of work, and must be converted to  $\text{kJ}$ . The conversion coefficient is 100 [multiplied by the numerator on the left side of Eq. (21)].  $\text{kg}\cdot\text{m}^2\cdot\text{s}^{-2}$  represents the work done by an electron moving a distance of 1 meter under acceleration. The energy unit in equation (21) is  $\text{kJ}\cdot\text{mol}^{-1}$ . Therefore, its left side must be multiplied by the Avogadro constant  $NA$ . After considering these factors and ignoring the relativistic effect, Eq. (21) can be summarized as

$$\lambda = \sqrt{\frac{(10^{-3}h)^2 \times 10^2 \times NA}{2 \times 1312.0 m_e \times 10^{-3}}} \sqrt{\frac{10^{-4}h^2 \times NA}{2426.0 m_e}} = \lambda_{(H1s)} \sqrt{\frac{1312.0}{I_{(Z1s)}}}. \quad (22)$$

Substitute each constant into the above equation (note:  $m_e$  uses the value of  $9.10938 \times 10^{-31} \text{g}$ ). Result in  $\lambda = 3.3259 \times 10^{-10}$  meters. Taking  $\lambda$  as the circumference, the radius of the enclosed circle is  $r = \lambda/2\pi \approx 5.2933 \times 10^{-11}$  meters (recognized as  $5.29 \times 10^{-11}$  meters). The error is very small. During the calculation process, the formula  $\pi = \lambda/2r$  was utilized. We can be certain that the extranuclear electrons of hydrogen atoms move along a circle in a plane (similar to the circular satellites of Saturn orbiting Saturn).

The function used here is still  $\psi(x, t)$ . The corresponding wave also propagates along this circumference. This indicates that there is no essential difference between Eqs. (17) and (18) [if the potential energy is derived from gravitational potential energy, using Eq. (17): if potential energy is electromagnetic potential energy, using Eq. (18)]. Therefore, in equations (18) and (19),  $x$  is the displacement of the bound state electron on the arc. This is also the reason why equation (3) can be simplified to equation (18) (i.e. they can be interchanged). The key is that this indicates the reason why it is not necessary to establish a two-dimensional form of the

wave function (one-dimensional wave functions can be used for the calculation of the two-dimensional Schrödinger equation). The situation where electrons in atoms appear randomly in three-dimensional space is fictional. The solution of Schrödinger equation can be obtained, but it is difficult to guarantee that there will be no incredible extraneous root ("the position of electrons outside the nucleus is uncertain and the motion mode is unimaginable" is probably extraneous root). The calculations and analysis in this section confirm the preliminary assumption we introduced at the beginning of the article (the assumption of elastic Saturn's satellite rings). In orthodox wave mechanics, when using the Schrödinger equation with a solution form such as equation (3), people do not care whether the propagation of waves represented by the wave function  $\psi(x, t)$  is really in two-dimensional space. In other words, in the process of solving equation (3), the Hamiltonian operator containing  $\nabla$  is three-dimensional, and  $r$  is also seen to be three-dimensional, while  $x$  in equation (17) of the wave function is one-dimensional. This is a contradiction. This contradiction has never been resolved by people. This section points out that 'it is a fictional characteristic that leads to root addition', thus revealing a long-standing misconception in the interpretation of quantum mechanics, which can be ignored.

If readers doubt the calculation results of equations (21) and (22), we can also choose an atom with a higher atomic number and calculate according to the series of operation principles selected above. For the Cu atom on the 29th, the ionization energy is  $I_{29} = 1116105 \text{ kJ}\cdot\text{mol}^{-1}$ . This includes relativistic effects. The energy calculated according to equations (18) and (21) does not include relativistic effects. With reference to formula (21), a formula

$$\frac{h^2}{2m_e\lambda^2} = \frac{29e^2}{r_{\text{Cu}(1s)}} = 1116105 \text{ is established, and the approximate value}$$

$$\lambda_{\text{Cu}(1s)} \approx 1.1334641094 \times 10^{-11} \text{ m}, r_{\text{Cu}(1s)} \approx 1.803964 \times 10^{-12} \text{ m}.$$

Alternatively, according to the 29th ionization energy and classical electrodynamic potential energy of copper element,

$$1116105 \approx 29e^2/2r_{\text{Cu}(1s)}, r_{\text{Cu}(1s)} \approx 1.803964 \times 10^{-12} \text{ meters}.$$

According to the statement 'the energy of waves in a potential field changes while the form of waves remains unchanged', it can be inferred that the form of waves in free electrons must be the same as that in bound electrons. When solving the problem using the Xue Dingxiang equation, it has been chosen that the electron is a de Broglie wave. The wave described by the wave function is similar in form to the plane wave solution of electromagnetic waves. So, free electron waves are also a type of electromagnetic wave (which can be circularly polarized light waves). This situation implies that the internal composition of electrons is an electromagnetic wave. The most fundamental assumption chosen by the author is also that electrons are composed of closed phase trajectories of basic circularly polarized photons that move along a circumference that is an integer multiple of the wave. One of the supporting hypotheses is that after entering the electric field space, a phenomenon similar to Huygens' principle occurs, causing the energy of the wave to change and become a beat wave with a beat length  $274n^2$  times that of the free electron. After taking the beat length as the wavelength, this kind of beat wave is what everyone calls the Broglie wave.

The second auxiliary assumption is that left-handed fundamental circularly polarized photons do not require spatial bending to move in a curved motion along a circle. This is also based on the fact that two sine waves that are orthogonal can become circles. This maintenance also does not require spatial bending.

Let's calculate a few microscopic particles again. Prove whether the theories and methods introduced by the author are effective or not

#### 4. Partial Progress or Improvement of Application Methods in this Study

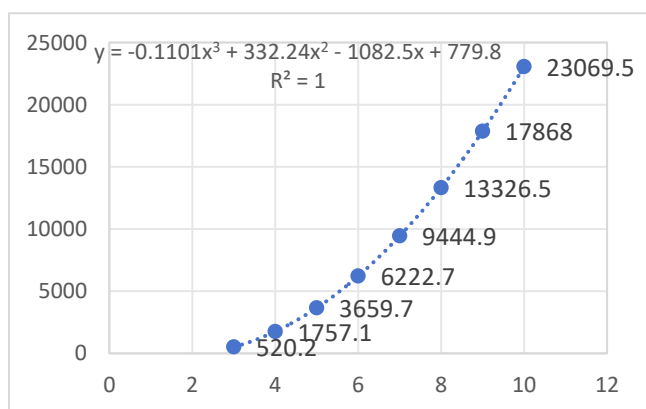
The following author uses an example that lacks corresponding

Atomic number	3	4	5	6	7	8	9	10
The ionization energy of 2s1 electrons	520.2	1757.1	3659.7	6222.7	9444.9	13326.5	17868	23069.5

**Table 1: Ionization Energy Data of 2s1 Electron for the Second Period Element**

The fitting curve of the above data is

$$E(2s^1) = -0.1101Z^3 + 332.24Z^2 - 1082.5Z + 779.8. \quad (23)$$



**Figure 3: The Ionization Energy of 2s<sup>1</sup> Electrons Versus Z Curve**

Regression curve with a power of 4 is  $E(2s^1) = -0.0487Z^4 - 1.3756Z^3 + 343.96Z^2 - 1127.9Z + 841.3$ .

Eq. (11) The formula is also created in this way. The nuclear charge of beryllium atom is 4. Substituting  $Z=4$  and  $n=2$  into equation (23) result in  $E(2s^1) = 1758.6$  kJ/mol. The corresponding experimental value is 1757.1 kJ/mol. The difference between the two is 1.5 kJ/mol

With a regression equation like equation (23), we can calculate the magnitude of the shielding effect of some inner electrons. The method of directly using ionization energy to calculate the effective nuclear charge in references can be updated to use regression equations to calculate the effective nuclear charge (it can be considered an improvement) [8-11]. The establishment of the Schrödinger equation to describe the true planetary motion (bound state macroscopic system) is also a research progress

known data. The author chose to calculate the dissociation energy and bond length of beryllium molecular ions. That is to make predictions about beryllium molecular ions based on the calculated data. We first find useful patterns based on the series of ionization energy data. The equation (11) is also obtained using a similar method.

According to the ionization table of the elements, the data for the third to last ionization energy of the second cycle (*i.e.*, the ionization energy of the 2s1 electron) is shown in Table 1.

relative to references [8-11]. Below, uses Eq. (23) to calculate some physical quantities of beryllium atoms. And make corresponding predictions based on these data.

In the potential energy function,  $Z_1 = 4Z^* \sin\theta = 4.48420$ . Just like dealing with hydrogen molecules, establish the steady-state Schrödinger equation based on the potential energy function  $V = -Ze^2/r$ , and obtain the eigenvalues of the energy of the bonded electron pairs:  $E_{B_2^+(2s^1)} = -Z^2 e^2 / (n^2 4a_0) = -3297.7$  kJ/mol.

According to the Saturn model, we have a relationship of  $1759.4 = (2e^2 Z^*) / (2a_0)$  [the relationship of  $1757.1 = (2e^2 Z^*) / (2a_0)$  is still available]. Considering  $n=2$ , we have  $Z^* = \sqrt{\frac{4 \times 1757.1}{1312.0}} = 2.31452$ .

Substituting it into Eq. (2) result in  $\theta = 28.9702^\circ$ ,  $\cos\theta = 0.874871$ ,  $\sin\theta = 0.484355$ . According to Fig. 2, the relationship between  $r$  and  $L$  is  $L = r / \sin\theta$ . According to the Tu's operation rules, the potential energy in the Schrödinger equation here should be written as a function of  $r$  [ $V_1 = -(2Z^* \times 2e^2) / L = -(4Z^* e^2 \sin\theta) / r = -4.48420 e^2 / r$ ]. At the same time, the repulsive effect between isotropic charges in beryllium molecular ions is temporarily ignored, and +2 valence beryllium ions are treated as point charges. The Schrödinger equation of the system is

$$\left[ -\frac{\hbar^2}{2m} \nabla^2 - \frac{4.48420 e^2}{r} \right] \psi = E \psi. \quad (24)$$

Using the same method as calculating hydrogen molecules, we can obtain  $Z_1 = 4Z^* \sin\theta = 4.48420$ . Just like dealing with hydrogen molecules the energy eigenvalue of the bonding electron pair is obtained as  $E_{B_2^{2+}(2s^1)} = -e^2 / (n^2 4a_0) = -Z_1^2 \times 3297.7$  kJ/mol. Substituting ( $2Z^* = 4.6290$ ) instead of  $Z$  into Eq. (11) result in  $E_{(2s^2)} = 1695.3$  kJ/mol.

On the basis of Eq. (24), increase the interaction potential energy between two beryllium ions, and Eq. (24) becomes

$$\left[ -\frac{\hbar^2}{2m} \nabla^2 - \frac{2Z^* \times 2e^2}{L} + \frac{Z^{*2} \times 2e^2}{R} \right] \psi = E\psi. \quad (25)$$

According to Fig. 2, convert  $R$  to  $L$ , where  $R=2L\cos\theta$ , and write the potential energy as a function of  $L$  (this is the unified Tu's operating rule). Considering  $Z^*=2.31452$ , merging the potential energy functions in Eq. (25) into similar terms yields  $V_2=-3.1349e^2/L$ . In this case,  $Z_2=3.1349$ ,  $Z^*=2.31452$ . Apply the operational principles to this example [using a series of operations such as Eq. (6)], and

the corresponding energy eigenvalues are  $-2 \times 1312.0 \left( \frac{Z_2^2}{n^2} \right) = -(3.1349/2)^2 \times 1314.0/2^2 = -1611.7$  kJ/mol.

Let  $|\Delta E|=3297.7-1611.73=1685.93$  kJ/mol, and substituting it into Eq. (10). The result is that the bond length of beryllium ion is  $r=8.31782a_0 \approx 4.40 \times 10^{-10}$  (m).  $|\Delta E|=1685.93$  kJ/mol is the interaction energy between two beryllium ions in beryllium-molecule's ion. One way to calculate the dissociation energy of beryllium-molecule's ion is to calculate the algebraic sum of "The energy eigenvalue of the beryllium ion (except for the internal interaction energy of the two-bond electrons), the interaction energy between the two bonding electrons, the energy released by that four free electrons return to the two  $\text{Be}^{2+}$  and revert to two beryllium atoms".

$$D_c = -3297.7 + 1685.93 + 2 \times (899.5 + 1257.1) = 1044.9 \text{ (kJ/mol)}. \quad (26)$$

The dissociation energy is a positive value indicating that the dissociation process system releases energy and the formation process absorbs energy. It indicates that in a mild environment, beryllium molecular ions cannot exist stably and exist under high temperature and pressure or laser irradiation conditions, with a bond length of  $4.40 \times 10^{-10}$  meters. This is one of the prophecies of this article. Below, we will also introduce some prophecies one by one.

As long as the electron is composed of fundamental circularly polarized photons, fundamental circularly polarized photons must have certain electrostatic properties. The author predicts based on this (or requests conditional readers to conduct experiments to verify the author's prediction) that the basic circularly polarized beam may deflect in an electric or magnetic field; There is a phenomenon similar to electromagnetic induction and can exhibit two polarities. Even if the photon decay valve frequency is not reached, this is still the case. The closer the frequency of fundamental circularly polarized photons is to the valve frequency, the more pronounced these phenomena predicted by the author.

## 5. Characteristics and Basic Prerequisites of the New Theory

The basic characteristic of the content described in this article and references is to "separate the explanatory system of quantum mechanics from the mathematical formal system, so as to make the mathematical formal system of the Bohr planetary model method in old quantum theory compatible with the mathematical formal system of wave mechanics [8-11]." The specific manifestation is that planetary models and wave mechanics can be mixed when

dealing with microsystems. In this way, it is not easy for us to abandon the explanations of local realism and determinism. The methods of localized realism and deterministic quantum mechanics explanations are superior to those of non-localized realism and non-determinism quantum mechanics explanations in accordance with natural science axioms and logicity. The author tends to refer to quantum mechanics theories with the above characteristics as localized realism quantum mechanics. The use of this name is not only more appropriate, but also to facilitate the differentiation of current orthodox quantum mechanics theories.

Everyone has accepted the concept that the wave function borrowed from quantum mechanics can be the wave function of electromagnetic waves. The viewpoint that "electrons are complete waves" has also been repeatedly used in the calculation and analysis process introduced above. This is not contradictory to popular beliefs and experimental facts of photon decay. So, the basic premise provided by the author for localized realism quantum mechanics is that electrons are composed of fundamentally circularly polarized light quanta propagating along smaller closed paths. The first step in the process of photon decay into electron pairs is a fundamental plane polarization photon decomposing into a fundamental left-handed circularly polarized photon and a fundamental right-handed circularly polarized photon. Secondly, a fundamental left-handed circularly polarized photon propagates along a small circumference of wavelength to form an electron, while a basic right-handed circularly polarized photon propagates along a small circumference of wavelength to form an antielectron. The affirmative statement here is inspired by the fact that "our world is a right-handed world": in a left-handed world, left-handed is positive and right-handed is negative. However, whether right-handed circularly polarized photons become electrons or left-handed circularly polarized photons become electrons requires experimental methods to determine. How do free electrons maintain this circular motion? Is the space curved or is there self-attraction? This requires more peer participation and exploration. Two columns of sine waves intersecting vertically can form a circle, and the existence of this circle does not require spatial bending. This is just a brief explanation of the hypothesis. In the history of technology, it has always been difficult to provide a comprehensive explanation when proposing. In addition, the author assumes that the duration at each point in the electromagnetic phase trajectory is the period of the wave, rather than infinitesimal. In this way, the propagation of photons with fundamental circular polarization photon along the circumference may also rely on self-attraction to maintain the original state of propagation along the circumference (the direction of rotation of the electric vector at the two endpoints of the diameter of this circle is opposite, which can generate attraction).

The above premise assumptions also have some auxiliary assumptions. One of them is that when the free electron ring approaches the electric field, a situation similar to Huygens principle occurs: the points on the circumference of the phase trajectory of the mother wave become  $274n^2$  nodal wave sources with the same wavelength as the mother wave. For example, the circumference

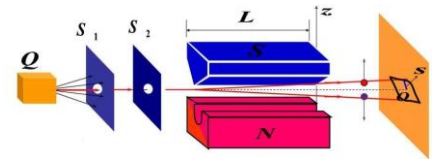
of the electron ring on the first main layer of a hydrogen atom is 274 times that of a free electron ring [to be precise, it is  $(2/\alpha)$  times]. The circumference of the electron ring on the second main layer is  $274 \times 4$  times that of the free electron ring [more accurately, it is  $(8/\alpha)$  times]. The above series of assumptions [Including the already used phrase 'two free electrons with opposite spin can pair'] can be referred to as Hypothesis 1.

This hypothesis series seems to contradict the explanation of quantum field theory. However, in reality, it is not contradictory to the mathematical form system of quantum field theory, but only conflicts with some explanations of quantum field theory. Furthermore, quantum field theory lacks the ability to describe the internal structure of electrons. It is not qualified to say that the assumptions about the internal structure of electrons in other theories do not conform to facts. We should believe more in the experimental fact that photons decay into positive and negative electron pairs. Furthermore, based on the assumptions chosen by the author, it is convenient to calculate the spin angular momentum and self-magnetic moment of electrons. This can also be considered as evidence of the author's chosen basic hypothesis.

One of the basic assumptions proposed by the author is that two free electrons with opposite spin can pair. According to superconductivity theory, a pair of electrons formed by the coincidence of two electrons with opposite spin directions has no resistance when passing through an object.

## 6. Prophecy and Validation Experiments Designed Based on the Theories, Methods, and Principles Introduced by the Author

- Basic circularly polarized photons exhibit some properties of electrostatic charge. For example, a circularly polarized photon beam can be deflected in a magnetic field and has two different deflection directions; Basic circularly polarized light passing through a conductor can generate electromagnetic induction and exhibit two polarities. The motion of extranuclear electrons around the nucleus in the Saturn model exhibits phase precession.
- The fine structure of hydrogen atomic spectra is related to this phase precession.
- When the same electron passes through multiple non-uniform magnetic fields or rotating magnetic fields, the spin magnetic moment can change its sign.
- Using the same stream of hydrogen atoms to conduct a multi-stage Stern Gerlach experiment in a relay manner, the two atomic rays separated from the upper stage can each be further divided into two beams by the non-uniform magnetic field of the lower stage.



**Figure 4:** Schematic diagram of the Stern Gerlach experiment. To verify prophecy d, an additional magnet needs to be added after the magnet in Figure 4. The two magnets have a magnetic field direction difference of 90-189 degrees. During the experiment, the atomic beam can be directly replaced with an electron beam.

e. After passing through multiple (multi-stage) rotating magnetic fields or non-uniform magnetic fields, the detected direction of electron spin or electron spin magnetic moment remains random.

By conducting double slit diffraction experiments in a cloud chamber, diffraction fringes can be observed. This phenomenon can prove that the collapse process of superposition state does not exist, and thus prove that the superposition process of states does not exist. If we believe that the molecules in the cloud chamber cannot cause the collapse of the superposition state, we can be certain that the stereo regression curve of the center coordinates of small droplets in the particle trajectory in the cloud chamber is the accurate motion path of the particles. The uncertainty relationship does not hold in this situation. In short, once this language is validated, the existing quantum mechanics interpretation system will face significant challenges [the superposition of states principle and the uncertainty principle can only be chosen one. Both principles are indispensable in the existing quantum mechanics interpretation system].

## 7. Application of Wave Element Material Structure Model to the Calculation of Electron Spin Magnetic Moment and Spin Angular Momentum

The results of the photon decay experiment prove that a photon decays into an electron and an antielectron. The Compton wavelength is the wavelength of electronic matter waves calculated by treating electrons as heavy objects. Among them, the material wave of electrons is also regarded as a wave in the same form as electromagnetic waves. So we have the relationship of  $h\nu = m_e c^2$ . Our basic assumption in the previous section was that a fundamental circularly polarized photon propagates along a small circle to form an electron. The fundamental circularly polarized photon is a circularly polarized photon obtained by splitting a plane polarized photon into two (in this decomposition process, the wavelength and frequency remain unchanged, only the amplitude changes). The relationship between electronic mass and frequency is  $h\nu/2 = m_e c^2$ . Based on this relationship and  $c = \lambda\nu$ , it is known that the wavelength of the waves that make up electrons is half of the Compton wavelength, and the frequency of circularly polarized photons is related to  $\lambda_e = h/2m_e c$ , which is half of the Compton wavelength. The value is

$$\lambda_e = h/(2m_e c) = 1.21315511945 \times 10^{-12} \text{m}. \quad (27)$$



$$r_e = \lambda_e / 2\pi = 193079633666 \times 10^{-13} \text{ m.} \quad (28)$$

Here,  $r_e$  is the radius of the free electron ring (the phase trajectory ring of the fundamental circularly polarized photons that make up the electrons),  $\lambda_e$  is the wavelength of the free electron. According to the basic assumption of this article, the radius of the 1s electron ring outside the ground state hydrogen atom nucleus is

$$r_{(1s)} = \frac{2}{\alpha} \times 1.93079634 = 5.29177210006 \times 10^{-11} \text{ m.} \quad (29)$$

Within the accuracy range of 10 significant digits, the calculated values are completely consistent with the experimental values. If a wave propagates along a circumference that is not an integer multiple of its wavelength, the consequence of its operation is that the phase of the wave has a precession on this circle. The phase precession rate is the percentage of phase precession per revolution to the circumference. Its value is  $[137.036 - 137.000] / 137.036 \times 100\% = 0.026\%$ . Among them, 137.036 is the precise value of the fine structure constant to 0.001. It is 10 times the precession rate of Mercury's perihelion. This is also the language of this author.

Knowing that the intrinsic motion of free electrons is the propagation of a wave along a small circle, where energy or mass is uniformly distributed. This mode of propagation happens to be a spin mode. We can easily calculate the spin angular momentum and spin magnetic moment of free electrons. The momentum of a plane polarized photon is  $p = h/\lambda = h/2\lambda_e$ . So, the corresponding linear momentum of the fundamental circularly polarized photon is only half of it:

$$p_e = p/2 = h/2\lambda = h/4\lambda_e = mc. \quad (30)$$

In the formula,  $m$  is the mass of the electron,  $p_e$  is the momentum of the simplest circularly polarized light, and  $mc$  is the linear momentum of the internal motion of the electron. According to hypothesis 1 and the law of equivalence between mass and energy, it can be inferred that  $h\nu/2c^2 = m$ . The electron spin is the rotation of a substance with a mass of  $h\nu/2c^2$ , and its angular momentum is

$$\vec{L}_e = \vec{r}_e \times \vec{p}_e = (\lambda_e/2\pi)(h/4\lambda_e) = \hbar/2. \quad (31)$$

The direction of angular momentum of fundamental circularly polarized photons inside electrons varies over time. Therefore, in general, we only consider its scalar (sometimes we only consider the linear momentum of electrons). Therefore, in general, we only consider its scalar (sometimes we only consider the linear momentum of electrons). According to the scalar form of Eq. (31),  $L_e = h/4\pi = (1/2)\hbar$  can be obtained (Many textbooks use  $M_s$  to represent  $L_e$ ).

For the first time, the specific form of electron spin was given, and the electron spin angular momentum and spin magnetic moment were calculated. If there are no other issues, this will further deepen human understanding of the material structure of nature.

The radius of the s-electron ring of other atoms can be calculated according to the following equation. If this s-electron is the outermost electron, the radius of its ring can represent the atomic or ionic radius.

The electron ring radius of ns electrons

$$(r_{ns}) = \frac{n^2}{Z^*} a_0 = 1312.0(Z^*/I)a_0. \quad (32)$$

The radius of the s electron in the outermost main layer is either the atomic radius or the ionization radius (The reason is that in the same main layer, most of the s, p, d, and f electron clouds overlap). This is the definition or assumption of the Tu's atomic radius. The atomic radius obtained by using the method of calculating the atomic radius determined by it is called the Tu's atomic radius. According to Eq. (32), the radius of many atoms or ions can be predicted. For example, the radii of helium atoms and +1 valent helium ions are  $(a_0/2) = 2.646 \times 10^{-11}$  meters (the result obtained from traditional atomic radius tables is  $3.1 \times 10^{-11}$  meters). The radius of helium atoms calculated based on the second ionization energy of helium is almost the same value:  $(Z^*/I) \times 1312.0 a_0 = 2.645 \times 10^{-11}$  meters. The operation that can provide strong support for the Tu's theory method should at least be to calculate the effective nuclear charge number based on equation (23) or a regression equation similar to Eq. (23), and then calculate the atomic radius. According to the equation  $519.49 \text{ kJ/mol} = Z^* 2e^2 / (2n^2 a_0)$ , Eqs. (23) and (32), it can be concluded that the radius of a lithium atom should be the radius of the 2s<sup>1</sup> electron ring, approximately  $1.68 \times 10^{-10}$  meters (very close to the value of  $1.67 \times 10^{-10}$  meters found in the recognized atomic radius table). The radius of lithium ions is  $1.76 \times 10^{-11}$  meters. If other methods are used to obtain the effective nuclear charge, the radius of the s-electron ring and ion radius can be predicted based on Eq. (32). For example, it is known that the effective nuclear charge sensed by sodium 3s electrons is 1.8374, and the radius of sodium atoms is approximately  $2.59 \times 10^{-10}$  meters. According to online research, the estimated radius of sodium atoms based on bond length is  $1.86 \times 10^{-10}$  meters. The estimation of atomic radius based on bond length has obvious drawbacks and may not be accurate. According to the definition of Tu's radius, a Tu's atomic radius table can be drawn (the atomic radii in the table are calculated using the Tu's method). The bond length of sodium molecule (Na<sub>2</sub>) calculated in Ref. is  $3.8 \times 10^{-10}$  meters [11]. Taking half of it as the radius of a sodium atom is  $1.9 \times 10^{-10}$  meters (two sodium atoms combine to form a sodium molecule, with a considerable amount of overlap in the middle. Therefore, the data on the radius of a sodium atom at  $1.9 \times 10^{-10}$  meters is not very reliable, but rather a default value that everyone has no choice but to use).

## 8. The Significance of the Successful Application of Localized Realism Quantum Mechanics

Quantum mechanics measurement perspective (using only projection based measurement methods to interpret measurement results - Greatly reduced the status of the intuitive way of explaining phenomena), material structure models (shaking the dominance of point particle structures and solid sphere particle structure models).

As long as it is the result of inverse measurement, it cannot be denied that the object that directly determines the observed phenomenon objectively exists before measurement. The principle is the same as the following situation: if the Geiger counter emits sound or the fluorescent screen detects light, it cannot be denied that the target particle objectively exists before reaching the measuring instrument. If the spin magnetic moment of an electron is detected using the inverse measurement method, it should not be denied that the electron has a clear spin motion before reaching the measuring instrument. As for not knowing the structure and form in which electrons rotate, it is a matter of your cognitive level, and it cannot be said that 'not knowing' means 'non-existent'. We cannot blame the relationship between the spin magnetic moment of electrons and the motion mode that generates the spin magnetic moment for not conforming to classical mechanics theory.

The existing quantum mechanics is developed based on the structural characteristics and/or properties of molecules, atoms, electrons, and photons. The most effective way to promote the significant development of theories and methods is to be inspired by exploring the characteristics and properties of the composition and structure of particles at the next level, such as electrons, in order to establish new theories and methods.

If the series of research conclusions or results mentioned in this article are identified as (a) not coincidentally consistent with experimental facts, (b) not pieced together by the author without a unified rule, and (c) achieving logical consistency, the author's series of research work has great theoretical and practical significance. I want to prove that (a) as long as enough calculation examples are found from the author (if there are more than 3 application examples, there should not be such a high probability of accidental coincidence). I want to prove that (b) can check if there are uniform operating rules. You can also try making up a calculation example yourself (if you can't come up with any molecular calculation results that match the experimental facts, it can explain the problem). To verify logical consistency, simply read it carefully. If all three aspects above have been verified and passed (i.e., positive conclusions have been obtained), the following results and their significance can be affirmed (at least interesting).

The explanatory system corresponding to the mathematical formal system of quantum mechanics may not be non local realism, and the mathematical formal system of Bohr's hydrogen atom theory (old quantum theory in the context of classical electrodynamics) can be compatible and complementary to the mathematical formal system of wave dynamics. The development direction of quantum mechanics and material structure theory can be reconsidered or chosen.

Is it impossible to use the same operating principle to calculate the s electrons of atoms of lithium molecules, sodium molecules, hydrogen molecular ions, and all elements to obtain reasonable operating results? The experiment supports the formation of electrons from photons. Photons that cannot be stationary can

become electrons with a stationary center of mass, and the most likely way is for photons to propagate along a closed kneeling path. The reason why the optical junction is particle is that the optical junction is very small, and the instrument with low resolution feels like a particle. According to a definite skeleton structure, the bond length and dissociation energy of hydrogen molecules can also be calculated by classical electrodynamics method. The new viewpoint that is logically sound and can find three or more successful application examples (and no counterexamples have been found yet) is thought-provoking and worth discussing. This new theory, which can make local realism and determinism compatible with wave dynamics, will not mercilessly abandon Bohr's classical analytical quantum mechanics mathematical system of local realism.

The relationship between energy and quality: The essence of quality is energy. Static mass originates from energy that can be concentrated in space. Prior to this article, the application of Bohr's planetary atomic model could not be extended to multi electron bound systems, let alone to molecules (This model can only be applied to hydrogen atoms). As long as Bohr's hydrogen atom theory is combined with wave dynamics, they can complement each other's strengths and weaknesses, and apply the planetary model to (extend to) multi center and multi electron bound state systems. This can be said to be a return to simplicity in theory, in line with the basic desires of humanity. The theory and methods compatible with planetary model theory and wave dynamics were used to calculate the "s-electrons of all atoms", "bond length and dissociation energy of diatomic molecules", and electron spin magnetic moment. Introduced the principles and principles on which this calculation method is based. The determination of the relationship between the solutions of the Schrödinger equation for some bound state microsystems and the Schrödinger equation for hydrogen atoms has brought great convenience to quantum chemical calculations.

One explanation is true, and the second explanation is that the Bohr planetary hydrogen atom is also a coupling. For electrons to undergo uniform circular motion, centripetal force and velocity are required, which cannot be explained unless rebellious thinking methods are used. Electric fields are distributed throughout the entire space. The calculated energy density is the electric field energy density rather than the probability density.

The highlights of the author's research work are as follows:

- (a) We calculated the dissociation energy and bond length of a series of small molecules using a planetary model
- (b) Separate the explanatory system of quantum mechanics from the mathematical formal system, so that classical planetary model methods can be compatible with wave dynamics methods
- (c) Found the relationship between the solution of the Schrödinger equation for complex microscopic systems and the solution of the simplest Schrödinger equation for hydrogen atoms;
- (d) It was found that when the bound state electrons are close to

the atomic nucleus, the Hamiltonian of the electrons can be different from the momentum operator;

- (e) Establishing an electronic internal structure model and conducting a series of application studies based on it, the results of which are consistent with experimental facts;
- (f) Established localized realism quantum mechanics and provided a solid evidence network through its application process and effects.
- (g) "The amount of energy change in the system" caused by the Hamiltonian operator of a bound state system acting on the wave function is often misunderstood as the kinetic energy of a moving particle (which is not kinetic energy for bound state waves), which is reflected in the law that "the energy of the wave changes in the potential field, but the form of the wave remains unchanged". Therefore, the author's research on quantum chemistry applications can be said to belong to the category of applied research in "local realism and determinism" quantum mechanics. Furthermore, it can be said that the author established local realism quantum mechanics.
- (h) For the first time, the dissociation energy and bond length of hydrogen molecules and their excited states were calculated (The calculated results are consistent with the experimental values).
- (i) Given the specific form of electron spin, the electron spin angular momentum and spin magnetic moment were calculated (The calculated results are consistent with the experimental values).

The above bright points are closely related. It can be said that Rise or fall together, as long as there is a logical problem or other disruptive error in one of them, they all have problems. If there are no issues, they are the composition of a reliable evidence network.

As long as there are no logical errors in the calculation process in this article and the references provided by the author, the author's research results are at least extremely interesting.

## References

1. Runsheng, T. (2018). Paradox of the Uncertainty Principle and Its Experiment, Evidence and Significance. *Infinite Energy*, 23(137).
2. Tu, R. S. (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).
3. Consa, O. (2020). The Unpublished Feynman Diagram IIc. *PROGRESS IN PHYSICS*, 16(2), 128-132.
4. Consa, O. (2021). Something is wrong in the state of QED. P. 1-16.
5. Bauer, H. (2024). Quantum Bullshit: How to Ruin Your Life With Advice From Quantum Physics & Farewell to Reality: How Modern Physics Has Betrayed The Search for Scientific Truth. *Journal of Scientific Exploration*, 38(1), 162-165.
6. Tu, R. (2017). Quantum Inverse Measurement Theory Contributing to the Birth of Interpretation System of Quantum Mechanics of Local-Realism and Determinism. *Journal of Modern Physics*, 8(08), 1398-1469.
7. Tu, R. (1998). Electronic fixation method. *Journal of Huanggang Normal University*, 10(2), 16-18.
8. Tu, R. (1992). Essays of the Hubei Henan Anhui Physics Society, 86-91.
9. Tu, R. (2016). Principles and Applications of Experimental Methods for Measuring the Interaction Energy of Electrons in Atoms. *International Journal of Scientific Reports*, 2(8), 187-200.
10. Tu, R. (2024). Progress and Review of Applied Research on New Theory of Electronic Composition and Structure. *Infinite Energy*, 67, 35-51.
11. Tu, R. (2014). Some Success 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), 309-318.
12. Tu, R. (2018). *Quantum Mechanics' Return to Local Realism*. Cambridge Scholars Publishing.

**Copyright:** ©2024 Runsheng Tu. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.