Quantum Mechanics' Return to Local Realism

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CONTENTS

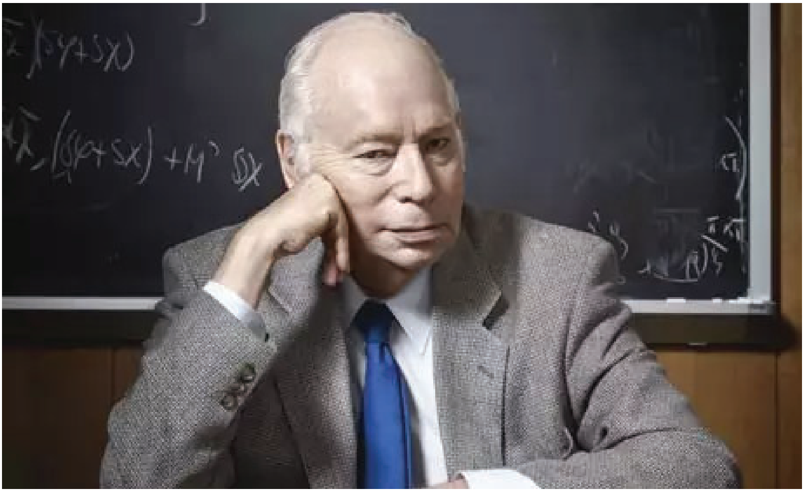
FOREWORD

A DECLARATION OF A QUANTUM MECHANICS REVOLUTION

Quantum mechanics is indeed very useful, but it really caught the essence of nature. Why is this? Quantum mechanics was born nearly a century ago. In the last few decades, it has brought great changes to physics, industry and human life. This is the source of the semiconductor industry, laser and nuclear magnetic resonance that we live on. However, while quantum mechanics is extremely useful, scientists' understanding of the basic concepts of quantum mechanics has been stagnant. For example, is the wave function in quantum mechanics real, or is it only a tool that scientists use for calculation? Is it true that the Schrödinger cat is both alive and dead in the box?

In interpreting quantum entanglement and quantum nonlocality experiments (linking Bell's inequality and Leggett-Garg inequality with experimental phenomena, we get the data on the right side of these inequalities based on experimental phenomena), we must use the concept of "all particles must be in the quantum superposition state before being observed" and "any measurement will change the quantum state of the measured particle.” Because "as long as a particle to be measured, its quantum state changes," these two concepts cannot be verified experimentally. Thus, these two concepts can only be two assumptions or speculate. The experimental interpretation of the existing quantum entanglement and quantum nonlocality can only be assumed. If the particles are really waves, there is only a possibility of superposition in mathematics, not necessarily superposition. It is also a kind of absurd speculation that a particle has two different quantum states simultaneously. The current quantum state of a particle cannot be superimposed with the future quantum state. So, there is no solid mathematical foundation for "the quantum state superposition must occur". This indicates that in the interpretation process of quantum entanglement experiments, speculation is more than empirical evidence. The description of the next natural section cannot be excluded.

An emission source emits a pair of electrons. In order to ensure conservation of the spin angular momentum, the spin directions of the two emitted electrons must be opposite. It was detected that the opposite directions of the spins of the electrons did not indicate that their spin directions were formed at the time of measurement rather than before the measurement when "this pair of electrons spin in the opposite direction" was detected. A light source emits a pair of conjugate photons. The electric vector of this pair of photons should also be conserved: At the same moment, the electron vector of one photon is radial, and the vector of another photon must be down. That is, the polarization direction of these two photons is the same (they vibrate up and down rather than left and right). It can be seen that the polarization direction of a pair of conjugate photons is also not formed when measured but is formed before being measured.



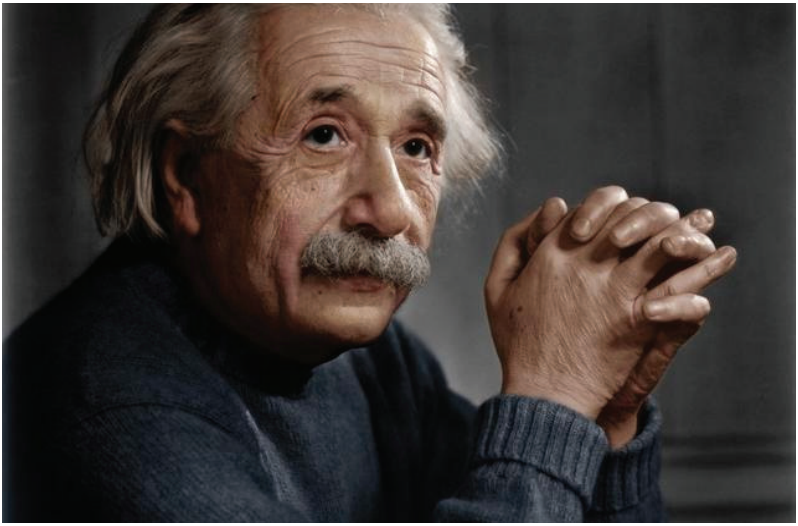
Steven Weinberg

The Patrusky Lecture is a seminar launched in 2013 by the American Association for the Promotion of Scientific Writing, which aims to promote communication between scientists and scientific writers. This year's speaker (2016’s speaker) is a famous scientist—Nobel laureate Steven Weinberg. The title of his speech is “Why am I dissatisfied with quantum mechanics?” Professor Weinberg is quite prepared, but at the very beginning, he wrote about scientific writing and has transferred to his new thinking on the basic concept of quantum mechanics in recent years.

Like most physicists, he once believed that quantum mechanics would be enough if it is practical, without going into any depth to explore its basic concepts and implications. Recently, however, he became increasingly dissatisfied with the various interpretations of quantum mechanics and urged scientists to invent new theories to explain some of the longstanding problems and to extrapolate quantum mechanics to a wider extent.

Weinberg's dissatisfaction mainly manifested in two aspects: first, the source of the probability of quantum mechanics (Einstein also has the same dissatisfaction. He has a famous saying that God won't play dice); and second, the collapse process required by quantum mechanics. These two issues are closely related. If we admit the process of collapse, we must admit the uncertainty of the state. The uncertainty of the state is precisely determined by the probability of quantum mechanics. I also have the same dissatisfaction, and will disclose in the following natural paragraphs why I am dissatisfied.

A child was lost. According to the analysis, the possibility of his being in A and B accounts for 50% respectively (his odds in A and B are respectively 50%). The child and where he lives are real and objective things (that is, his state is real, if he is not at A, at B or elsewhere). The probability in the result of the analysis is not the uncertainty of the child's state (it is indicated that the prediction for the child's state is inaccurate, not that the child's state is uncertainty). In quantum mechanics, however, physicists think that the child's body is in a mixed state of "50% at A and 50% at B". In quantum mechanics, except for Born's probability interpretation, the probabilities are obtained by such as this. In fact, only for unordered multi-element systems, is such probability true and objective. In this case, the probability is caused by the inaccuracy of the prophecy, and does not correspond to something that is truly probable. However, quantum physicists treat the probability of reflecting inaccurate predictions as the segmentation ratio of the entity. Can you be satisfied with such a probability?



Albert Einstein

Maybe some people think “a lot of experimental facts (especially the electron diffraction experiment) proved that an electron can appear at two different places at the same time.” However, those are incorrect, unrealistic non-locality explanations. We can use direction quantization that does not deny the reality to explain the electron diffraction experiment. In this way, unrealistic explanations are avoided. Only by proving that direction quantization is absolutely impossible, can we believe in the unrealistic explanation. It is not difficult to find that the child in this example is the Schrödinger cat and it's the Schrödinger cat which avoids observations to be taken as the basis of sophistry. A lot of people say that the Schrödinger cat state is observed. What's the matter? The fact is that the phenomena they observe are defined as the Schrödinger cat state. This is similar to the situation where hundreds of French authors claimed to have discovered and applied non-existent N-rays. In addition, the specific process and state of quantum entanglement are not completely known. This determines that it is impossible to prove its existence strictly by experimental methods. Every particle, from the moment of its born time, must be in the superposition of its various eigenstates. This is an untrue conclusion caused by cognitive dissonance. We will also discuss this issue below (for a more detailed discussion, see Section 2.10).

A mother knows and confirms that her son is thousands of miles away. But her son appeared immediately at her side. Her son said that he had become an invisible man and returned to human form at the moment of his arrival. If the mother believed that her son came home for a moment from being an invisible man to a normal person, she must believe that her son was in a state of invisibility. As long as the invisible man state of the son is not true, the process of returning the invisible man to the normal person is not true. In other words, as long as we fabricate a state of an invisible person, we must fabricate a process of transforming invisible people into normal people. Otherwise, the mother cannot see the normal humanoid son immediately. Similar to this, as long as we believe that the wave packet collapse process exists, it is necessary to believe in the existence of the uncertain state of wave-particle duality or superimposition. As long as we have fabricated the superposition state of the two particles or the uncertainty of the wave-particle duality, we must fabricate a collapse process. Otherwise, after the end of the measurement, a definite state of reality cannot be observed. If there are no reliable reasons for the occurrence of quantum decoherence or the collapse of quantum states, there is no sufficient reason for the existence of an uncertain quantum state. It is a fact that the quantum state collapse lacks reason. The idea that an electron is in a mixture of positive and negative spin before measurement, is also highly likely to be fictional (**Figure 1**). Are you satisfied with the behavior of "treating the most likely imaginary thing as absolutely true?"

Weinberger may also believe that the fictional uncertainty state exists. This is a common problem for scholars who oppose the existing interpretation of quantum mechanics. The reason why their efforts cannot be successful is also here. At this point I am totally different from him. The specific discussion begins now.

Most people agree with the view that the existing mathematical formalism of quantum mechanics is successful, but the existing quantum mechanical explanations are puzzling. It is precisely because of the long and strong dissatisfaction with the interpretation of the Copenhagen school and an unwillingness to continue to believe in its quantum mechanics interpretation, that the more ridiculous theory of multi worlds would rather be adopted (Weinberger said I don't know which world the mixed observation is in. In my opinion, even the creators of multi-world theory do not know this). But the general situation is that the multi-world theory cannot be fully accepted instead of the quantum mechanics interpretation of the Copenhagen school. The influence of other theories is not as good as

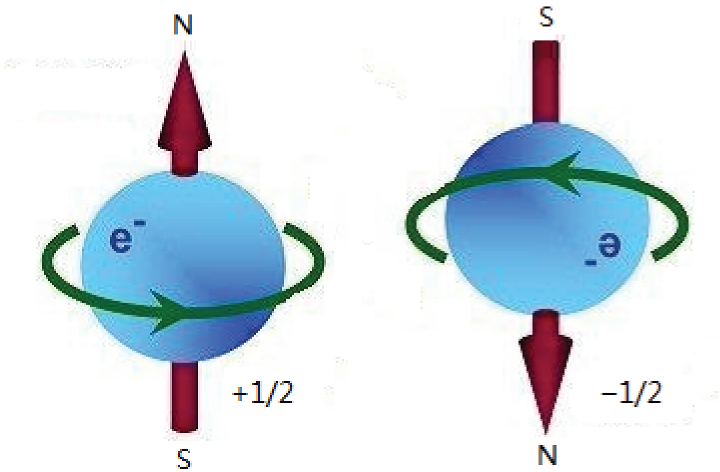


Figure 1. An image description of electron spin. To believe an electron to be in a mixed state in these two states, is equivalent to believing that half of the body of the lost child is at A and the other half at B.

Copenhagen's interpretation and multi-world theory. Now many people prefer to adopt a more outrageous theory of many worlds. Many people have long suppressed their inner voices. They dared not disclose their voice until they became older people (Weinberg is classic). It is certain that the existing quantum mechanics interpretation system has some problems. In that case, one should allow others to reveal its problems and propose a new explanation of quantum mechanics. Under the precondition of believing the old wave-particle duality, the establishment of a new interpretation system of quantum mechanics is doomed to failure. One of my key jobs is characterized by the establishment of a new wave-particle duality concept (see the eighth question).

The existing orthodox quantum mechanics referred to in this book refers to the Copenhagen School and the predominating quantum physicists before 2018. The way that orthodox quantum scientists deal with problems is too bizarre. They often use the excuse of causality as failure and don't speak logic. They even take the "micro world is very strange" as an excuse to put aside the substantiality and laws of conservation of energy. They are unreasonable, but consider themselves out of helplessness (there is no way to preach a reason and speak logic, logically because there is no way to believe causation and reality).

The author firmly exposes the lie of orthodox quantum scientists and points out that the so-called helplessness is due to incorrect thinking. The author will use sufficient reason to convince the reader that as long as the correct thinking is adopted, the law of causation, determinacy, locality and reality can be upheld. The key method I'm going to use is to build a model of the light knot electronic structure to produce a new concept of wave-particle unification without internal contradictions. The model of the light knot particulate structure has solved the discrete problem of the micro particle and the problem of the nature of wave function. It is one of the theoretical foundations of Quantum Mechanics of Local Realism.

The irrationality of the existing quantum mechanics interpretation is determined by the fact that quantum physicists believe that God will create a natural matter that has no pure objective state (that is, particles are like a ghost, and the "unknown is uncertain"). That the probability of the prediction results caused by that cannot be accurately predicted is regarded as the probability of the subject itself, and the different possible states of the prophecy that cannot be realized are regarded as the real states of coexistence. In other words, the unreasonable explanation of quantum mechanics contains all the troubles brought by "without a pure objectivity state": unknown things being uncertain things, the inaccuracy of prediction being the inaccuracy of ontology and "may exist separately" is treated as "simultaneously real" (isn't the wave function). God does not create natural matter without a pure objective state. This should be an important objective law. All the behavior and the conclusion of its violations are wrong. If there are problems in the source of probability, there are problems in the original state which has uncertainty when it is measured, the concept of quantum entanglement cannot be established. From another perspective, the concept of quantum entanglement comes from the circular argument. The savagery and absurdity of orthodox quantum scientists are mainly manifested in the following 9, 10 and 11 three aspects. The most important thing is the tenth question (the existing quantum mechanics problem is described below).

1. It Exists that the Fact of the Momentum and Position of Microscopic Particles Is Accurately Measured Simultaneously. But They Find Reasons for not Recognizing This Fact

In order to maintain the idea expressed by the principle of uncertainty, even if the physical quantities are measured, orthodox quantum physicists do not recognize them. The trajectory of microscopic particles can be gained by using a cloud chamber and other equipment. According to the working principle of the chamber (the coagulation to be induced by electronic field), the measured charged particle does not reach the edge of the cloud track. As long as the working principle of the cloud chamber is applicable, the 3D regression curve of the droplet center coordinates in the cloud track should be the exact moving route of the measured particle. However, orthodox quantum mechanics scientists never talk about the significance of 3D regression curves of cloud trails. Instead, the idea of "absolute correctness of uncertainty" is used to negate the accuracy of the measurement results. If you continuously measure the position of a particle accurately, the uncertainty relation cannot be tenable continuously (if the position of a moving particle is measured continuously, then the lines of these positions indicate the exact momentum of the particle). Orthodox quantum physicists use a fictitious collapse process to deny continuous measurements. The conclusion is ridiculous: when a particle is measured for the first time it loses its representation (it can't represent itself as a microscopic particle). There is no basis for the collapse process. How irrational it is for a microscopic particle to represent the properties of a macroscopic object! It is only an idea that r and p cannot be used to describe microscopic particles. The experimental fact supports "the cloud track in the cloud chamber is formed according to the designing principle of the cloud chamber", and does not support "the cloud track in the cloud chamber is formed based on the non-locality of micro-particles." At least it cannot deny that "the formation of the cloud track following the coagulation is induced by electronic field—the working principle of the cloud chamber." The experimental result of capturing microscopic particles is the fact that microscopic particles can be described by r and p.

The wave packet collapse of microscopic particles is considered irreversible. If the particles are coming out of the accelerator, but the diffraction can still occur, the inverse process of wave packet collapse（or quantum decoherence）is bound to occur. If this inverse process does not exist, then the wave collapse process (or quantum decoherence process) does not exist. In that case, we can't deny that the 3D regression curve mentioned above is the accurate motion path of particles (the environment of the accelerated electrons in the cyclotron are very similar to the one of the environment of the measured electrons in the spark chamber). The existence of the secondary electron diffraction phenomenon directly denied that measurement can cause the wave packet to collapse (supported viewpoint that the wave packet collapse process does not exist).

Orthodox quantum scientists set up a magic wall between the calculated values of quantum mechanics (or the purely objective state of the system) and the measured values. All the things that pass through the magic wall will change in a ghostly way (the change in reverse is the quantum decoherence and the wave packet collapse, but the inverse process is considered impossible). The measurement of the micro particles is the same. Why is the structure in the nucleons before the injection affirmed according to the injecting situation? Another way to ask is: why is the injection caused by the measurement not the state after the wave packet collapses? Is wave packet collapse a logical result or the concept which is only artificially assumed as needed in the end?

Perhaps the orthodox quantum physicists insist that the helplessness is determined by the wave-particle duality which we must accommodate to the microscopic particles. I'll soon talk about whether the old idea of wave-particle duality where there are internal contradictions comes from the wrong interpretation of the diffraction of particles in matter.

2. The Certainty Value Is Determined, and the Certainty Is not Recognized by Means of an Idea

In reality, it is often easy to obtain the definite value of some physical quantities of the system. For a single-particle system, a deterministic value can be obtained by measuring a given physical quantity (for example, angular momentum of electron spin, orbital angular momentum of s electrons, etc.). In the event of insufficient evidence of the collapse of the wave package, it may be preconceived that the eigenvalue measured is the value present in the system itself, rather than collapsed from another value to this value at the time of measurement. Is there any reason to deny that electron spins and the movement of electrons in an atom has many different purely objective orientations rather than a mixture of different orientations? In many cases, the only definite value obtained by measurement is fact, and the certainty of the system is also true. However, orthodox quantum physicists accept and use the deterministic values of microscopic systems, but deny the certainty of the micro system. That is, in order to maintain the notion of uncertainty (to deny the concept of certainty), orthodox quantum physicists should try to deny it; even if certain values are calculated using a defined causal relationship. One of the methods they use is that the superposition of states must happen (a microscopic particle does not have any purely objective state. The measured state is formed at measurement). The reason is that the definite states become undefined once they have been superimposed.

3. Cyclical Demonstration in the Case of Incomplete Empirical Evidence

In layman's terms, as long as you admit that you have observed a spooky action at a distance (quantum entanglement), you must think that measurement changes the state of the particle. As long as you admit that the measurement changed the state of the particle, you must admit that the particle before measurement is in the superposition state. It has not been proved by experiments that the particle is in the superposition state before the measurement. Therefore, the empirical chain is incomplete. How do you know that particles are superposed before measurement?

The empirical process is generally not purely objective, but contains subjective elements (the empirical chain generally has a subjective judgment link like mending seam putty). However, the subjective judgment link must be self-evident and logical. In the empirical process of quantum entanglement, there is a critical process of subjective judgment. The subjective judgment is that measurement inevitably leads to quantum state changes. The reason is that only one measurement does not prove that the quantum state has changed due to this measurement. Only by admitting that the quantum states before and after the measurement are indeed different can we admit that the measurement leads to the change of the quantum state. It is a fact that “the quantum state after measurement is a definite un-entangled state.” Therefore, it is necessary to admit that the quantum states before measurement are entangled states. That is, only beforehand, assuming that the quantum entangled state (superposition state) exists, can we admit that the measurement has led to the quantum state change. Finally, according to this conclusion, we get the conclusion “the existence of quantum entangled states is tested and verified by experiment." This is the obvious circular argument (the proof process starts from the existence of quantum entangled states to the end of quantum entangled states). The additional note is shown in Sections 1.2.5 and **1.3.2**.

4. The Negative Energy Solutions of the Dirac Equations Corresponding with Positive Energy Antimatter

Dirac's relativistic quantum mechanics equation has two solutions—the positive energy solution and the negative energy solution. If these two solutions have counterparts in the real world, then the negative energy solutions should be worthy of the name of the material for negative energy. However, experts in quantum mechanics believe that negative energy solutions correspond to antimatter. This is in order to acknowledge that antimatter has positive energy. This belief of the quantum physicists is a mistake that even middle school students should not commit. Why do they have this belief? It is because of the need to select the concept of "zero point energy" in the basic theory of quantum mechanics and quantum field theory. The correct solution is for the negative energy solutions to correspond with the negative energy matter, and then the virtual particles in a vacuum are a positive-negative energy Particle-pair, rather than a matter-antimatter Particle-pair. By solving the Schrödinger equation of a one-dimensional potential well, the zero point can be generated from the infinitesimal fraction of the space as a finite value. The mistakes mentioned in this section make many people carry out the research and development of vacuum energy, and waste a lot of resources.

5. Heisenberg Relationship Has a Variety of Meanings, but Only One of Them Has Been Chosen

The Heisenberg relation can be expressed as the relation ($pr=\hbar$) between the radius of curvature and the linear momentum of a microscopic particle for uniform circular motion. It can also represent the relationship between the curvature and the curvature radius of a microscopic particle for curved movement. However, orthodox quantum physicists only choose the explanation of the "uncertainty relation". They ignore the fact that there is a paradox in uncertainty relation. If a continuous measurement is allowed and the position is measured continuously and accurately, the momentum is accurately measured (the particle velocity can generally be measured accurately. According to the connection of a moving particle's defined position, we know the determined momentum). This is the paradox of uncertainty relations. If we believe the relationship of uncertainty, we must deny that we may continuously measure. It is hard to deny continuous measurement both logically and in practice, unless certain concepts are implicitly imposed.

6. Strained Interpretation Is too Much, and Often Look at Things in Isolation

For many conclusions in quantum mechanics, it is better to say that it is to be defined, than it is to be obtained, by measurement. For example, the alternately changing state of the two states of quantum states is defined as a continuous quantum entanglement. However, according to the concept of state superposition, we know that the quantum entanglement state is not the alternate change of two distinct quantum states but the non-definite mixed states of the two quantum states. The method of identifying multipartite entanglement is also defined and is often the meaning that is given by the person who claims it. Other misinterpretations contain ingredients that are far-fetched (e.g., the interpretation of wave-particle duality and that of non-reality, etc.).

When discussing electron diffraction experiments, they only looked at the performance of the electrons from the slit to the screen and did not analyze the experience and performance of the electrons in the entire circuit. When discussing the secondary diffraction experiments of electrons, they only considered diffraction but don’t consider whether the measurement could cause the wave packet to collapse.

7. Ignoring the Law of Conservation of Energy

Orthodox quantum physicists admit that microscopic particles have non-realities, that is, a particle can appear in two different places at the same time. A particle is divided into two, but the size does not change, and the energy must be two times that of the original. If a particle that appears in two places at the same time meets the antiparticle at the same time, can it be annihilated at the same time? If not, it cannot show that it can occur at the same time in two different places. If it can, it does not meet the law of conservation of energy. The explanation that a photon can pass through both seams at the same time is also contradictory to the Huygens principle (should we believe the Huygens principle or believe that particles have non-realities?).

When there is only one particle in the system, “Thinking that the state superposition is not the superposition of the entities but only the superposition of the quantum states” does not violate the law of conservation of energy. However, when interpreting the phenomenon of electronic double-diffraction experiment, one has to think that “electrons happen in parallel, and parallel electronic entities superpose.” In this way, an electron is divided into two, and it violates the law of conservation of energy.

8. Misunderstanding Wave-particle Duality

The existing quantum mechanics interpretation system simply describes the microscopic particle as an uncanny ghost (it is neither a wave nor a particle, but a ghost of non-localized reality). In fact, the diffraction phenomena of object particles such as electrons can be explained by the quantization of the direction of the micro particles. Direction quantization can be caused by angular momentum quantization. It would be cost-effective to avoid all the problems explained by Copenhagen (eliminating the singularity of Copenhagen's interpretation) by using a direction quantization concept. Of course, using only direction quantization is not enough. We can establish the model of the light knot electronic structure. So, the object particle is a real localized wave (an object particle is surrounded by a wave. Viewed at a distance, it is an object particle, but viewed close by, it is a wave propagating along a closed path). This is the essence of the new wave-particle duality: a microscopic particle is both a wave and a particle, and the discreteness and the locality are unified. In Kelvin’s words, the particle is the kink of the wave. In this way, the particle is a complete wave, and the illusion of humans for waves. According to this new wave-particle duality, particles cannot be considered non-local-real. As long as the directional quantization explanation and the model of the light knot particulate structure are used, the existing orthodox interpretation system of quantum mechanics can be subverted.

9. Subjective Assumption in the Construction of an Important Theoretical Foundation

Schrödinger's cat is a bridge between the popular example and profound theory about the "existing quantum mechanics interpretation." It is an example that is both common and rewarding (appealing to all). Schrödinger's thought experiments on cats have linked the development of microscopic particles with the development of macroscopic objects. If the superposition of live-dead cats cannot occur, it is impossible for microscopic particles to be in the superposition state of the two eigenstates.

Analyzing it from different perspectives can cause wide interest. If we change the Schrödinger cat into a prisoner sentenced to death, and consider "the superposition between the broken bottle and the undamaged bottle" and the origin of the cat's state, we can obtain conclusions that have never been drawn before (the bottle is an ampoule bottle filled with poisonous gas in the box).

The Schrödinger cat was replaced with a dead prisoner and the box was made of light-shielding material. Therefore, although the entire box is dark, there are still optical signals transmitted to the eyes of the prisoner. This device links microscopic particles with macroscopic prisoners and the ampoule bottle. As long as the microscopic particles are superimposed on the two states of "decay and no decay", the prisoner must have a live-die state-superposition. The ampoule bottle containing Highly Toxic Gases must have been superimposed on both the intact and broken state.

We assume that the final result is exactly the prisoner's undead state which is collapsed. The prisoner should be able to describe what he saw after coming out of the box. Can he see that the ampoule filled with highly toxic gases is intact and broken? If the highly toxic gases are mixed with special odorous substances, can the dead prisoner smell the odor?

If he saw the superimposition state of the broken-perfect ampoule, should the ampoule be broken into 8 pieces or broken into 24 pieces? The entropy of highly toxic gases that permeate the entire box should be greater than when the highly toxic gases accumulate in the bottle. If, at the instant of opening the box, the outside observer sees the poison gas cylinder undamaged and the prisoner alive, he must think that the highly toxic gases have collapsed into the bottle. Why does this collapse process lead to reduced entropy? Existing quantum scientists believe that ampoules filled with poisonous gas must be in a superimposed state in their intact and broken state before they are damaged. However, the degree of bottle breakage cannot be determined logically. Before opening the box, there were many different damage eigenstates for that ampoule bottle. Which one should we choose to overlap with its intact state? Can't we let the process happen and later decide?! Before opening the box, since the damage level of the ampoule bottle cannot be determined, the superposition of the broken state and the intact state cannot be determined. It is forcibly assumed that the superposition of states will inevitably occur, and it can only be subjectively assumed.

If the box is large, the prisoner is away from the side of the ampoule bottle. We assume that, after the ampoule bottle was broken, it took one second for the Highly Toxic Gases to reach the mouth of the prisoner, and the prisoner held his breath and broke the box within a second to escape. In this case, the ampoule bottle was broken and the prisoner was not dead. This result is inconsistent with the analysis result for the Schrödinger cat thought experiment (in the Schrödinger cat thought experiment, the bottle was broken and the cat had to collapse to death). What is the factor that determines the collapse direction of the superposition state?

Is the prisoner's observation inside the box a measurement? If not, we cannot logically judge what he can see. What category of results did he observe? If the answer is affirmative, then he will not see the superimposed state in which the ampoule bottle is both damaged and intact (his first observation was that the state of the ampoule bottle collapsed to an undamaged state. In this way, he always sees the integrity of the ampoule bottle). However, the existing interpretation of quantum mechanics and the device together determine that the probability of the ampoule bottle being “broken or unbroken” accounts for 50% each, and the state of damage to ampoules is also likely to be observed.

Within one minute, the investigated particle has three possible states: the undecayed state; the decayed state; or the decayed-undecayed superpositioned state. What are the reasons for thinking that it must be in the third state? Before the collapse, why is “the probability that the first state and the second state stand alone” zero? The appearances of these three states are three separate events. Before the collapse, the first state and the second state are the original states (eigenstates), and the third state is the derived state. Why should the eigenstates all develop into superposition? In layman's terms, there is no state 3 if there is no original state 1 and state 2; if there is no state 3, there may be states 1 and 2 as well. It is already very clear which state is more basic and cannot be ignored. At present, orthodox quantum mechanics just puts the cart before the horse. It is considered that state 1 and/or state 2 can only be derived from state 3, and we think of the derived probabilities as $C_1^2/(C_1^2+C_2^2)$ and

$C_2^2/(C_1^2+C_2^2)$, respectively. If eigenstates 1 and 2 are not both superimposed, their probability of occurrence cannot be determined by the combination coefficient of their derived states. In fact, the probability of state 1 is equal to its original probability plus $C_1^2/(C_1^2+C_2^2)$. In fact, the probability of state 2 is equal to its original probability plus $C_2^2/(C_1^2+C_2^2)$. It is not logical to think that “the original existence probability of state 1 and state 2 is always treated as zero and they are considered to have collapsed only from the superposition state”. This is just as ridiculous as “alien people think that the Earth's people were both hermaphrodites when they were born, and the observed dioecious bodies were changed from hermaphrodites.”

Both state 1 and state 2 are eigenstates. At least some of the particles may always remain in the eigenstate (the principle of superposition of state is also like this). Only 100% of the particles will necessarily develop to the superposition state derived from the eigenstates. The probability of collapse is likely to be $C_i^2/(C_1^2+C_2^2)$, and only using the normalization condition $C_1^2+C_2^2=1$. If the state superposition is imaginary, then the superposition state collapse is fictional (**Figure 2** can clearly illustrate this point).

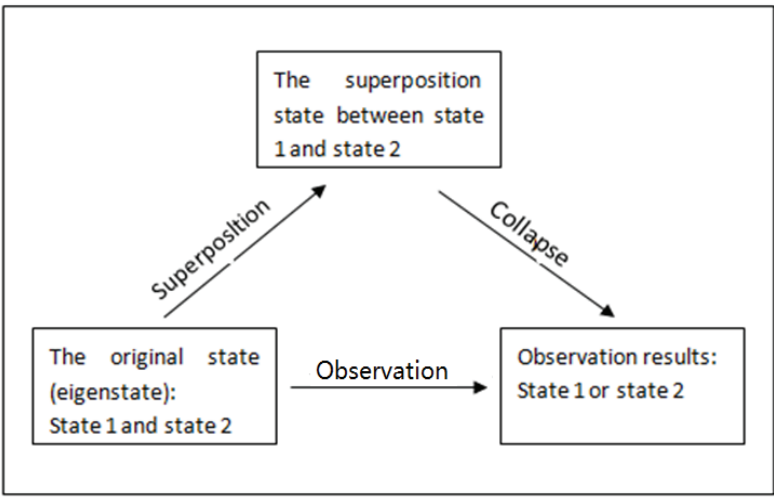


Figure 2. Relations between eigenstates, superposition states and observation results.

It can be seen visually from **Figure 2**: it is observed that the ampoule is not broken or damaged, and it is possible to observe the pure and objective state of the system. Then, state superposition and superposition state collapse are both fictional. Observed results can be directly explained by observing the purely objective state of the system. Why do we have to go on a detour that passes through the superimposed and collapsed?

For single-particle systems, the condition required for superposition is quantum parallelism. If the state of quantum parallelism can be really superimposed, it violates the law of conservation of energy. Some people may say that quantum parallelism is only the parallelism of particle states. However, there can be no "state" out of the particle. Let electrons pass through the double slit one by one in order to do electron diffraction experiments. In interpreting the results of such experiments, quantum parallelism is not the parallelism of states, but refers to the parallelism of entities. If it is non-physical parallelism, no diffraction will occur.

In summary, there are three plausible speculations about the single-particle system of existing quantum scientists:

(1) Before the superposition, eigenstate 1 and eigenstate 2 appear at the same time;
(2) Eigenstate 1 and eigenstate 2 must be superimposed;
(3) The superposition state of Eigenstate 1 and this Evidence State 2 are not a possible state but the only necessary state of the system. All eigenstates are collapsed without the original eigenstates.

The state superposition principle clearly shows that for the single particle system, eigenstate 1 and eigenstate 2 and the superposition states of the two eigenstates may appear. However, the three above are inconsistent with the superposition principle. Existing quantum scientists use the third conjecture when using the state superposition principle. The calculation of probability based on the third conjecture is like calculating the proportion of single people in the world without recognizing "unmarried singles" and only acknowledging divorce-induced singles.

In short, using the Copenhagen School's point of view to explain the above examples would be very contradictory. The multi-world theory cannot explain why the prisoners in the box must be in a different world from the observers outside the box.

10. The Source of Probability Is Unreliable, but It Is Regarded as a Basis for Uncertainty

The origin of randomness in quantum mechanics is divided into two main categories: the source of wrong ideas and the source of theory.

Before the measurement, the quantum state of a microscopic particle is unknown. Some people think that microscopic particles have no purely objective and definite quantum state. Others estimate and predict it. The first type of human approach directly acknowledges the probability of microscopic particles. The second kind of human approach is to consider the probable result of the inaccurate prediction as the true state (objective state) of the microscopic particles, and this probability is regarded as the basic attribute of the particle. Another type of thought is that the interference of the measurement is inevitable, and then the random interference leads to the measurement result being random. So, they take this random measurement result as the true state of a particle. The above is the source of the knowledge of probability. The above is the source of knowledge of the probability of quantum mechanics. The theory sources of quantum mechanics probability can be divided into three sub-categories: the interpretation of wave-particle duality (or unrealistic explanation); Born's probability interpretation; and the principle of superposition. There may be a different probability source classification (for example, wave-particle duality and non-reality can be thought of as the general source of quantum-mechanical probabilities). However, the basic content is the same. The probable source of the value of the physical quantity is similar to that of the quantum state.

For an isolated system, the evolution of the quantum state with time is described by the Schrödinger equation when we don't measure. That is to say, given a quantum state at any time, the quantum state of any other time can be uniquely fixed. With any moment of quantum state, we can get the average of various physical quantities at any moment. It can be seen that the purely objective state of the isolated microscopic system is inherently deterministic and has various definite values. Just after the measurement, the result of the measurement is random. No matter whether the measured mean is consistent with the average value calculated by pure theory, the orthodox quantum physicists don't admit that the measurement results reflect the state before measurement (this is what we have said above, that a wall of magic has been placed between the measurement result and the pure objective state). In addition, orthodox quantum scientists believe that the uncertainty of the Microsystems is caused by the superposition of states. Even an isolated system with only one particle becomes indefinite as the particle overlaps with its own shadow. We can also say that there are three sources of uncertainty in quantum mechanics: the first is that it does not recognize certainty directly; the second is that uncertainty is caused by the measurement of random interference and wave-package collapse; and the third is state superposition leading to uncertainty.

Probability interpretation is also a sophistic way of "acknowledging the constant value and denying certainty" (if you deny the certainty of a position while recognizing a certain value related to the position, you can only use this method. This is the customary technique of existing quantum scientists). According to the model of the light knot electronic structure mentioned in the previous section, we know that the probability density is actually the energy density. "The energy density at each point in the outer space of the single particle system" representing the position of the particles enclosed by that photon is constant. "The field can be extended to infinity and full of full space" is much more reasonable than "a particle itself reaches also each point in the infinite space". It can be said that as long as the concept of the point particle is cleared, it is not impossible to introduce the probability of non-introduction.

Let's look at the other case of the lost child. According to analysis, he is 50% at A, 30% at B, and 20% at C. In the end, the parents found him at B. His pure and objective reality is always at B. However, the quantum physicists regarded the previous analysis as his true state: It is considered that "the child's body is 50% at A, 30% at B and 20% at C" before it is found, this is an uncertain chaotic state, and it just collapsed to B at the moment of discovery. They do not admit that the child's state is a purely objective whole. The conclusion of the analysis before finding the child (in this case, this is a guess, a mathematical operation in quantum mechanics) was taken as the description of the true state. The child's body being 50% at A, 30% at B, and 20% at C corresponds to the three solutions of the wave function. The principle of superposition states that the linear combination of the three solutions is also a solution of the wave function (a possible state of the child's body). Obviously, it can be seen that the probability of the principle of state superposition is produced by mathematical operation, and is not necessarily a pure and objective reality. According to the principle of state superposition, the linear combination of the three solutions is also a solution of the wave function (a possible state of the child's body). Obviously, the probability derived from the principle of state superposition is generated by mathematical operations (it is an expression that the prediction is inaccurate) and not necessarily the purely objective and true state. In this case, the correct rate of prediction is 30%; 70% is wrong. As long as the state of the prophecy is regarded as a real and objective state, 70% of the proportion is wrong. The Copenhagen school thought the prophecy was absolutely accurate and used a collapse process to cover up the adverse consequences.

The next section contains a further explanation of the problems in this section.

11. Think There Is Natural Matter Without a Purely Objective State

This error is that an unknown state is regarded as an indefinite state, not A is B is secretly replaced by both A and B ("a particle can only be in one of many states" is secretly exchanged with "a particle can be in many different states simultaneously"). Generally speaking, it is a mistake to think that God can create a ghost.

Denying the fact that microscopic particles have a purely objective status, means that "unknown" is regarded as "nothingness." In philosophy, this is a mistake made by idealism. It is also a scientific violation of objective laws. Some orthodox quantum mechanists nakedly state that some of the microscopic particles are formed under the influence of the environment at the time of measurement. These states are undefined (and nonexistent) before the measurement. This directly denies that the microscopic particle has a purely objective and definite state.

It may be said that the state of uncertainty is one of the objective states. It depends on whether the state of uncertainty is an objective existence. Let's take the example of a coin that stands up and rotates (note: this coin has only words on the A side and only pattern on the B side). As the coin rotates, which side is facing up is unknown. At this point, the state in which the probability of side A facing up and the probability of side B facing up by 50% each is not the objective state at present but a prediction of the future. Because a coin cannot be half A facing up, and half B facing up. The objective state at this time is the state of rotation, while the predicted future state of uncertainty is not the present objective state. The state of the coin after its fall in the future cannot be determined at present, and does not indicate that the state of the now-rotating coin is indefinite. In other words, the specific contingent content in the future uncertain state must not be the objective state. Take the target as an example and the situation will be clearer. When a sharpshooter hits the target, before shooting, it is predicted that there is a 90% chance of winning a 10-ring, a 4% chance of a 9-ring, and a 1% chance of an 8-ring. This prediction and its description are objective, however, the state of description is not the purely objective natural state on the target; it exists only in the human mind (even writing it on paper can only mean that the paper on which those words are written is an objective reality). The reason is simple. Predicting the outcome of the state (only a shot and the result is 90% is 10 rings, 4% is 9 rings and 1% is 8 rings) cannot be an objective existence.

The statement "it can only be one of them" (a single thing is not in a variety of states at the same time) to describe system states was stealthily changed by quantum physicists into "it is absolutely all" (a single thing is in a variety of states at the same time). For the state of the system, "perhaps one of them" (a single thing is only in a variety of states, respectively) is mathematically correct. The expression of the principle of state superposition is still "possible". However, in the process of applying it in practice, there is the behavior that disguised the replacement of the above-mentioned concept. Partial probabilities in quantum mechanics are also generated in the behavior of this one, and God does not play dice. No matter how much of the mathematics of Hilbert space is correct, it cannot be proved that quantum mechanics' behavior that disguised the replacement of the concept is correct. Only by first affirming that the uncertainty of the microscopic particles is fundamental, can the probability of quantum mechanics be considered fundamental. That is, the conclusion that "the probability of microscopic particles is fundamental" stems from a logical cycle. It can also be said that one of the sources of the probability of quantum mechanics is the denial of a purely objective definite state of a particle. Further analysis is shown in the following.

For single-particle systems, probabilities similar to those above are the performance that predictions are not inaccurate. Only for multi-particle systems, the probability of quantum mechanics may be true. If the statistical laws suitable for a multi-element system are applied to the single-element system, we have to introduce the concept of probability density, and otherwise, we can only admit that it is a ghost. Of the existing orthodox quantum physicists, some people regard the unknown state as a state of uncertainty, and another part of the person is equivalent to the state described in the prediction result as a real state (regarding the performance of prediction to be as inaccurate as the affair itself).

As mentioned above, the source of probability in quantum mechanics is not reliable. Professor Weinberger discusses it in more detail (for example, neither the wave function nor Schrödinger's equation is a source of probability).

Since there are so many problems in the existing orthodox interpretation system of quantum mechanics, we should try to solve or avoid these problems. I am here to announce to the world: I am determined to subvert the existing quantum mechanics interpretation system.

About the foundation of quantum mechanics, P. A. M. Dirac has speculated several times recently that it is impossible to re-introduce determinism in quantum mechanics if we do not give up some strongly upheld fundamental conceptions. It rigorously proves that if we do not give up the conception about wave-particle duality, in other words, if we do not give up the state superposition principle and the probability interpretation, and consequently we do not give up the uncertainty relation, it is impossible to re-introduce determinism in quantum mechanics.

The method I used was to deny the old wave-particle duality by establishing a model of the light knot electronic structure, using direction quantization to explain the diffraction experiments of the object particles, and thus denying the old wave-particle duality. I would like to establish the realm of localized realms on the premise of preserving the mathematical formalism of quantum mechanics and subverting the interpretation system of quantum mechanics. The writing outline is as follows.

This book is divided into several parts: first, a critique of the existing quantum mechanics interpretation system; second, a presentation of the reasons for returning to the realm of localized realism and determinism; third, the establishment of the mathematical form system of quantum mechanics under the new premise; fourth, the application of the concept of localized realism quantum mechanics to the quantum mechanics calculation; and fifth, the prediction and verification methods. Regardless of how the titles of the directory are different from the text in the following outline, the context of this book is described on this page. If we expand the general outline slightly, it has the following contents.

(1) To expose the contradictions in the interpretation of quantum mechanics.

These include: “discussed a serious problem in the interpretation of quantum entanglement experiments—the changes of quantum states due to measurements have not been experimentally validated.”

(2) Establishment of quantum inverse measurement theory.

(3) Establishment of the electronic structure model for the light knot.

Because of this, a new concept of wave-particle duality was established.

(4) To expose the errors of the randomness source of a micro system.
(5) To propose the direction-quantization interpretation of the electron diffraction experiment.
(6) Establishing the theoretical premise and new quantum mechanics measurement view of local realism.

Replace the five basic postulates with new and fewer premises. Above are the reasons for returning to realism and determinism.

(7) Establishment of the mathematical formal system of local realism quantum mechanics.
(8) Establishment of the structural model of some atoms and molecules by applying the concept of local realism.
(9) Calculation of some atoms and molecules in detail by using the above method.
(10) Putting forward a prediction and the experimental verification scheme.

Here, I declare to all mankind: quantum mechanics of localized realism and determinism has been born. “Quantum inverse measurement theory (QIMT)”, the “direction quantization explanation” and “the model of the light knot particulate structure” are its three theoretical bases.

CHAPTER ONE

QUANTUM INVERSE MEASUREMENT THEORY SUPPORTS THE INTERPRETATION OF LOCALIZED REALISM AND DETERMINISM

The existing interpretation of quantum mechanics is contrary to common sense. The existing quantum mechanical interpretation schemes are puzzling. The confusing theory is unconvincing, and needs to be amended and completed. The successful interpretation program of quantum mechanics of local realism and determinism is undoubtedly the most attractive. The preparation of the interpretation program deserves to be chosen as a research goal. It is a very good premise to believe that an object particle consists of a light knot of monochromatic waves. According to this premise, the erroneous recognition about the "superposition principle, wave-particle duality and uncertainty principle" can be corrected. Under this premise, the above research goal is achieved by establishing and applying quantum mechanics inverse measurement theory, adhering to the principle that there must be a complete empirical chain in the derivation process of experimental conclusion, and using the side effect caused by directional quantization (see Section 2.3 for details) to explain the diffraction experiment of object particles. Electron secondarily diffraction and other experiments directly prove that there is the measurement (observation) which may not destroy quantum coherence. The diffraction experiments of all kinds of particles show that the keeping and playing of the coherence of moving particles in the vacuum have nothing to do with their previous experience. These are the existing experiments, to be found, that support the theory of quantum inverse measurements. The verification experiment of quantum inverse measurement is designed. The absolute superiorities of quantum inverse measurement and the new view of the measurement of quantum mechanics are listed. These superiorities are: that it has the characteristics of local realism and determinism; it is not contrary to common sense and there is no confusing place; and it can predict several phenomena that cannot be predicted by other theories. A solid theoretical foundation has been laid for "correctly understanding the microscopic world" and the establishment of local realism quantum mechanics.

1.1. The Background and Preparation

Quantum mechanics can be divided into several components: the mathematical formal system of quantum mechanics, the interpretation system of quantum mechanics (the most important is the quantum mechanics measurement view) and the quantum mechanics philosophy view. The mathematical form system of quantum mechanics can be divided into: the theoretical premise part (quantum mechanics postulate), the logical inference part and the conclusion part. The successful application of quantum mechanics shows that its mathematical logical conclusions are available. However, the postulates of quantum mechanics, the interpretation and the philosophical view of quantum mechanics are puzzling (confusing). In this case, it is necessary to optimize the postulations of quantum mechanics and improve the interpretation of quantum mechanics. The composition program of quantum mechanics postulations has more than one. This indicates that it has room for optimization. The author has reduced the quantum mechanical postulates to 1 in the book *Local Realism Quantum Mechanics*,[1] and retains the successful part of quantum mechanics (the brief introduction of the method of reducing the quantum mechanics postulate is shown in Section 1.6.2 of this book). The relation between the interpretation system of quantum mechanics and the mathematical formal system is desalinated by the result which does not require the third postulate of quantum mechanics to be related to the measurement definition and probability generation. It makes the measurement view and mathematical formalism of quantum mechanics change from a strong correlation to a weak correlation, and the successful application of quantum mechanics is not valid proof of the correct evidence of the interpretation system of quantum mechanics. quantum inverse measurement theory (QIMT) is only to reform the premise of quantum mechanics, the interpretation system of quantum mechanics and the philosophical view of quantum mechanics, and does not deny part of its success. There is no contradiction between QIMT and the quantum mechanics logic system. In a word, QIMT criticizes the interpretation system of quantum mechanics without denying the mathematical formal system of quantum mechanics. In other words, we only deny some qualitative explanation of quantum mechanics rather than denying the quantitative conclusion of quantum mechanics. In this way, it cannot deny QIMT that the correctness of the quantitative descriptions of quantum mechanics is verified by numerous experimental facts. In fact, “quantum mechanics verified by experimental facts” means “validating the quantitative conclusions of quantum mechanics (the conclusion from the mathematical formal system of quantum theory) rather than the qualitative interpretation in the strict sense”.

Quantum mechanics has been very successful in applications, but the interpretation of quantum mechanics has been puzzling. The famous Steven Weinberg also wrote that quantum mechanics is confusing (Steven Weinberg, 2017). In addition, quantum mechanics has many different competing interpretations, showing a “quantum mechanical interpretation jungle” of the chaotic state.

Although Copenhagen's explanation can make a good case, the cost of paying is, the wave function is no longer a completely objective existence, but rather becomes something that depends on the observer. In addition, from the perspective of theoretical completeness, one of the drawbacks of the Copenhagen interpretation is that it needs to presuppose the existence of objects (measuring instruments or observers) described by classical mechanics, and cannot completely derive all the results from the quantum mechanics itself. This leads to it being difficult to apply to quantum cosmology so that there is no “observer” or any classical object in principle. Since the Copenhagen explanation has a problem, other explanations will be born. Multi-world theory is one of them. Multi-world theory can avoid some problems in Copenhagen’s explanation, but there are other problems. There are still some questions and controversies about how to explain the probability phenomena in quantum experiments in the multi-world theory: since each possibility has been achieved, how to talk about the odds? In the description of quantum theory, this probability comes from whichever of the many possible worlds is random. In the multi-world interpretation, each time a small interaction will produce a huge number, almost the same parallel to the universe, and we cannot help but feel weird about this. There are also questions about how to understand the so-called “multiple worlds” and whether these parallel universes “really exist”. Multi-world theory is like the human ancestors imagining the underworld, the human world and heaven of the three worlds when they cannot explain the natural phenomenon. The phenomenon can be explained, but cannot confirm the existence of more worlds. Someone claimed that the phenomenon of continuous entanglement was detected. A person observing the phenomenon of continuous entanglement is the same person observing the phenomenon in different worlds. This is to deny the existence of the Multi-world. For the existence of more worlds, the affirmative experimental evidence is not found, but the evidence of denial has been found. The shortcomings of other explanations are not enumerated. There are many kinds of quantum mechanics interpretations, but they are built on the premise that microscopic particles have spooky characteristics, and all of them have not solved the problem of the ontology of quantum mechanics (we should know, the confusion of quantum mechanics mainly derived from the ontology of quantum mechanics). It is a fundamental explanation that microscopic particles behave like spooks. As long as the basic explanation is incorrect, the different explanations put forward on this basis are wrong. One of the advantages of QIMT is that it never explains the behavior of micro particles into spooky behavior.

Among the existing quantum mechanical interpretations, only one explanation is correct. It is more likely to be incorrect that they are all not correct because their common drawback is that they are non-local realism or non-determinism, to be contrary to common sense and confusing. In other words, their common drawback is that they cannot be separated from the spooks. The Copenhagen explanation has to admit that microscopic particles had ghost characteristics. Multi-world theory has to admit that the universe has a spooky character. Implicit parameter interpretation has to admit that the interaction has a spooky character. Confusing and contradictory are unsatisfactory, with no charm at all, and it needs to be improved and perfected. The incorrect interpretation of quantum mechanics can lead to quantum mechanics and even human knowledge develops in the wrong direction. Not caring about its unsatisfactory situation is just an optimistic attitude, rather than the unreasonable things in quantum mechanics not existing. A theory or idea occurs, once it is admitted that consciousness can affect the behavior of natural things, and there must be a significant lack of understanding. After the establishment of the interpretation system with the advantage of “the problem of the source of the wave function has been solved by means of the model of the kink of the waves forming the particles”, this is all the more so. Now, it is a bad sign that those physicists today who are most comfortable with quantum mechanics do not agree with one another about what quantum mechanics all means. The dispute arises chiefly regarding the nature of measurement in quantum mechanics (Steven Weinberg, 2017).

As mentioned above, it is meaningful to explore a satisfactory explanation of quantum mechanics.

The initial motivation of this chapter is to solve the problem of the development of quantum weak measurement theory (*i.e.*, to solve the measurement problems of quantum mechanics). With the deepening of exploration, I found the existence of events of quantum inverse measurement; then the function of quantum inverse measurement is found, and QIMT is established. And then later, the influence of QIMT on the existing quantum mechanics interpretation system was discovered. Finally, a new interpretation system of quantum mechanics was established. That is to say, the motive of exploration has gradually developed into the establishment of QIMT and the correction of the misunderstanding of the microscopic world (which is part of the "understanding of the composition, structure and nature of microscopic particles"). The most attractive quantum mechanics interpretation system is scientific and logical, and does not violate the common. I long ago had such a desire to build the most attractive interpretation system of quantum mechanics to solve the problem of quantum mechanics. It is necessary to establish the quantum mechanics of local realism. However, Ref. [1] did not solve the problem of quantum mechanics interpretation well. Ref. [1] makes up for the deficiencies of my previous research work. This chapter is complementary to Ref. [1] and constitutes a completely new quantum theory. For the sake of convenience, the most attractive measurement view of quantum mechanics established by me—the measurement view of quantum mechanics of local realism and determinism—will be called "Tu's measurement view of quantum mechanics". It is not difficult to establish Tu's interpretation system of quantum mechanics; as long as we adhere to the principle that the empirical chain must be complete, use directional quantization to explain the diffraction experiment by the double-slit of electrons, and wake up and find everything changed.

At the end of the 1980s, Aharonov, Y. et al. proposed the theory of weak measurement.[2] Quantum weak measurement theory is used to measure the signal as weak as possible, so making the interference of the instrument to the measured object as little as possible. The application of the theory has solved a series of problems which cannot be explained by standard measurement theory, and the understanding of the basic problems in quantum mechanics is given a relatively clear image. As mentioned above, the ideal quantum inverse measurement is the measurement of the measured particle only sending information to the instrument, and the observer (or instrument) does not send any information to the measured particle (the positive-going signal interference can be ignored). *Scilicet*, the measurement that the influence (interference) of the observer or instrument on the measured particle can also be ignored is belonging to inverse measurement. Although the observer has an effect on the observed object it does not affect the part of the observer who wants to see it. This observation is also a partial inverse measure. It is the extension of the concept of quantum inverse measurement that the measurement to be evenly or very symmetrically influencing the measured objects also belongs to quantum inverse measurement. That is, QIMT believes that if the measured particles are affected by the equilibrium (uniform order or very symmetrical), an objective state can also be obtained. Quantum strong measurement and quantum weak measurement generally refer to the measurement where the information sent by the measuring instrument has an effect on the measured object (destroying its original state: effective interference).[3] Just the intensity of interference is different. In the direction of information transfer, they are opposite to the quantum inverse measurement. The connotation of the concept of quantum inverse measurement is the measurement where there is only reverse signal transmission or action. Its extension is the measurement where the impact of the environment on the measured object can be neglected.

The development model of quantum weak measurement theory is measurement using a signal that is as weak as possible, or using more and weaker signals. However, the measured signal is weak and to a certain extent cannot be measured. Therefore, this development idea is a dead end. We must think about this question: Can we use other ways to achieve the ideal that can get pure objective measurement results? All observation or measurement is achieved through the transmission of the signal, and the signal transmission has positive and inverse two directions: a positive signal is transmitted from the observer to the observed object; and the reverse signal is transmitted from the observed object to the observer. If only the signal is from the observed object to the observer, the observation and measurement are also achievable. In the macro world and real life, there are a large number of such measurements (and/or observations). For example, in the night, we observe the signal bomb (tracer); according to the whistle and determining the approximate location of a travel vehicle; according to their friends or family, the blind judge their position and identity; the snake measures the position of the prey object……. that is to say, the measurement does not necessarily have to be like a bat to the prey on the need for two-way signal transmission and mutual influence. It is also possible that only the measured object (or the observed object) adversely affects the observer (this type of measurement is called inverse measurement). From a logical perspective, in the microscopic world, the measurement where there is only signal reverse transmission is the measurement that has no disturbance of the observation object and that cannot lead to wave packet collapse. Such measurements are the ideal measurements that can obtain purely objective results. The development and ultimate goal of quantum weak measurement theory are to realize the interference-free measurement.

In the course of any measurement, the effective process is that the observer receives the information from the observed object. This information is not necessarily the feedback information from the observer. It can be just the reverse information that is sent by the observed object. It does not meet the logic that pure objective observation results cannot be obtained by interference-free measurement. Nowadays, there are a number of people who acknowledge the existence of protective measurement. Quantum inverse measurement belongs to the category of quantum protective measurement. The rest of the question is “whether there is the measurement without positive interference”. This chapter will demonstrate this critical issue. In this chapter, the measurement where the instrument does not interfere with the measured object (or the measurement where the interference intensity is less than the anti-interference ability (robustness), interference can be ignored, and may not lead to wave packet collapse) is called the measurement without positive interference, inverse measurement (or interference-free measurement) for short.

The author introduces his research motivation at the beginning. The starting point and basic principle of QIMT are introduced in section 3. In the following chapter, the conclusion, the case, the prediction and the verification method of QIMT are introduced. Especially QIMT as an important influence on the superposition principle, the uncertainty principle and the concept of wave-particle duality is introduced in detail. In section 8, we will design the principle of the several experiments: electron diffraction experiments in a cloud chamber, in an electric field and/or special medium. These kinds of experiments can judge the measurement view and the interpretation system of quantum mechanics. When combined together, the effect is better. One of the most important contents of this paper—the advantage of QIMT and the deficiency of other similar theories—will be introduced in Section 1.7.

The definition of measurement by quantum mechanics is a hypothesis—the third postulate of quantum mechanics. The concise expression for this definition is that when a physical system is in state$|a\rangle$ and a physical quantity Q is measured, the expected value is$\langle Q\rangle = \langle a|Q|a\rangle$. It is misinterpreted as: the only operation that can cause the quantum state to change is quantum measurement. This kind of misinterpretation exists in a series of questions. First, why do we not consider the positivism effect of the operation with a positivism function other than quantum measurement? That is, why should we exclude the measurements that do not lead to change in state? Second, are the quantum state change and quantum decoherence always synchronized? If you think they're synchronous, what's the reason? Under the premise that they are not synchronized, if the quantum state changes but decoherence does not occur (or decoherence occurs and the quantum state does not change), how do we handle these operations? In fact, no matter how we define measurement, we can't change this fact that: In the process of measurement, the transmission and function of information and matter can be divided into two cases of one-way or two-way. The one-way can be divided into two kinds of reverse and forward. "Information transfer" is the soul of measurement, and "empirical function" is the basic requirement for measurement. State change is neither the essence of measurement nor the basic requirement for measurement. If, as long as the measurement occurs, a quantum state change is made, then the quantum measurement cannot have an empirical effect on the pure objective quantum state. Empiricism needs to be perceived, while perception requires interaction or transmission of information. Quantum measurement has been understood as "spiritual communication" by existing quantum scientists. This is clearly contrary to the spirit of science. The measurement I define is a set operation where the empirical function is determined by the real interaction. Quantum inverse measurement is the measurement where there is only the reverse signal transmission or the effect of a positive signal on the measured object is negligible. The following is using interaction as an element to define a measurement with an empirical function.

Measure the object: the object being measured or observed is also called the object of measurement. Abbreviation: the target object. Measuring instrument: artificial environmental substances that can be affected by the target object and/or the artificial environmental substances that target substances are affected by them; it can also be called the observer. Measurement: the process of unidirectional or bidirectional transmission of information (or there is one-way or two-way interaction) between the target and the instrument. A more complex measurement can be divided into several local measurements. Human participation is not a necessary condition for measurement. People play two roles in measurement: one is to design the measurement process and implement the measurement operation; and the other is to collect and analyze the information obtained from the measurement. Observation belongs to the category of measurement. The classification of the measurement is shown in the following figure:

Measurements
- The measurement that pure objective results can not be obtained
  - The measurement that the interference of instrument on the target cannot be ignored (For example: projection measurement)
- The measurement that purely objective results can not be obtained
  - measurement of only the target affects the instrument (inverse measurement);
  - The measurement that the interference of instrument on the target is negligible;
  - The measurement that the instrument has little effect on the target and is symmetrical;
  - The measurement to meet the Zeno - effect.
- The measurement that the pure objective results in local can be obtained
  - The measurement that the instrument does not have a large effect on some parts of the observed object (for example, using a slit to measure, the instrument did not cause the wave - packet collapse).

1.2. The Very Serious Logical Questions in the Interpretation System of Existing Quantum Mechanics

The problems described in this section are the serious problems that exist in quantum mechanics. In other chapters, these questions may be discussed. Other chapters also discuss other issues of quantum mechanical interpretation. The existence of these problems fully indicates that the existing interpretation system of quantum mechanics is incomplete. If we do not care about these contradictions, do we still want the spirit of science? The existence of these questions suggests that the other explanations that are less problematic are worth discussing.

Can the measurement cause the packet to collapse? One is a hypothesis, the other is experimental fact, and should we first choose which one? For quantum physicists, these two questions seem to be difficult to answer.

However, at present, there is a big problem with their choice. For example, they chose to prioritize the assumptions, and they sometimes use the idea that measurements did not cause the waves to collapse.

1.2.1. Does the Measurement Lead to Wave Packet Collapse and Quantum Decoherence Inevitability?

Quantum physicists have chosen the conclusion that “as long as measurements occur, wave packet collapse and quantum decoherence will be caused.” For example: the use of the cloud chamber, spark chamber and other equipment to measure micro particles (see Section 1.4.3 for details); a quantum state is measured for the first time in a quantum entanglement experiment. The existing interpretation system of quantum mechanics also requires this choice. But on some occasions, they secretly chose the conclusion that measurements would not cause wave packet collapse (*i.e.*, they were not consistent. For example, when quantum entanglement is proved to exist, they did so). That is to say, their actions are very contradictory.

In addition, many experiments and facts show those quanta decoherence and wave packet collapses cannot be caused by measurements (or it is proved that the wave packet collapse process does not exist by experiments). These experiments are as follows.

In the experiment of microscopic particle diffraction, when a particle beam passes through the slit, the influence of the slit on the particle beam belongs to the influence of the instrument on the measured object. However, the undulatory property of the particles passing through the slit not only does not disappear, but shows the undulatory property in the process of penetration. The charged particles are subjected to the action of a strong electric field and the collimation of the magnetic field before passing through the slit. These actions are in line with the definition of measurement (observation). None of them caused the wave packet to collapse (otherwise we can't see the diffraction pattern). This is the experimental fact that measurements do not cause wave packet collapse. The secondary diffraction phenomenon of electrons more accurately shows that the front and rear two slits (especially the first) did not cause the wave packet to collapse (it can be said that the slits in all diffraction experiments did not cause the wave packet to collapse. The reason is that the collapse occurred on the screen). Double-slit diffraction experiments of photons and electrons show that there is only the superposition between measured particles, and the superposition between particles and instruments does not occur. It can be seen that the double-slit diffraction experiment of electrons and the secondary diffraction experiments of electrons show that the measuring instrument does not cause the essential properties of the measured particles to change. In other words, the purely objective properties of the measured particles are presented by these measurements, rather than the purely objective properties of the measured particles are changed by these measurements. The above facts explained as part of the measurement cannot lead to wave packet collapse and quantum decoherence, but also can be interpreted that the wave packet collapse process and the quantum decoherence process do not exist. If the measurements must lead to a superposition of the states between the instrument and the measured particles, a small piece of optical fiber can only transmit signals that are seriously distorted. The fact is that a long fiber can transmit undistorted signals. In a sense, anti-distortion technology is also a technique to recover the quantum coherence of a signal carrier. The fact is that the state superposition between the instrument and the measured particles is not necessary, with the instrument measurement may be seen the pure objective of the performance of particles. In this way, it is possible to achieve the quantum inverse measurement mentioned above (spying on the purely objective properties of microscopic particles). Some people claim to observe the continued entanglement of particles. Logically, only the measurement (observation) did not lead to quantum decoherence, the phenomenon of continuous entanglement may be observed. Therefore, the experiments that have observed the continuous entanglement of particles have proved that the measurement may not lead to quantum decoherence. Some experiments have been done to keep the ions stationary in the microcavity while maintaining the coherence characteristics of the ions. This experiment also shows that the measurement operation of the controlling ions did not lead to the disappearance of coherence.

If we adhere to the principle of science, we must choose between “the measurement will inevitably lead to wave packet collapse and quanta decoherence” and “measurement may not lead to wave packet collapse and quantum decoherence.” If the former is chosen, the experimental facts are violated. If the latter is chosen, first, the existing concepts of quantum mechanics are eliminated, and secondly, the conditions for maintaining and destroying quantum coherence must be discussed. The existing quantum mechanics does not discuss the conditions for maintaining and destroying the quantum coherence, but chooses two diametrically opposite views subjectively and alternately according to their own needs. So, at this point, quantum physicists make ordinary readers confused (they themselves are confused). In fact, existing interpretation systems of quantum mechanics will disintegrate as long as measurements do not lead to wave packet collapse and quantum decoherence. As long as it is proved that there is the experiment which may not destroy quantum coherence, it is proved that the quantum inverse measurement experiment can be realized.

1.2.2. Should We Believe in Hypothesis Or Should We Believe in Experimental Facts?

Photon and electron diffraction experiments can also be said to use slits to measure photons and electrons. However, the majority of the process ahead of this measurement did not cause the wave packet to collapse; otherwise we would not see the diffraction pattern. In the experiment that claimed the seizure of Schrödinger's cat of the dead-live hybrid, persistent entanglement was observed by continuous measurements. If this is true, it also shows that measurements do not result in wave packet collapse. If the measurement will lead to wave packet collapse, the experimenter cannot see the continuity of quantum entanglement, but can only see the quantum entanglement stopped at the beginning of the measurement. Glass is also used as an instrument to measure photons. When the photons pass smoothly through glass, state superposition did not occur and the photon did not change into a pure particle without volatility.

Section 1.2.1 lists the experiments that can prove that wave packet collapse does not exist or does not occur. Both the collapse of the wave packet and the related superposition of quantum states are only theoretical hypotheses. Which one should we believe? At present, the quantum physicist believes the hypothesis and not the facts. These ideas have solidified in his mind. Many people willingly are unscientific, but also maintain their established ideas (of course, some people don't do it consciously).

The concept that interference-free measurement can also change quantum states has no experimental basis, there is no reliable theoretical basis, it is not consistent with the logic, and does not belong to the category of natural scientific concepts. It is a kind of philosophical view (or it is an illogical belief). QIMT points out that, wanting to get the measurement results determined and purely objective, the measurement under the condition of only reverse influence is equivalent to interference-free measurement. The establishment of QIMT breaks through this concept and the concept that interference cannot be eliminated (the old view of measurement of quantum mechanics) is conceptual progress, and a leap of human knowledge.

Maybe someone will ask whether the existence of quantum entanglement and the experimental results of double-slit diffraction are the two obstacles to QIMT, and what does the author think about this problem? Here I want to tell everyone that quantum entanglement experiments did not use the experimental method to exclude that the twin particles are all pigeon pairs when they are born. The sex of pigeon pair alternating is still the pigeon pair, rather than the mixture of boy and girl. We have no reason to say that the experimental method has been used to confirm the existence of quantum entanglement. As already mentioned, the electron secondary diffraction experiment can also prove that the general measurement does not lead to wave packet collapse, and quantum inverse measurements can be achieved. Only the possibility is excluded that the diffraction in the diffraction experiment by double-slit is caused by accompanying light and directional quantization, so we can say that this kind of experiment confirms the existence of the wave-particle duality and the non-local particle. It is recognized that physical particles such as electrons are not composed of wave packets and can be made of monochromatic waves. It is concluded that the effective superposition of states is limited by the spatial distance and the direction of the force. See Section 1.2.5 for a more detailed description.

1.2.3. If the Function of the Instrument Can Cause Decoherence, Then How Do Coherent Particles Come from the Instrument?

Why is a change in the state of a measured particle necessarily caused by the measurement in which the association between the instrument and the measured particles has not occurred (one in which quantum decoherence has not occurred)? Does quantum state change always occur simultaneously with quantum decoherence and wave packet collapse? If it does not, what should I do?

Does the instrument in the end produce quantum coherence or damage quantum coherence? Since the particles are produced by the instrument, the quantum coherence of the particles is bred by the instrument. This sentence says that the instrument can nurture quantum coherence. The Copenhagen school believes that as long as the measure occurs, the observer (or instrument) will destroy the quantum coherent state. This sentence says that the role of the instrument must destroy the quantum coherence. Particles with quantum coherence are all born out of the instrument. The studied particles are made out of instruments, not out of thin air. Even cosmic radiation also comes from the super instruments of the universe. It is an experimental fact that an apparatus for breeding particles does not cause decoherence. If the effect of the instrument would lead to quantum decoherence, then particles with quantum coherence would never be created. Conversely, if the instrument can produce particles with quantum coherence, the instrument may not destroy quantum coherence. It is obvious that the viewpoint that the instrument can destroy quantum coherence is contradictory to the experimental facts. This is also one of the most serious contradictions that exist in the interpretation system of existing quantum mechanics.

The two electron diffraction experiment shows that the slit has led to the change of the motion state of an electron. However, the first slit does not result in the disappearance of the quantum properties of the incident electrons (does not cause wave packet collapse and quantum decoherence). This indicates that the measurement of quantum states and quantum decoherence can occur at different times. The association between the instrument and the measured particles may also not occur when measurement. As long as there is the case where the state superposition between the instrument and the measured particle does not occur, we can discover the purely objective and determined quantum properties of the particle by measurement. If you insist that the measurement will inevitably lead to changes in the quantum state, it produces a question: Why is a change in the quantum state of a measured particle necessarily caused by the measurement where the association between the instrument and the measured particles has not occurred (one where quantum decoherence has not occurred)? Measurements lead to changes in the motion state of the electron without changing the quantum properties of the electron. Why does it necessarily change the quantum state? "In some quantum-measurement process, the association between the measured particles and the instrument does not occur" is an empirical point of view. It has not verified that the association between the measured particles and the instrument is inevitable in all quantum measurements. Which view should we believe?

1.2.4. Does the Instrument that Gives Birth to Particles Protect "Its Child" with Motherly Love? Is the State of the Particle Prior to Measurement Obtained by Extrapolation Reliable?

Before and after two measurements of the polarization of the same photon, the result is that the polarization direction of the photon has not changed, *i.e.*, “the measurement does not cause the quantum state of the photon to change”. The spin direction of the same electron is measured two times before and after, and it can be also found that the spin direction of the electron has not changed due to measurements. This kind of experiment can be repeated many times. It can be said that “the measurement does not lead to changes in the quantum state” has been empirical. Now, on the basis of the above empirical results, we deduce whether the first measurement will lead to a change in the quantum state. The rigorous deductive result is also the first measurement and will not lead to a change in the quantum state. However, the interpretation of orthodox quantum scientists by means of deduction is that the first measurement can lead to changes in the state, and the subsequent measurements will not lead to state changes. Such a conclusion does not accord with deductive logic on the one hand, but on the other hand, it runs counter to the deductive way of obtaining the conclusion of uncertainty. The reason they use this deductive logic is that the measurements after the first measurement are not quantum measurements again, but classical mechanical measurements. Such sophistry leads to an obvious problem that is difficult to answer, which is how to make a photon, under the circumstances that both its morphological features and mode of motion are invariant, into a classical mechanical particle by means of measurement? The same is true for electrons: electrons fly in a vacuum that is almost unaffected by an external field. Why say it is the classic particles? You know, before the measurement, it is also impossible that the particle is not affected by the instrument breeding it (Section 1.2.3). Unless the instrument that gives birth to particles can take care of its child with motherly love, the laws for the effect of all instruments on the particles should be the same.

Since it is believed that the measurement will change the quantum state of the particle, the state of the particle before the measurement cannot be verified by experiment. Quantum scientists use a deductive method to obtain the states of particles before measurements (or when they are not measured). The diffraction experiments of electrons and other particles prove that the particles in measurement are uncertain. Thus, scientists also deduce the conclusion that particles are also uncertain when they are not measured. The two conditions, affected by the measuring instruments and not affected by the measuring instruments, are not the same. Extrapolating from the affected by measuring instruments to the not affected by the measuring instruments is not a deduction, but a guess.

1.2.5. Does the Quantum Entanglement Disappear When Measured or Does It not Exist Originally? How to Exclude the Concept that the Quantum Entangled State Does not Exist Originally

Experiments on quantum entanglement can be divided into two categories: the experiment to observe the instantaneous quantum entanglement effect and the experiment to observe the continuous quantum entanglement effect.

There are other problems that quantum mechanics has not solved. For example, what is the basis of the necessity of state superposition? How can the contradiction be overcome between the interpretation of the instantaneous quantum entanglement experiment and the interpretation of the continuous quantum entanglement experiment? And so on.

The existence of quantum entangled states is a hypothesis. When we use the instantaneous quantum entanglement experiment to prove the authenticity of this hypothesis, the other hypothesis that measurements inevitably eliminate the entanglement state is necessary. The general result is to use the assumption of entanglement elimination to verify the assumption that an entangled state exists. This is a very funny logical cycle. This logical cycle simply cannot prove the tangent state of the real existence.

For experiments that prove persistent entanglement, the interpretation is based on the fact that measurements do not cause entanglement to vanish. This is contrary to the idea that "measurements can lead to the disappearance of entangled states" to be used by instantaneous quantum entanglement experiments (there is a contradiction between the two). What kinds of beliefs should we believe? This kind of contradiction determines that the existing quantum entanglement experiments cannot prove the existence of quantum entangled states without ambiguity.

As mentioned above, the destruction of the original state of a measured particle by an observer (instrument) is imaginary, without empirical evidence. This makes the interpretation for quantum entanglement extremely unreliable (because the existence to verify quantum entanglement must depend on that measurement and can lead to the change in the state). There is neither a solid theoretical foundation nor a solid experimental basis for the existence of entangled states and other superposition states before the measurement of a particle. It is still just a hypothesis that is imagined. No conditions of superposition (entanglement) without the limitations of distance are absurd. "The experimental facts have proved the existence of quantum entangled states" was remarked too early.

It is claimed that the entanglement state between two electrons is observed; in fact it is observed that the spin directions of the two electrons change alternately. It is also observed that the opposite of the spin of the two electrons is an objective existence. When the two electrons are separated, it is observed that their spin states are still in the opposite direction. The biggest possibility is that the spin direction of these two electrons is always the opposite, rather than obtained by collapse when measured. This possibility can never be ruled out. This is the most worrying thing about the experimental results that validate Bell's inequality.

For some physicists, the new quantum entanglement experiment claims “there is not a logical loophole.” However, this is not the case.

“David Kaiser from the Massachusetts Institute of Technology beautifully solved two of the three loopholes, but 2/3 was not all.” Dr. Kaiser said, “I believe from my bones that quantum theory is the correct interpretation of the universe, but to be honest, we have not reached that level yet by proclaiming proof of that” (David Kaiser, 2014)

One potential flaw in the experiment, he believes, is that the electronic systems that researchers use to increase the randomness of the measurements may in fact still be predetermined and the way in which decisions are made may be subtle and imperceptible, meaning that experimental results may still be like love. As Einstein believed, it was decided in advance. In other words, “the particle was in an entangled state before the measurement” was not experimentally confirmed. This point cannot be proved by the experimental method on the premise of measuring the quantum entanglement state. For the measurement result of “opposite direction of spin or direction of magnetic field”, it cannot be excluded that it is the expression of homologous conjugate particles to be pigeon pairs before measuring. “Believing in the existence of quantum entanglement” is still just a belief.

1.2.6. Is Entanglement a Virtual Mathematical Structure? Is the Stochastic Process in which Pick One of Two Equal to “the Structure of Entanglement Coexistence between the Two Parties” Plus “the Stochastic Process of the Two to Collapse into One?”

If the probability results predicted before an event occurs are regarded as the reality, there must be entanglement between the carriers (objects) of the probability events. So far, the entanglement of so-called discovery and confirmation is the entanglement of this definition (it is also the method to identify entanglement). For example, there are the two cards: red 5 and black 6 in a black box, the observer touches the poker card and only one card can be taken at a time. Before the event occurrence, the mathematical prediction is that the probability of catching the red 5 and black 6 are 1/2 respectively. Quantum scientists regard this prediction as a reality, and must think that the reason for “each with a probability of 1/2” is “the red 5 and the black 6 are entangled”. The next step, the hypothesis that “at the moment of catching a card, an entangled card collapsed into the card in normal condition” is needed. The classical probability theory holds that “the prediction before the event" and the "realized reality” do not need to be connected by a collapse process, nor does it need that, before the event, the objects whose probabilities are predicted, are entangled. Through this example readers should be able to understand the sentence that “entanglement is caused by the language (tools, methods, ideas, etc.) that describes events, not by the characteristics of the particles themselves”. In this example, the entangled state is derived from regarding the possibility of a schism in prophecy as a coexisting reality state (the stochastic event is transformed into an inevitable event determined by the composition and structure of the object. Hereinafter we refer to such a composition and structure as the mathematical virtual structure). The condition of the dead-living cat is also due to the fact that the virtual structure of mathematics is treated as a real state.

If the reader does not understand, we will change the poker cards to eels. The two eels in the black box are intertwined, and constantly rotating. Reach out to catch them, and the catch is a mixture of two eels. The probability of catching one of the eels is 100% (this is the inevitable event rather than the random event). When carefully looked at, the two eels that have been caught immediately collapse into one eel. If there are a number of eels in the black box, and the observer grabs two mutually intertwined eels, when the observer sees this, they immediately collapse into a mud eel. It can be seen that the collapse effect is completely subjective (the collapse effect must be set according to the subjective needs). This shows that the collapse process cannot be true. In Copenhagen's interpretation system of quantum mechanics, the formation of quantum entanglement and the wave packet collapse are two opposite processes (the formation of entanglement causes the system to enter the virtual state, and the wave packet collapses the system and returns to reality from the virtual state) which must exist simultaneously in the interpretation process. Otherwise, the state of the particle cannot come back to reality. As long as the wave packet collapse is virtual, the quantum entanglement is also virtual. This is why the theory of multiple worlds that only need entanglement and do not need collapse, has been taken seriously. But the explanation that neither entanglement nor collapse exists is truer than the explanation that entanglement exists and collapse does not exist. To deepen our impression, let's look at **Table 1.1** again.

As long as wave functions are used to describe macroscopic objects, the concept of entangled states can be applied to macroscopic objects. However, as long as the concept of entangled states is applied to macroscopic objects, especially to living macroscopic objects, these contradictions which cannot be overcome will immediately appear. For example, put five male wolves and an estrus she-wolf into a large sinkhole. From the mathematical point of view, the chance of each of these five wolves mating successfully is 1/5. It is described by quantum mechanical methods (wave functions). The reason for deciding "the chance of each of these five wolves mating successfully is the same" is the mathematical virtual structure of "the entanglement of the five coexists successfully in the mating state (the entangled state of the five male wolves successfully mating at the same time)" (this corresponds to the hybridization structure of the sm^5 mating state). Three months later, there were human beings to

Table 1.1. A comparison between the classic description and the quantum mechanical description of the probability event “pick one of two” between a red 5 and a black 6 in a dark box

Contents	Classic description	Quantum theory description	Under the premise of the existing quantum theory, the requirement of the concept in the left column
The existence form of red 5 and black 6	Two separate entities	Two waves that are expressed by wave functions, which can be superimposed	Postulate of quantum mechanics, principle of superposition of states
In an event to catch a card, a mathematical prophecy of the probability of catching one of the cards	<1> Before you grab the card, they're all 1/2 <2> After the event occurs, if you are holding the red 5, it cannot be the black 6 and vice versa	<1> Before you grab the card, they are 1 at the same time <2> When the event occurs, the wave function collapses (If the caught something collapses into red 5, it cannot collapse into black 6 at the same time and vice versa)	By using entanglement, the stochastic process is transformed into a non-random process, and then the non-random results are transformed into stochastic results by means of collapse. The collapse process is instantaneous, and the specific causes, processes and forms are unknown.
The determinants of prophecy <1>	Determined by randomness, and is the statistical result of several realistic <2>	It is determined by the real entanglement of the object, that is, by the composition and structure (mathematical virtual structure) of the object directly	The entanglement of the object and the authenticity of the entanglement are hypothetical, and argue that the two cards are in the form of a freak that there is no explicit character mark before the event.

The value of probability and the truth of its corresponding state	Prophecy <1> is a prediction made by statistical methods. Prophecy <1> cannot be realized by single measurement.	Both the states of prophecy <1> and prophecy <2> are real. Neither of them is the probability value of the chance size	The authenticity of prophecy <1> is obtained by a virtual structure in which red 5 and black 6 are entangled together. The authenticity of prophecy <2> is obtained by a virtual collapse process
The relationship between prophecy <1> and prophecy <2>	It is the relation between possibility and reality, or the relationship between the statistical result of multiple measurements and the results of a single measurement (<1> is the statistical result of multiple <2>)	It is the relation between mathematical structure and reality (<1> is not the statistical result of multiple <2>)	From the reality <1> to the reality <2>, a wave function collapse process is needed

observe. How do the wolf cubs in the womb in the state of being entangled develop? Did the *sm*[5] mating state hybridization of such a composition and structure (including semen injection and pleasure tasting) last for a long time? When this entanglement ends, how do the sexual pleasure and the ejaculated semen of the four male wolves collapse, fall back and transfer to a male wolf? This collapse process requires a time reversal process and a process that does not spend time and any power. When no one observed, if the entanglement is terminated, is it the entanglement process which can also terminate their own? If the entanglement ends when they are observed by someone, then, how do the genes in the body of the wolf cub bred by the mother wolf get distributed and collapse into the genes of one male wolf? These problems show that the quantum entanglement state cannot change itself (that is, it cannot be dynamic, only static), or can only be a transient state or a persistent state. These problems show that the quantum entanglement state cannot be changed by self-development (*i.e.*, cannot be dynamic, only static), or can only be an instantaneous state or a constant state. Even so, the various transitions associated with the collapse remain illogical. This is the fundamental problem of quantum entanglement. They cannot be eliminated by experimental methods.

There are two problems in quantum entanglement that cannot be eliminated by experimental methods. The first was introduced in the previous paragraph, and the second one is the incomplete empirical chain in the explanation of quantum entanglement phenomena that will be discussed in Section 1.2.8 and Section 1.5.1.

1.2.7. Is "a Particle whose Two Quantum States Superimposed" the Mature Integral particles?

A complete particle gathers three major characteristics in one body: mass, charge and spin. In other words, admitting that a particle exists independently must be distinguished from other particles according to its mass, charge and spin. Quantum scientists hold that the particles superposed by quantum states do not have a definite spin state. Their definite spin states are generated during the measurement. Is an electron which does not have a clear spin state, also called electronic? If it's an unknown particle, the problem is more obvious: according to established rules, it cannot be determined that it is a new particle. Particles that do not form definite spins are not mature intact particles. How do measurements make immature electrons spin? What is the mechanism of action? If the spin of the electron is real rotation (the spin number is the quotient of intrinsic angular momentum and ħ), spin-fuzzy electronic entangled states are immediately denied. If we think that electron spin is a peculiar quantization motion, it is not easy to deny quantum entanglement in this way. The polarization of photons should be a definite thing!

Quantum mechanics holds that entangled twin-photons have no definite polarization direction. Is a wave with no definite polarization direction an electromagnetic wave? Especially when the two twin-photons are very far apart, if the two photons do not have a definite polarization direction, are there no definite directions for the electric and magnetic fields in them? You know, both electric fields and magnetic fields are vectors! What is a vector without definite directions? From a spatial distribution point of view, twin particles are not conjoined twins. But existing quantum mechanics describes twin-particles as chaotic twins.

The spin of fundamental particles and the polarization of photons are determined by their internal structures. They are not the variable state of their whole, but the basic characteristics of their composition and structure.

Measurements that do not cause decay do not cause changes in the internal structure of the elementary particles. The measurement which is not intended to change the direction of polarization does not cause the polarization direction of the photon to change. Even if the measurement of the polarization direction is deliberately changed (for example, by allowing the photon to pass through the optically active substance) the polarization direction of the photon before and after the measurement is clear, and the polarization direction changes slowly and has a clear mechanism. For a photon, the polarization direction is its soul, not its overall state. A photon without definite polarization is not a photon. Thus entangled photons are immature photons or meaningless photons. If both an electron and a photon is a complete and mature particle, then, after their superposition, and the spin or polarization intrinsic motion is still there, but not disappeared, it must wait for clarification under external effects.

In summary, considering that microscopic particles exhibit peculiar properties, the cost is to sacrifice the integrity of the particle structure. If the integrity of the particle structure is beyond doubt, the curious nature of the immaturity and incompleteness of the internal composition and structure is unreliable. (It is hard to say it is true. It is only an understanding of the results of mathematical operations.) Since quantum entanglement is only a virtual mathematical structure, whether there is a corresponding reality must be verified by experimental methods. The current interpretation of such validation experiments is in that kind of mathematical structure to find ways to identify entanglement. This is not a "third party" validation. The first, an imaginary out of an entangled state, and the second, using another imaginary out of a collapse process move the particles from the entangled state back to reality. This approach does not conform to the simplicity principle in scientific theory. Therefore, the complete experimental verification of quantum entanglement must also include the experimental verification of wave packet collapse.

1.2.8. Has the State Change of Twin Particles Been Verified?

The empirical train in the experimental interpretation to verify Bell's inequality[7] [8] is incompleteness. This is also the greatest logical loophole in the explanation of quantum entanglement experiment phenomena, which is irrelevant to the experimental method and is only related to the method of phenomenon interpretation. Specifically, the premise that the change of the quantum state of the twin particles is due to measurement, which is required by the explanation that the existence of quantum entanglement has been verified, is speculated by theoretical methods rather than rigorously verified by experimental methods.

Just believing that the state of the twin particles must be changed by any measurement, and then the state of the twin particles cannot be experimentally verified before the measurement. However, the interpretation of the relevant experimental phenomena into quantum entanglement requires the premise that "entangled states exist before measurement and are changed in measurement." Thus, the quantum entanglement explanation has to sink into a logical loop: to explain the relevant experimental phenomena into quantum entanglement, it is necessary to assume that the quantum entangled state exists before measurement and is changed at the time of measurement. In other words, only when we measure the same particle twice before and after and find its state is different can we think that the state change of the particle has been experimentally verified. For only one measurement, it is not possible to say that the state of the particle has been experimentally verified. Thus, the "change in the state of the twin particles" is not proven (the empirical chain is incomplete). If the associated experimental phenomena are interpreted as quantum entanglement, it must be assumed that the states of the twin particles are changed at the time of measurement. This is a logic loop and is the largest logical loophole in the quantum entanglement experiment and its interpretation.

The largest logical loophole is only relevant to the interpretation for the measurement results, but not to the measurement methods. No matter how it is improved the measurement method (no matter what the measurement method) cannot plug it. Thus, the existence of this largest logical loophole makes all Aspect experiments (including the recent Ronald Hanson team experiment) not worth a penny. I was very surprised that Ronald Hanson, a physicist at Delft University in the Netherlands, did not find or ignored the biggest logical loophole like everyone else. Then I figured out that they want to cover up the biggest logic loopholes, so they simply do not consider the existence of the logic loopholes. In fact, Ronald Hanson reported in the validation of Bell's inequality in the same article that no Bell experiment can exclude all imaginable local realism.[9] However, this sentence is submerged among the coaxing sound that media and other scientific workers agree that the quantum "spookiness" passes its toughest test yet. The reason is still that quantum physicists hope so. Otherwise, the existing interpretation system of quantum mechanics will collapse.

As mentioned above, because of the lack of empirical chains and logical chains, the explanation of quantum entanglement phenomena falls into a logical cycle. Therefore, the existing experimental results which claim to verify the existence of quantum entanglement are unreliable.

In addition, the superposition of quantum states is only a mathematical possibility, not the inevitable reality. The state superposition is conditional, not unconditional. The wave packet collapse caused by observation is conditional, not unconditional. It is a kind of sophistry need that takes the possibility in mathematics as the inevitability in physics.

1.3. The Scientific Basis of Quantum Inverse Measurement Theory

Prior to this article, quantum scientists discussed quantum measurements to discuss only projection measurements; as if other measurement methods did not exist at all. In fact, the types of measurement method are much more than the one of projection measurement. In addition, quantum scientists also strangely believe that the anti-interference ability of microscopic particles is zero. In fact, the anti-interference ability of high-energy particles is relatively strong, and the ability of medium-energy particles to resist weak fields is not zero. Based on the fact that non-projective measurement methods exist and the anti-interference ability of microscopic particles is not zero, the QIMT is proposed. The basis of the quantum inverse measurement theory discussed in this section can be regarded as a starting point. Section 1.3.1 together with Section 1.6.2 can form a solid foundation for QIMT.

In the world of classical mechanics, there is a measurement where only the signal is sent by a measured object and the signal only is received by the measuring instrument and the measured object is undisturbed. In the micro world, this form of measurement is also an objective reality. The theoretical basis of quantum inverse measurement is that there is interference-free measurement in which the measured object sends only signals while the measuring instruments only receive the signals. In this measurement, the measured object is the same as the isolated object in the vacuum. The evolution of the state of the measured object can still be described by the Schrödinger equation. All experimental facts show that the keeping up and bringing into play of the diffraction properties of the electrons moving in the vacuum are independent of their previous experience (see Section 1.3.2.2). It is possible to find the experimental facts that measurements do not cause coherence to disappear. This suggests that the inverse measurements where interference can be neglected can also be found. According to the "irrelevance" mentioned above (we consider that: the wave packet collapses as a hypothesis; in the electron-diffraction experiment, the electron beam is subjected to the action of a strong electric field and the collimation of a magnetic field), we can infer that the electrons passing through the spark chamber must be diffracted. Then the electron beam in the spark chamber does not lose its quantum coherence. If priority is given to experimental facts rather than assumptions, such a conclusion will be accepted—the measurement utilizing the spark chamber and cloud chamber may be the measurement where the coherence of the measured particle does not disappear (see Sections 1.3.1 and 1.4.3 for details). The uncertainty principle, which hinders the recognition and acceptance of quantum inverse measurements, has been challenged with unprecedented intensity.

1.3.1. Tracing the Source of Quantum Inverse Measurement

Quantum weak measurement is the measurement of interference as weak as possible. Quantum weak measurement theory needs to continue to develop. Its ultimate goal must be to achieve interference-free measurement. Quantum inverse measurement is interference-free measurement and/or the measurement where interference can be ignored. This is the ultimate goal of quantum weak measurement, and also a type of nondestructive measurement. Therefore, the source of the theory of quantum inverse measurement is the theory of quantum weak measurement. The weakness of both quantum weak measurement theory and existing quantum nondestructive measurement theory is that, in the framework of projective measurement, interference is minimized by means of weakening signals. The quantum inverse measurement theory breaks through that frame.

To observe the mechanical quantity A, the measured value must be one of its eigenvalue spectra a_i. After the observation, the system will be in its corresponding eigenstate $|a_i\rangle$. If the system is also in the eigenstate $|a_i\rangle$ before observation (before and after measurement, the state of the system does not change), the measurement result must be a definite value a_i. This process can be expressed by an eigenfunction equation

$$\hat{A}|a_i\rangle = a_i\,|a_i\rangle. \tag{1.1}$$

That is, if the system is in a certain state before the observation, the result of the interference-free measurement is unique. This is determined by the nature of the wave function. It indicates that the measurement leads to a change in the state and the randomness of the measurement results is not necessary, but conditional. These conditions are: <1> if the state of the system is uncertain before the observation, the obtained eigenvalues after the observation are uncertain; <2> if the interference of measurement cannot be ignored and unpredictable, it conforms to the law of statistics, and the result of measurement is random. Only according to the rules of Bonn (which is based on the uncertainty principle) and that the system state is always uncertain $|\alpha\rangle$ before observation, the system state changes to $|\beta\rangle$ after measurement (observation), and gets the eigenvalue of a mechanical quantity *A*, we can consider a measurement will inevitably lead to state change. This procedure can be expressed in the lower form.

$$\hat{A}|\alpha\rangle = a_i|\beta\rangle . \tag{1.2}$$

However, the situation described in Eq. (1.2) is also very common in quantum mechanics. Such as,

$$\hat{p}|\psi(x,t)\rangle = p|\psi(x,t)\rangle . \tag{1.3}$$

(Replacing $\hat{p}$ with another mechanical quantity operator, this formula is also established). For real particles, the description in Eq. (1.2) is hypothetical (for example, it is a hypothesis that measurement necessarily leads to the destruction of superposition states. EPR has assumed an entangled state wave function

$$\Psi(x_1, x_2) = \int_{-\infty}^{+\infty} \exp\left[ip(x_1 - x_2 + x_0)/\hbar\right]dp . \tag{1.4}$$

It is assumed that the measurement of it will result in the disappearance of the x_0 entry in the state function. Here, the state function is hypothetical, and the state function change is also hypothetical).

Comparing the conditions that Eqs. (1.1) and (1.2) are tenable, it is known that, as long as the state before measurement is determined, and the interference can be ignored (measurements do not lead to a change of state), it is entirely possible to obtain the determined eigenvalue. Quantum inverse measurement is discussed in the applicable case of Eq. (1.1). This matter that the state of the system is uncertainty before observation is not and cannot be empirical, always just a hypothesis. The uncertainties at measurement and after measurement are confirmed by electron diffraction and other experiments. The uncertainty before the measurement is the extrapolation of this empiricism. You should allow others to doubt this extrapolation. Quantum scientists must also allow others to suspect that measurements are inevitably changing the state of the system.

In Schrödinger's death-live cat state experiment, we first install an infrared detector probe in the box. People have already acquiesced in that the box and the equipment in the box had no effect on the cat's state. Adding a probe that receives only signals, the equipment does not affect the cat's state. The occurrence and continuation of this matter in that the cat's body emits infrared signals do not have anything to do with whether the observer is watching or not. The difference between detection and non-detection (observation and non-observation) is merely the difference in consciousness of the observer. If it is believed that human consciousness cannot directly affect the movements and changes of natural objects, such inverse measurements will not change the quantum states of the measured objects (this procedure can be expressed as $\hat{A}|\alpha\rangle = a_i|\alpha\rangle$ or Eq. (1.1)). It is this process that occurs when the charged particles shoot into the cloud chamber before the collision.

If we use $\hat{M}(a_i)\hat{M}(b_j)$ to indicate the order of measurement, the reverse order is $\hat{M}(b_j)\hat{M}(a_i)$, we have

$$\hat{M}(a_i)\hat{M}(b_j)|\alpha\rangle = |a_i\rangle\langle a_i|b_j\rangle\langle b_j|\alpha\rangle, \tag{1.5}$$

$$\hat{M}(b_j)\hat{M}(a_i)|\alpha\rangle = |b_j\rangle\langle b_j|a_i\rangle\langle a_i|\alpha\rangle. \tag{1.6}$$

This is the operator expression of continuous measurement. Its realization condition is that the measurement does not cause a change in the state. There is no reason why interference-free measurement can cause a change in the state. Therefore, interference-free measurement can be carried out continuously. Section 1.6.2 illustrates why general measurements do not cause changes in wave form.

If <1> the two eigenvalues a_i and b_i of two mechanical quantities *A* and *B* of a particle have the common eigenstates $|a_i\rangle = |b_i\rangle$, and <2> the system is in this state, the measurement of mechanical quantities A and B is that you can exchange (of order measurement), and it can be done at the same time, we have

$$\hat{M}(b_j)\hat{M}(a_i) = \hat{M}(a_i)\hat{M}(b_j),$$

$$\hat{M}(b_i)\hat{M}(a_i)|a_i\rangle = \hat{M}(a_i)\hat{M}(b_j)|b_j\rangle = |a_i\rangle = |b_j\rangle. \tag{1.7}$$

The condition that Eq. (1.7) is tenable is just the condition that can be measured at the same time. If one condition is added, <3> the interference of measurement is too weak so that the effect on the state of the system can be neglected, $\hat{M}(b_j)\hat{M}(a_i)=\hat{M}(a_i)\hat{M}(b_j)$ can be changed to

$$\hat{M}(a_i)\hat{M}(a_i)\approx\hat{M}(b_j)\hat{M}(b_j)\,. \tag{1.8}$$

Compared with Eq. (1.7), the condition of Eq. (1.8) to be tenable is the condition that can be measured continuously at the same time. For the measurement where the instrument is only affected by the measured object and the instrument does not affect the measured object, the above condition <3> should be achieved so that continuous measurement can be realized. Not only can we fail to eliminate condition <3>, but we can also find the proof that condition <3> has been satisfied: use clouds to capture particles (see Section 1.4.3).

Believe that the same particle will not appear in two and more than two different places. In particular, do not use the interpretation and ideas that "human consciousness can affect the behavior of micro particles". Determining the superposition of states allowed by mathematics does not represent the inevitable superposition of states in physics. In particular, do not believe that micro particles must be superimposed with their own shadow. Even if quantum superposition occurs, it is not destroyed without touching it (that is, the anti-interference ability of the quantum superposition state is not zero, and it is not allowed to be zero by reality). The facts of the asymmetry of information transfer and interaction influence between the instrument and the measured object are ubiquitous. These are the basis of QIMT. The next section will talk about the experimental basis. That is, only the measurement of the information passed from the observed object to the instrument (or the measurement of negligible positive interference, which does not lead to the collapse of the wave packet) is real.

We divide the influence of things into three types: the positive influence, the reverse influence and the two-way interactions. In the instrumental (or observer) unilateral effect on the observed object, the information is transferred from the instrument (or observer) to the observed object; this is the positive influence (or information forward transfer). In contrast to the situation is the inverse influence (information reverse transmission). Both the information (or matter) transferred from the observer to the observed object, and the information (or matter) transferred from the observed object to the observer form a two-way interaction. Only the quantum measurement of the information reverse transfer is called quantum inverse measurement, you can detect “other analogies”. Please note: the reverse effect is equivalent to the instrument having no effect on the observed object (or influences can be ignored)! The extension of the quantum inverse measurement concept is the measurement where the effect of the environment on the target could be neglected. If we describe it in the language of quantum mechanics, the quantum inverse measurement is a measure that does not lead to wave collapse and quantum decoherence. The measurements exist where there is only the reverse influence and no positive influence (or a positive influence can be ignored). There is no reason to deny the existence of such measurements. We can easily find examples of such measurements. The principle, method, basic idea (conclusion), prediction and verification will form QIMT.

Launch a signal bomb (tracer) into the darkness of the night sky and no matter whether the people on the ground can observe it with the naked eye, the movement state of the signal bomb will be not affected by the observer. The reason is that only the signal is transmitted from the observed object to the viewer's eye, there is not any signal transmitted in the opposite direction when an observer observes it with their naked eye (there is not any signal transmitted from the viewer's eye to the observed object). The movement state of the signal bomb is not affected by the observer. When no one is observing, the light emitted by the signal bomb is absorbed by the environment. Whether the light signal is absorbed by the environment or by the eyes of the observer, the degree of the signal bomb to be interfered by the light receivers is exactly the same. It can be seen that observing the signal bomb with the naked eye is the observation of a one-way transmission of information. It belongs to the non-interference measurement. In the quantum mechanics measurement, there exists the measurement that the information only transmits one-way.

Orthodox quantum mechanics scientists believe the state superposition principle, and believe that microscopic particles can superpose with their own shadow, the homologous conjugated particles are also in the superposition state (entangled state). Hereinafter these superposition states are referred to as the original spontaneous superposition state of the microscopic particles. The form of superposition may be

$$\left|\psi\right\rangle = \sum_i c_i \left|\psi_i\right\rangle \tag{1.9}$$

Here c_{i} is the probability amplitude that the system is in the $\left|\psi_i\right\rangle$, and $|\psi_i\rangle$ is the intrinsic state of measured mechanical parameters $\hat{A}$. Its correspondence eigenvalue is a_i. If the system is in contact with the instrument, the state of the measuring instrument is described by quantum state $|\phi\rangle$. The Hamiltonian of the interaction between the system and the instrument is

$$H = -g(t)\hat{A}\hat{P}, \tag{1.10}$$

Here g (t) is the coupling coefficient between a quantum system and the measuring instrument, and $\hat{P}$ is the regular momentum of the measuring instrument. If the initial state of the quantum system and the measuring instrument is $|\psi\rangle \otimes |\phi\rangle$, then the end state of the total system can be written as

$$|\psi\rangle = \sum_i c_i |\psi_i\rangle \otimes |\phi_i\rangle. \tag{1.11}$$

If there is only the inverse effect, can the wave packet collapse and the quantum decoherence occur when a particle is to be measured? We can find the answer in the logical analysis and the discussion of the experiment's result. There are problems related to this: What are the occurring conditions for the superposition of quantum states? What are the conditions for the quantum superposition state to be destroyed? The understanding of these two problems by orthodox quantum mechanics scientists is rather vague. When talking about them, they are always confused. In fact, they actually identified that the superposition of a microscopic particle with its own shadow is unconditional, and the resistibility of the quantum superposition state to the external influence is zero. Quantum mechanics scientists often use this point of view for a lack of theoretical basis. Orthodox quantum mechanics scientists believe that the coupling between the measured particle and the instrument leads to the destruction of the quantum superposition state described by formula (1.9), so that the measured particles go back to the classical state. Although these two kinds of knowledge (this one and "original state superposition of microscopic particles is unconditional and inevitable") lack a theoretical basis in physics and only take the Hilbert space as the mathematical basis, they are regarded as the golden laws and precious rules in quantum mechanics. So it is not rigorous, contrary to the spirit of science. Below we will discuss in more detail the coupling condition and the anti-interference ability of the quantum superposition state.

Both Eq. (1.9) and Eq. (1.11) are written with the assumption that the measured particles are entangled with the environment. The irrational concept that the state stack is not limited by the distance of the action is used. In fact, according to the description of section 1.6.2, as long as the single particle and the measuring instrument are separated by a certain distance, or the field where the environment has effects on the investigated particle is weak to a certain extent, there is no reason to use Eq. (1.9) and Eq. (1.11).

If the anti-interference ability of the quantum superposition state (the original, spontaneous superposition state) is zero, then, the quantum superposition state can only exist in the ideal environment with absolutely no interference. However, this kind of ideal environment does not exist in reality (any particle will be at least affected by neutrinos, gravitational fields and other cosmic noises, and bound electrons will be affected by the electromagnetic field). In practice, the fact that measurement (or observation) does not change the quantum state of the observed object is substantial. For example, the observation of a diamond cannot make the slightest change to its sp^3 hybrid state. It is also difficult to change the spin direction of the paired electrons in the diamond's internal orbital hybrid. It is known that the orbital hybrid is also a quantum state superposition. Two homologous conjugated particles separated by 1.3 km (or infinity) are not independent individuals; they lack the objective evidence that there is a logical connection between particles. It does not conform to the logic that interference-free measurement can also change the quantum state of the logic. How can an interference-free measurement (or an observation without deliberately changing the polarization direction of the photon and the direction of the electron spin) change the polarization direction of the photon and the spin direction of the electron? It is concluded that, if the anti-interference ability of quantum superposition states is zero, the quantum superposition state (the original, spontaneous superposition state) does not exist in reality. The concept of quantum state superposition and the concept of quantum decoherence (or wave packet collapse) need the quantum superposition state to have a certain ability to resist interference (the anti-interference ability of the quantum superposition state cannot be zero).

Lee Rozema in the quantum optics research group of the University of Toronto has designed a device for measuring object properties. The results of the study were published on September 7, 2012 in the *Physical Review Letters*.[4]

In order to achieve this goal of measuring interference as little as possible, measurement is needed before the photon enters the instrument. But this process can also cause interference. In order to solve this problem, Rozema and his colleagues used a weak measurement technique; allowing very little interference of the measured object. Before each photon entered the instrument, the researchers weakly measured it, then used the instrument for measuring, and finally, compared the two results. It is found that the interference caused by them was so big unlike the deductions of the Heisenberg principle. This finding is of disbenefit to the uncertainty principle and the Neumann quantum measurement standard model.

In the results of the study by S. Kocsis, B. Braverman, S. Ravets, M. J. Stevens, R. P. Mirin, L. K. Shalm, and A. M. Steinberg in 2011 in *Science* magazine, the weak measurement introduced has directly proved that the interference fringes have not disappeared after the quantum decoherence.[5] Serge Haroche and David Wineland independently invented and developed the methods to measure individual particles in the case of keeping the quantum mechanical properties of individual particles. The particles are still in the potential well, but their quantum properties still seem to be not destroyed. This is subversion before people think that the view cannot be observed directly (let the particle at rest also be measured and it is also the interference of the instrument to the particles. The quantum properties still exist. This shows that the original spontaneous quantum superposition state is not destroyed in the measurement).

The above experimental results show that the anti-disturbance ability of the quantum superposition state is not zero. That is not to show that once it is observed, the quantum superposition state will collapse and disappear. In particular, they do not show that the collapse of the superposition state will also occur when the consciousness of people wants to observe the act on the observed object. In other words, as long as the anti-interference ability of the quantum superposition state is not zero, there is the measurement that Quantum Coherent States are not destroyed. There is this kind of famous experiment that has been done. The development trend and ultimate goal of weak measurement are interference-free measurement (i.e. reverse measurement). In order to be more intuitive, we list **Table 1.2** to compare and analyze several different situations.

Instrument interference (impact) of the measured particle is showing that the instrument can change the state of the microscopic particles being measured. If there is no contact between the two systems, and the information transmits one-way between the two systems, the role is also one-way. If only the information is emitted from the measured microscopic particle to the measuring instrument, the particle does not change the motion state of the whole instrument. Therefore, the processes (and/or results) where the instrument affects the particle and the particle is influenced by the apparatus are asymmetric.

Table 1.2. Analysis of the measurement results of information reverse transmission

Case	The type of signal emitting from the measured particle to the instrument (observer).	The effects of observation and no observation on a measured particle.	The state superposition (coupling) between the measured particles and the instrument. Observed results.
1	Field signal (electric field, magnetic field, gravitational field)	The same: Whether or not observed, the measured particles are not affected (interfered) by the observer (instrument).	State superposition (coupling) is very reluctant. The measured particle is undistorted.
2	Photons, neutrinos, sound waves	The same: Whether or not observed, the measured particles are not affected (interfered) by the observer (instrument).	State superposition (coupling) is very reluctant. The measured particle is undistorted.
3	Object particle (electron, neutron, proton, ion, atom)	As long as the signals are not bounced back to the source of the launch, whether or not observed, the result is the same.	Under the conditions set， the measured particle will not distort. State superposition (coupling) is very reluctant.
4	Measured particle direct contact with instrument.	Difference: The observer (instrument) has a reaction force, which has a serious effect on the measured particle.	May conform to the condition of state superposition (or coupling), distortion.
5	Measured Particle is trapped (or absorbed) by instrument.	Difference: the instrument (observer) has a serious effect on the measured particle.	May conform to the condition of state superposition (or coupling), distortion.

If the signal on each row in the table is transmitting in the opposite direction, the measured particle will be subject to interference by the instrument. This is the performance of the asymmetry of the above mentioned. In the case of the first and second lines in Table 1.1, if the target particle is observed, both the motion state of the target particle and the signal emitted by the target particle are not changed (note: the target particles are the measured particles). The reason is that the parts of the inverse signal come into the visual organ of the observer when a person is observing the target particle; the signal is received by the environment when no one is observing it. There is no difference between the two conditions (the inverse signal to be received by one’s visual organ and the inverse signal to be not received by the environment) for the target particle.

If the first two cases in Table 1.1 can also cause the coupling between the measured particle and the instrument, the original superposition state of the measured particle is destroyed, so that the target particle should be coupled with the environment (because, the environment is receiving the information from the target particles when no one is measuring). There are two problems in this way: first, if the coupling between the measured particle and the environment is unconditional, no one can get the original superposition state of the microscopic particle described by Eq. (1.9), under any circumstances (any so-called quantum properties cannot be observed). Second, how far can the particles be coupled with the environmental matter? If you cannot satisfactorily solve these two problems, just believe that the first two cases in Table 1 cannot cause the coupling between the measured particle and the instrument, the original superposition state of the measured particle cannot be destroyed. If the ability of the microscopic particles to resist the external disturbance described by Eq. (1.9) is not zero, we can change “believe” to “firmly believe”. In this case, there is a larger space for the realization of quantum inverse measurement.

1.3.2. The Facts and Experimental Phenomena which Are not Supporting the Existing Interpretations of Quantum Mechanics

Section 1.2 enumerates the fact that the existing quantum mechanics is not supported (it is to look at those facts from the different levels and angles). This section will give some more specific analyses of those facts and phenomena. We can say that "measurement can cause the collapse of a wave packet" has not its direct experimental evidence. Instead, there are many experiments that deny that "measurement can lead to the collapse of a wave packet" (the facts are very clear).

1.3.2.1. The Root of the Confusion of the Explanation and the Understanding of Quantum Mechanics Is Also that It Does not Match the Experimental Facts

For explaining and understanding quantum mechanics, the situation is chaotic. This indicates that there is a problem with the existing quantum mechanics explanation. This indicates that there is a problem with the existing interpretation of quantum mechanics. In order to make this research meaningful, it needs to exceed Einstein in theoretical depth and uniqueness. As long as we have the existing experimental facts to find the material of refurbishment of quantum mechanics interpretation, it is easy to find that electron diffraction experiments, known as the lifeline of quantum mechanics, also present the exact facts that deny the existing interpretation of quantum mechanics. The breakthrough point is to look at the whole experience of the electron beam in contact, and it is found that the quantum coherence of the electron beam is independent of the experience before it is passing through the slit. This "irrelevance" does not support the concepts of wave packet collapse and quantum decoherence. For quantum entanglement experiments, the change of quantum state has not been verified by experiments (because a single observation of a particle's state does not verify a change in states). Since the state change has not been experimentally verified, the super-distance correlation between the entangled particles has not been experimentally verified. With the hypothesis of "quantum state change due to measurement" as the premise, the experiment's conclusion that has been confirmed by the experiment was obtained. There is a significant logic loophole in this process. The "irrelevance" in the above electron diffraction experiment and the "logical defect" in the quantum entanglement experiment together determine that the existing interpretation system of quantum mechanics is incomplete, and the system cannot be supported by all experiments. The most annoying irrelevance and the biggest new logical loophole in quantum mechanics have been found by me. I am sure that, for similar studies, I have exceeded Einstein in theoretical depth and uniqueness.

In quantum mechanics, the quantum state is not a physical quantity, there are also measurement problems. Therefore, it is not surprising that there are the interpretation problem and other basic problems of quantum mechanics. Some people do not think there is interpretation problem, and some people adopt a mixture of some or several interpretations, or some kind of personal understanding. For the basic problems of quantum mechanics, in the general teaching and research rarely involved, only a small number of physicists concerned, and did not reach a consensus. These situations probably reflect that the basic problem of quantum mechanics has not yet been fully solved. Many physicists take pragmatism and only use quantum mechanics as a calculation rule. This behavior is only to avoid the problem without solving the problem, but cannot say that the problem does not exist.

Including the death of Einstein, there are many people questioned the basis of quantum mechanics.[6-11] Exposing and resolving problems in quantum mechanics can serve as a research goal. Einstein's accusations of quantum mechanics did not mention the key points. The refutation of others is less than Einstein. In order to make this research meaningful, it needs to exceed Einstein in theoretical depth and uniqueness. I also take to expose the basic problems of quantum mechanics as a research goal. The method I use is different from others (I analyzed every detail of the measured particles in the whole process of the experiment, and avoided to look at their partial performance during the experiment in isolation. An irreparable new logic flaw in quantum entanglement experiment is found). The theory of quantum inverse measurement is established. A model of light-knot particle structure also is established).

Many people believe that the existing experimental facts support quantum mechanics without exception. However, this understanding is too arbitrary. On the one hand, experiments and facts that do not support the existing interpretation of quantum mechanics are present. On the other hand, so-called experiment support of quantum mechanics refers to all experiments support mathematical form system of quantum mechanics, rather than the existing interpretation system of quantum mechanics to be supported by all experiments. Moreover, the wrong understanding and explanation can also make the experiment that original does not support a theory support this theory. We can all find examples of these.

1.3.2.2. The Retention and Play of the Diffraction Properties of the Moving Electrons in the Vacuum Are Independent of Its Previous Experience

Quantum coherence (quantum parallelism, quantum entanglement, quantum cannot be cloned, the diffraction and interference of particles, etc.) is the characteristic of microscopic particles that are different from macroscopic objects. It is also the birthplace of quantum theory. Quantum decoherence is the disappearance of such quantum coherence. In the existing quantum mechanics explanation, the description for measuring instruments influencing the measured system is mainly that the environment led to the collapse of the wave packet. The basic idea that the environment leads to decoherence is that any physical system will not be completely isolated from the environment, and the interaction between the system and the environment will lead to the entanglement of the system and the environment (some call it association, others call it superposition). The prerequisite for the environment to lead to decoherence is that measurements can cause waves-packets to collapse. Simply put, "as long as the measurement occurs, quantum coherence disappears." The following discussion shows that there is a serious contradiction in the view of quantum mechanics. The most famous double-slit diffraction experiment by electron does not always support the existing interpretation of quantum mechanics.

In fact, the electron diffractometer and the power supply are in a current loop with generators and electrical appliances (we only consider the current loop consisting of one generator and one electron diffractometer and it is assumed that the generator and the diffractometer continue to work). When the diffractometer is in operation, the electrons that form the current move directionally in this loop and undergo diffraction when passing through the slit. In the generator and the wire, those electrons that undergo the diffraction are affected by the electromagnetic field. In particular, electrons are subjected to strong electric fields (more strongly than in the wire) on the cathodes in the circuit. The electron beam leaving the cathode is generally subject to the collimation of the magnetic field. The intensity of these effects is no less than the intensity of the instrument acting on the electrons in general measurements (for example, using the cloud chamber and the spark chamber to measure incident electrons). According to the existing measurement view of quantum mechanics, the electrons in the generator and on the cathode should be in a quantum decoherence state. But in fact, they are not in a state of decoherence, and diffraction can still occur in the electron beam. The 5000 electrons flowing through the generator are numbered by us. Some of these 5000 decoherence electrons will flow into the electron diffraction instrument and participate in electron diffraction once again. Thus, there is a problem that decoherence electrons recover quantum coherence. After the diffraction, the numbered electrons return to the wires of the closed circuit, and the quantum decoherence occurs once again as the role of the magnetic field in the generator and the role of the strong electric field on the cathode. They continue to flow and can take the next round of diffraction (coherence is restored). As long as the system works continuously, the above cycle can occur countless times. Each cycle requires: <1> the “quantum decoherence process and the superposition process of quantum state to be reversible”, or, <2> “quantum coherence of moving electron in vacuum has nothing to do with past experience of these electrons” (the electrons are in quantum decoherent states before passing through the slit, but the electronic diffraction can still occur. this fact is referred to as “irrelevance” hereinafter), or <3> the wave packet collapse process and the quantum decoherence process do not exist or do not occur. The assertion that the measured system and the measuring instrument are inseparable does not hold water (the recovery process of quantum coherence is just the process where the measured system gets rid of the instrument interference).

In the past, people believed that the collapse of the wave packet in this experiment occurred on the fluorescent screen. As the experiment continues, diffraction occurs continuously and the collapse of the wave packet must continue. The electrons before entering the slit are in the quantum decoherence state (because they are accelerated by strong electric field and are collimated by magnetic field). However, we do not know when and where the formation of wave packets (including quantum properties such as quantum parallelism) occurs. If we say that the quantum properties of electrons in this experiment are intrinsic to electrons, they cannot continue to disappear, and the collapse of the wave packet is not necessary. This achievable thought experiment plays an important role in explaining the relationship between measurement and quantum characteristics. I want to give it a name. It is called “closed circuit electron diffraction experiment!”

If the electrons always have diffractive properties in all experiences before passing through the slit, the argument that “any measurement will inevitably lead to wave packet collapse and quantum decoherence” is not correct, and the pure and objective state of the particles can be observed (quantum inverse measurements can be implemented). The final conclusion is that the coherence of a moving electron in a vacuum is not related to its past experience. In this case, many quantum entanglement experiments must be rewritten. Both the action of the strong electric field on the electron beam and the effect of the magnetic field used for collimation on the electron beam are in line with the measurements defined in this paper. These measurements are the local measurements which do not lead to quantum decoherence and wave collapse. The experiment where electrons are subject to a double layer lattice and undergo secondary diffraction directly proves that the measurement of the electrons passing through a double-layer slit cannot cause the wave packet collapse. The reason is that only the wave packet collapse did not occur when the electrons pass through the first slit, the electrons continuously advancing can undergo secondary diffraction. In view of the importance of the electron secondary diffraction experiment, the experiment will be repeated and analyzed below.

The "irrelevance" mentioned above is one of the most important conclusions of this research. It is based on experimental facts. Readers who try to deny this research must first deny this irrelevance. I do not know how the authors and the pious readers of these articles[12-15] look at this "irrelevance".

As mentioned above, in an electron diffractometer, the diffracted electrons are transmitted from the cathode plate rather than newly generated (they are affected by the magnetic field in the generator, obstructed by the metal atoms and the electrons in the wire, affected by the strong electric field outside the cathode, and affected by electromagnetic lenses). Diffraction can also occur when electrons coming out of the cyclotron or linear accelerator pass through the slit. This indicates that the magnetic field, the electric field, and the internal environment of the conductor cannot destroy the quantum coherence of the flowing electrons (or quantum coherence can be restored under certain conditions). The electrons can also undergo secondary diffraction when passing through the appropriate crystals. This indicates that the slit leading to the first diffraction as a measuring instrument does not lead the electrons to produce quantum decoherence. The electron beam in the electron microscope is collimated by an electron lens, and the electron lens does not cause the quantum properties of the electron beam to vanish. The stationary ions trapped in the microcavity can also maintain the quantum coherence of quantum entanglement. Considering the mechanism of the secondary diffraction of electrons, electronic double-slit diffraction experiments show that there is only the state superposition between the measured electrons, rather than between the instrument and the incident electrons. The fact that it is difficult for the optical signal to be distorted by the long distance fiber does not support the inevitability of the association (superposition) and the collapse of the wave packet between the instrument and the measured particle. Numerous facts show that the quantum coherence of free electrons in a vacuum is independent of the source of electrons (*i.e.*, the electrons with the same velocity in the vacuum are not distinguishable). Popularly, "no matter what the sources of the electrons are, the electrons that move in the vacuum have quantum coherence, which can be diffracted.” This conclusion shows that “wave packet collapse”, “the quantum state superposition between measured system and instrument (environment)” and “the inseparable between measured system and instrument” and other concepts are not correct.

The electron beam can produce diffraction. This quantum coherence is independent of the source of the electron beam (independent of the previous experience of electrons). Is quantum coherence formed (restored) at the moment the electrons leave the source? A variety of different quantum coherences should not be independent of each other. If the electron diffraction characteristics can be restored, the quantum entanglement properties can also be recovered. The quantum entanglement of twin electrons is also independent of the previous experience of homologous electrons. For example, the $4s^2$ electrons of a calcium atom are emitted and then reflected back to the $4s$ sublayer, and the entanglement between the $4s^2$ electrons can be restored. If the quantum coherence cannot be recovered, the decoherence process is irreversible, that is, quantum coherence does not exist or can withstand considerable intensity interference. In this case, the experiments using the cloud chamber and the spark chamber to capture the movement trace of electrons deny the principle of uncertainty (especially the assertion that "it is also uncertain when there is no measurement and no interference"). If the decoherence process is reversible, a physical quantity has many different eigenvalues and the eigenvalue that is random is denied, also denied is the existence of the process of wave packet collapse (no need for the concept of wave packet collapse).

Although the moving particles in a vacuum affected by the electric field and the magnetic field still maintain the diffraction properties, they still retain diffraction characteristics. This fact indicates that the anti-jamming capability of the quantum coherence of the particles is not zero. We can find the measurement methods whether there is any interference or interference can be ignored, and the pure objective state (or the purely objective state) of the particles can be observed. In another way, “the diffraction characteristics (one of the quantum coherences) of the moving electrons are independent of the origin of the moving electrons.” There are three possible reasons for this fact: first, the wave packet collapse process does not exist; second, the wave packet collapse process (or quantum decoherence process) is reversible; and third, the diffraction of electrons and other object particles is not directly caused by the object particles, but the side effects of particle movement. These possibilities are detrimental to the existing interpretation system of quantum mechanics.

In the above-mentioned irrelevance performance, the various experiences of electrons before diffraction are that they undergo a variety of different measurements. These measurements do not destroy the coherence of electrons, and do not result in wave packet collapse and quantum decoherence. This is the measurement where electrons have experienced "interference which can be ignored" (this is what the author calls reverse measurement). Thus, enumerations of these examples are experimental evidence that quantum inverse measurements can be achieved. They can also be used as experimental evidence for "quantum coherence and quantum decoherence process does not exist."

1.3.2.3. The Concept of Quantum Entanglement Lacks a Solid Theoretical Basis and an Experimental Basis

In theory, the concept of quantum entanglement derives from the idea that the quantum state is not determined when it is not measured (this concept holds that homologous conjugate particles must be in a superposition state), and the definition of "a quantum system in a complex system cannot be decomposed into tensor products of their respective quantum states." For the measurement where there is only a reverse signal, no measurement (no observation) and measurement (observation), the material role between the measured substance and the environment is exactly the same, except that the human consciousness of its role is not the same. If you do not believe that the human consciousness can directly affect material movement, "both the instrument and the measured object are inseparable" and "the measurement will change the quantum state" are incorrect. The root of the concept of quantum entanglement has become a problem.

In the experiment, it is considered that the instantaneous quantum entanglement has been proved by experiment, and it must be recognized that the measurement leads to the change of state. That is, it is necessary to admit that the quantum state before measurement is not the same as the observed quantum state. It is precisely this point that cannot be empirical but only hypothetical. We have to assume that the quantum state before the measurement is an uncertain superposition state. The superposition state is a quantum entangled state. That is to say, if we want to admit that the experiment of measuring quantum states proves the existence of quantum entanglement, we must first assume the existence of the quantum entanglement state. This is a clear circular argument (it also shows that the existence of quantum entanglement has not been experimentally verified: there is a lack of empirical evidence). As long as the concept of state change is determined by measurement, it is difficult for us to use experimental methods to prove that the state before measurement is the ambiguous superposition state (different from the observed state).

For continuous quantum entanglement, the alternation of two distinct states is defined as continuous entanglement. How to identify persistent entanglement and multi-particle entanglement? People who advocate them will have the final say.

At the beginning of the concept of quantum entanglement, for the instantaneous quantum entanglement experiment, there is the interpretation that just the birth of the twin particles is a clear pigeon pair. The existing quantum mechanics (specifically the year of Bohr) denies this possibility with the principle of uncertainty (he uses the assertion that conjugate physical quantities are also uncertain in the absence of measurements or interference). However, the uncertainty principle does not specify that the spin state also has uncertainty. We know that some quantum states are not a physical quantity, only the certain physical quantity to meet the principle of uncertainty. Weinberg said that we cannot find the theoretical source of the probability of quantum mechanics (S. Weinberg, 2017). In this way, the theoretical source of the assertion that conjugate physical quantities are also uncertain in the absence of any measurement or interference is also not found. Logically, this assertion cannot be experimentally verified. If we combine the discussion of this paragraph with the discussion of the previous paragraph, we can obtain the conclusion that Bohr's method is very far-fetched.

In theory, two fermions are not allowed to have exactly the same quantum states. In fact, two 1*s* electrons (also two fermions) are identical particles. Both need them to be two states, and must admit that they are indistinguishable. This is contradictory. In order to solve this contradiction, it is assumed that there is an entangled state. In other words, $1s^2$ electrons are admitted to have a difference between spin up and spin down (it is the requirements of the Pauli incompatibility principle). However, identical fermions require that they not be distinguished. In order to solve this contradiction, it is assumed that there is an entangled state. It can be seen that the theoretical basis for the existence of quantum entangled states is weak.

The process of the state evolution of wave packet collapse caused by measurement cannot be described by the Schrödinger equation. The fact that the electron beam can undergo secondary diffraction shows that the first measurement did not cause the wave packet collapse (quantum decoherence). The diffraction characteristic of the electron beam is independent of its previous experience, but also has nothing to do with the role of the electric field. These three facts together show that the assumption that "measurements would necessarily lead to wave packet collapse (quantum decoherence)" is not true. It is also shown that continuous measurements cannot lead to the particles remaining always in quantum decoherence.

The theoretical basis of the concept of quantum entanglement is the contradiction between the "incompatible principle" and "all the same fermions to be indistinguishable", and the principle of uncertainty. It is this pair of contradictions and the principle which led to a kind of helpless choice, and this is a hypothesis. There are logical loops and the problems of cyclic argumentation in quantum entanglement experiments. The concept of quantum entanglement has neither a solid experimental basis nor a solid theoretical basis.

1.3.2.4. Quantum Entanglement Experiments Cannot Confirm the Existence of Quantum Entanglement (Super-Distance Association)

Does the quantum entanglement experiment support the existing interpretation system of quantum mechanics? As long as careful analysis is conducted, it is not difficult to find a definite answer. Now, quantum entanglement experiments are divided into two categories: the first category is the effect test of instantaneous entanglement; and the second category is the discovery and verification of continuous entanglement. The experiments for the effect test of instantaneous entanglement have a very large logic vulnerability—the change in the state of one of the twin particles has not been experimentally verified but is inferred from a certain idea. If you want to use experimental methods to verify the change of a particle's state, you must observe the particle two times before and after. However, the existing instantaneous quantum entanglement experiments only make one measurement (observation) of the state of one of the twin particles, and the change of the quantum state is the result of theoretical speculation rather than being found (validated) by measurement. This kind of experiment has no way to exclude that "the twin particles are a definite pigeon pair at the time of their birth." If the twin particles are the definite pigeon pair at first, it cannot be said that this experiment proves the instantaneous entanglement of the twin particles (how can there be the verification of the "paranormal association of state change" when the change of state is not verified?). In other words, for instant quantum entanglement experiments, physicists do not use experimental methods to verify the existence of quantum entanglement, but suppose that the quantum entanglement-state exists before the experimental operation. It is from the concept to argue that the experimental operations destroy (change) the already existing quantum entanglement-state. The earlier "irrelevance" conclusion also shows that even the measurement does not necessarily lead to coherence disappearing. If we consider the aforementioned "irrelevance" and "state change to be not verified" at the same time, the experimental conclusion "detection of the super-associated quantum entanglement" even more does not fly.

The twin photon entities are independent (they can be separated and can be separated very far). But their states cannot be independent. This is a freak in itself (the equivalent of the bodies of the pigeon pair being independent, but their reproductive organs and chromosomes mixed together), and it is imagined (which is not derived from the wave function, nor is it found in the experiment. The principle of indiscernibility of homologous fermions is not effective for twin photons). Some people may say that these are the characteristics of micro particles. However, even for micro particles, they have a strange entangled state, but also must find the theoretical basis and experimental basis. As the current method of verification of quantum entanglement is not reliable, therefore, the so-called measurement of the existence of entanglement is the experimenter's self-talk.

There are also significant logical problems in continuous quantum entanglement experiments—it is observed by the experiment that Schrödinger cats change alternately between the dead cat state and the live cat state, rather than the superimposed state of the dead-live cat. Theoretically, the persistent entanglement between twin particles A and B should be the continuous superposition (or mixing) of state 1 of A and state 2 of B, rather than the alternating conversion between state 1 and state 2. In this case, the quantum entanglement is considered to be experimentally verified, but in fact, it is not logical (we need to change the original definition of quantum entanglement and the content of the principle of state superposition). It is observed that "the twin particles are alternately converted between state 1 and state 2." It is observed that the two particles are the pigeon pair. It's just the sex instability of the twins (the dragon changes into a phoenix, at the same time that the phoenix changes into a dragon. Although this change does not stop, the dragon body and the phoenix body are clear and independent. It has been measured that this alternating change is sustainable for 50*ns*. Note: the dragon represents the male, and the phoenix represents the female). This indicates that the “superluminal correlation between entangled particles” has not been experimentally confirmed. In other words, the continuous entanglement experiment proves that the twin particles are a pigeon pair before the quantum state is destroyed by the experimental operation, and denies the existing conclusions of the instantaneous quantum entanglement experiment. If we believe that quantum entanglement is a mixture of dragon and phoenix (no independent dragon body and phoenix body), the experimental conclusion of continuous quantum entanglement is denied. It can be seen that the conclusions of the existing continuous quantum entanglement and instantaneous quantum entanglement are mutually negative. The quantum scientists cannot explicitly answer the question: is the quantum entanglement-state a quantum state uncertainty or a quantum state instability?

There are two processes of quantum state evolution, one is, before measurement, the evolution to be described by the Schrödinger equation, which is reversible and deterministic; and the other is the collapse caused by measurement, which is irreversible and random. Why is it irreversible? Since the quantum state before the measurement can collapse to one of several states, the state before the collapse cannot be determined according to the state after the collapse. This change is not harmonious with the evolution of the Schrödinger equation, and is regarded as a basic assumption of quantum mechanics. That is, the entangled state (the superposition state of the twin particles) is assumed, and it is also assumed that the superposition state of the measured twisted twin particles is assumed. In this way, in the logical order of the measurement process of instantaneous quantum entanglement, it is assumed that the entanglement phenomenon exists, and finally the conclusion is that the entanglement phenomenon exists. This is a very obvious logical cycle that is the biggest logical loophole about quantum entanglement experiments. The statement "Both twin-electron entities are independent, but their state cannot be independent" is a freak (*i.e.*, the premise in the logic sequence of the experiment of instantaneous quantum entanglement is not common). It can clearly be seen that the experiment’s conclusion of the instantaneous quantum-entanglement is neither a logical conclusion nor the conclusion to be validated by experiment. Moreover, other logical loopholes of the experiments to validate Bell's inequality are not all blocked.

1.3.2.5. The Significance and Follow-up Work of This Section

The so-called experiments have confirmed the correctness of quantum mechanics, mainly referring to the experiment of quantum entanglement. However, as long as the twin particles at the time of birth are a pigeon pair, Bell's inequality criterion is invalid (not working). In particular, the fact that the diffraction properties of electrons are independent of the previous experience of the electron beam is very detrimental to the existing quantum concepts.

The above is mainly about the issue of Copenhagen’s explanation. Other explanations are equally problematic. “Multi-world theory” regards the quantum state itself as an objective nature, and there is no collapse, and all possibilities are contained in the huge quantum state of the whole world. This interpretation is burdened with a heavy metaphysical burden. Are there any links between different worlds? If there is physical contact, is that not a world? If there is no physical connection, how do different worlds coexist in a “super-world”? What is the world of this “super-world”?

I also agree with the Nobel laureate Weinberg who said that it seems that each interpretation has its own problems, and I also agree with Professor Yu Shi's additional comments that the problems of various interpretations may be essentially a different performance of the same problem (Yu Shi, 2017). I think their common ground is inseparable from the ghost. The Copenhagen interpretation takes a particle as a ghost, and the hidden parameter interpretation takes interaction as a ghost, and the multi-world theory takes the universe as a ghost.

Some people say that the impact of the environment will destroy quantum entanglement, and some people say that laser irradiation of silicon carbide can create quantum entanglement. So, is the impact of the environment in the end to destroy the entangled state or create the entangled state? At present, the method of verifying quantum entanglement is extremely unreliable. The reason for the existence of the accepted quantum entanglement is mainly that the state of homologous twin particles is also uncertain when they are not measured. However, logically, this assertion cannot be verified by any experiment. Can we say that quantum entanglement has been rigorously verified? It is a fact that the coherence of microscopic particles has nothing to do with their past experience. This experimental fact is a heavy blow to the existing interpretation system of quantum mechanics. If, "as long as the system is impacted by the environment, the wave packet will collapse", there will be no collapse-free quantum wave package in nature. If, "as long as the system is impacted by the environment, the entangled state will be destroyed", there is no quantum entangled state in nature. The reason is that the observed particles cannot be isolated. It is obvious that the experimental conclusions about quantum entanglement cannot stand close scrutiny.

In the above case, if there is an interpretation system of quantum mechanics for localized realism, which interpretation system would you choose?

1.4. Experiments with Conforming Quantum Inverse Measurement Conditions

The purpose and function of quantum measurement are to obtain information about the micro world. As long as the information is transmitted from the measured object, the purpose of quantum measurement can be achieved, and it is not necessary to send information to the measured object. In this way, there must be a class of measurements that does not interfere with the state of the quantum system in the measurement process and can continuously read a certain observable quantity. Existing quantum nondestructive measurement is limited to projective measurement, and belongs to the category of quantum inverse measurement, but it is not the core of quantum inverse measurement. Any measurement that does not destroy the quantum superposition state or does not lead to the collapse of the wave packet is a protective measurement (it can be local or all. It is not necessary to meet the conditions of the quantum Zeno effect) and meets the conditions of generalized quantum inverse measurement. Measurements outside the projection measurement of the Bonn are likely to be consistent with the conditions of quantum inverse measurements. See Sections 1.2 and 1.3 for details.

In fact, in the existing concept of quantum mechanics, the quantum state is not real movement speed, movement direction, and fluctuation mode and so on, but particle spin, polarization, superposition and wave packet width. The superposition of the state is the integration (fusing) of nothingness. The idea of identical particles indicates that it is meaningless to measure and distinguish the spin and spin direction of the electron. For photons, the operation to measure the direction of polarization does not change the polarization direction of the photon. Using the micro particle structure, Section 1.6.2 shows that the general measurement is mainly to change the motion state and energy of the particle rather than change the others.

1.4.1. The Measurement which does not Destroy Quantum Superposition State

The French scientist Serge Haroche and the United States scientist David Wineland won the 2012 Nobel Prize in physics. The reason is "for the discovery of measurement and manipulation of an individual quantum system by experimental method, and realized" the imprisonment and manipulation of the small number of atoms or ions system, which previously, was considered to be unachievable.

T. Hanesch, D. Prichard, Cohen-Tannoudji, W. Phillips, C. Wieman, E. Cornell, W. Ketterle and others have done the work of cooling and imprisoning particles. They found that: an ion in a Paul trap is much more honest than the same ion in a Penning trap; it can stay motionless in the center of the trap. The same ion in a Paul trap is more honest than in a Penning trap, and can stay in the trap motionless. A string of the same ion can be imprisoned in the center of the four pillars and suspended in a line, at the same time, an electrostatic repulsive force makes them related to each other. The German Rampe team found that the momentum perturbation of the mass center of the cooling atom can be reduced to a negligible degree.

That is to say, some of these Nobel laureates allow individual particles to be at rest in the trap. In this case, the position and momentum of the particles can be measured simultaneously and accurately, and the kinetic energy is zero. An imprisoned ion may be a smaller proton. The still particles are full of particles (the waves have collapsed). It is clear that in these experiments, packet collapse occurred, but quantum decoherence did not occur.

In Leibfried's experiment introduced by Ref. [16], the researchers fixed beryllium ions in electromagnetic field wells at intervals of several micrometers and then cooled the beryllium ions to nearly absolute zero by laser and manipulated these ions in a three step exercise. In order to allow as many particles as possible to achieve the "Schrödinger cat" state for as long as possible, researchers on the one hand improve the cooling efficiency of the laser, and on the other hand, make the electromagnetic field trap absorb as much heat as possible from ion vibration. In the end, they caused 6 beryllium ions to spin in both clockwise and counterclockwise directions simultaneously in 50 microseconds, and the same amount of superposition entanglement of two opposite quantum states is realized, that is, the Schrödinger cat state. Researchers at the University of Innsbruck, Austria, also reported in the same issue of *Nature* that they achieved a "Schrödinger cat" state in 8-ion systems, but it was maintained for a shorter time.[17]

The entanglement in these reports is defined by the experimenter. They are not necessarily a true quantum entangled state. The reason is that humans do not know the essence of the real quantum entanglement process; the state of entanglement in the end is what we do not know. If an ion is in a clockwise spin and counterclockwise spin state, the whole is not spinning and is difficult to be perceived. Most importantly, beryllium ions are not distinguishable. A beryllium ion of clockwise rotation rotating 180 degrees is a beryllium ion of counterclockwise rotation. Beryllium ions continue to flip on the performance of that look, not Schrödinger's cat state.

It is meaningless to talk about the static of non-localized things. Particles that can remain stationary must not be delocalized.

1.4.2. The Measurement that Has not Caused the Collapse of the Wave Packet

There is an experimental phenomenon called secondary electron diffraction. It is high-speed electrons passing through the first slit and generating diffraction. After that, the electrons pass through the second slit, generating diffraction again. If the collapse of the wave packet is reversible, the probability explanation is destroyed. Therefore, the direct conclusions of the experiment are: continuous slit measurements did not result in wave packet collapse (or the state-superposition between the instrument and the measured particle); and second, there is a definite motion path when an electron passes from the first slit to the second slit (the electron is not scattered waves). The experimental results show that, either "wave packet collapse does not exist" or "the process of wave-packet collapse is reversible." As long as the wave packet collapse does not exist, the cloud chamber and other instruments to capture the state of the particles can only be a pure-objective state of the particle. The influence of the slit on the incident electron is much greater than that of the cloud chamber on the incident electrons. If the slit does not cause the wave packet of the incident electrons to collapse (or the state is superimposed), the vapor fraction in the cloud chamber does not cause the wave packet of the incident electrons to collapse. The secondary diffraction experiment of electrons to be combined with experiments such as the cloud chamber and other equipment to capture charged particles can form the complete experimental evidence of denial of the existing interpretation about the uncertainty relation. The experimental combination is also strong experimental evidence that the uncertainty paradox exists (Runsheng Tu, 2017).

The diffraction experiments of electrons and photons can form a diffraction pattern that only waves can cause. After the first diffraction, the electrons can diffract again (this is the second diffraction of the electrons). This proves conclusively (as evidenced by experimental methods) that the slit (its width is about 1 angstrom, and is also an instrument) does not cause the measured particle to collapse. It is generally accepted that wave-collapsing occurs at the moment of particle contact with the screen. If you do not explain this phenomenon as “wave packet inflation”—the reverse process of wave packet collaps—but use the Copenhagen interpretation, it is necessary to recognize that the local process where the microscopic particles pass through the slit conforms to the condition of quantum inverse measurement (just the process of particle arrival on the screen does not conform to the quantum inverse measurement condition). It is believed that measuring the polarization state of a photon with a polarizer inevitably destroys the superposition state of the twin photon by the Copenhagen interpretation. However, the width of the gap of the fence column in a polarizer can reach tens of millimeters. A slit whose width is 10^{-8} cm does not lead to the disappearance of quantum properties, and can the barrier gap that is a few tens of millimeters wide lead to the disappearance of quantum properties? The success of the electron diffraction experiment shows that the strong electric field of the emitted electrons does not make the electron wave packet collapse. In addition, the electron beam collimated and focused by the electromagnetic field can still exhibit volatility in the electron microscope. The facts listed above show that the quantum properties of the particles may not be lost even if the instrument exerts an influence on the particles, at least partly in accordance with the conditions of quantum inverse measurements. Thus, the conclusion that the measurement of entangled photon polarization will lead to the collapse of the wave packet is not reliable. If there are measurements that do not destroy the quantum state (which do not cause the collapse of the wave packet), the entire quantum mechanics interpretation system suffers a considerable impact (in fact, the orthodox quantum mechanical interpretation and measurement concept were subverted).

An electron coming out of a cyclotron or a linear accelerator is still able to exhibit fluctuations and diffraction. Once again this indicates that the wave packet collapse is not caused by the effect of the electromagnetic field on the electron. The process of accelerating electrons by electromagnetic fields is in accordance with the quantum inverse measurement conditions.

Nuclear decay is also one of the characteristics of microscopic particles. However, nuclear decay has nothing to do with all the conditions of the outside world, and it has nothing to do with whether to observe it. This situation is unquestionably consistent with quantum inverse measurement conditions.

1.4.3. The Measurement which Has Only Inverse Influence, Or the Measurement that Positive Effects Are Weak and Negligible

Based on the idea of direct observation of the robustness and the physical quantity, the Li Chuanfeng research group realized two kinds of quantitative measurement methods of the quantum coherence of the photon polarization. It is proved that the anti-jamming ability of the relevant quantum system is not zero.[18]

The observation that the superposition state of Schrödinger's death-live cat was observed is that it has been observed that the quantum entanglement lasts for a while by continuous observation. This observation during the continuous observation process does not destroy the quantum state, and does not lead to wave packet collapse and the disappearance of the state superposition. Observations (measurements) during this period accord with quantum inverse measurement conditions, and also meet the conditions of quantum protective measurements. This example shows that the anti-interference ability of the quantum state is not zero, as long as the interference intensity is less than the anti-jamming ability, the interference will not work, and the wave packet collapse will not occur.

When thinking about the question of whether the experiment of quantum inverse measurement can be realized, the first thing we think of, in the experiments that have been done, is whether there is an experiment to meet the conditions of quantum inverse measurement. The propagation of particles in the cloud chamber or the spark chamber is very similar to the propagation of photons in the fiber. The optical fiber does not distort the optical signal, and the cloud chamber and the spark chamber cannot distort the incident particles. The use of the cloud chamber and spark chamber to capture the moving track of the micro particle is mainly completed by emitting the electric field signal from the measured particles to the measuring instruments. Instruments have almost no interference signals to the measured particles. The effect of the instrument on the measured particle is smaller and even order or symmetry, does not affect the objectivity of the measurement results. In addition, this measurement is a continuous measurement, the time interval between the two measurements is zero, and less than Zeno time, and judgment is according to the quantum Zeno effect, so the original state of the system can be observed. This kind of experiment is in full compliance with the conditions of quantum inverse measurement. Explaining the motion of charged particles in the chamber by using the existing measurement view originated from von Neumann's theory, and there is a sharp contradiction (see next paragraph). Using QIMT to explain this kind of experiment can overcome this contradiction.

The proof derived by Neumann is wrong that the implicit function theory is unable to give the unique solution to the observations. This error was first discovered by David Bohm, a very famous scientist. Later, we all realized Neumann's mistake.

As we all know, the thickness of the cloud chamber must be less than the penetration of the incident particles. The working principle of the chamber to capture the charged particle tracks is that the electric field of the target particle passing the “supersaturated steam” at high speed leads to ionization of nearby vapor molecules, and the secondary electrons produced by ionization in turn cause ionization of further vapor molecules to produce sub-secondary electrons. This process occurs in a similar way to a cascade shower and affects a larger range of steam molecules. The measured particle (target electron) does not reach the edge of the cloud track (the electrons reaching the edge are generated by secondary ionization). The measured electron (target electron) is still moving forward at high speed. In a word, in this range, only the measured particle affects the instrument, the instrument has little effect on the measured electron, and the superimposed state of the measured particle with its own shadow does not exist. The ionized molecule becomes the center of vapor condensation due to charge. That is, the high-energy particles injected into the cloud chamber can cause near-molecular ionization, so that the ionization process can be transmitted many times, every ion formed by ionization is the condensation center of steam. Since the steam is supersaturated, the agglomeration can be sustained and produce minute droplets. As a result, a sufficiently thick fog-belt appeared on the path on which the particles passed. Under appropriate lighting conditions, you can see or shoot the past trajectories of the target particle. In the cross-section of the cloud line (belt), the target particle is located at the regression center of the cloud point. The accurate moving orbit of a target particle is the 3D regression curve of the drop center coordinates in the cloud track.

If it is considered that the 3D regression curve is not an accurate movement route of the charged particles at high speed, it must be admitted that uncharged particles can also leave traces in the cloud chamber. If there is no collision, the motion of a high-speed particle in the chamber is moving in the vacuum with a weak field. Taking into account the important “irrelevance” mentioned earlier, the measurement using instruments such as cloud chambers and spark chambers is continuous measurement without breaking the quantum coherence. It supports the theory of quantum inverse measurement and rejects the principle of uncertainty. The core of the working principle of the cloud chamber is the cohesion induced field. The center of the small droplets in the cloud trail is the secondary (or secondary-secondary) charge center (the seat of the secondary field-source), and the 3D regression curve is the place passed by the center incident charge (the original field source), and this is the starting point to be similar to cascade showers. The original field source did not reach the edge of the track. If the measured charged particles will reach the edge of the cloud track, on the one hand, it does not comply with the principle of the chamber, and on the other hand, it does not comply with the fact that the track is extremely regular (if the measured particles can reach the edge of the track, the cloud tracks cannot be so regular, and the 3D regression curve will not be so smooth). It is generally believed that the 3D regression curve is the classical trajectory of the particle. However, its positional accuracy can reach the atomic scale. This also indicates that the position and momentum are measured continuously and accurately enough, and the uncertainty relation does not hold true in the classical mechanics field. Uncertainty relations are also not true in the field of quantum mechanics.

The orthodox statistical interpretation also conflicts with the meaning of the 3D regression curve of the drop center coordinates in the mist track decided by the working principle of the cloud chamber. As everyone knows, the thickness of the cloud chamber must be less than the penetrating power of the incident electrons. The working principle of the chamber to capture the charged particle tracks is that the electric field of the target particles passing through the “over saturated steam” at high speed leads to the ionization of the nearby vapor molecules, and the secondary electrons produced by ionization are also like the charged target particles, resulting in the secondary-secondary ionization of the further vapor molecules. This process occurs in the form of a shower and affects a larger range of vapor molecules. The measured particles did not reach the edge of the cloud track (the electrons reaching the edge are generated by the secondary ionization). Measured electrons are still moving forward at high speed. In a word, in this context, only the measured particle impacts the instrument. The influence of the instrument on the measured electrons is small, and the superposition state of the measured particle and its own shadow does not exist. The ionized molecule becomes the center of vapor condensation due to charge. That is, the ions at all levels caused (induced) by the incoming high energetic particles to the chamber as the source can become the condensation center of the over saturated steam, and around these ion centers will be produced tiny droplets. Thus, a sufficiently thick fog band appears on the path of the target particle. Under the proper lighting, we will be able to see or to shoot the past motion track of the particle. At the edge of the cloud track, obviously it is not the target particles that arrive there, but a lot of secondary effects caused by the target particles appear there. On the cross-section of the cloud belt, the position of the target particle is at the regression center of the cloud point. The moving orbit of the target particle is the 3D regression curve of the cloud fog band.

It does not conform to the fact that each droplet in the cloud fog band is formed by the discharge and condensation of the vapor molecule caused by the measured particles that visit there (it does not comply with the working principle of the chamber). It is the orthodox interpretation that the measured charged particles first superimpose with their own shadow, then coupling with the vapor molecules (also a superposition), such a double superposition state leads to the formation of the fog band. This explanation requires that the cohesion center of each droplet is caused by the measured particle visiting there. This requires not only the super speed of light, but also, a lack of mechanisms that the measured particles return to the 3D regression center. In addition, this orthodox interpretation and the interpretation that the measured particle in a cloud chamber has returned to the classical state are contradictory. In the year of this explanation is to meet the principle of uncertainty but it does not meet the facts. This explanation has been widely accepted (acceptance of the uncertainty principle must accept the interpretation of disregarding the facts). You know, even if the droplet track in the chamber is a superposition state space, the gravity center of the measured particle is also moving along the 3D regression curve of the droplet center coordinates in the track.

In a cloud chamber, for high speed electronics, the distance between vapor molecules is great. The penetration ability of high speed particles (such as electrons) is very strong. The probability of collision (in particular, the collision that can change the path) between target particles and neutral molecules is very low. Neutral vapor molecules have little effect on the high speed particles that passed through (almost no influence, and the influence is less than the resistance). From Rutherford's experiment of the detection of the atomic structure we can see that the effect of electrons in atoms and molecules on the high speed particles is very small, As long as there is no collision with the atomic nucleus, high-speed particles will not change the movement route. The electric field of the incident particles affects the environment (instrument) when a particle is captured by a spark chamber, and the environment (instrument) has little effect on the incident particle (the design idea of the spark chamber is that the motion path of the incident particles cannot be changed because of the influence of the instrument). Since the anti-interference ability of the quantum coherent state is not zero, we only consider the effective measurement result that the impact strength is lower than the anti-interference ability. For the experimental results using the cloud chamber to capture the track of a charged particle, the quantum decoherence interpretation is in contradiction to the interpretation that the measured particles have visited every condensation center. The orthodox interpretation of the experimental results using the spark chamber to capture the track of a charged particle also has the above contradiction. In order to overcome the contradiction, and considering the working principle of the chamber, we can recognize that the effective experimental results using cloud chamber trapping of the charged particles track accord with quantum inverse measurement conditions. The motion track of micro particles (the 3D regression curve) obtained by measuring is the intrinsic state (undistorted state) of the particle. They are not due to be measured and returned to the state of the classical. To capture the same particle, the same track can be obtained by using the spark chamber, cloud chamber and bubble chamber. This fact has proved that, in a short distance, the effects of the equipment to capture the particle track on the incident particles are negligible. The subjective intervention, where the measured particles to be effected by the consciousness about an observer want to measure the microscopic particles, lacks a scientific basis.

When a high-speed particle passes though the chamber, the principle of the formation of cloud track is of field-induced aggregation. We only discuss the process before the collision of the incident particle with the vapor molecule. When the particle passes through the chamber, the electric field signal affects the steam molecule in the instrument, and the steam molecule has no effect on the incident particle. This fully conforms to the conditions of quantum inverse measurements. In the spark chamber, the electric field of the incident particle causes the space between the strings of the instrument to be broken down and discharged to produce a spark. The electric field between the strings is very weak and has little influence on the incident particles (much weaker than the electric field needed to make an electron beam). In the secondary diffraction experiments of electrons, the effect of the slit on the electrons being measured did not result in quantum decoherence and wave packet collapse. High-speed electrons penetrating into the cloud chamber are also likely to have no occurrence of wave packet collapse and quantum decoherence. The 3D regression curve of the center coordinate of the droplet in the cloud chamber is most likely to be an accurate movement route of the measured particle. The thickness of the cloud track is the reflection of the effective distance that the electric field of the incident particle can affect (neutral particles not being able to form a cloud track is proof). If the incident particles are considered to reach the edge of the cloud track, superluminal motion is required and the segmented 3D regression curve is not a straight or smooth curve.

For the use of the measuring chamber, people always avoid talking about the significance of the 3D regression curve. Both the accuracy of the 3D regression curve and the characteristics of the motion path of the particles in the second half, predicted according to the first half of the 3D regression curve, are the powerful materials that deny the principle of uncertainty.

In summary, in the measurement of nuclear decay processes, Leibfried's experiment, the localization of electron diffraction experiments, and the locale of the electron microscope, using the cloud chamber and bubble chamber, spark chamber, etc., to capture the micro particle track, the effect of measuring instruments on microscopic particles is very small (these experiments can be said the one that only has the reverse influence), the working principle of these instruments is the electromagnetic field of the particle to be influenced on the medium in the instrument, and the target particle is just skimmed over at the regression center of the transverse section of the track. The inverse effect of the medium on the particle being tested is very small (negligible). Therefore, according to the above results (the operation of catching charged particles conforms to the laws of electromagnetism, and the results are obtained by electromagnetic theory) we can know that the 3D regression curve of the cloud track of a charged particle in the chamber is the moving trajectories of the measured particle in the past. This explanation is much more accurate and reasonable than the explanation of "micro particle dispersion interpretation in the whole track space". It can be said that the experiment of the cloud chamber and spark chamber to capture the motion path of high-speed particles has confirmed that the uncertainty principle is not universal (for the paradox of the uncertainty principle, see Sections 1.6 and 1.7). The image process abut quantum decoherence is setting man-made obstacles for quantum measurement. As long as the experiment using a cloud chamber to capture charged particles to meet the conditions of the quantum inverse measurement are recognized, the experimental results that have captured the tracks of motion particles have denied that the microscopic particles spontaneously and inevitably can overlap with their own shadow. Superposition between micro particles and their own shadow being a common phenomenon has been denied by the combination of the three factors (QIMT, the logical conclusion that superposition is a mathematical possibility but not the inevitability of physics and the experimental results to capture the track of charged particles).

If the quantum inverse measurement is realized, we can find the real situation of microscopic particles under the Free State. The existing quantum mechanics theory holds that the quantum superposition state of free particles is never observed, and can only be inferred by the results of the its destruction. To insist on this point of view, we must deny the existence of quantum inverse measurement. In this section, the author points out the trapping of charged particles in a cloud chamber and spark chamber with quantum inverse measurement conditions. Some people have succeeded in observing the state of a single particle. The results of this kind of experiment together with the experimental results of quantum inverse measurement deny the existing quantum mechanics interpretation. In the existing theories of quantum mechanics, both “the state superposition” and “the collapse of the superposition state” are hypothetical and unverifiable unknown processes (it is also a changing process at infinite speed that does not require time). “We'll never see the free state of microscopic particles” and “the change of quantum state is instantaneous and the super speed of light—can never know its specific circumstances and mechanisms”. Is this explanation makeshift (improvising) or not? You know that something that will never be observed may not exist, at least there are more than 50% of possibilities. The superluminal process is a non-real process. How reliable is it that the non-real process has at most a 50% possibility of occurrence?

1.4.4. The Measurement of Wave Function Unchanged and the Measurement That the Wave Packet Collapse Cannot Be Caused

For any wave function of the quantum system at a given moment, we can use the quantum Zeno effect to keep it constant, while simultaneous projection measurements of any observable amount will produce a definite measurement result, which is the expected value of the measured observable quantity in the measured state. This measurement is called the protective measure (Yakir Aharonov and Vaidman, 1993; Aharonov, Anandan and Vaidman, 1993).

The results of the secondary diffraction experiments of electrons show that continuous measurements do not result in the wave packet collapse and quantum decoherence of micro particles. The influence of the slit with more dense electrons on the incident electrons is not greater than the influence of the cloud chamber of the thinner vapor molecules on the incident electrons. According to this logic to judge, high-speed electronics in the cloud room is unlikely to be in the state of wave packet collapse. Even if the high-speed electronics in the cloud room occurred in the collapsed wave packet and returned to the classic state, contradiction still exists. The 3D regression curve of the center coordinates of the droplets in the cloud trace of the electrons being measured in the cloud chamber is the precise trajectory of the measured particles (the position is accurate to reach the atomic size). In the microscopic world, if the position of the particle cannot be measured accurately to the atomic scale, there is an unreasonable phenomenon: in terms of position measurement granularity, classical mechanics and quantum mechanics are upside down. Reason tells us that we should abandon the hypothesis about wave packet collapse. The 3D regression curve of the center coordinates of the droplets in the cloud trace of the electrons being measured in the cloud chamber is the precise trajectory of the measured particles (the position is accurate to reach the atomic size). It is not difficult to see that in the electron secondary diffraction experiment, the state of the electrons changed before the electrons reached the phosphor screen, but the wave packet collapse did not occur.

The state changes, but the wave packet collapse (quantum decoherence) does not occur, the quantum decoherence occurs, and the state does not change, and can partly meet the requirements of quantum inverse measurements.

1.4.5. The Experiment to Measure Neutrinos

Neutrinos are the smallest microscopic particles, and their quantum properties are more obvious normally. However, the general measurement is difficult to interfere with the movement of neutrinos. Almost all of the experiments on neutrino measurements are in accordance with the conditions of quantum inverse measurements.

1.5. The Influence of QIMT on the State Superposition Principle

The two reasons for the state superposition principle being used to describe object particles are: the non-local interpretation of the experiment's results about quantum entanglements and electron diffraction experiments; and object particles are made up of wave packets. These two reasons can be denied (the first is in Section 1.5.1 and the second is in Section 1.5.2).

Quantum entanglement is one of the most famous predictions of quantum theory, theoretically derived from the principle of superposition. However, we have no reason to say that the superposition must occur. The superposition of entangled states must be nonlinear superposition, while the principle of superposition is linear superposition. This is also a contradiction. Since the process of quantum entanglement is unknown, at present, "the quantum entanglement process observed by someone" is the thing defined by the reporter himself, rather than the real phenomenon of quantum entanglement being observed. In Aspect and other experiments to verify Bell's inequality, the twin particles are entirely possible always as the pigeon pair (there is no experimental evidence to deny this argument). Before measuring the polarization state or spin state of the twin particles, we did not use the experimental method to deny that the twin particles are the pigeon pair (it is not validated by experiment that the twin particles are not a pigeon pair). Under these circumstances, the process of proving the existence of quantum entanglement by experiment lacks a complete empirical chain. The empirical chain is also a logical chain. Therefore, it is also a logical loophole to test Bell's inequality.

The theory of quantum inverse measurement insists that: "The measurement without disturbing also changes the quantum state" is not logical; for moving particles, when there is no measurement, there is not a definite movement track but it is not known where the determined movement track is. These concepts not only have a profound influence on the superposition principle, but also have a profound influence on the uncertainty principle. QIMT denies the mysterious effect of the unknown, and pursues the establishment of the strict and complete logical chain and empirical chain. This makes it easier to discover the superposition principle and its application.

The superposition of the two possible states of the system is still a possible state of the system. This is a popular expression of the superposition principle. It explicitly states that state superposition is simply a mathematical permissible behavior, not an unconditional inevitable behavior. The superposition state “may be a kind of physical reality”, not that it “must be the physical reality”. It is a great mistake to regard possibility as necessity. Adherence to this error means the interpretation of quantum mechanics cannot be a scientific explanation.

The quantum state of the complex system cannot be decomposed into the tensor product of the respective quantum states of the member system. The corresponding superposition is a nonlinear superposition, and the superposition principle is the superposition of linear superposition. Both that a single particle is superimposed with its own shadow and has lost the original classic characteristics and that twin particles are superimposed and have lost their independence are also processes to be described mathematically rather than as the necessary processes in physics.

The principle of state superposition originates from the compositional properties of the solution of a linear wave function: If both φ_1 and φ_2 are solutions of a linear wave function, then their linear combination $C_1\varphi_1+C_2\varphi_2$ is also a solution of this linear wave function. A solution of a wave function corresponds to a state of a particle, and the constitutive property of the solution of the wave function becomes the principle of superposition of the state. The principle of state superposition acknowledges that there are at least three possible states of particles: φ_1, φ_2 and $(C_1\varphi_1+C_2\varphi_2)$. However, orthodox quantum scientists believe that the particles are absolutely in the third state. It is obvious that the constitutive property of the solution of the linear wave function is not the solid theoretical basis of the principle of state superposition.

The most important part of this section is the proof that the evidence chain for quantum entanglement experiments is incomplete. The evidence chain (logical chain) is incomplete in the demonstration process of the conclusion of spooky action at a distance. It can be expressed in mathematical ways. But it is not a mathematical logical result.

1.5.1. Empirical Train Incompleteness in the Experimental Verification of Bell's Inequality

This is also the insurmountable maximum logic vulnerability for the validation experiments of Bell's inequality. The reason is that the change in the quantum state of the twin particles is speculated by theoretical method rather than rigorously verified by experimental methods.

A logical chain is the logical "human reasoning path" or the main line of development of things, and is the string of a causal relationship (the interlocking strings of taking causal relationship as the main link). However, there must be an "empirical chain" when explaining experimental phenomena. An "Empirical chain" means a rational chain formed by a series of sensory experiences to be mingled with a logical chain. An "Empirical chain" is also an important part of the logical chain and evidence chain. Some experimental results are explained by quantum entanglement, in which the reasoning does not form a logical chain, and the evidence chain especially is incomplete.

Only observing a point cannot determine the speed. By only measuring the state of a particle on a point, we cannot be said to use experimental methods to prove the quantum state changes. When verifying Bell's inequality, we only measure the quantum state of the same particle at a point. From an empirical point of view, we cannot say that Bell's inequality is verified, that the existence of inter-related phenomena is proved by the experimental method. The detailed discussion is as follows. The reason is that the change of quantum state has not been experimentally verified (the situation that twin particles are the "pigeon pair" from beginning to end must be ruled out, but we did not use the experimental method to exclude). This is the incompleteness of an empirical chain. If the empirical chain is incomplete, the logical chain is also incomplete.

If we want to determine the change of state by the experimental method, we must use the experimental method to measure the difference between before and after the two states. However, the existing quantum entanglement experiment only measures the states of twin particles after the change, and the states before the change are not measured by the experimental method. The particle state before measurement is assumed (or just inferred from the theory). The change of the quantum state has not been experimentally verified, and the super correlation derived from the quantum state change has not been experimentally verified. In the process of interpretation of the measurement results of quantum entanglement, it is visible that the so-called "change of quantum state" is very likely to be that the quantum state does not change at all. Concretely speaking, the explanation of the quantum entanglement experiment made two mistakes: first, it is wrong to think that the homologous conjugated particles must be in an entanglement state (it is also a superposition state or a mixed state) before the observation; and second, it is wrong to think that even with interference-free measurement, the quantum state can be changed. It is recognized that the entangled state existed before the experiment. After the experiment, it was admitted that the existence of the quantum entangled state has been proved. This is obviously a logical loop. The first wrong understanding is just a hypothesis, has never been directly confirmed by the experiment, and cannot be confirmed by the experiment. Entanglement interpretation of the quantum entanglement experiment depends on the first error. The first mistake is to assume (or cognizance) that the particles are in an entangled state before being measured (the entanglement state of homologous conjugated particles is the superposition state or mixed state). The purpose of the quantum entanglement experiment is to prove the existence of quantum entanglement, but the explanation of the experiment must use the assumption that quantum entanglement exists before the measurement. This process obviously belongs to a kind of circular argument. Professor Ronald Hanson's experiments[19] did not completely rule out the most critical logical vulnerabilities in the John Stewart Bell experiment.

As described above, in the verification experiment of Bell's inequality (or the Alain Aspect experiment), the change of quantum state has not been proved by experiments, and super-correlation between twin particles can only be expressed through change of state. Therefore, the demonstration (interpretation) process of the experimental results does not form a complete empirical chain and a complete logical chain.

Only the measurement of information reverse transmission is equivalent to no interference measurement. The measurement of free particles without interference can be realized by quantum inverse measurement. The true colors (true state, to be also the state of reality) of micro particles can be observed by quantum inverse measurement. Since the measured object is not subject to the interference of the observer, the presence or absence of the observer is independent of the motion state of the measured object (the coupling between the measured object and the observer cannot occur). Since there is no coupling between the measured object and the observer, there is no need for segmentation of them. In other words, in the process of quantum inverse measurement, "this important 'Archimedes segmentation point' of segmentation of the observer and the observed object can be obtained."

Taking an electron of free movement as an example, if it is at *A* but not at *B* as observed by an inverse measurement, then the mixture state that it is both at *A* and at *B* (at the same time, the electrons are both at *A* and at *B*) cannot be observed. Maybe someone will say, in the diffraction experiment by the double slit of electrons, that an electron can be simultaneously located at *A* and *B* has been observed, hasn't it? However, the previous electron diffraction experiment is not a quantum inverse measurement experiment (because the instrument has a serious interference with the target particles as measured). Moreover, the results of the electron diffraction experiment can be explained with the viewpoint that the effect of incident electrons leads to the generation of photons, and the diffraction fringes are caused by direction quantization. Electron diffraction experiments have not ruled out this possibility at this time. Since this possibility has not been ruled out, it is not strict to strongly adopt the interpretation that electrons have wave character. The diffraction of a photon passing through a double slit is not explained by a photon being both at *A* and at *B*, but the Huygens principle is used for explanation. It is visible that even if the electrons are completely waves, the results of the diffraction experiment by double slit of electrons do not necessarily prove that at the same time, the same electron can be at both *A* and at *B*. it could not prove that the electron is in a superposition state: the entity of the electron at *A* is superimposed with its shadow at *B*. The superposition state of an electron with its own shadow is a state of non-reality. It cannot be observed by quantum inverse measurements. In the concept of orthodox quantum mechanics, the superposition state of an electron with its own shadow can also not be observed (as long as the measurement occurs, this state is destroyed).

Put a cat in a closed box, and then connect the box to a device. The device contains an atomic nucleus and a toxic gas facility. The atomic nucleus has a fifty per cent chance of decay, and a particle will be emitted when the nucleus decays. The particles will trigger the poison gas facility, so as to release the poison gas to kill the cat. This is the famous Schrödinger dead-live cat state of thought experiment.[20]

For this thought experiment, the past three errors are: first, the way of observation is confined to opening the box; second, it is considered that the resistance of the quantum superposition state is zero, and any observation and measurement can destroy the quantum superposition state; and third, it is erroneously assumed that macroscopic objects can also be superimposed in quantum states. Quantum physicists set up an unproven observation barrier, then take the artificial obstacle as the premise, and derive the conclusion that purely objective quantum states cannot be observed, and the observed ones are newly produced in observation. This is a thinking trap, and is also a mud pit of agnosticism. We must bypass it, and can also bypass it. In fact, in the thought experiment of the Schrödinger cat state, observation of the cat can also take the way of inverse measurement (only the signal is transmitted from the cat to the viewer and no signal is transmitted from the observer to the cat). One of the concrete methods is to put an infrared receiver's probe into the box with the cat. The outside observer is only looking at the display screen of the infrared receiver. Through this screen you can see whether the cat is standing or falling down. The whole process from putting the cat into the box to opening the box can be photographed by the infrared camera. Regardless of whether the observer sees the display screen, he cannot interfere with the status of the cat, and can promptly know whether the cat inside the box is dead or living (standing or falling). The observer also knows whether or not the nucleus has decayed. Another method is to attach the auscultation head of a stethoscope to the cat's chest, with the hose extending to the outside of the box and connecting with the earplug; the experimenter listens to the cat’s heartbeat in the box. In the past, people only thought about the method to open the box. This is really too rigid. For macroscopic objects, the quantum state superposition is not possible. Therefore, the mixed state of the dead-living cat cannot be an objective existence for real observation, and it’s also not to be seen. As long as the mixed state of the dead-living cat does not exist, the superposition between the decay state and the non-decay state of the nucleus does not exist. The Subjective Intervention Concept that the ideological consciousness of an observer wanting to observe the cat state has disturbed the cat state doesn’t have enough bases.

The complete Schrödinger cat state thought experiment will convert the measurement of quantum states of microscopic particles into the measurement of macroscopic objects. While the measurement of the macro object is easier to achieve the operation of the instrument has no interference to the measured object. In fact, it is theoretically possible to deny the existence of the superposition state by transforming the observation of the microscopic state into the observation of the macroscopic state of the object. The reason is that quantum states do not superimpose, for macroscopic objects, and do not appear to overlap with their own shadow.

In this experiment, the measurement of microscopic particles is transformed into the measurement of macroscopic objects. For macroscopic objects, it is easier to realize interference-free measurement (or the interference can be ignored completely).

As mentioned above, the superposition state of the microscopic particles with their own shadow is the non-real mathematical virtual state which does not exist and is not observed. By using the quantum inverse measurement technique, we can enable Schrödinger, using his cat state experiment, to achieve his desired objectives. At least we can use the quantum inverse measurement experiment to check whether there is this kind of non-real mathematical virtual state.

1.5.2. The Contradiction of the Stability of the Superposition State in the Interpretation of Quantum Entanglement

This is also the contradiction between the explanation of the continuous quantum entanglement experiment and the explanation of the instantaneous quantum entanglement experiment.

In December 2005, in the journal *Nature*, D. Leibfried, E. Knill, et al. reported that the entanglement was sustained by 50 *ns*.[16] For convenience, this type of experiment is called a continuous quantum entanglement experiment (continuous quantum entanglement is observed by it). An experiment, such as Aspect *et al.*, which tests Bell's inequality, is called the instantaneous quantum entanglement experiment (the instantaneous quantum entanglement effects are observed by it). In the quantum entanglement state of 50 *ns* duration, the measurement must also only be uninterrupted continuous measurement. In other words, the measurement of the "The entanglement [that] lasted for some time" requires that the measurement (observation) is also continuous and that the measurement (observation) operation does not destroy the quantum state (without causing the wave packet to collapse). This measurement is in accordance with the quantum inverse measurement condition: a purely objective measurement result can be obtained by the measurement that the interference can be ignored. It can be seen that this experiment to capture the Schrödinger cat's state actually supports QIMT. The interpretation of the superluminal correlation between two twin particles in the entangled state requires the premise of "as long as the measurement occurs, it will destroy the superposition state (wave packet collapse)". It is obvious that the explanation of the sustained entanglement of the Schrödinger cat state experiment and the "superluminal correlation of entangled particles" in the Alain Aspect quantum entanglement experiment are contradictory: if it is "as long as measuring the wave packet will collapse", continuous entanglement cannot be observed; if it is "measurements may not result in the collapse of wave packets", we cannot use the explanation that "there is superluminal correlation between twin particles". People do not exactly know what the state of quantum entanglement is. After the alternating change of the spin direction (or the alternating change of the polarization direction) is measured, it is believed that this is the quantum entangled state. However, admitting this is to admit that the twin particles were a pigeon pair. If the twin particles are recognized as a pigeon pair, the existing quantum entanglement experiments have become problematic. The "boy" and "girl" in the pigeon pair being intertwined (especially, the "boy" and "girl" in a single particle are intertwined) has no strong experimental basis.

The measurement action (or instrument) of the continuous quantum entanglement experiment does not destroy quantum entangled states. Admitting the results and interpretations of their experiment, it is recognized that the measurements do not change the superposition state of the microscopic particles, *i.e.*, the measurements do not result in the collapse of the wave packet. If it is admitted that the entanglement can be sustained during the measurement, it must be recognized that the measuring instrument and the observed object can be segmented in this duration (supporting the existence of quantum inverse measurements). However, in order to obtain the instantaneous quantum entanglement experimental results, it was previously believed that for as long as the measurement occurs, the quantum superposition state, especially the quantum entangled state, will be changed (destroyed). If we do not recognize the change, we cannot recognize that quantum entanglement has been found. This is a fatal contradiction in the interpretation of quantum entanglement experiments: for as long as the measurement will change the quantum state, it must not be able to continuously measure the quantum entangled state; if the measurement cannot change the quantum state, many of the so-called quantum entanglement experimental results (*e.g.* Aspect's experimental result) cannot show the mysterious correlation between the twin particles. It has been argued that both quantum entanglement and quantity teleportation are philosophical rather than physical explanations. That is, quantum entanglement is a psychological product rather than a real physical process.

The thinking behind the interpretation of the instantaneous quantum entanglement experiment is: before measurement: the spin state of the twin particles is uncertain → Measurement leads to the collapse of the wave packet → The spins of the twin particles were simultaneously measured to be opposite (there is a mysterious association between them) → Conclusion (there is spooky action at a distance). The thinking behind the interpretation of continuous quantum entanglement experiments is: Continuous measurement → the continuous entanglement of twins is measured → Conclusion (measurement does not destroy the quantum entangled state, and measurement does not lead to wave packet collapse). Obviously, these two kinds of experiments are obviously contradictory: for the former, measurement must lead to the quantum state change; and for the latter, continuous measurements do not lead to quantum state changes. If these two kinds of experiments are connected in series (continuous is in front, instantaneous is behind), scientists will not be able to explain the experimental results. QIMT can eliminate this contradiction. If you do not recognize the contradiction between the two experiments, it is not logical, and the existing interpretation of these two experiments is not science.

In quantum mechanics, the superposition of the solution of a linear wave function is the place that can most deceive people. It cannot withstand scrutiny that “the superposition of the solution of a linear wave function” corresponds to the reality. It is too arbitrary to think that observation must change the objective state in the way of collapse. It can't be verified, and it can only be subjective. The existence of the superposition state before observation comes from the mathematical result that does not necessarily correspond to the reality. For Schrödinger’s cat, the last glimpse of the observer can only change the concept, and collapse is only the concept that the cat is born or dead, but it is simply impossible to make the observed object clear from chaos. Logically, the so-called collapse process is “removing mathematical results that cannot correspond to reality.”

1.5.3. The State Superposition between Particles is only “Allowed to Happen” in Mathematics Rather than the “Inevitable” in Physics; Even if the Superposition, There Are Differences in Degree and Efficiency

The overlay between an individual particle and its shadow is a low probability event. Twin particles are the pigeon pair; at the beginning. The physical state that most matches the mathematical state-superposition is the superposition of empty states. In addition, we must consider the superposition efficiency. The superposition efficiency includes the intensity of the interaction between the various parts involved in the superposition or their contribution to the spatial point. The next section shows that the object particles are localized. The superposition efficiency between the localized particles is related to the distance between them (or the distance of the center of gravity of each part from the point of consideration).

Superposition principle is a basic principle in quantum mechanics. It illustrates the nature of the wave function. If ψ_1 is an intrinsic state of the system, the corresponding eigenvalue is A_1, ψ_2 is one of the intrinsic states of the system, and the corresponding eigenvalue is A_2, and according to the linear relationship of the Schrödinger equation, $\psi=C_1\psi_1+C_2\psi_2$ is also a possible existence state of the system ($\psi=C_1\psi_1+C_2\psi_2$ is one of the forms of expression of Eq. (1-9)). If you measure the observable quantity A in this state, the A values to have measured are both likely to be A_1 or A_2, and the corresponding probability ratio is $|C_1|/|C_2|$. The average value of A in three-dimensional full space is $<A>=\int\psi^*A'\psi dx$ or the Dirac symbol $<\psi|A'|\psi>$. The ratio of the probability being $|C_1|/|C_2|$ is the theoretical source (theoretical basis) of the quantum mechanical probability interpretation.

The above statement, "if ψ_1 is an intrinsic state of the system, ψ_2 is also an intrinsic state of the system" can be used to describe empty states. However, if we use it to describe real states and recognize that a system can simultaneously be in two states, we admit that a system can simultaneously be in these two states. It is equivalent to admitting that a person has two faces at the same time, and that these two faces are his real face, because the eigenstate is a state of full representation, not a partial state. If there is only one objective real face of a particle (or a person), then, there must be one in the ψ_1 states and ψ_2 states of microscopic particles that is fictitious (or spare/alternate). The idea that a particle simultaneously has two different real faces was based on supposition (hypothesis). This is also a hypothesis that microscopic particles have non-local-reality. Interpretation of the experimental results of the double-slit diffraction of electrons does not rule out the accompanying light effect that is most likely to occur, and cannot be served as solid evidence of an object particle simultaneously having two different real faces. In addition, in the above statement, the person to propose the state superposition principle firstly recognizes that the state superposition at first was just a possibility. The next words, "the A values to have measured are both likely to be A_1 or A_2, and the corresponding probability ratio is $|C_1|/|C_2|$" recognized the state superposition to be inevitable (if the superposition does not occur, the measurement results are not statistical).

For the superposition of states, there is a lack of a necessary logical transition from “possibility” to “inevitability”. State superposition is also inevitable (hypothetical).

It can clearly be seen that, if the state superposition principle is used to describe the real state of individual particles, there are two virtual things: microscopic particles are made up of wave packets, or "a particle has two different faces"; and the superposition between the first face and the second face of a microscopic particle is necessary. From a scientific point of view, the “principle” containing twice fiction is not strict. The experiments using a cloud chamber to display the motion track of charged particles have proved that the charged particles do not have two different faces. The superposition of the two different faces of a particle is sheer fiction. QIMT is not optimistic (criticism) about the state superposition principle based on twice imagination. The above statement shows that, whether according to the theory or according to the experiment, we don't have enough reason to deny “the existence and realization of quantum inverse measurement”. The von Neumann theory is derived from the mathematical method of Hilbert space operations. He also did not prove that the possibility of mathematics must be the inevitability of physics. The hypothesis and speculation are just fictitious. Therefore, the superposition of quantum states can only be assumed. In the micro world, whether such a hypothesis is generally true is a problem. There is no good reason to raise it to the height of the principle. Denying the superposition of quantum states also denies the interpretation of quantum mechanical probability.

The outer layer of the carbon atom has 2*s* and 2*p* electrons. Before they are hybridized, the 2*p* electron is not another eigenstate of the 2*s* electron, and the 2*s* electron is not another eigenstate of the 2*p* electron. The eigenstate of the 2*s* electron is the electron movement state that the 2*s* electron is in the 2*s* sub layer (only an eigenstate). Whether the 2*s* orbit and the 2*p* orbits of the carbon atom are hybridized or not, the form of hybridization must be determined according to the conditions. Electronic orbitals in gaseous carbon atoms are not hybridized; under the condition of low temperature and pressure, the carbon atoms form graphite in the form of the sp^2 hybrid; and in the high temperature and high pressure condition they form the sp^3 hybrid diamond.

If the physical particles are not discrete but localized, they are farther away from each other, their superimposed degree is lower, and the superposition efficiency is lower. The superposition can be ignored when the degree and efficiency of stacking are reduced to a certain extent.

Mathematical possibility is not inevitability in physics. Not all of the coupling has a very high degree and efficiency. If there is no coupling between the measured object and the observer or the degree and efficiency of the coupling is very low, there is no need to divide them. One of the serious mistakes that quantum mechanics has made is to regard mathematical possibilities as a physical necessity. This behavior is not very dialectical.

A branch of mathematics is called Hilbert space. The theory of quantum mechanics can be constructed by the mathematical construction of Hilbert space. Both the state superposition expressed by Eq. (1.9) and the coupling expressed by Eq. (1.11) are derived from the mathematical method of Hilbert space. The wave packet collapse model of von Neumann[21] was regarded as the standard model of quantum measurement. Its main idea is that if we want to measure a certain mechanical quantity of the quantum system, we must consider the function of the measuring instrument, and use the language of quantum mechanics to describe it. This model is that the mathematical possibilities of the coupling described by the Hilbert space are regarded as the inevitability of quantum mechanics ("we must also consider the function of the measuring instrument" and admit "the coupling is inevitable"). However, as this chapter has been explaining, in the process of quantum inverse measurement, the observer has no sufficient effect on the observed object, and the coupling between them will not occur. Against the background of QIMT, a new measurement view is "under certain conditions, in order to take into account the role of the instrument".

The concept of quantum entanglement is that the original superposition (or entanglement) of the microscopic particles expressed by Eq. (1.9) is unconditional, there is no interference-free measurement, and the measurement with interference is bound to destroy (change) the original superposition state. If a non-superposition state of the microscopic particles has been observed by using the quantum inverse measurement method, it is indicated that the non-superposition state is the intrinsic state of the measured particle. The realization of the quantum inverse measurement is to realize that the measurement has no interference with the observed object, and such a measure of action does not change the original superposition state of the measured particle. If the quantum inverse measurement is realized, not only does it indicate that the coupling between the instrument and the observed particle has not formed, but also that there is no sufficient reason for the superposition between the particle and its shadow (there is no reason that the possibility of mathematics must be the inevitability of physics). The existing significance of the experiment on quantum entanglement and the verification of Bell's inequality are questionable.[22-24]

If we believe in the existing explanation for the experimental results of quantum entanglement, we must first admit the existence of quantum entanglement expressed by Eq. (1.9), then it can be said that the quantum entanglement has been measured by experiment. If we do not admit the existence of quantum entanglement expressed by Eq. (1.9) (and do not take the possibility of mathematics as the inevitability in physics) the experimental results cannot be interpreted as "the quantum entanglement to be observed by the measurement". It can be seen that there exist logical cycles in the interpretation of the results of the quantum entanglement experiment. If there is no original and spontaneous superposition of the quantum state, there is no concept of quantum decoherence and wave packet collapse.

In short, the superposition of quantum states is only a mathematical possibility, not the inevitable reality. The state superposition is conditional, not unconditional. The wave packet collapse caused by observation is conditional, not unconditional. It is a kind of sophistry that needs to take the possibility in mathematics as the inevitability in physics.

1.6. Fresh Blood Is Inputted for Quantum Mechanics by the Model of the Light knot Electronic Structure

There is an association between these three: the principle of state superposition, the wave-particle duality of matter particle and the uncertainty principle. It can be said that they are bound together for good or ill. Letting electrons pass through a slit is not a good way to measure the position and momentum of an electron simultaneously. QIMT allows the presence of interference-free measurements and allows for the presence of non-random interference measurements. Both the interference-free measurement and the non-random interference measurement can obtain the pure objective state of the measured object, and the uncertainties of the microscopic particles mentioned earlier are also absent. In this section, we first comment on the quantum mechanics measurement method, then talk about the electronic structure model of light junction, and finally talk about the influence of QIMT on the uncertainty principle.

The first two sources of uncertainty theory are Heisenberg's presentation and Earl Kennard's presentation. Described in modern language, these two statements are: <1> measurement inevitably and irreversibly destroyed the state of quantum; <2> the inevitability of superposition of quantum states (or microscopic particles with wave-particle duality) determines that the uncertainty of microscopic particles is primitive and spontaneous. Now, it is believed that, in the determinants of the uncertainty principle, there is still: <3> an explanation of the electron diffraction experiment; and <4> according to the principle of quantum mechanics, the mathematical expression of uncertainty principle can be derived. The emergence of QIMT can make people more clearly understand the problems of the four determinants.

We will introduce the following: the direct influence of QIMT on the uncertainty relation; the other problems of the principle of uncertainty; and the best method to measure the position and momentum of particles is introduced.

1.6.1. Both the Projection Measurement to Use Photons to Influence the Observed Particles and the Measurement to Use Slits Are Not the Best Measurement Methods

When Heisenberg put forward the uncertainty principle, the quantum measurement method enumerated by him was a projection measurement method (in comparison with inverse measurement, it belongs to forward-inverse measurement). This is an unreasonable measurement method for measuring microscopic particles. The method in which the "electric field of the measured particle" is unilaterally accepted by the measuring instrument (i.e., the inverse measurement method) is the best measurement method. There are other protective measurement methods. It is difficult to obtain a universal conclusion by using the projection measurement method.

The direct meaning to reveal the paradox of the uncertainty principle is to know that the past motion path of a microcosmic particle can be accurately measured when it is continually measured. This conclusion can be verified by the experimental method of continuous measurement.[24-25] Von Neumann's quantum measurement standard model cannot be used to completely eliminate the paradox of the uncertainty principle.

The uncertainty of microscopic particles originates from the superposition of states. For a particle far from the environment and other particles, it is only superimposed with its shadow. As long as the particle is not a ghost that has independent consciousness and/or spooky action occurring there is no legitimate reason that free particles are not certainty.

The best way to measure the electron position and momentum is to observe the motion trajectory of electrons with a cloud chamber. This method was not used before. The reason is that the position and momentum of the electronic case are accurately measured at the same time, and the Copenhagen school does not recognize that it is also an accurate measurement of the electronic momentum and position. The school argues that electrons may appear in the space occupied by the entire cloud track. So there is a logical problem: while recognizing the collapse of wave packets while recognizing the superposition of electron and space hole (two state superposition leads to an electron in the dispersion state); the space occupied by an electron is not the measurement uncertainty of the electron position. Therefore, the thickness of the track is not the measurement uncertainty of the electron position. The electron track measured in the cloud chamber does not correspond to the strict definition of the uncertainty relation. Orthodox quantum physicists believe that electrons passing through the chamber and the wave packet will collapse, and the observed electron returns to the classical state. However, they still believe that the motion electron in the cloud chamber is dispersed in the space of the whole cloud track (be aware that the latter does not believe that the wave packet has collapsed). Dispersion is produced by the superposition of quantum states. Now that the wave packet collapses and the quantum superposition disappears, how can it still diffuse? Even it is diffused, the physical meaning of the 3D regression curve of the droplet center coordinates in the cloud track should also be the trajectory of the center of gravity of the measured particle! We have no way to rule out "the 3D regression curve of droplet center coordinates in the cloud track" which is the exact movement route of the electron.

1.6.2. The Model of the Light knot Electronic Structure Can Reduce the Number of Quantum Mechanical Postulates and Can Reveal that Sources of Probability Are not Reliable

A circularly polarized photon propagates along a closed path to form an electron or a proton. This kind of particle structure model is called the model of the light knot object-particle structure. This model shows that the essence of the object particles in the wave-particle duality is that the whole of the object particle has the characteristics of classical particles, and the reason that the object particles are volatile (can be described by the wave function) is that the particles are surrounded by waves. This wave-particle duality does not determine that the particles are non-local-real (discrete). This good unity between wave and particle has not been used before. The particle structure model shows that: wave-particle duality is the combination of two characteristics and the performance in one, which does not mean that the whole of a particle is discrete.

The influence of state superposition on particle uncertainty and the influence of wave-particle duality on particle uncertainty are in the form of a different but the same result. The problem of the superposition of quantum states has been discussed above, so this section focuses on the problem of wave-particle duality. The erroneous ideas of quantum mechanics are due to the lack of understanding of the composition and structure of microscopic particles. To correct the wrong idea of quantum mechanics, one is to proceed from the theory. Another is to start with the structure and composition of micro particles. In this section, we briefly introduce a kind of model of the light knot electronic structure. The wave function of electrons is determined by this structure.

The uncertainty principle must depend on: the original spontaneous superposition of the state of the microscopic particle is widespread and spontaneous; the measurement destroys the quantum superposition state. The existing quantum mechanics scientists think that after the first measurement, the superposition state of the measured particle has been destroyed and has returned to the classical state, and cannot return to the original quantum superposition state again. That is to say, we can't measure continuously without destroying the quantum superposition state. Measurement of the particle system without interference has been realized by quantum inverse measurement. There is no limit to the above. We can measure a microscopic particle continuously without interference. For the measurement in accordance with inverse measurement conditions, the measured trajectory is not caused by the dispersion of the particles, usually caused by particles emitting electromagnetic field signals.

Logically, the particles that can be stationary are localized particles, the particles that cannot be stationary are discrete waves, and the discrete wave propagates along a small closed path to form a localized particle. This is the structure of the wave knot of a fundamental particle. For electrons or proton, the “wave knot” is an “light knot”. Closed chords are also of this structure. At the beginning of the establishment of quantum mechanics, Lord Kelvin mentioned the elementary particle structure model. But he mistakenly believes that this structural model cannot solve the problem of atomic stability, so that the model has not been recognized.

Kelvin is too famous, he has no confidence in his theory, and others will not support it. Not that the model is incorrect. In the 21st century, whether it is superstring theory or loop quantum theory, as well as geometric algebra material structure theory, in essence, they are based on the quantum motion—the closed curve of the knot.

In Ref. [1], I point out that an electron is formed by the simplest circularly polarized photon propagating along the closed path (belonging to a closed string structure model: this is the one kind of Kelvin wave model of the knot). The wave function of circularly polarized light is

$$\psi(x,t) = ae^{-i2\pi(\nu t - x/\lambda)}. \tag{1.12}$$

The wave function of an electron is also Eq. (1.12). It also shows that an electron wave is a real monochromatic wave rather than a probability wave or a wave packet. The square of the module of the amplitude is field strength rather than probability density. The whole of this light knot is localized. The center of gravity of the object particles can still be described by position and velocity, and the future of moving particles can be predicted. This structural model laid the foundation for the establishment of the interpretation system of quantum mechanics of local realism and determinism. The experimental results of diffraction by a double-slit of electrons can be explained by the effect of accompanying light. After reading this passage, you should be more convinced that the 3D regression curve of the cloud belt in the chamber is the exact path of the particle.

The reader may have noticed that I replaced "the wave function in the general textbook to be similar to Eq. (1.12)" with "to be Eq. (1.12)". This is not just a word problem, but there are essential differences. First, I pointed out the source of the wave function. Second, a variety of operators can be derived from Eq. (1.12). The method is as follows, to do a partial differential operation of q and t for Eq. (1.12). Both the first order partial differential and the second one are required. According to the classical formula of mechanical quantity, $p=h/\lambda$ (or $m\upsilon=h/\lambda$), the bound motion equation of a charge, the fine structure constant expressions, and the electron velocity in the ground state hydrogen atom $\upsilon=\alpha c$ obtained by Bohr's atomic model, we can get the corresponding mechanical quantity operator. The eigenvalues of the corresponding mechanical quantities can be obtained by applying the resulting operator to Eq. (1.12) (see Eq. (1.13)).

$$\hat{A}\psi(x,t) = A\psi(x,t) \tag{1.13}$$

The operator $\hat{A}$ of mechanical quantities is arbitrary. If the operator acting on the wave function is equivalent to the measurement, then Eq. (1.13) means that the state of the system is not changed by measurement (the wave function $\Psi(x, t)$ on both sides of the equal sign (=) is exactly the same).

According to $E_p=p^2/2m$, $E=E_p+V$ and the above method, the energy operator can be obtained. The energy operator acting on the wave function is the Schrödinger equation.[1] It can be seen that the third postulate of quantum mechanics is not the most fundamental, but can be deduced. Third, the eigenvalues of the mechanical quantities thus obtained are unique, not probabilistic. Fourth, it is finally shown that the state after the measurement can still be described by the Schrödinger equation. It is the four that have completely destroyed the existing quantum mechanics measurement concept, and smashed the cornerstone of quantum mechanics for non-local realism.

The electron spin angular momentum operator obtained by the above method is

$$\hat{M}_s = -i\frac{\hbar^2}{4mc}\frac{\partial}{\partial x} \quad . \tag{1.14}$$

The spin angular momentum obtained by the above operator to be applied to the wave function is $\hbar/2$. The spin angular momentum divided by ħ is the spin number. It can be seen that the spin is actually a quantum number describing the angular momentum characteristics of particles. Spin, like mass and electric energy, is the reflection of the intrinsic properties of elementary particles (specifically, angular momentum properties).

The premise that the electron consists of the simplest circularly polarized photon determines that the wave function described by Eq. (1.12) is very stable. If it does not meet the violent conditions of annihilation or decay, its form will not change. If you do not achieve the above two conditions, the other actions are equivalent to the actions of the field to the wave. These effects follow this law that, in the potential field, the energy of the wave changes but the form of the wave does not change. In other words, measurements under non-violent interactions result in only energy changes without causing structural changes in particles (the structure has not changed, of course, the nature has not changed). Change in energy, the speed of motion and the direction of motion (and perhaps the direction of spin) can be caused by measuring. The main content of the model of the light knot electronic structure is that the wave making a circle is the particle, and the particle nature is the wave. When a wave changes into a particle, it does not collapse. The movement of particles is the overall movement of the light knot, not the movements that appear and disappear mysteriously. When it is not measured, it conforms to Newton's laws of motion and the laws of electromagnetism (the states of particles are definite). In other words, as long as the particle is objective, it is definite (with a definite form of existence and motion) before it is measured.

The closed-string structure of the localized particle is the particle structure which is most coordinated between the discrete wave and the local particle. This particle structure denies the existence of the point-particles, affirmed the object particles are also waves, and explained the wave-particle duality of object particles. If you follow the past concept of particles, this structure is the unity of particles and waves. Although the particles are formed by waves, the whole of a particle is localized and has a center of gravity. Since the particles are formed by waves, it is not surprising that the particles have wave-particle duality. It intuitively denies the spontaneous uncertainty that localized particles are in a diffuse and/or discrete state. In this model, the uncertainty of particle motion has only a determinant factor of the instrument's interference during the measurement. Quantum inverse measurement can rule out the only determinant factor. Therefore, with the use of quantum inverse measurement, the purely objective state of a particle can be obtained.

A 3D regression curve of droplet center coordinates can be obtained by using a cloud chamber to capture a high-speed moving charged particle. According to the working principle of the chamber we know that, even if "a measured particle returning to the classical state due to the collapse of the wave packet" is true, this curve can only be an accurate moving path of the measured particle. The secondary diffraction experiments of electrons show that continuous measurement can be made under conditions that ensure that quantum coherence does not disappear. If we believe the model of the light knot electronic structure, then the 3D regression curve caused by the measured electron is the curve drawn by the movement of the gravity center of the light knot. The thinking to infer this conclusion is very clear. However, in order to cater for the uncertainty principle, the quantum physicists unreasonably deny the fact. The uncertainty principle allows the position of the moving particle to be accurately measured. The second-order diffraction experiments show that the electron can be continuously measured under the condition of keeping the quantum coherence. If the particle's position is continuously measured, both the past position and the momentum of the particle are accurately measured. This proves the past state of particles from two aspects of theory and experiment. The diffraction results of material object particles can be explained by "direction quantization". We can be sure that wave-particle duality cannot be used as a basis for the "particles [to] have non-locality and spontaneous uncertainty." Moreover, it is pointed out that the object particles are not wave packets, and the state obtained by means of measurement is not the state of the collapse of the wave packet but the original state of the particle. In this case, the 3D regression curve mentioned above can only be the exact path of the particle. Even if the particle is composed of a wave packet, the 3D regression curve is also the line drawn by the center of gravity of the wave packet.

1.6.3. The Results of Electron Diffraction Experiments Are not Conclusive Evidence of the Principle of Uncertainty

The first experimental evidence of the uncertainty relation is the electron diffraction experiment. However, as long as we carefully analyze, the diffraction experiments of electrons and other object particles are not the experimental basis of uncertainty relation. The choice of the Copenhagen interpretation needs to rule out a possibility, but it has not been ruled out. This possibility is that the diffraction is caused by the excited photons. That is, the diffraction of the object particles is a side effect, and the positive effect is the performance after the so-called wave packet collapse.

When the results of electron diffraction experiments are taken as the basis of the uncertainty relation (in the process of according to the experimental results of electron diffraction derived uncertainty relations), measuring the position of the electron and measuring the direction of movement of the electron are not simultaneous: the moment at which the position of the electron is measured is the moment when the electron passes through the slit; the moment to measure the direction of the electron is the two times that the electron hits the screen and the electron passes through the slit. From this we deduce the direction of motion of the electron, and we must admit that the electron is in a straight line between the slit and the screen. For a single measurement of an electron, admitting that the electron is in a straight line along the direction of the determination equals admitting that its position and direction of motion are determined. In this way, between the slit and the phosphor screen, the position and the direction of movement of the measured electron have a certain value at the same time. This result does not support the uncertainty relation. Recognizing that the measured electrons take a straight line during this time, there is another problem: the collapse of the wave packet must occur before the electron passes through the slit and reaches the screen, and the diffraction pattern should not appear. However, the diffraction pattern actually appears. This is a contradiction, or logical loophole.

Letting a particle pass through a slit is not a good way to measure the position and momentum of a particle. The measurement uncertainty (Δx and Δp) obtained by this method is not a universal limit measurement uncertainty. The reason why we cannot accurately measure is because the method is not right. According to QIMT, it is considered that interference-free measurement is the best method of measurement (or the interference can be ignored). In the electron diffraction experiment, the slit width (or pinhole diameter) Δx is not the measurement uncertainty of the position (it is intuitive that the length of the rectangular slit is not the measurement uncertainty of the position of the incident particle). Just as the airplane passes through a bridge hole, the size of the bridge hole is not the measurement uncertainty of the aircraft's position. Δx is a man-made space constraint and its value reflects the strength of the interference. The measurement uncertainty of position is a statistical value. Δp is also not the measurement uncertainty of momentum. We let a large number of electrons through a small hole to get a concentric circular diffraction pattern, and then one by one send electrons through the hole. We examine the electron which has reached the center of the concentric circle. The uncertainty of the direction of the electron is mainly determined by the measurement error of the deflection angle and the measurement error of the electronic velocity.

The momentum uncertainty calculated by the theory and method of uncertainty (JJF 1059.1-2012 or GUM: ISO/IEC Guide 98-3-2008) is not the $\Delta p = mv\sin\theta$. Only after the numbers of the same electrons were measured, the obtained standard deviation is A type of uncertainty, and its value is also not equal to $mv\sin\theta$ (it is certain that it is less than $mv\sin\theta$). Moreover, the position of the electrons emitted by an electron gun passing through the small hole each time is not the same. In this case, the $\Delta p = mv\sin\theta$ is caused by the interaction between the electron and the slit, rather than the uncertainty of the momentum of each electron passing through the center of the hole. According to the quantum inverse measurement concept that the particle beam will not be deflected when the measurement is interference-free (or interference is very small, or interference is very balanced), the electrons that hit the phosphor screen are also passing through the center of the hole, and the electrons traveling in the direction parallel to the electron gun are also emitted from the center of the aperture of the electron gun. We can also determine whether this electron really passes through the center of the hole by observing whether the three points (ejection center, the center of the hole and the point on the screen which this electron hits) are in a straight line or not. If they are, it indicates that the electron locates in the center of the orifice. The measurement uncertainty of the position of the electron passing through a small hole is determined by the measurement error of the spot diameter on the screen, the measurement error of the electron gun caliber and the measurement error of the deflection angle of the straight line, and it is also not the aperture (or slit width) Δx of the small hole. At this point, the degree of the electron beam deviation from the center of the small hole is caused by the deviation of the emission direction of the electron, rather than the measurement uncertainty of the position of the electron. When Δx is large, it is not the case that the measurement uncertainty of the particle position is more pronounced. Therefore, we conclude that the experimental results of electron diffraction do not show that $\Delta x\Delta p\approx\hbar$ is the relation of measurement uncertainty. It can be a mathematical relationship of AB=C.

1.6.4. The Past State of a Particle can be Measured Accurately

Heisenberg used an erroneous testimony about the uncertainty relation (the cited examples are projection measurements where the interference cannot be eliminated). It does not have universal significance. Under the constraints of misinterpretation, the present situation is that even if the position and the momentum of a microscopic particle are accurately measured at the same time, they are not recognized. The relationship between non-localization and the uncertainty relation is contradictory.

If we continuously measure the position of a particle in flight applying the way of quantum inverse measurement, both QIMT and the uncertainty principle allow the position of the particle to be continuously measured accurately. So, as long as the position of the particle is accurately measured continuously, the motion track of its past can be painted according to these position points (that is, its past track has been accurately measured), and the instantaneous velocity and motion direction of its past are also accurately tested. Logically, if the position of a moving particle in space is continuously determined, its past momentum cannot be uncertain. This is the logical paradox of the uncertainty principle (the paradox of the uncertainty principle for short). It is revealed by QIMT. If a microscopic particle is delocalized, then, both its position and its momentum cannot be accurately measured rather than just one of them can't be measured accurately.

As we all know, the principle of uncertainty allows one of the two conjugate physical quantities of a moving particle to be measured accurately enough. There is brief mathematical proof as follows. At the time interval *dt*, the position of a moving particle is measured twice. If both of the positions of the particle are measured sufficiently and accurately at these two moments, and they are (x_1, y_1, z_1) and (x_2, y_2, z_2) respectively, the distance between them is small enough $|\overrightarrow{dr}|$, then, in this interval, the past movement direction of the particle is accurate $\overrightarrow{dr}/dr$, the accurate momentum of the classical mechanics of the particle in the past is $m\overrightarrow{dr}/dt$. It is visible that at the point (x_1, y_1, z_1) (or between the two points (x_1, y_1, z_1) and (x_2, y_2, z_2)), both the position and momentum of the particle in the past can be simultaneously measured accurately enough. The connection between the two points (x_1, y_1, z_1) and (x_2, y_2, z_2) is the motion path of the particle in the past time interval *dt* obtained by measuring. Since both *dt* and *dr* are very small, the measured track *dr* has been very close to the true motion trajectory of the particle in the past. In mathematical language, the path integral *dt* is the movement track of the particle in the past minute intervals. In a certain space, only if the past position of a particle is determined continuously, the past momentum of the particle cannot be uncertain. If we only measure the momentum continuously, we can also get the result that the past position has a definite value in a certain space. It can be seen that the uncertainty principle is not applicable to the past of microscopic particles. The same problem exists in the uncertainty relation between the energy and the action time: the energy of a photon passing through the space can be measured accurately enough by its wavelength (or frequency); according to the uncertainty relation, the measurement time must be infinite. But the actual situation is not a very long time to be able to measure the photon energy.

1.6.5. The Heisenberg Relation Is not Necessarily a Relation of Measurement Uncertainty, Δx Is not the Uncertainty of Position Measurement

We can derive the Heisenberg relation from the classical motion law. For the microscopic particles as bound states of uniform circular motion, the product of its curvature radius r and linear momentum p is equal to $\hbar$, that is, its classic orbital angular momentum is $rp=\hbar$. Using the several relations of $r\leq\Delta x$, $\Delta p=p\sin\theta$ and $\sin\theta\leq 1$, $rp=\hbar$ can be turned into the form of $\Delta x\Delta p\geq\hbar$. The method is $rp=\hbar$ on both sides of the same times by $\sin\theta$, resulting in $rp\sin\theta=\hbar\sin\theta$. Because θ is the angle between the tangent and the direction of movement, they always have the relations of $\sin\theta\leq 1$. So, we have $rp\sin\theta\leq\hbar$. To make $\Delta p=p\sin\theta$, we have $r\Delta p\approx\hbar$. This is the formula whose shape is similar to the Heisenberg relation obtained according to the equation of orbital motion.[25] Note: for the regular curve motion of the particle, $\Delta p=p\sin\theta$ is not the uncertainty of the movement direction of the particles caused by random appearance in the range of $0\rightarrow\theta$, but is the emergence value of momentum in the normal direction appearing with a certain law. For uniform circular motion, it is the radial component of momentum. When a high-speed electron goes through the slit consisting of two fixed atoms, the effective action distance r of the electron passing through from the slit is less than or equal to the slit width Δx (that is $r\leq\Delta x$). In this way, when a particle does a uniform circular motion of bound state, its $rp=\hbar$ becomes $\Delta x\Delta p\sim\hbar$. At this time, although Δx is slit width, it is definitely not the uncertainty of position measurement. For high speed particles passing through the simple slit, there is a tight logical connection between r and θ. Once r has been accurately measured, both θ and $\Delta p=p\sin\theta$ can be calculated accurately. Once θ has been accurately measured, r can be accurately calculated. It is not possible that only one of r and θ can be accurately measured.

This brief derivation process shows: if it is not assumed that the microscopic particles can't do orbital motion, the Heisenberg relation cannot express that momentum and position cannot be accurately measured simultaneously. At the same time, it shows that the formula whose shape is similar to the Heisenberg relation doesn't deny "the state of microscopic particles can only be described by the wave function $\psi(x, t)$, and cannot be described accurately by the classical state function $f(r, p)$". It can be seen that the uncertainty relation itself cannot completely exclude orbital motion. The uncertainty relation can tolerate the determination and track motion of microscopic particles. The Heisenberg principle has been misinterpreted by the quantum physicists in the Copenhagen School. In the process of deriving the uncertainty relation, first, Heisenberg supposes that the momentum and position cannot be accurately measured simultaneously according to intuition, the $\Delta x \Delta p=\hbar$ relation formula is derived later. After that, it was interpreted as “two mechanical quantities whose operators are not commutation cannot have a determined value simultaneously.” This explanation obviously contains the component of the accommodation of the Heisenberg hypothesis. Its logical error is the widths Δx to be treated as the measurement uncertainty of spatial position. People also mistakenly extended the application scope of the Heisenberg relation to the free movement particles and the movement particles of bound states only to have constant interference.

It has been clearly pointed out that the slit width Δx is not a measurement uncertainty, but the reduction action distance between the incident particle and the nucleus. In the electron diffraction experiment, Δx is also the artificial region of random disturbance rather than the measurement uncertainty of position. When we shoot beyond the window into the distance with a gun, the location of the bullet through the window is random, but the size of the window is not the measurement uncertainty of the bullet's position. When a plane passes through a bridge, the size of the openings is not the measuring uncertainty of the position of a plane. It is similar to the case of a high speed electron passing through a slit. According to the theory of probability and mathematical statistics it is known that the significance of Δx in $\Delta x \Delta p \approx \hbar$ does not conform to the definition of uncertainty in spatial measurement (the method that obtained Δx is not the evaluation method for position measurement uncertainty). If we do some electron diffraction experiments in a chamber, we will certainly be able to intuitively find that the slit width is not the position measurement uncertainty of a high-speed electron. This kind of experiment can also judge whether the electron between the slit and the screen is in the diffuse state (or discrete). If the electron has a clear orbit in such an experiment, the diffraction pattern can be formed, which indicates that the diffraction is not electron diffraction.

The theoretical basis for the uncertainty relation and the explanation of Copenhagen's quantum mechanics are the von Neumann theory, the assumption of the De Broglie wave and “uncertainty relations can be derivate based on quantum mechanics basic postulate.” However, the above stringent analysis shows that these three bases are also unreliable. Since the Heisenberg relation is not necessarily the measurement uncertainty relation, and Δx is also not the uncertainty of position measurement, then, the principle of uncertainty mathematical expression can be derived according to the basic premise of quantum mechanics, it cannot be established as a solid foundation for the principle of uncertainty. $\Delta x \Delta p = \hbar$ is the Heisenberg relationship rather than the uncertainty relation.

Unless denying that the particle is a point particle or an entity, the particle's past can be accurately measured, whether or not it is subject to random interference. So the conclusions of this section echo each other with the conclusions of Sections 1.6.2 and 1.6.4.

1.7. The Main Content and Advantage of Tu's Measurement View and Interpretation System of Quantum Mechanics

According to the existing quantum mechanics, the microscopic particles have a verifiable property until the particles are measured or observed in some way. At this time, a particle can also appear in two or more places. But once measured, a particle collapses into a more classical reality, and only appears in one place. This concept can lead to two problems: first, the state before the measurement can never be verified experimentally; this leads to a number of conclusions at the inferred level (can only be speculative, which cannot be considered to have been verified by experimental methods); and second, the measurements led to the collapse and return to the classic reality, or it is already the case (classic reality), but never said clearly. There are no two problems in the measurement of quantum mechanics. There are no such problems as described in Section 1.2.

1.7.1. Tu's Interpretation System of Quantum Mechanics

The basic contents of QIMT and the measurement view and interpretation of quantum mechanics are as follows.

(a) Section 6.2 shows the structure of the object particles—an object particle is composed of a circularly polarized photon. It shows the source of the wave function of the object particle (for example, an electron is not a wave packet but a monochromatic wave). The square of the absolute value of the wave function is the field strength rather than the probability density. After the discrete waves form the localized particles, their whole is no longer discrete, and will not be non-localized. The moving route of the particle is the moving path of the point particle (the field source moves with its field: according to practice, often only considering the motion of the field source, it is also the movement of the center of gravity). In the case of a hydrogen atom, the extra-nuclear electron will not reach far places. In the space point at a distance, the electromagnetic field strength is not zero just as the appearing probability of an electron is not zero. If you want to let the object particles return to the state of a discrete wave, they must go through a decay process. In other words, it is only through a slit that the object particles will not return to the state of discrete waves.

As stated in Section 1.6.2, the wave of the object particles is not a probability wave. An object particle of motion will not appear, but comes and goes like a shadow, in the whole space. Under the condition of quantum inverse measurement, the eigenvalue obtained by a measurement is the only eigenvalue of the measuring time rather than one of many alternative eigenvalues (pure objective results can be obtained by interference-free measurement or the interference can be ignored). We no longer need the concept of wave collapse.

The model of the light knot electronic structure shows that an elementary particle is composed of a photon which is twisted. The wavelet packet structure model of the elementary particle is denied. The main contents of the existing superposition principle and wave-particle duality are also denied. The whole of the kinked photon is local and has a center of gravity, and the energy is relatively concentrated above the field source. The movement of such elementary particles is the movement of the local entity, in mechanics it can be seen as the movement of point particles. The results of double-slit diffraction experiments of physical particles were explained by the side effects of companion light. All phenomena of microscopic particles can be explained by the use of local realism and determinism. The uncertainty of microscopic particles can only be caused by random interference, rather than interference that is spontaneous and inherent. This explanation is Tu's interpretation of quantum mechanics.

The light knot basic particle model tells us that the free movement of the whole particle should not be described by wave function; the bound motion of particles in atoms and molecules is suitable for description by wave functions.

(b) In the diffraction experiments by double-slit of the object particles, one object particle can only pass through a slit at a time. The diffraction is caused by the effect of accompanying light, in the performance of the Huygens principle, and it is not possible to prove that the particles are non-localized. The truth is similar to the diffraction of a single water wave through a double slit which cannot prove that the water is non-localized.

The essence of Huygens' principle to be unknown is the expression of the complexity of the photon rather than the overall performance of the object particles.

At the same time, a particle cannot appear in two different places. The past position and the momentum of the particles can be accurately measured simultaneously.

(c) There is the measurement where only the information or substance is transmitted from the measurement system to the observer. This measurement is equivalent to the measurement of the measured system without interference.

(d) In the process of quantum inverse measurement, there is no coupling between the instrument and the measured quantum system, and the particle state of non-distortion can be obtained. In causing coupling between the two, the instruments' influence over the measured particle and the particle's influence over the instrument are asymmetrical.

(e) The Archimedes' segmentation point between the observer and the measured object can be obtained. The new measurement view in the context of QIMT is that "under certain conditions, it has to take into account the role of the instrument".

(f) The non-superposition state of microscopic particles can be observed by the quantum inverse measurement. The spontaneous original superposition state of microscopic particles (the superposition state between yourself and your shadow) is not the normal state of microscopic particles. That is to deny that the superposition state is the normal state of microscopic particles. To change the way of expression, the superposition of virtual states is also a virtual reality. That is, the superposition of the empty state without filling can be carried out at any time, but there are harsh conditions for the superposition of the filled states. For instance, the superposition of atomic hollow orbits can be carried out at any time, but the superposition of the track—how to fill the electron—is conditional. The superposition of coherent light is easy to implement, but it is not easy to realize the superposition between an electron and an electron. It is conditional on whether or not the homologous conjugated particles are stacked, rather than being in a state of superposition.

The situation will not happen where the classic characteristics of a particle are lost by the superposition between the particle and its own shadow and the loss. There is a less likely possibility that the twins lose their independence due to the superposition of states.

(g) QIMT reveals that the superposition principle can only be an assumption of the superposition of states. There is still a lack of conditions to lift it up to the principles. Even if it is called the assumption of state superposition, it is also not universal in the micro world. The universality of quantum state superposition is denied, and the universality of quantum mechanical probability interpretation is also denied.

(h) QIMT is closer to local realism than quantum weak measurement theory.

(i) The quantum inverse measurement can realize continuous measurement of the measured system without interference, and can be accurately measured everywhere. In this way, for the past of microscopic particles, it is impossible that the motion and position must not be accurately measured at the same time. It reveals that there is a logical contradiction in the principle of uncertainty.

(j) The anti-interference ability of quantum superposition states (quantum coherent states) is not zero, and the observer's consciousness has no effect on the state of the microscopic particles.

(k) Twin particles are always a pigeon pair. Wave packet collapse does not exist (even if there is a wave packet collapse, after the collapse, the state is the true colors of particles). Both quantum teleportation and quantum entanglement do not exist.

(l) QIMT itself does not deny the existence of a variety of phenomena (and related theories) that instruments have serious interference in the measured system. Only interference is random, and the result is random.

1.7.2. The Advantages of Tu's Measurement View of Quantum Mechanics

Existing important explanations of quantum mechanics require or acknowledge the existence of ghosts. The theory of more worlds does not need to think of particles as ghosts. However, the division and choice of the world (the distribution of signals in different worlds) requires a ghost or God for completion. The necessary condition for the existence of the world is that different worlds can overlap each other but must be independent of each other in the affairs of the process of things. It logically denies the independence of different worlds and that the same observer can see signals from different worlds. If different worlds cannot be independent, more worlds also do not exist (*i.e.*, still only one world). For the explanation of the experimental phenomenon, it is very important to find out the explanation which does not need any ghost and God.

Quantum inverse measurement theory has opened up a new method for the thorough application of quantum mechanics: quantum measurement has been integrally turned into an objective physical process without subjective intervention fundamentally. The advantage of Tu's measurement view and interpretation system of quantum mechanics lies in that it is deterministic and local realism. It can explain all the experimental phenomena of quantum mechanics, predicting the phenomena that the previous explanation system cannot predict. They are described as follows:

(1) Can explain the source of the wave function

See Sections 6.2 and 7.1 (a) for details. An explanation of the source of the wave function is also an explanation of the causes of wave-particle duality. Using the structural characteristics of particles to illustrate the nature of particles is also a major feature of this chapter (in this respect, Tu's theory is better than others' theory of homogeneity).

(2) Has the nature of local realism and determinism

It is assumed that the discrete waves propagate along the closed path to form the localized particles. The object particles can be described by wave functions, but the whole is consistent with the definition of classical particles. In the absence of decay, the object particles are localized and cannot be returned to the discrete state, and the movement can be described by coordinates and momentum. The future state of the particles can be accurately predicted. The superposition of the two object particles is generally a linear superposition of the field. The volatility of the observed object particles is actually a side effect, not a manifestation of the essential properties of the particles. There is the interference-free micro-measurement or the interference can be ignored. Under such a measurement condition, a purely objective state can be obtained. Only by random interference is the measurement result random.

(3) Not contrary to common sense, not confusing, and no need for the concept of wave collapse

The last advantage determines this advantage. This paper argues that: instantaneous quantum entanglement is derived from the fact that the twin particles are the pigeon pair originally; the empirical chain of the derivation of the instantaneous quantum entanglement conclusion is incomplete; and the conclusion of the continuous quantum entanglement experiment is defined by the experimenter. The interference fringe in the diffraction experiment of the object particles is the side effect caused by the accompanying light. In this way, quantum mechanics is no longer necessary to break common sense; it is no longer confusing.

(4) The interference fringes of the object particles are the side effect caused by the accompanying light

(5) Logicality is strong, and contradiction is less

This is decided by the above three.

(6) Easy to understand, easy to learn and remember

This is also determined by the above (1), (2) and (3).

(7) Can predict the phenomena that other theories cannot predict

See Section 1.7.3 for details.

1.7.3. The Predictions of Tu's Measurement View of Quantum Mechanics

(1) Doing the diffraction experiment by the double-slit of electrons in the spark chamber or the cloud chamber, we can observe the movement track of the electron, and determine which slit is passed through by an electron. Outside such an experimental device, if we add a magnetic field or an electric field, a small number of spots drift but the overall pattern of diffraction does not drift.

(2) If we insert a piece of glass that the electron beam cannot pass through but the photon can between the phosphor screen and the slit in an ordinary electron diffraction instrument, the diffraction stripes can still be formed.

(3) If we insert a piece of sheet that the photon cannot pass through but the electron can between the phosphor screen and the slit in the ordinary instrument of electron diffraction, the first order diffraction pattern cannot be formed (a secondary diffraction pattern may appear).

(4) The diffraction can be caused by the particles from the accelerator.

This can deny the conclusion that "wave packet collapse" can be caused by any experiment.

(5) Whether it is still or in movement, an object particle can flip (it's like a Ping-Pong ball and football shoot out) and not flip. This is the reason why the micro particles are not distinguishable (the concept of all identical particles is formed).

1.8. Concluding Remarks

The error in the interpretation and understanding of quantum mechanics stems from the lack of knowledge of the structure of the elementary particles. In addition to the limitations of this knowledge, the weakness of human nature is also the wrong source of quantum mechanics (for their own interests and blindly following the authority and the mainstream and suppressing new ideas). The weakness of human nature leads to the mainstream scholars in the interested community not explaining experimental phenomena according to the facts, but to select some interpretations of experimental phenomena of quantum mechanics according to their own needs (that is, they deviated from the dialectical track and lost the logic principle because of the weakness of human nature). The most representative of the two types of wrong behavior is as follows: strictly speaking, no Bell experiment can exclude all conceivable local-realist theories, because it is fundamentally impossible to prove when and where free random input bits and output values came into existence.[19] The diffusion and preservation of errors in quantum mechanics are also related to philosophical errors. They always use "agnosticism" in quantum mechanics to cover up the inadequacy of knowledge, the defects of understanding, and the logical defects. It is also common to use the term "weird features" to stop people asking questions and more questions.

The diffraction of object particles is most likely caused by directional quantization. However, in the case of the absence of an experimental approach to deny that the diffraction of object particles is caused by directional quantization, orthodox physicists have used interpretations that object particles themselves have volatility.

As long as we stick to the principle that the empirical chain must be complete, and use the side effect caused by the accompanying light to explain the experimental results of electron diffraction, everything will change. The essence of the instantaneous quantum entanglement experiment is that the twin particles are a pigeon pair before being measured. The experimental results of the continuous quantum entanglement result from the experimenter's definition of quantum entanglement. Orthodox physicists did not use the experimental method to deny that the twin particles were originally a pigeon pair. In the case of the absence of an experimental approach to deny that the diffraction of object particles is caused by accompanying light, the orthodox physicists have used the interpretation that object particles themselves have volatility. It can be seen that the conclusions in this chapter are no harsher than those of previous physicists. See Section 1.7.2. for additional information on Tu's theory.

Before the prediction is confirmed, existing phenomena can be interpreted by this book in a manner that does not violate common sense, and logical self-consistency has been achieved. This reflects the significance of this research work (there is the value of discussion and hot debate). Once the prophecies have been experimentally verified, it will quickly change the concept of people understanding the micro-world and end the debate on quantum mechanics, so that quantum theory and its application go back to the correct direction of development. The birth of the interpretation program of quantum mechanics for local realism and determinism also opens the revolutionary path for material structure theory.

Quantum inverse measurement theory has created a new method of thorough application of quantum mechanics—quantum measurement has been turned, from the whole, into an objective physical process without subjective intervention. Tu's interpretation of quantum mechanics is at least an alternative quantum mechanical interpretation scheme. It also needs to be supplemented and perfected. The most urgent task is to complete the verification experiments designed in this paper. Tu's measurement view and interpretation system of quantum mechanics must be applied to quantum electrodynamics. The relation between Tu's interpretation system of quantum mechanics and the mathematical formalism of quantum theory must also be established. The mutual transformation between photonics and electrons, photons and protons has been reliable experimental evidence. However, the mechanism of such a transformation process remains to be studied. I hope the conditional readers will do it voluntarily. It is necessary to verify the predictions in this chapter by using the experimental method, even if it is to maintain the old quantum mechanics interpretation system.

References

[1] Runsheng Tu (2015), *Local Realism Quantum Mechanics*, 1-242. Lanham: American Academic Press.

[2] Y. Aharonov, D. Z. Albert, and L. Vaidman (1988), *Phys. Rev. Letts.*, **60**, 1351.

[3] Yusuf Turck (2012), Quantum Weak Measurement Theory and Its Applications [D]. Graduate University of Chinese Academy of Sciences.

[4] Lee A. Rozema, Ardavan Darabi, Dylan H. Mahler, Alex Hayat, Yasaman Soudagar, and Aephraim M. Steinberg (2012), Violation of Heisenberg's Measurement-Disturbance Relationship by Weak Measurements. *Phys. Rev. Lett.,* 109, 100404.

[5] S. Kocsis, A. M. Steinberg, et al. (2011), Observing the Average Trajectories of Single Photons in a Two-slit Interferometer. *Science*, vol. 332, 1170. An experiment which determined the Trajectories of

Single Photons through a Two-slit Interferometer.

[6] A. Einstein (1936), Physik und Realität, *Journal of the Franklin Institute*, 221, 313-347, reprinted in translation in Einstein (1954).

[7] A. Einstein, B. Podolsky, and N. Rosen (1935), Can Quantum-Mechanical Description of Physical Reality Be Considered Complete? *Physical Review*, 47, 777-780. http://fanyi.baidu.com/ - ##.

[8] Steven Weinberg (2017), The Trouble with Quantum Mechanics. *The New York Review of Books*, January 19, 2017 Issue. http://www.nybooks.com/articles/2017/01/19/trouble-with-quantum-mechanics/.

[9] Runsheng Tu (2015), *Local Realism Quantum Mechanics*, 1-242. Lanham: American Academic Press.

[10] Yu Shi (2017), Continue the quantum mechanics revolution. *Guangming Daily*. May 25, 2017. 13th Edition.

[11] Runsheng Tu (2013), The Formula Whose Shape Is Similar to a Heisenberg Relation Possesses the Double Meanings of Determinism and Indeterminism. *Infinite Energy*, no. **107**, 44-46. http://www.docin.com/p-765650007.html.

[12] N. Bohr (1929), The Quantum of Action and the Description of Nature. *Naturwissenschaften*, Planck special issue. Originally published in German in *Naturwissenschaft*, vol 17, 1929. First published in English in 1934 by Cambridge University Press.

[13] Alastair Rae (1991), *Quantum Physics: Illusion or Reality*. J. J. Sakurai, *Modern Quantum Mechanics*, 223-241.

[14] David W. Cohen (1989), *An Introduction to Hilbert Space and Quantum Logic*, 94-104. Springer-Verlag.

[15] N. Boh. (1935), Can Quantum-Mechanical Description of Physical Reality Be Considered Complete? *Physical Review*, 48, 696.

[16] D. Leibfried, E. Knill, S. Seidelin, J. Britton, R. B. Blakestad, J. Chiaverini, D. B. Hume, W. M. Itano, J. D. Jost, C. Langer, R. Ozeri, R. Reichle & D. J. Wineland (2005), Creation of a six-atom 'Schrödinger cat' state, *Nature* **438**, 639-642 (1 December 2005) | doi:10.1038/nature04251.

[17] H. Häffner, W. Hänsel, C. F. Roos, J. Benhelm, D. Chek-al-kar, M. Chwalla, T. Körber, U. D. Rapol, M. Riebe, P. O. Schmidt, C. Becher, O. Gühne, W. Dür & R. Blatt (2005), Scalable multi-particle entanglement of trapped ions. *Nature* 438, 643-646 (1 December 2005) | doi:10.1038/nature04279.

[18] Yi-Tao Wang, Jian-Shun Tang, Zhi-Yuan Wei, Shang Yu, Zhi-Jin

Ke, Xiao-Ye Xu, Chuan-Feng Li, and Guang-Can Guo (2017), Directly Measuring the Degree of Quantum Coherence using Interference Fringes. *Phys. Rev. Lett.,* 118, 020403. Published 12 January, 2017.
[19] B. Hensen, H. Bernien, A. E. Dréau, A. Reiserer, N. Kalb, M. S. Blok, J. Ruitenberg, R. F. L. Vermeulen, R. N. Schouten, C. Abellán, W. Amaya, V. Pruneri, M. W. Mitchell, M. Markham, D. J. Twitchen, D. Elkouss, S. Wehner, T. H. Taminiau, R. Hanson (2015), Loophole-free Bell inequality violation using electron spins separated by 1.3 kilometres. *Nature* **526***,* 682-686.
[20] E. Schrödinger (1935), *Proc. Cambridge. Phil. Sol*., 31, 555-763.
[21] J. Von Neumann (1955), *Mathematical Foundations of Quantum Mechanics*. Princeton: Princeton University Press. German Version 1932.
[22] J. Bell, *Physics*, 1, 195-200 (1964); *Rev. Mod. Phys*. 38, 447 (1966).
[23] A. Aspect, et al., *Phys. Rev. Letts*., 47, 460 (1981); ibid. 48, 191 (1982); ibid. 49, 1804 (1982).
[24] L. R. Kasday, J. D. Ulman and C. S. Wu, Nuovo Cimento 25B, 633 (1957).
[25] Runsheng Tu (2013), The Formula Whose Shape Is Similar to a Heisenberg Relation Possesses the Double Meanings of Determinism and Indeterminism. *Infinite Energy*, no. **107**, 44-46. http://www.docin.com/p-765650007.html.

CHAPTER TWO

MANY RELIABLE REASONS HAVE BEEN FOUND FOR "NON-RANDOMNESS" AND "NON-NECESSARY SUPERPOSITION" OF THE MICRO SYSTEM: BREAK AWAY FROM THE SHACKLES OF THE OLD THEORY AND OLD IDEAS

The things that can be described by the wave function are not necessarily waves. The things described by wave functions don't always superpose together. The most famous example is that the motion of a spring harmonic oscillator can be described by a wave function, while the spring harmonic oscillator isn't a wave, and cannot superimpose across a separated place. In addition, the things described by wave functions are not necessarily non-local and non-reality.

Many people are dissatisfied with the explanation of the existing quantum mechanics. These are all the disasters courted by the concept of wave-particle duality which are full of contradictions (there is inherent contradiction in the existing concept of wave-particle duality—wave dispersion is irreconcilable with the localization of particles). Both non-local-reality and indeterminacy are generated to cater to wave-particle duality (the inherent contradictions of wave-particle duality have not been solved, and will be left to pass on).

For the first time, the reason that people have to focus on the non-classical description is that the concept of the wave-particle duality of microscopic particles has been created by the electron diffraction experiment. In theory, the uncertainty relation and uncertainty principle also consolidate the idea that microscopic particles have to be described by the wave function. Later, some people claimed to have discovered the phenomenon of quantum entanglement experiments. This lays the foundation for the explanation of the quantum mechanics of non-locality realism. This chapter will critique the existing interpretations of quantum mechanics from these sources.

Previously, people did not succeed in establishing localized realism quantum mechanics. The fundamental reason was that they did not find a deeper problem in existing quantum mechanics, and did not find a solution to these problems. What they all have in common is that they are inverse quantum mechanics under the assumption of wave-particle duality and quantum entanglement. As long as the inherent contradictions in the concept of wave-particle duality are eliminated (having found the structural model of wave and particle harmonization), the description of non-locality, non-reality and indeterminism can be avoided. The effect is better if electron diffraction experiments are explained under the condition that wave-particle duality isn't used. Whether "Quantum Mechanics of Local Realism" can be established successfully or not depends on whether we can find the "structural model of the harmony of waves and particles" and the explanation of the non-wave-particle duality of the phenomenon of double-slit experiments. Before me, someone wanted to establish a localized reality of quantum mechanics without success. The reason is not to do what should be done.

2.1. The Serious Problem of Huygens' Principle

There are many problems in Huygens' principle, and the biggest problem is that it violates the law of conservation of energy. We should try to avoid bringing the problems of Huygens' Principle to quantum mechanics.

Energy conservation law is one of the basic laws of nature. Any theory that does not comply with the law of conservation of energy is wrong. Using Huygens' principle to explain the interference of light waves does not conform to the law of conservation of energy.

Every point (surface source) on the wave surface is a sub-wave source of secondary spherical wave. The wave velocity and frequency of the sub-wavelet are equal to the wave speed and frequency of the primary wave. Thereafter, the envelope of the wavelet face at each time is the wave surface of the total wave at that time. That's Huygens' principle. It is more successful to use it in medium vibration waves. The use of it in light waves will expose a lot of serious problems.

The energy of the light wave is only related to the frequency ($E=h\nu$. The frequency is constant and the energy does not change). In the splitting of waves described by Huygens' Principle, the number of wavelets is more than the primary of mother waves, but the frequency, wavelength and wave speed of the sub-wave and primary wave are equal. In this way, the total energy of the sub-waves is greater than the total energy of the primary waves. It is acknowledged that Huygens' principle is more difficult to use to explain the various phenomena of the wave quantitatively. It includes the inability to quantify the change in the energy of the light wave when it passes through the slit. This is a very serious problem, enough to cause Huygens's principle to explain the failure of light wave diffraction.

If some of the parent photons pass through the slit and reach a fluorescent screen, they are diffracted. According to Huygens' principle, the number of primary photons is not equal to the number of sub-photons, and the number of photons reaching the screen is not equal. In other words, the number of photons found on the screen is not equal to the number of primary photons and not the number of the sub-photons. In this way, the probability of finding a photon across the slit on the screen cannot be normalized.

To retain the Huygens-Fresnel principle, it is necessary to admit that the energy of the electromagnetic wave is not only related to the frequency of the wave, but also to the amplitude of the wave.

$$E=(A/A_0)^2\, h\nu \tag{2.1}$$

Where: Wave A real-time amplitude, A_0 is the basic amplitude constant. This formula is derived from the absolute value of the square of the amplitude of the wave that is proportional to the energy density. In such a case, the Huygens-Fresnel principle can be used only when explaining diffraction phenomena. For example, if a primary photon decomposes into 16 sub-photons, it is not a violation of the law of conservation of energy as long as the amplitude is reduced by a factor of four.

However, it is still a problem to use Huygens' principle to explain the double-slit diffraction experiment of electrons. How does an electron split into a number of sub-electrons? Can the wave form of electrons split and the particle form of an electron not split?

2.2. The Paradox of the de Broglie Wave Hypothesis: The Experimental Evidence of the Wave-particle Duality of the Object Particles Is Weakened

De Broglie put forward the real volatility hypothesis of particles, which is considered to be an inspired passage. But the de Broglie wave has a scientific problem from beginning to end. Incredibly, the quantum physicists in those years treated these difficulties in the way of "caring for this and losing that".

2.2.1. Difficulty of Wave Front Velocity

We use electronics as an example. Electrons flying at a speed of 30,000 kilometers per second have a de Broglie wavelength of $\lambda=\hbar/m\upsilon=\hbar/p$ while, $E=\hbar v=\hbar\upsilon/\lambda=p\upsilon$. When it is associated with the mass energy equation $E^2=m^2c^4+p^2c^2$, $\upsilon^2=m^2c^4/p^2+c^2$ can be obtained. The electronic wave front velocity (*i.e.* its phase velocity) is $\upsilon = c\sqrt{1+m^2c^2/p^2}$. This speed is greater than the speed of light.

It is problematic to describe the energy of de Broglie waves of particles with $E = \hbar v$. The result that the phase velocity of de Broglie waves is greater than the speed of light is the result of this problem. $E=\hbar v=\hbar\upsilon/\lambda=p\upsilon$ describes twice the kinetic energy of the particle's overall motion. It is not the total energy of the particles (because the particles also have an intrinsic motion), and the total energy of the particle is $E^2=m^2c^4+p^2c^2$. It is necessary to get the kinetic energy expression $E=\hbar v=\hbar\upsilon/\lambda=p\upsilon$ together with the total energy expression $E^2=m^2c^4+p^2c^2$ to get the wrong result. However, if one admits that the microscopic particles have internal energy in addition to $E=\hbar v=\hbar\upsilon/\lambda=p\upsilon$, it is admitted that the microscopic particles always have intrinsic motions rather than complete waves. In this way, the interpretation of de Broglie waves of particles is not available.

As long as we consider the particle group speed there are no de Broglie wave velocity problems. The reason for this is that there is no error in the calculation of the total energy of the physical particles, rather than the disconnection between the wave front and the wave group of de Broglie waves.

2.2.2. Wave-packet Stability is Difficult and Coherent Superposition is Difficult

In order to overcome the difficulty of the wave speed of de Broglie waves, it is believed that the de Broglie wave is a wave packet concept. Wave packets consisting of different wavelengths are unstable and will be discrete over time. However, the electron as a de Broglie wave is stable.

As a result, stable electrons are difficult to equate with the erratic de Broglie wave package. In other words, it is impossible to be scientific and reasonable to think that the electronic de Broglie waves are wave packages. If we believe that the electron diffraction experiment confirmed the existence of a de Broglie wave, we must adopt the point of view that the de Broglie wave of an electron is a monochromatic wave. Is an object particle in the end a monochromatic wave or a wave package?

For the De Broglie wave package, there is also the problem of interference (interference problems). If de Broglie waves are wave packages, how do the electronic de Broglie waves interfere with each other to create interference fringes? You know, in the study of the phenomenon of electron diffraction experiments, both qualitative and quantitative, is the electronic de Broglie wave as a monochromatic wave.

2.2.3. The Difficulty of Mutual Conversion between Waves and Particles

In the course of a particle passing through a double slit, it is much harder to split an electron into a number of sub-electrons than a photon to split into a number of sub-photons. We do not know the specific form of a de Broglie wave, nor do we know the wave field of a de Broglie wave (we do not know the interaction between de Broglie waves coherent superposition).

In view of the above reasons, the following two questions are difficult to answer. How to change the particle state of microscopic particles into a fluctuating state? How to change the particle state of microscopic particles into a fluctuating state? In describing the microscopic particles, they are considered either as complete particles or as complete waves. On many occasions, people also think that the microscopic particles have the dual nature of waves and particles, namely wave-particle duality. The conversion between a particle and a wave is instantaneous, and the physical mechanism is never clear. This is the difficulty of mutual conversion between waves and particles.

2.3. The Essential Exploration of the Electron Diffraction Experiment

Many people have done experiments in which cathode rays are deflected in the magnetic field. In this experiment, the path of the cathode ray is visible (see **Figure 2.1**). The reason, however, is that the electrons do not emit light themselves, but electrons and small molecules in the vacuum tube act as a result of luminescence. Since the electrons of motion can cause luminescence, the light emitted is not necessarily visible light; *X*-ray machines produce *X*-rays in a similar way. It is necessary to exclude this possibility. It is necessary to eliminate this possibility.

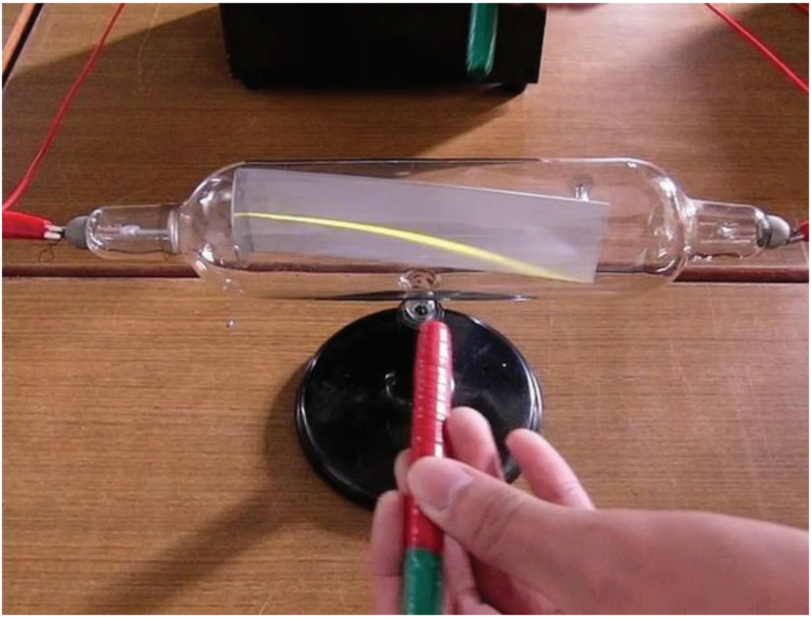


Figure 2.1. The cathode ray deflected in the magnetic field.
In this figure, the two-color stick in the left hand is a magnet, and the luminous rays in a transparent glass tube are electron beams. The cathode ray itself is not visible. We see is its accompanying light.
Cited from: http://p4.qhmsg.com/t012024fb2d37cc1d56.jpg.

Not long ago, I reworked the electron diffraction experiment. Compared with the electron diffraction experiments made in the last century, my improvement is that: first, the electron beam was collimated (focused) by using an electromagnetic field in the device; second, I added a magnetic field at the end of the phosphor screen (the experiment results are shown in **Figures 2.2**, **2.3** and **2.4**); third, I use a small generator as a dedicated power supply (generator produces 220V 50Hz AC). I implemented the "closed-circuit electron diffraction experiment" (except for the electronic numbering operation). In the diffraction pattern, the bright spot in the middle is small and the darker lines are wider. In the whole diffraction process, the deflection of the electron beam is exactly similar to that of the electron beam in **Figure 2.1** (point charge in a magnetic field deviating from its original orbit by force). Someone has done experiments to let electrons pass through one double slit one after another. As a result, the light and dark stripes are formed by the accumulation of point particles rather than by the interference of waves (shown in **Figure 2.5**). This more intuitively reflects the fact that electrons exist in the form of point charges throughout the diffraction process. Combining these two experimental results, we can be sure that the diffraction pattern in the electron diffraction experiment is the collective manifestation of point particles without the interference of waves (without coherent superposition of waves). The reason is that the experiment I did showed that the measurement of electrons by the magnetic field did not cause the electrons to collapse in space (if the wave-packet collapses between the slit and the screen, we cannot see the diffraction phenomenon).

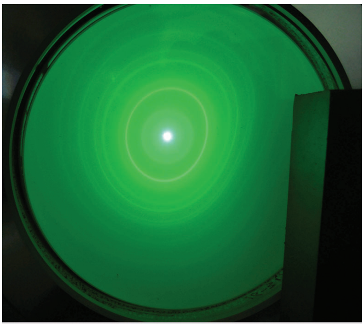


Figure 2.2. Electron diffraction pattern shifted left in the magnetic field. The right side of the strip is a magnet whose surface magnetic field strength is 6000GS.

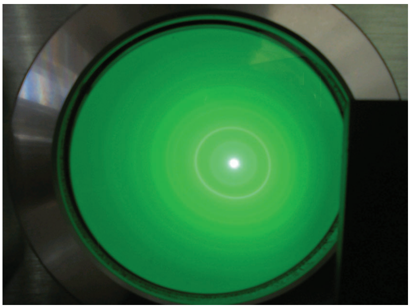


Figure 2.3. Electron diffraction pattern shifted right in the magnetic field. The direction of the magnetic field is opposite to the one of figure 1.

Figure 2.4. Electron diffraction pattern (unaffected by magnetic field).

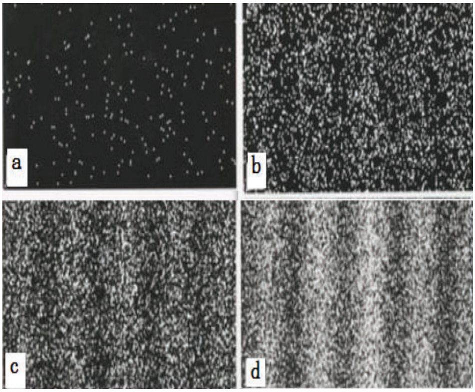


Figure 2.5. Single electron double-slit diffraction pattern. The number of electrons passing through the slits: a) 200; b) 3000; c) 5000; d) 70000.

2.4. Direction Quantization Interpretation of Diffraction Fringes

This is one of the strong technical supports of determinism. We may not turn our eyes to the non-classic description's most powerful technical support that wave function may be not used.

Compared with photons, electrons are more difficult to split. Using the Huygens-Fresnel principle to explain the diffraction of electron waves is more far-fetched. In fact, the motion of electrons in an atomic orbit follows the law of angular momentum quantization. Angular momentum quantization leads to the direction quantization of moving electrons. Although the incident electron is not the particle bound by the nucleus, it is near the nucleus, and it is not impossible to follow the laws of quantization. If the direction is quantized, and the quantum numbers are 0, $\pm(2k+1)$, among them, $k=1,2,3\ldots$, the pattern of light and shade of electronic diffraction and/or X-ray diffraction can be interpreted. The rays and directions are determined by $a\sin\varphi=\pm(2k+1)\lambda/2$ (if the incident particles are not affected or are affected by the uniformity and symmetry, the direction of the ray is determined by $a\sin\varphi=0$). The ambiguity of the bright pattern is mainly caused by the interaction between the electrons and phonons. There is less contradiction in this explanation. Moreover, in the microscopic system, quantization is the characteristic that is not to be doubted. We have no reason not to use it. This interpretation acknowledges that electrons are localized particles, and denies “that object particles can either be complete waves or complete particles, and can be instantaneously converted between the two”. It breaks the commandment that the microscopic particles must be unconditionally described by the wave function, and removes the barrier between the microscopic world and the macro world. Thus, the phenomenon of electron diffraction experiments is to support the theory of local realism rather than to the contrary, as is now generally accepted.

In summary, when crossing the slit, why do the electrons show statistical volatility? This still needs to be explored at least. If direction quantized interpretation is used, the microscopic particles will no longer have the spontaneous uncertainty (this is especially true for free movement of microscopic particles in a vacuum). Quantum properties such as quantum parallelism, non-locality, and uncertainty have lost a great deal of support.

The role of direction quantization interpretation is to deny the wave-particle duality and the non-reality of micro particles (does not support that microscopic particles can appear in different places at the same time). In addition, it is extremely disadvantageous to the discreteness, the state superposition principle and the wave packet collapse concept of micro particles.

2.5. The Model of Light knot Electronic Structure: The Second Powerful Technical Support that Probability Interpretation may be not used

With this model, a probability interpretation is no longer used even if the wave function description is used.

Logically, the particles that can be stationary are localized particles, the particles that cannot be stationary are discrete waves, and the discrete wave propagates along a small closed path to form a localized particle. This is the structure of the wave knot of a fundamental particle. For electrons or protons, the “wave knot” is an “light knot”. Closed chords are also of this structure. At the beginning of the establishment of quantum mechanics, Lord Kelvin mentioned the elementary particle structure model. But he mistakenly believes that this structural model cannot solve the problem of atomic stability, so the model has not been recognized. Kelvin is too famous, he has no confidence in his theory, and others will not support it. It is not the model that is incorrect. In the 21st century, whether it is superstring theory or loop quantum theory, as well as geometric algebra material structure theory, in essence, they are based on the quantum motion—the closed curve of the knot.

In Ref. [1], I point out that an electron is formed by the simplest circularly polarized photon propagating along the closed path (belonging to a closed string structure model: this is the one kind of Kelvin wave model of the knot). The wave function of circularly polarized light is

$$\psi(x,t) = Ae^{-i2\pi(\nu t - x/\lambda)}. \tag{2.2}$$

The wave function of an electron is also Eq. (2.2). It also shows that an electron wave is a real monochromatic wave rather than a probability wave or a wave packet. The square of the module of the amplitude is field strength rather than probability density. The whole of this light knot is localized. The center of gravity of the object particles can still be described by position and velocity, and the future of moving particles can be predicted. This structural model laid the foundation for the establishment of the interpretation system of quantum mechanics of local realism and determinism. The experimental results of diffraction by double-slit of electron can be explained by direction quantization or the effect of accompanying light. After reading this passage, you should be more convinced that the 3D regression curve of the cloud belt in the chamber is the exact path of the particle.

Some people may say that Eq. (2.2) is the wave function of a planar polarized light. The fact is that the wave function of plane-polarized light is $\Psi(x, t)=A\cos[2\pi(\nu t-x/\lambda)]$, while Eq. (2.2) is not equivalent to this equation. More specifically, Eq. (2.2) is not a wave function of plane-polarized light but a wave function of circularly polarized light. The reader may have noticed that I replaced “the wave function in the general textbook to be similar to Eq. (2.2)” with “to be Eq. (2.2)”. This is not just a word problem, but there are essential differences. First, I pointed out the source of the wave function. Second, a variety of operators can be derived from Eq. (2.2). The method is as follows, to do a partial differential operation of q and t for Eq. (2.2). Both the first order partial differential and the second one are required. According to the classical formula of mechanical quantity, $p=h/\lambda$ (or $mv=h/\lambda$), the bound motion equation of a charge, the fine structure constant expressions, and the electron velocity in the ground state hydrogen atom $\upsilon=\alpha c$ obtained by Bohr’s atomic model, we can get the corresponding mechanical quantity operator. The eigenvalues of the corresponding mechanical quantities can be obtained by applying the resulting operator to Eq. (2.2) (see Eq. (2.3)).

$$\hat{Q}\psi(x,t) = Q\psi(x,t)\,. \tag{2.3}$$

The operator $\hat{Q}$ of mechanical quantities is arbitrary. If the operator acting on the wave function is equivalent to the measurement, then Eq. (2.3) means that the state of the system is not changed by measurement (the wave function Ψ $(x,\ t)$ on both sides of the equal sign is exactly the same).

According to $E_p=p^2/2m$, E=E_p+V and the above method, the energy operator can be obtained. The energy operator acting on the wave function is the Schrödinger equation.[1] It can be seen that the third postulate of quantum mechanics is not the most fundamental, but can be deduced. Third, the eigenvalues of the mechanical quantities thus obtained are unique, not probabilistic. Fourth, it is finally shown that the state after the measurement can still be described by the Schrödinger equation. It is the four that have completely destroyed the existing quantum mechanics measurement concept, and smashed the cornerstone of quantum mechanics for non-local realism.

The electron spin angular momentum operator obtained by the above method is

$$\hat{M}_s = -i\frac{\hbar^2}{4mc}\frac{\partial}{\partial x}\quad . \tag{2.4}$$

The spin angular momentum obtained by above the operator to be applied to the wave function is $\hbar/2$. Spin angular momentum divided by $\hbar$ is the spin quantum number. It can be seen that the spin is actually a quantum number describing the angular momentum characteristics of particles. Spin, like mass and electric energy, is the reflection of the intrinsic properties of elementary particles (specifically, angular momentum properties).

The premise that the electron consists of the simplest circularly polarized photon determines that the wave function described by Eq. (2.2) is very stable. If it does not meet the violent conditions of annihilation or decay, its form will not change. If you do not achieve the above two conditions, the other actions are equivalent to the actions of the field to the wave. These effects follow this law that, in the potential field, the energy of the wave changes but the form of the wave does not. In other words, measurements under non-violent interactions result in only energy changes without causing structural changes in particles (the structure has not changed, of course, the nature has not changed). Change in energy, the speed of motion and the direction of motion (and perhaps the direction of spin) can be caused by measuring. The main content of the model of the light knot electronic structure is that the wave making a circle is the particle, and the particle nature is the wave. When a wave changes into a particle, it does not collapse. The movement of particles is the overall movement of the light knot, not the movements that appear and disappear mysteriously. When it is not measured, it conforms to Newton's laws of motion and the laws of electromagnetism (the states of particles are definite). In other words, as long as the particle is objective, it is definite (with a definite form of existence and motion) before it is measured. The idea that an electron must be in the state of superposition of the two opposite states of spin has no market in the theoretical framework of the electronic structural model of light knots.

The closed-string structure of the localized particle is the particle structure which is most coordinated between the discrete wave and the local particle. This particle structure denies the existence of the point-particles, affirmed that the object particles are also waves, and explained the wave-particle duality of object particles. If you follow the past concept of particles, this structure is the unity of particles and waves. Although the particles are formed by waves, the whole of a particle is localized and has a center of gravity. Since the particles are formed by waves, it is not surprising that the particles have wave-particle duality. It intuitively denies the spontaneous uncertainty that localized particles are in diffuse and/or discrete states. The closed-string model is in harmony with the quantum inverse measurement theory (mutual evidence and mutual support). This model dictates that there is only one factor that determines the uncertainty of the state of the particle—the interference of the instrument at the time of measurement. Quantum inverse measurement can rule out the only determining factor. Therefore, quantum inverse measurement can be the purely objective particle state.

A 3D regression curve of droplet center coordinates can be obtained by using a cloud chamber to capture a high-speed moving charged particle. According to the working principle of the chamber we know that, even if "a measured particle returning to the classical state due to the collapse of the wave packet" is true, this curve can only be an accurate moving path of the measured particle. If we believe the model of the light knot electronic structure, then the 3D regression curve caused by the measured electron is the curve drawn by the movement of the gravity center of the light knot. The secondary diffraction experiments of electrons show that continuous measurement can be made under conditions that ensure that quantum coherence does not disappear. The thinking to infer this conclusion is very clear. However, in order to cater for the uncertainty principle, quantum physicists unreasonably deny the fact. The uncertainty principle allows the position of the moving particle to be accurately measured. The two diffraction experiments of electrons show that it can be measured continuously under the condition that quantum coherence does not disappear. If the position of a particle is measured continuously and accurately, the position and momentum of the particle are measured accurately and simultaneously. From two aspects of theory and experiment, it has been proved that the state of the particles in the past can be determined. In addition, the experimental results of particle diffraction can be explained by "directional quantization". Therefore, we can be sure that the diffraction of the object particles cannot be used as the basis for the "non-locality and spontaneous uncertainty" of the particles. Moreover, it is pointed out that the object particles are not wave packets, and the state obtained by means of measurement is not the state of the collapse of the wave packet but the original state of the particle. In this case, the 3D regression curve mentioned above can only be the exact path of the particle. Even if the particle is composed of a wave packet, the 3D regression curve is also the line drawn by the center of gravity of the wave packet.

The function of the model of the light knot particulate structure is to clarify the essence of the wave functions—the equation of motion of a wave forming a particle. It gives the two wave images with a new connotation—a wave is propagated along a very small closed path to form a domain entity (a form of harmony and unity between waves and particles, or a form of harmony and unity between discreteness and locality). The shelter of the concept of wave packet collapse was cleared by it. It allows the "Born probability density" to be replaced by the "energy density". It returns the main properties of a quantum from "discrete change" to "quantization". The next chapter also talks about its contribution to the reduction of the number of postulations in quantum mechanics and the establishment of a mathematical form of quantum mechanics.

2.6. The Major Logic Defects of Experiments Explain Quantum Entanglement: The Third Powerful Technical Support of Local Realism and Determinism

Has the state change of twin particles in a measurement process about quantum entanglement been verified? The answer is no. The reason is actually very simple. Only, two times before and after, the measurement of the same system and the discovery that the state is not the same, just confirmed the previous measurement and led to state changes. However, admitting that "as long as the measurement results in a change in state," it is inevitable that two measurements of the same constant system of quantum states cannot be made. In addition, there must be an entangled state (*i.e.*, the superposition state), and then a change in the state is caused by measurement. Orthodox quantum physicists interpret some experimental phenomena as the existence of quantum entangled states on the basis of “measurement-induced state change”. This is a logic cycle. In other words, the experiment explained on the basis of the argument that "measurements lead to changes in the entanglement state" is not a verification of the existence of quantum entangled states. Since the "measurement-induced change in state" has not been demonstrated, the existence of quantum entangled states has not been empirically proven. The above rigorous logic analysis shows that the existence of entangled states is hypothetical.

The empirical train in the experiment’s interpretation to verify Bell’s inequality[7][8] is incompleteness. This is also the greatest logical loophole in the explanation of quantum entanglement experiment phenomena, which is irrelevant to the experimental method and only related to the method of phenomenon interpretation. Specifically, the premise is that the change of quantum state of the twin particles is due to measurement, which is required by the explanation that as the existence of quantum entanglement has been verified, it is speculated by theoretical method rather than rigorously verified by experimental methods.

It is self-evident that some people may think that the measurement will inevitably lead to quantum state changes. However, even if "measurement necessarily leads to the change of quantum state" is self-evident, before admitting that the measurement leads to the change of the quantum state, it is necessary to admit that the entangled system (in the system of quantum superposition states) exists before the measurement. Otherwise, one cannot assume that the quantum state changes before and after the measurement.

In this way, the explanation process of the quantum entanglement experiment is like this: Quantum entanglement exists → Measurement leads to this quantum state change → The measurement shows that the quantum entangled state exists. The beginning is the existence of the quantum entangled state; the end is also the existence of the quantum entangled state. No matter what kind of process is in the middle, it is a circular argument.

Just by believing that the state of the twin particles must be changed by any measurement, then the state of the twin particles cannot be experimentally verified before the measurement. In other words, only when we measure the same particle twice before and after and find its state is different can we think that the state change of the particle has been experimentally verified. For only one measurement, it is not possible to say that the state of the particle has been experimentally verified. Thus, "the states of the twin particles are changed when they are measured" is not proven (the empirical chain is incomplete). For quantum entanglement experiments, the so-called "state change in the measurement" means that the quantum entangled state is present before the measurement and changed during the measurement. If it is hoped that the Aspect experiment will be interpreted as the existence of a super association between the twin photons, it must be assumed that the quantum entanglement between the measured twin particles is present before the measurement. The premise is "that the quantum entangled state exists", and the reasoned result is also "that the quantum entangled state exists". This is a typical logical loop.

As long as we do not assume that the quantum entangled states of the twin photons exist before the measurements, in the measurement of one of the twins, there is no change in the direction of polarization of the photon, and the Aspect experiment cannot be interpreted that the existence of a super association between the twins was discovered. In other words, the existence of "instantaneous quantum entanglement effects" is related only to the "artificial assumption that quantum entanglement exists before measurement", independent of the Aspect experiment. For the scientific demonstration process, the empirical chain is included in the logical chain. The incomplete strand of the empirical chain is a logical loophole. In the explanation process of the quantum entanglement experiment, the incomplete empirical chain is the biggest logical loophole in this process. The most common way to mask logical loopholes is a circulatory argument. Quantum entanglement is the emperor's new clothes. Quantum mechanics scientists, however, have fooled many people for many years with a logical loop trick.

The largest logical loophole is only relevant to the interpretation for the measurement results, but not to the measurement methods. No matter how the measurement method is improved (no matter what measurement method is used), it cannot be blocked. Thus, the existence of this largest logical loophole makes all Aspect experiments (including the recent Ronald Hanson team experiment) not worth a penny. I was very surprised that Ronald Hanson, a physicist at Delft University in the Netherlands, did not find or ignored the biggest logic loophole like everyone else. Then I figured out that their attitude is extremely unpleasant about the biggest logic loopholes, so they simply do not consider the existence of the logic loopholes. In fact, Ronald Hanson reported in the validation of Bell's inequality in the same article that no Bell experiment can exclude all imaginable local realism.[9] However, this sentence is submerged among the coaxing sound that the media and other scientific workers agree that the quantum "spookiness" has passed the toughest test yet. The reason is still that quantum physicists hope so. Otherwise, the existing interpretation system of quantum mechanics will collapse.

Acknowledging that cognate conjugated particles are in a state of superposition (also an entangled state), they are recognized as a whole; that is to say, as long as the measurement exerts an influence on the whole of the superposition state instead of exerting an impact on one of them. If the measurement of a particle is only to first influence one of the conjugate particles, it is to admit that the two particles are independent of each other. It is impossible to leave the entity state. If matter and energy are not transmitted, the state of matter is not possible. It can be seen that the state change in the quantum mechanical entanglement experiment is not the transfer of the state.

As mentioned above, because of the lack of empirical chains and logical chains, the explanation of quantum entanglement phenomena falls into a logical cycle. Therefore, the existing experimental results which claim to verify the existence of quantum entanglement are unreliable.

In addition, the superposition of quantum states is only a mathematical possibility, not the inevitable reality. The state superposition is conditional, not unconditional. The wave packet collapse caused by observation is conditional, not unconditional. It is a kind of sophistry requirement that takes the possibility in mathematics as the inevitability in physics. In reality, two circularly polarized photons are superimposed into a plane polarized photon, which is linear superposition. Although the generalized polarization direction after stacking is different from the direction of the parts before the superposition, it is a polarization pattern with clear regularity, and the original polarization direction of each component does not disappear before and after superposition (still functioning). The polarization state of a plane polarized photon can be decomposed into the tensor products of polarization states of two circularly polarized photons. In mathematics, there is no case where the state of the linear superposition system cannot be decomposed into the tensor product of the respective quantum state of the member system. It is also assumed that the quantum state of the linear superposition system cannot be decomposed into the tensor product of the respective quantum states of the member system. That is, in theory, quantum entanglement is also a hypothesis.

Section 2.2 has explained that the direction quantization interpretation of the electron diffraction experiment has made non-local realism quantum mechanics lose great support. It is pointed out in this section that the explanation of quantum entanglement is a logical cycle, which makes the quantum theory of non-local realism lose greater support. The theory of non-local realism quantum mechanics has collapsed. From now on, we come to find an alternative theory.

2.7. The Retention and Play of the Diffraction Properties of the Moving Electrons in the Vacuum Are Independent of Its Previous Experience

The independence mentioned in the title of this section is the negation of the quantum decoherence hypothesis and the wave packet collapse hypothesis.

Quantum coherence (quantum parallelism, quantum entanglement, quantum cannot be cloned, the diffraction and interference of particles, etc.) is the characteristic of microscopic particles that are different from macroscopic objects. It is also the birthplace of quantum theory. Quantum decoherence is the disappearance of such quantum coherence. In the existing quantum mechanics explanation, the description of the measuring instruments’ influence of the measured system is mainly that the environment led to the collapse of the wave packet. The basic idea that the environment leads to decoherence is that any physical system will not be completely isolated from the environment, and the interaction between the system and the environment will lead to the entanglement of the system and the environment (some call it association, others call it superposition). The prerequisite for the environment to lead to decoherence is that measurements can cause waves-packets to collapse. Simply put, "as long as the measurement occurs, quantum coherence disappears." The following discussion shows that there is a serious contradiction in the view of quantum mechanics. The most famous double-slit diffraction experiment by electron does not always support the existing interpretation of quantum mechanics.

In fact, the electron diffractometer and the power supply are in a current loop with generators and electrical appliances (we only consider the current loop consisting of one generator and one electron diffractometer). When the diffractometer is in operation, the electrons that form the current move directionally in this loop and undergo diffraction when passing through the slit. In the generator and the wire, those electrons that undergo the diffraction are affected by the electromagnetic field. In particular, electrons are subjected to strong electric fields (more strongly than in the wire) on the cathodes in the circuit. The electron beam leaving the cathode is generally subject to the collimation of the magnetic field. The intensity of these effects is no less than the intensity of the instrument acting on the electrons in general measurements (for example, using the cloud chamber and the spark chamber to measure incident electrons). According to the existing measurement view of quantum mechanics, the electrons in the generator and on the cathode should be in a quantum decoherence state. But in fact, they are not in a state of decoherence, and diffraction can still occur in the electron beam. The 5000 electrons flowing through the generator are numbered by us. Some of these 5000 decoherence electrons will flow into the electron diffraction instrument and participate in electron diffraction. Thus, there is a problem that decoherence electrons recover quantum coherence. After the diffraction, the numbered electrons return to the wires of the closed circuit, and the quantum decoherence occurs once again as the role of the magnetic field in the generator and the role of the strong electric field on the cathode. They continue to flow and can take the next round of diffraction (coherence is restored). As long as the system works continuously, the above cycle can occur countless times. Each cycle requires: <1> the “quantum decoherence process and the superposition process of quantum state to be reversible”, or, <2> “quantum coherence of moving electron in vacuum has nothing to do with past experience of these electrons” (this fact is referred to as “irrelevance” hereinafter), or <3> the wave packet collapse process and the quantum decoherence process do not exist or do not occur. The assertion does not hold water that the measured system and the measuring instrument are inseparable (the recovery process of quantum coherence is just the process whereby the measured system gets rid of the instrument interference).

If the electrons always have diffractive properties in all experiences before passing through the slit, the argument that “any measurement will inevitably lead to wave packet collapse and quantum decoherence” is not correct, and the pure and objective state of the particles can be observed (quantum inverse measurements can be implemented). The final conclusion is that the coherence of moving electrons in a vacuum is not related to its past experience. In this case, many quantum entanglement experiments must be rewritten. Both the action of the strong electric field on the electron beam and the effect of the magnetic field used for collimation on the electron beam are in line with the measurements defined in this work. These measurements are the local measurements which do not lead to quantum decoherence and wave collapse. The experiment where electrons are subject to a double layer lattice and undergo secondary diffraction directly proves that the measurement of the electrons passing through a double-layer slit cannot cause the wave packet collapse. The reason is that only the wave packet collapse did not occur when the electrons passed through the first slit, and the electrons continuously advancing can undergo secondary diffraction. In view of the importance of the electron secondary diffraction experiment, the experiment will be repeated and analyzed below.

The “irrelevance” mentioned above is one of the most important conclusions of this research. It is based on experimental facts. It can deny the existence of quantum coherence and quantum decoherence.

Readers who try to deny this research should first deny this irrelevance. I do not know how the authors and the pious readers of these articles[12-15] look at this “irrelevance”.

As mentioned above, in an electron diffractometer, the diffracted electrons are transmitted from the cathode plate rather than newly generated (they are affected by the magnetic field in the generator, obstructed by the metal atoms and the electrons in the wire, affected by the strong electric field outside the cathode, and affected by electromagnetic lenses). Diffraction can also occur when electrons coming out of the cyclotron or linear accelerator pass through the slit. This indicates that the magnetic field, the electric field, and the internal environment of the conductor cannot destroy the quantum coherence of the flowing electrons (or quantum coherence can be restored under certain conditions). The electrons can also undergo secondary diffraction when passing through the appropriate crystals. This indicates that the slit leading to the first diffraction as a measuring instrument does not lead the electrons to produce quantum decoherence. The electron beam in the electron microscope is collimated by an electron lens, and the electron lens does not cause the quantum properties of the electron beam to vanish. The stationary ions trapped in the microcavity can also maintain the quantum coherence of quantum entanglement. Considering the mechanism of the secondary diffraction of electrons, electronic double-slit diffraction experiments show that there is only the state superposition between the measured electrons, rather than between the instrument and the incident electrons. The fact that it is difficult for the optical signal to be distorted by the long distance fiber does not support the inevitability of the association (superposition) and the collapse of the wave packet between the instrument and the measured particle. Numerous facts show that the quantum coherence of free electrons in a vacuum is independent of the source of electrons (*i.e.*, the electrons with the same velocity in the vacuum are not distinguishable). Popularly, "no matter what the sources of the electrons are, the electrons that move in the vacuum have quantum coherence, which can be diffracted." This conclusion shows that "wave packet collapse", "the quantum state superposition between measured system and instrument (environment)" and "the inseparable between measured system and instrument" and other concepts are not correct.

The electron beam can produce diffraction. This quantum coherence is independent of the source of the electron beam (independent of the previous experience of electrons). Is quantum coherence formed (restored) at the moment the electrons leave the source? A variety of different quantum coherences should not be independent of each other. If the electron diffraction characteristics can be restored, the quantum entanglement properties can also be recovered. The quantum entanglement of twin electrons is also independent of the previous experience of homologous electrons. For example, the $4s^2$ electrons of a calcium atom are emitted and then reflected back to the $4s$ sublayer, and the entanglement between the $4s^2$ electrons can be restored. If the quantum coherence cannot be recovered, the decoherence process is irreversible, that is, quantum coherence does not exist or can withstand considerable intensity interference. In this case, the experiments using the cloud chamber and the spark chamber to capture the movement trace of electrons deny the principle of uncertainty (especially the assertion that "it is also uncertain when there is no measurement and no interference"). If the decoherence process is reversible, the physical quantity has many different eigenvalues and that the eigenvalue is random is denied, also denied is the existence of the process of wave packet collapse (no need for the concept of wave packet collapse).

Although the moving particles in a vacuum are affected by the electric field and the magnetic field still maintaining the diffraction properties, they still retain diffraction characteristics. This fact indicates that the anti-jamming capability of the quantum coherence of the particles is not zero. We can find that the measurement methods where there is any interference or interference can be ignored, and the pure objective state (or the purely objective state) of the particles can be observed. In another way, “the diffraction characteristics (one of the quantum coherences) of the moving electrons are independent of the origin of the moving electrons”. There are three possible reasons for this fact: first, the wave packet collapse process does not exist; second, the wave packet collapse process (or quantum decoherence process) is reversible; and third, the diffraction of electrons and other object particles is not directly caused by the object particles, but the side effects of particle movement. These possibilities are detrimental to the existing interpretation system of quantum mechanics.

In the above-mentioned irrelevance performance, the various experiences of electrons before diffraction are that they undergo a variety of different measurements. These measurements do not destroy the coherence of electrons, and do not result in wave packet collapse and quantum decoherence. This is the measurement where the interference undergone by electrons can be ignored (this is what the author called reverse measurements). Thus, enumerations of these examples are experimental evidence that quantum inverse measurements can be achieved.

2.8. Things that can be Described by Wave Functions Are not Necessarily Waves

The equation of motion of a spring harmonic oscillator is

$$m\frac{d^2y}{dt^2} = -k(y - y_0) \tag{2.5}$$

The solution of this equation is

$$y = y_0 + A\sin(2\pi\nu t + \phi_0) \tag{2.6}$$

Among them, $\nu = 1/T = \sqrt{k/m}/2\pi$ (T is a periodic). Eq. (2.6) is a typical wave equation (wave function). The spring harmonic oscillator can be described by the wave equation. However, the spring oscillator itself is not a wave. This shows that even what is described by the wave function is not necessarily a wave or a wave-particle duality. Although the waves in the mathematical permissive description can have linear superposition, the long-distance superposition of the spring harmonic oscillator is actually impossible. Physical particles and electromagnetic waves should be more like a spring harmonic oscillator and be very different from water waves and sound waves.

Even though the microscopic particles are waves, they are not necessarily non-real and they don't have to superimpose.

2.9. The Paradox of the Uncertainty Principle: We Have no Choice but to Turn Our Eyes to Non-classic Description

This section will introduce the paradox of the uncertainty principle and its experiment-evidence and significance

Under the premise that momentum and position can only be accurately measured if we continuously measure a particle’s position, we can get an accurate motion trajectory, if both the past momentum and position of the particle have been accurately measured. Obviously, there is such a paradox in the uncertainty principle: the statement “in the case of continuous measurement, one of the past momentums and position of a particle can only be accurately measured” is impossible in logic. Since the principle of uncertainty is the basis of quantum mechanics, it is necessary to prove whether this paradox really exists. As long as it is proved that it is possible to continuously measure a microscopic particle without destroying its pure objective state, it is proved that the paradox of uncertainty exists. In theory, continuous measurements to keep the original state of the particle being measured unchanged can be achieved by using quantum nondemolition measurements and quantum inverse measurements without interference. Whether such experiments exist is also interesting. According to the work principle for the aggregation at the center of charge and the 3D regression analysis method, it can be understood that the accurate motion track of micro particles can be captured by using a cloud chamber. The secondary diffraction experiments of electrons show that the wave packet collapse process does not exist or the anti-interference ability of quantum coherence is not zero. The secondary diffraction experiments of electron experiments and the experiments of the particles captured by the cloud chamber, etc., together constitute the experimental evidence of the paradox of the uncertainty relation. How high is the principle of uncertainty in quantum mechanics? How important is it to discuss the paradox of the principle of uncertainty? Heisenberg's uncertainty relation can be derived by the classical motion law. This also strengthens the theme of the existence of the uncertainty principle paradox.

Using logical reasoning it is not difficult to find that if the two conjugate physical quantities can be measured as one, then in the case of continuous measurement, it is impossible that of the two conjugate physical quantities only one can be accurately measured out. If this problem cannot be avoided, the conceptual system of quantum mechanics will be seriously threatened. Logically, the only way to deny the problem is to deny that a microscopic particle can be measured continuously. Unfortunately, the quantum nondemolition measurements[1] that have been implemented allow continuous measurements without damaging the quantum states. The interference-free measurements in quantum inverse measurement theory[2] are the same. I found[2] that "the quantum coherence of a high-speed motion electron has nothing to do with its previous experience...the quantum coherence has considerable anti-interference ability." (The experiments of the secondary diffraction of electrons also prove this.) This ability determines that more observation of weak interference can be an example of nondestructive and sustainable observation.

The most famous example is the use of a cloud chamber to capture the charged particles of the experiment. The most talked about quantum mechanics is the situation when random interference is encountered in measuring the microscopic particles. If the interference is very weak or uniform and constant, for the measurement of microscopic particles, what will happen? Is a particle entering the quantum decoherence state and returning to the macro field or reflecting the state of there not being any random interference? What happens to measuring a particle continuously? What is the effect of electron secondary diffraction experiments on the concept of wave packet collapse? What is the meaning of the 3D regression curve of the central coordinate of the droplet in the cloud chamber track? The following text is written in order to answer these questions (of course, I also argue that we can continuously measure a micro particle without destroying the original state).

2.9.1. The formulation of the Uncertainty Principle Paradox

K. W. Heisenberg posits that two regular conjugate physical quantities of a microscopic particle (such as position and momentum, or position and angular momentum, and time and energy, etc.) cannot have the determined value at the same time—one is more determined, and the other has greater uncertainty. The product of the measurement error (standard deviation) of the two regular conjugate quantities is necessarily greater than the constant $\hbar/2$. That is, the two conjugate physical quantities cannot be accurately measured simultaneously, or just one of the two physical quantities where the operators are not commuted can be accurately measured. If we continuously measure the position of a flying particle, then, the position of the particle can be accurately measured continuously. As long as the particle's position is accurately determined continuously, its trajectory can be drawn, and its instantaneous velocity and direction of motion are also accurately determined continuously (seen in **Figure 2.6**). For situation (a) indicated by **Figure 2.6**, the moving track of the microscopic particles is not impossible if measured accurately, but is impossible if estimated accurately (can't be accurately predicted). For situation (b), the moving track of the microscopic particles not only can be accurately measured but also can be accurately estimated. If the position of a point particle can be measured with sufficient accuracy, continuous measurement will be able to get a dot dash line, and the moving orbit of the point particle has been accurately measured. It can be seen that if there is continuous measurement of a particle, then it is not logical that just one of the two conjugate physical quantities can be accurately measured at the same moment. If the position of a microscopic particle in space is continuously determined, its momentum cannot be uncertainty in logic. This is the logical paradox of the uncertainty principle (it is also called the logical paradox of uncertainty principle, and it is called the uncertainty principle paradox for short, or paradox of uncertainty relation).

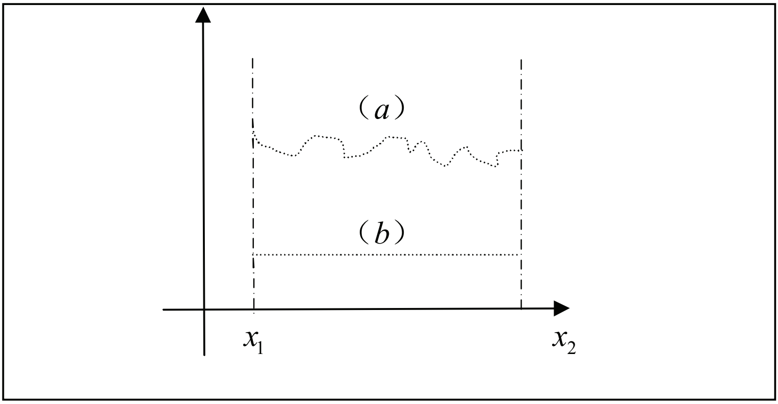


Figure 2.6. When we continuously measure the position of a particle in the spatial range from x_1 to x_2, if the position of the particle has been accurately measured every time, the particle has its determined trajectory. (a) A particle walks an irregular curve in the case of stronger random interference; (b) A particle walks a straight line under the condition that the interference is very weak or uniform and constant.

If there is no concept of a point particle, we cannot talk about the location of object particles. The interpretation of the uncertainty relation uses the concept of momentum and position. This is to discuss the state observation of the object particles under the concept of point particles. The movement of a point particle can produce a dotted line: the past trajectory of the particle. Using the point particle concept and denying that the point particle has a movement orbit, there must be a logical contradiction. This is another expression (abstract expression) of the paradox of the uncertainty relation.

Brief mathematical proof is as follows. At the time interval dt, the position of a moving particle is measured twice. If both the positions of the particles are measured accurately enough at these two moments, and they are (x_1, y_1, z_1) and (x_2, y_2, z_2) respectively, the distance between them is small enough $|\overrightarrow{dr}|$, then, in this interval, the movement direction of the particle is accurate $\overrightarrow{dr} / dr$, and the accurate momentum of the classical mechanics of the particle is $m\,d\vec{r}\,/dt$. Visible at the point (x_1, y_1, z_1), both the position and momentum of the particle can be measured accurately enough. The same problem exists in the uncertainty relation between the energy and the action time: the energy of a photon passing through the space can be measured accurately enough by its wavelength (or frequency); according to the uncertainty relation, the measurement time must be infinite. But the actual situation is not a very long time to be able to measure the photon energy. It can be seen that the experiment to measure photon energy does not support the Heisenberg interpretation of uncertainty relation.

For AB=C, when C is not zero, A and B cannot be zero at the same time, but it allows A and B to have the determined value at the same time. Considering that two regular conjugate physical quantities "cannot be simultaneously zero" is equivalent to "cannot have a simultaneously determined value" is also wrong. The contradiction belongs to the category of the paradox of the uncertainty principle. The uncertainty principle is often considered as "microscopic particles have no real movement track," that is, the existence of the "true value" of "reflecting the movement trajectory of the microscopic particles has been denied." Since the true value does not exist, the idea that the motion trajectory of the microscopic particles cannot be accurately measured is completely independent of the measurement method, and has nothing to do with the uncertainty relation (there is no true value, which comes from the uncertainty of measurement). To deny the existence of the "true value" of "reflecting the movement trajectory of the microscopic particles" is just believing that "it is not accurate when it is measured, and it is also not accurate when it is not measured" or believing that microscopic particles possess independent uncertainty. To deny the microscopic particle motion state having the true value doesn't make any sense. Only when a viewer in time-like space observes the things in the empty-like space does the microscopic particle possess independent uncertainty. However, the observation that the subject and object are respectively in different spaces is not impossible to achieve. This also suggests that the existence of the uncertainty principle paradox is inevitable.

Orthodox quantum scientists must use "quantum state superposition to cause the wave packet collapse" to deny that a particle can be measured continuously. For this, the author wants to say that quantum decoherence is only a hypothesis, not a reliable reason. Moreover, some experiments have shown that continuous measurements do not lead to quantum decoherence. This experiment includes the electron diffraction experiments which are the soul and lifeblood of quantum mechanics, especially the secondary diffraction experiments by electron. The secondary diffraction experiments of electrons show that after the measurement of the first slit, the quantum coherence of the electrons does not disappear so that it can still diffuse when passing through the second slit. This is the fact that the same electron is measured twice without causing quantum decoherence (either both the wave packet collapse and the quantum decoherence process do not exist or the robustness of the quantum coherent states is not zero). People have long recognized that in the electronic diffraction experiments, the wave packet collapses only when an electron hits the screen; the wave packet collapse does not occur when the electron is through the slit (it is a measurement device). The electron beam in an ordinary electron diffraction experiment does not appear suddenly out of thin air, but escapes from the cathode after passing through a metal conductor and is affected by a strong electric field, and sometimes it is collimated by a magnetic field before it enters the slit. Before the electron beam passes through a slit, it is hindered by metal atoms, affected by the force of Coulomb of a strong electric field and by the Lorenz force of a magnetic field (and it is effected by a magnetic field in the generator and continuously effected by the electric field in the wire). Under these combined effects, electrons do not lose their coherence (no wave packet collapse). This is the experimental evidence "that the existence and maintenance of the quantum coherence of the moving electrons in the vacuum is independent of the previous experience of the electrons"[2] (either both the wave packet collapse and the quantum decoherence process do not exist or the anti-jamming capability of the quantum coherent states is not zero), and also the experimental evidence of continuous measurements without losing coherence. One side is the hypothesis, and the other is the clear experimental fact. Which side do you believe?

The "wave-packet collapse and the quantum decoherence process do not exist" and "the quantum coherent state of the anti-jamming capability is not zero" can clean up the logic barrier of interference-free continuous measurement. In theory, as long as the particle can be continuously measured without breaking coherence, the principle paradox exists. Quantum nondemolition measurements and other quantum measurements without interference (or interference can be ignored) can make this theory a reality.

2.9.2. The Experimental Evidence of the Existence of the Uncertainty Principle Paradox: Experimental Results of Continuous Interference-free Measurement of Nondemolition

A. M. Steinberg *et al.* use the weak measurement technique to observe the trajectory of the particles in the double-slit interference experiment by way of the interference fringes on the screen not being destroyed.[3, 4] Their weak measurement thought is opposed to the complementary principle of quantum mechanics. The conclusion is that the particle's wave and the particle can be expressed simultaneously. This conclusion is completely different from the basic knowledge of quantum mechanics which we now recognize, and against the Heisenberg uncertainty principle. The experimental results of weak measurement techniques of Steinberg *et al.* belong to the experimental evidence of the paradox of the uncertainty principle.

The electronic diffraction experiment is intermittent measurement with strong random interference, its side effects are large, its interpretation prone to ambiguity; it is not an ideal experiment for measuring the behavior of microscopic particles. Even without the side effects, the electron diffraction experiment can only measure the non-continuous behavior of the electron. The non-continuous behavior is difficult to represent the continuous behavior of an extranuclear electron only with uniform constant interference. Only if continuously measured under the condition of uniform constant interference will the obtained electronic behavior be closest to the continuous behavior of the extranuclear electrons. More seriously, the mechanism of the phenomenon of single-slit electron diffraction experiments is not very clear. First, there is the velocity difficulty of the de Broglie wave. Second, electron diffraction is quasi-diffraction without interference. If diffraction theory is used to explain the single-slit diffraction phenomena of electrons, the diffraction of them can only be diffraction of monochromatic waves, while the phase velocity of the monochromatic de Broglie wave is greater than that of light. If the whole of the electron is a wave packet composed of different wavelengths of monochromatic wave, it is impossible to form a clear diffraction pattern (the reason is that monochromatic waves with different wavelengths in the packet cannot interfere at the same time in the same place). Therefore, the experimental results of electron diffraction cannot be used as evidence of "denying the existence of the paradox of uncertainty," and cannot be used as conclusive experimental evidence of the uncertainty principle.

In view of the above reasons, the existing interpretation of the electron diffraction phenomenon itself is a hypothesis, and it is even crazier to extrapolate it to the unmeasured case with different conditions. Under the premise that quantum nondemolition measurement and interference-free quantum inverse measurement can be achieved, both measurement and non-measurement do not change the purely objective state of particles. We cannot infer the state of the particles in the unmeasured state by means of the deduction according to the disturbed electron diffraction experiment's results. The purely objective state of the particles must be observed directly by means of nondemolition measurements and interference-free measurements. Unconfirmed, the speculation of "a particle is uncertainty when unmeasured: microscopic particles have spontaneous uncertainty" cannot be used again.

Secondary electron diffraction is high-speed electrons passing through the first slit and generating diffraction. After that, the electrons pass through the second slit and generate diffraction again. If the collapse of the wave packet is reversible, it is contrary to the principle of superposition of states. Therefore, the direct conclusions of the experiment are: continuous slit measurements did not result in wave packet collapse (or the state-superposition between the instrument and the measured particle); and second, there is a definite motion path when an electron travels from the first slit to the second slit (the electron is not scattered waves). The experimental results show that either "wave packet collapse does not exist" or "the process of wave-packet collapse is reversible." It is also possible that the quantum coherent states have a relatively large anti-interference ability. As long as the wave-package collapse does not exist, the cloud chamber and other instruments to capture the state of the particles can only be a pure-objective state of the particle. The influence of the slit on the incident electron is much greater than that of the cloud chamber on the incident electrons. If the slit does not cause the wave packet of the incident electrons to collapse (or the state is superimposed), the vapor fraction in the cloud chamber does not cause the wave packet of the incident electrons to collapse. The secondary diffraction experiment of electrons to be combined with experiments such as the cloud chamber and other equipment to capture charged particles can form complete experimental evidence of the denial of the existing interpretation about the uncertainty relation. The experimental combination is also strong experimental evidence that the uncertainty paradox exists.

I emphasize that quantum nondestructive measurements can be used to escape the effects of the instrument on the measured particle again. Since the instrument has no effect on the measured particle, the continuous measurement of the incident particle will not change the state of the measured particle. Continuous nondestructive measurements are possible.

The propagation of particles in the cloud chamber or the spark chamber is very similar to the propagation of photons in the optical fiber. The optical fiber does not distort the optical signal, and the cloud chamber and the spark chamber cannot distort the incident particles. The basic working principle to be based on the design and manufacture of Wilson's chamber is that the saturated steam will begin to condense at the center of the charge at low temperature. After a charged particle enters the cloud chamber, hits the extranuclear electron and causes the nearby vapor molecules to ionize to produce positively charged ions, the ionized secondary electrons cause ionization of the vapor molecules at further distances. This is repeated until the momentum of the secondary electron is small enough not to cause the ionization of the vapor molecule. For quantum mechanics, it is most important that the measured incident particles do not reach the center of each droplet. This principle also implies that the target charged particle is a point particle (the target charged particle is the measured particle). Quantum scientists use the concept of wave packet collapse to acknowledge that the measured particles at this time are point particles. Other experimental facts have also proved no ambiguity that the electric field of the electric charge could result in the condensation of the saturated steam starting from the center of the charge. In this way, the center of each droplet in the chamber is the place that the ion is already at. The incident measured electrons only pass through the regression center of the cross-section of the cloud track. Regardless of whether the point particles are obtained by the collapse of the wave packet, and as long as the working principle of the cloud chamber is recognized, it is shown that the 3D regression curve of the center coordinate of the drop is the particle's accurate motion path. The measurement uncertainty of the position of charged particles indicated by the 3D regression curves is smaller by dozens of orders of magnitude than the droplet track width (the specific method found for the calculation of the measurement uncertainty). But it is not the purpose of this section to discuss this problem. The reasons are as follows.

The working substance in the instrument affects the incoming particles, but does not change the motion path of the particles in a certain range (that is, incident particles, especially alpha particles, have strong resistance to the effects of electrons in the working material). As mentioned above, the 3D regression curve is the connection of the center of each cross-section of the cloud track. The droplet deviating from the center of the cross-section is not a random event but the inevitable event decided by the working principle of a cloud chamber (ionization + field-assisted cohesion—the working principle of a cloud chamber determines that the centers of the droplets are the locations of the ions rather than the place at which a measured incident particle randomly arrived). Although the event is not a random event, we can treat it as a random event. The result of this treatment is very favorable to us: under the same confidence level, the confidence interval is smaller; under the same confidence interval, the confidence level is higher. The measurement uncertainty of the position is much smaller than that of the confidence interval. In addition, the correlation coefficient of the 3D fitting curve is not the size of the linear correlation. The existence of a fitting curve indicates that the results of continuous measurements are valid. These are determined by the fact that the droplet centers are not the points randomly arrived at by an incident particle. The 3D linear regression equation obtained from the first 20000 drop coordinates is the exact equation of motion for the incident particle. According to this equation, the future motion path of the incident particle can be predicted exactly (it is an extension of the known linear regression curve). Note: we only discuss the situation within the penetration range of the incident particles (that is, to only discuss the situation before it collides with a nucleus.

From the observed cloud trails, it can be seen that these 3D regression curves are smooth curves rather than irregular. In this case, even if the incident particle has entered the classical state in the chamber, it also shows that the particle motion path can be measured very accurately (as long as the measurement error of the position of a particle is smaller than the atomic scale, it is meaningless to think that the particle has entered the classical state). The reasons are as follows: first, continuous measurements do not cause intolerable errors (even under the requirements of the measurement accuracy in the microscopic world, the same is true of the situation); second, we can predict the future of the incident particle according to the 3D fitted curve equation; third, since the accuracy of the continuous measurement results reaches the atomic size, even if the relationship of $\Delta x \Delta p \geq \hbar$ holds water, it cannot indicate that the position and momentum cannot be accurately measured at the same time; and fourth, if the uncertainty is not true in classical mechanics, then it cannot be universal (that is, in the microscopic world it is also difficult to hold water).

As mentioned above, denying that "the use of cloud chambers can continuously measure an electron (especially α-particle) moving at high-speed without damage" must give priority to the hypothetical "mathematical structure of state superposition and quantum decoherence process," while denying the cloud chamber working principle of "ionization + field-assisted cohesion" that has played a practical role.

The working principle of the chamber has decided that the existence of the 3D regression curve of the central coordinates of the drops has shown that the charged point particle has an accurate motion path (the uncertainty is less than atomic scale). It does not mean that the particle's motion path does not exist or that the movement path of microscopic particles cannot be accurately measured by means of the projection. As to whether the moving path of a particle can be accurately measured is another matter. That is to say, the movement path not being measured accurately is not to say that there is no accurate movement path. Before the advent of radar and sonar technology, the motion path of shells and arrows could not be accurately measured. For microscopic particles, it is also the same. However, it does not mean that the exact motion path is not present. But orthodox quantum mechanics scientists surreptitiously supersede "the motion trajectory of the particles cannot be accurately measured in the wrong way" with "the motion trajectory of the particles cannot be accurately measured in any way." At the same time, they surreptitiously supersede "the motion trajectory of the particles cannot be accurately measured" with "there is no motion trajectory of the particles." The scientific and technological community is not ashamed of this behavior. But orthodox quantum physicists have not yet come to their senses. In the same way, the uncertainty principle is at the most representative of the future trajectory of a particle and can't be accurately predicted and it is not on behalf of that, that the trajectory of a particle does not exist. Excessive use of the idea of positivism is also not allowed, because the "trajectory of a particle does not exist" is still only an extrapolation. The electrons go in a straight line in the chamber to not have a magnetic field, and go in a spiral in the chamber to have a magnetic field; combined with the working principle of the chamber and the 3D regression analysis method, we can understand that an electron can move on a track.

The position of a particle can be continuously measured by using the chamber, bubble chamber, spark chamber and emulsion chamber, and the measurement results are in accordance with situation (b) in Figure 1. In Figure 1, in the situation in which (b) belongs to a weak interference (or the interference of even constant), the future state of the particle can be predicted according to the state of its past (for trapping particle experiments, we can predict based on the condition of the particles and the

3D regression equation whose correlation coefficient is very close to 1). Situation (a) belongs to the existence of random disturbance; particles in the future cannot be predicted accurately based on their past. In the electron microscope, the electron is also being aligned to the position with sufficient continuous position accuracy and momentum accuracy. If a particle walks a circle instead of a straight line, although the product between the curvature radius and the momentum is equal to the Planck constant, they are all determined values (seen in Section 4 or Reference 5). If particle dispersion is used as an explanation, the microscopic particles must be considered as ghosts: they have wave-particle duality, it hits the photosensitive target, the point of fall is the center of the light spot, and the trajectories of the neutral particles may also be captured. The fact that a neutral particle does not show the moving track confirmed that the mechanism of a charged particle producing track in the chamber is the cohesion (condensation) of a liquid drop which begins from the center of the charge. The 3D regression curve of the center coordinates of the drops is the particle's accurate motion path, and the target particle is a point particle. It does not support the viewpoint that condensation is caused by the non-local-reality of the particle. Series capture experiments of microscopic particles are the verification for the paradox of the uncertainty principle.

It is not hard to discover when we open the history of the discovery of the uncertainty principle: initially, that the space range of the track width of an incident particle in the chamber may be the space range in which the incident particles appear is only Heisenberg's intuition, and purely a guess. Later he derived the uncertainty relation; some people believe that his previous guess has been verified in theory. Born took the partial cover as a whole and took the projection experiment as an example to get the unavoidable conclusion of the "uncertainty" of all microscopic measurements. Soon after the completion of the electron diffraction experiments, some people believed that the initial guess of Heisenberg was verified by the experimental method. Uncertainty is considered to increase the reason for "wave-particle duality" (after that, there are also reasons for state superposition, the probability wave and non-locality). It is not difficult to find that either Heisenberg's method of deriving the uncertainty relation or the experiment to prove the Heisenberg relation uses instantaneous measurement at a point instead of a continuous measurement on the line. To do so, the argument is clearly inadequate. No matter when, no one has mentioned the mathematical analysis method and the significance of its analysis of the 3D regression curve about the cloud track (except the author of this paper). Before this work, people never discussed the meaning of the 3D regression curve for cloud trails.

A spark chamber to capture the particle track is the performance of the microscopic particles under the condition that there will not be serious random disturbance. Cloud chambers, bubble chambers and emulsion chambers to capture particle tracks are the performance of the microscopic particles under the condition of weak random disturbance. Electrons in a magnetic field going into the spiral wire are the orderly performance of the electron under the condition of uniform and constant interference. Electrons in a magnetic field going into the spiral wire are the orderly performance of the electron under the condition of weak random disturbance and uniform constant strong disturbance. The micro particle dispersion in the whole track space is just a guess; there is no theoretical basis (Heisenberg's uncertainty relation is not its theoretical basis, and the reason is the existence of the uncertainty principle paradox). The electronic diffraction experiment is not its experimental basis. (There are two reasons: in the experimental process of capturing particles, microscopic particles have not happened in the similar diffraction; there are very strong side effects in the electronic distribution experiments.) A series of experiments to capture particles has verified Eq. (2.7) to be established. The argument provided by it is far tougher than the argument in John von Neumann's measurement theorem (von Neumann could not prove that the limit in Equation 1 had no meaning).

The correct analysis method of the experimental results to capture microscopic particles is that we must use the 3D regression analysis method and the principle of condensation and discharging starting from the center of the charge. The basis of this method is much better than the basis of the intuition that the particles may appear in all the space of the trace and the basis of the application of the concept of wave packet collapse and quantum decoherence. Within the range of the interference from strong to weak, if we repeatedly measure the behavior of a microscopic particle, according to these experimental results, we can conclude the behavior characteristic of the particle under the condition without interference (or without random interference). The measurement results of the quantum optics research group of Lee Rozema at Toronto University using weak measurement technology have confirmed that the following limit is tenable:

$$\begin{aligned}&\text{The determination state of the particle}\\&=\lim_{\substack{\text{Interference}\to\text{Uniform}\\ \text{Interference intensity}\to 0}}\left[\text{The state function of a microscopic particle}\right]\end{aligned} \tag{2.7}$$

David Wineland used light or photons to capture, control and measure charged atoms or ions, and realized the desire of an individual ion to be static in the trap. To acknowledge that an individual ion is static in a trap is to just acknowledge that the motionless ion in the trap is observed by continuously measuring, and simultaneously the knowledge that the momentum and position of the ion are accurately measured. Wineland's experiment denied the existence of the zero point energy effect, and denied that microscopic particles had independent uncertainty. Since we can detect an individual ion to be static, and can detect the slow movement of an individual ion, we can also detect the motion trace of a microscopic particle, so as to deny the uncertainty principle. Therefore, Wineland's experiment can prove the existence of the uncertainty principle paradox, too.

The quantum superposition between the instrument and the microscopic particles has no direct experimental evidence (some have only von Neumann's mathematical proof) when we measure the microscopic particles. In the process of the double-slit diffraction experiment, it is easy for the superposition between particles to occur, but it is not so easy for the superposition of states between particles and instruments to occur. In this experiment in which the microscopic particles are strongly disturbed by the instrument, there is no state superposition between the instrument and the particle. In the weak interference experiment, it is more difficult for the state superposition between the instrument and the particles to occur. This phenomenon is very bad for the measurement theory of von Neumann (which has denied its universality). A number of experiments have thus turned into an experiment in which to deny the principle of uncertainty. For example, if you cannot prove that the accurate orbits of the particles in the experiment which chamber capture charged particles are caused by the collapse of the wave packet and the quantum coherence, then, the experimental results of chamber capturing particles are powerful experimental evidence of the paradox of uncertainty principle.

2.9.3. The Error of von Neumann's Proof, Quantum Superposition Trap, Wave Packet Collapse Promise and the Hoax of Quantum Decoherence, and the Disaster in Quantum Mechanics

The discussions in the above two sections respectively indicate that the mathematical proof of the conclusion of von Neumann on micro particle statistics inevitability is in conflict with mathematical logic and the experimental facts. The proof derived by von Neumann that the implicit function theory is unable to give the unique solution to the observations is wrong. This error was first discovered by David Bohm. Later, we all realized von Neumann's mistake. The interesting thing is that von Neumann's proof supports Bell. But Bell also discovered von Neumann's mistake and pointed it out publicly.[6]

The "scientific basis" of the concept of "subjective intervention" is the measurement theorem of John von Neumann. He indicated that statistical characteristics of quantum theory are not caused by the unknown of the observer's state. With the help of the Hilbert space operator theory, he proved that the hypothesis of every quantum theory which includes general physical quantities will inevitably lead to this result. As the measurement process is the process of entropy increase, it is difficult to ensure that the interaction between the object and the instrument still has linear features; its result cannot be deduced within the range of the Schrödinger equation.[7,8] Von Neumann's "proof," in essence, is the wrong conclusion from the premise of the error. It is considered that the conclusion of von Neumann's mathematical proof is unable to find the limit of the expression by Eq. (2.7). However, from the point of view of mathematical logic, it is recognized that the microscopic particles have independent uncertainty. Actually, both the capture experiment of the microscopic particle and von Neumann's experiment have verified that this is not the case.

The result of von Neumann's proof is, there is no distance concept in the process of interaction between the instrument and the measured particle, and there is no difference of strength-weakness. This conclusion is contrary to common sense. Therefore, his proof cannot be correct. Bohm first discovered von Neumann's mistake, after which everyone recognized the mistake. An experiment without an ambiguous result can block mathematical proof thousands of times. Besides, the deviation will inevitably appear when "mathematical processes and results" are endowed with physical meaning. When measurement results using weak measurement techniques are in conflict with von Neumann's quantum measurement standard model, we should believe the experimental results more. If you take the opposite view, that is contrary to scientific spirit and positive ideas.

You may not believe that even big name scientists lie. When a conventional theory or a conventional concept is inconsistent with the facts (or they are contradictory to each other), their maintainer must lie and use sophistry. When a new theory has a problem or is not mature, the inventor of the new theory (to pursue universal acceptance by the outside world) will lie and conceal contradictions naturally or half unconsciously. The invention and maintenance of the quantum mechanics interpretation system, measurement and philosophy are also the case.

The necessary condition of the general establishment of the von Neumann theorem is that the superposition of states is bound to occur in quantum measurement (is inevitable). However, the superposition of quantum states is conditional, not unconditional. The theory of state superposition has pointed out that the superposition state is a possible state and not necessarily the state of necessity. In fact, von Neumann has pointed out that his theory of measurement is applicable to the associated particles (*i.e.*, that synthesis is the condition of the superposition of states).[9] If there is no association there is no state superposition, and it will not appear in the wave packet collapse and quantum decoherence. For example, in the double-slit electron diffraction experiment, superimposed states are only between electrons, and the slit wall (*i.e.*, the instrument) and the electron do not have a superposition of states. Neutrinos through dense objects are not superimposed with objects. The interference condition of two beams is the same wavelength, and the optical path difference is a half wavelength. If they do not meet these conditions, the two beams of light can only mix (mechanical superposition) and cannot occur in quantum superposition. Some experiments show the measured particles to be a particle's reverse impact instrument. (A signal is emitted by the observed object and received by the observer. Such a process satisfies the requirement of observation, and the object is not disturbed. It is equivalent to a no-interference measurement.) In such an experiment, we cannot talk about the superposition of the states. The vindicators of the existing quantum mechanical ideas stealthily substitute: "superposition may occur" for "superposition is inevitable"; "mechanical superposition" for "quantum superposition"; and "general interaction and mixed" for "association." Since it is sneaky change, it is difficult to find, a carefully designed trap, lies and deception.

As mentioned above, it is a trap that quantum superposition is bound to occur. The collapse of the wave packet (the particles that are bound to lose the quantum properties in the measurement process) caused by the superposition of states is a lie. On this basis, depriving the power of "the experimental results of the momentum and position of the microscopic particles can be accurately measured simultaneously" as evidence by using quantum decoherence is a hoax. Three concepts of quantum state superposition, wave packet collapse and quantum decoherence are the serial program for sophistry, and the emperor's new clothes.

Since quantum state superposition, wave packet collapse and quantum decoherence are the emperor's new clothes, the existence of the paradox of the uncertainty relation is inevitable. Quantum decoherence and the collapse of the wave packet are after all outside the process of conjecture. Its reliability is far lower than the reliability of the mathematical logic of the establishment of Eq. (2.7) and the reliability of the logical conclusion that the 3D regression curve of the center coordinates of the liquid drops is the accurate motion trajectory of the particle. Both the experiment of the particle to be static in a potential trap and the experiment of the charged particle captured by means of a cloud chamber have directly denied von Neumann's mathematical proof.

If there is no set of non-local-reality relation between particles, then, if there is interference it is a purely experimental operational problem. Under this premise, the use of mathematical methods in any case cannot prove that the interference cannot be eliminated. Even if there is the relation of non-local-reality between particles, we can measure using the method that does not allow the association to occur. For example, if weak field measure particles are used, the relation of non-local-reality between particles does not occur.

Experiments confirmed that the size of elementary particles is very small. In the case of the overall measurement, they are all point particles. Every solid particle has a barycenter (*i.e.,* center, or center of mass) and the movement of the particles is the movement of its centroid (*i.e.*, the displacement of the point). As long as we recognize that the stationary particles are point particles or substance (physical) particles, it is necessary to recognize that their movement is in orbit—the chain line of its centroid in the space. This chain line cannot be accurately measured due to random interference being predictable, and we can't prove that the particle's motion tracks do not exist. Every real particle has its own center of mass. As long as the centroid of the particle is not negative, it cannot be denied that the particles have a moving track. Once the moving route of a microscopic particle is measured, we cannot seek the explanation of "quanta decoherence" and "wave packet collapse." If we change the size of the interference and measure the behavior of the particles, according to these measurement results, the free state of the particle can be concluded or deduced without interference. In addition, if the interference caused by the measurement is not random, rather it is uniform and constant, it is certain that the precise movement of particles can be observed (using the spark chamber to capture the charged particles). The uncertainty principle must deny that the particles can be static. However, we can use the experimental method to produce static particles. It can be seen that the inference of the uncertainty principle is contradictory to experimental fact. This discussion also shows that the mathematical proof of von Neumann that the measurement of microscopic particles can only obtain statistical results is a problem. Perhaps some people think that microscopic particles are dispersed evenly when they are static. However, even if a particle disperses, it also has a center of mass (even if it is a photon, still there is an energy center). The moving orbit of the dispersed particles is still the chain line of the center. The space occupied by the dispersion substance of a particle is not the uncertainty scope of its motion trajectory.

2.9.4. Discussion of the Significance of the Uncertainty Relation and the Paradox of the Uncertainty Principle

The existence of the paradox of uncertainty has given the principle of uncertainty a reprieve from the death penalty. The principle of uncertainty is modified even if it is not abandoned. The discussion of the paradox of uncertainty principle to be combined with the following discussion can make the problem of the uncertainty principle more difficult to conceal. In other words, since there is a paradox in the principle of uncertainty, the meaning of the uncertainty relation should be redefined. We discuss the problem first, and then discuss the significance of this work.

In order to avoid a paradox, the significance of the uncertainty principle can be reduced to: both of the two conjugate physical quantities of non-commutation operators cannot have any accurate value. The experimental results to catch particles in a chamber have limited the uncertainty principle to being tenable only in the case of strong random interference. The statistical significance of the uncertainty relation is the same as the principle of uncertainty. The non-statistical significance of the uncertainty relation is the same $rp=\hbar$. There follows a detailed explanation of the second meanings.

Planck's constant is h=6.62606957(29)×10^{-34}J·s, $\hbar=h/2\pi\approx10^{-34}$. If Δx is in the range of 10^{-8} m, the momentum uncertainty Δp is in the range of 10^{-26} J·s·m^{-1}. Table 1 lists the other four combinations of Δx and Δp. In a variety of different combinations, there is always a combination to meet the measurement requirements. In the microscopic world, this measurement error is generally tolerable for particles much larger than electrons. If both measurement errors of Δx and Δp are 10^{-17}, some requirements are also met (the diameter of the electron is about 10^{-15} m). There is no random interference when not measured and the corresponding values have no reason to be randomly distributed within a certain range. Using nondestructive measurements, similarly, the result of a measurement does not have the justification to be randomly distributed over a range. If the particles are delocalized (non-locality), their positions are meaningless, and $\Delta x\cdot\Delta p\approx\hbar$ doesn't make sense either. The basis of "particles have spontaneous uncertainty" is insufficient. To sum up, the expression of "both two conjugate physical quantities are inaccurate" cannot be accurate (the sixth line in **Table 2.1** reflects the problem directly).

Table 2.1. Several sets of data under the Heisenberg relationship

$\Delta x\cdot\Delta p\approx\hbar$, among them	Δx, m	Δp, J·s·m^{-1}
The Δx is about track thickness of an α-particle in the chamber.	0.5×10^{-3}	$\approx2\times10^{-31}$
Location is accurate	10^{-8}	$\approx10^{-26}$
Location is more accurate	10^{-10}	$\approx10^{-24}$
Location is very accurate	10^{-17}	$\approx10^{-17}$
Both position and momentum are accurate	Any accurate value q	Is also an exact value ħ/q

After quantum nondestructive measurements and quantum inverse measurements without interference come out, the state of particles not measured no longer needs to be obtained by deduction of the extrapolation, and both Δx and Δp are no longer always in the random range of values. Therefore, the "uncertainty relation can only be tenable in the process of random interference measurement" is doomed as meaningless.

According to the classical motion law, we can derive the Heisenberg relation. When microscopic particles do the bound state uniform circular motion, the product between the radius of curvature and linear momentum is equal to $\hbar$, namely the classical orbital angular momentum of a microscopic particle is $rp=\hbar$. The explanation of Bohr hydrogen atom instability cannot deny that $rp=\hbar$ is one of the classic motion equations of an electron. Applying several relations $r\leq\Delta x$, $\Delta p=p\sin\theta$ and $\Delta\sin\theta\leq1$, $rp=\hbar$ can be completely transformed into the form $\Delta x\Delta p\geq\hbar$. (Note: for the particle to make a regular curve movement, $\Delta p=p\sin\theta$ is not the uncertainty value of the momentum, but is the component value of the momentum which has appeared, in the x direction, according to a certain rule), we have $r\Delta p\leq\hbar$. The method, on both sides of $rp=\hbar$ multiplied by $\sin\theta$, results in $rp\sin\theta=\hbar\sin\theta$. Because θ is the angle between the tangent line of the circle and the movement direction, there is the relation of $\sin\theta\leq1$. So, we have $rp\sin\theta\leq\hbar$, let $\Delta p=p\sin\theta$ results in $r\Delta p\leq\hbar$. (Note: for the particle to make a regular curve movement, $\Delta p=p\sin\theta$ is not the uncertainty value of the momentum, but is the component value of the momentum which has appeared, in the x direction, according to a certain rule). If the electron passes through the slit whose width is Δx, the effective distance of the electron effectively acted upon by the slit wall is less than Δx (*i.e.*, $r\leq\Delta x$). So, we have the relation of $\Delta x\Delta p\approx\hbar$. This brief process of derivation indicates that if you do not beforehand assume the microscopic particles cannot move along the curve track, the Heisenberg relation cannot represent momentum and position cannot be accurately measured simultaneously. It also suggests that the formula whose shape is similar to a Heisenberg relation cannot affirm that the micro particle state can only be described by the wave function $\psi(x, t)$ but cannot accurately be described by the classical state function $f(r, p)$. Thus it can be seen that the uncertainty relation cannot completely exclude the orbital motion (*i.e.*, the uncertainty relation can tolerate the determination and the orbital motion of the microscopic particles). The Heisenberg principle is misinterpreted by the quantum physicists of the Copenhagen School. The above argument has at least explained that because $\Delta p=p\sin\theta$ is not always the momentum uncertainty value, $\Delta p\cdot\Delta x\approx\hbar$ as the uncertainty relation is not universal. The Heisenberg uncertainty relation can be like $rp=h$—and is the equation of circumferential motion of the bound state at uniform velocity. More generally, it should be the meaning of the sixth line in **Table 2.1.**

When microscopic particles do the bound state uniform circular motion, the product between the radius of curvature and linear momentum is equal to $\hbar$, namely the classical orbital angular momentum of microscopic particles is $rp=\hbar$. This indicates that the product of the two conjugate physical quantities whose operators are not the commutation relation cannot only show that these two physical quantities cannot have the certainty value simultaneously. It does not express that the microscopic particles cannot have the certain moving track, too.

Heisenberg conceived the application of a γ-ray microscope to observe the coordinates of an electron. The measurement uncertainty of the electronic coordinate Δx is proportional to the wavelength λ (*i.e.*, $\Delta x \propto \lambda$). We take the vertical perfectly elastic collision between the photon and the electron as an example. According to the momentum conservation law, as long as the photon momentum is a known determined value h/λ, the momentum transferred to the electron by the photon is a determined known value $2h/\lambda$, the momentum increment of the electron in the direction to be perpendicular to the motion direction of the electron is also $2h/\lambda$ (there is only one photon to hit the electron vertically). In this case, the influence of the photon on the electron can be a completely predicted, rather than an unpredictable, random quantity. So, Δp_x is not the measurement uncertainty of the electron momentum but is the non-random ascertained value determined by the experimental conditions and measurement methods. $\Delta x\Delta p\geq\hbar/2$ is the relationship between the position uncertainty and the ascertained value of the momentum change quantity and is not non-random. In this example, the momentum measurement uncertainty is determined by the degree that the angle of light irradiation on the electron deviates from the vertical direction, and in general should be far less than $2h/\lambda$. Even though applying other examples can also illustrate that $\Delta x\Delta p\geq\hbar/2$ is the uncertainty relation between the two physical quantities, we cannot deny the conclusion in this natural section. Visible in the microscopic world, $\Delta x\Delta p\geq\hbar/2$ as the uncertainty relation is at least not universal. So it cannot be upgraded to the universal principle of uncertainty.

Some people use the resolution limit to explain the uncertainty. But at that time people only thought of projective measurements, and projective measurement cannot avoid random interference. The quantum inverse measurement theory I established[2] has broken free from the constraints of projective measurements. Once freed from the constraints of projective measurements, the measurement accuracy of the interference-free measurement is no longer limited by resolution.

Some people may think $\Delta x\Delta p\geq\hbar/2$ can be obtained according to the Schrödinger equation. However, the ensemble average concept may be used in the derivation process. That is to say, we must first assume that the track does not exist, and the equation to deny track existence $\Delta x\Delta p\geq\hbar/2$ can be obtained. If we do not first assume the existence of the track, we can only get the equation $A\cdot B\geq\hbar/2$ whose significance is the same as $pr=\hbar$.

In my earlier paper,[10] Heisenberg’s uncertainty relation can be derived by the classical motion law and by applying more examples. This fact confirms that the existence of the logical paradox in the uncertainty relation is mutual confirmation. The existence of the logical paradox in the uncertainty relation has also indicated that the uncertainty relation cannot be universally applicable. In theory, the statistical significance of the uncertainty relation is dependent on the von Neumann proof. In the experiment, it is dependent on the explanation of the electron diffraction experiment. Von Neumann’s proof has applied the entropy increasing process of interference measurement in the range of the Schrödinger equation. Therefore, his conclusion is wrong. The electron diffraction experiment is not a good method to measure electron trajectories (the interference is not uniform and weak, and the side effect is too large). The logic paradox of the uncertainty principle shows that the motion track of a microscopic particle can be accurately measured by continuous measurement. That the motion track of a microscopic particle can be accurately measured by continuous measurement shows that the experimental results of electron diffraction caused by discontinuous measurement at a point are independent of the characteristic of “the continuous motion of the electron.” For the movement of an electron, its future cannot be accurately predicted by its past (especially with the idea of “it is also uncertainty when it is not measured”). This conclusion lacks both a theoretical basis and an experimental basis.

The existence of the uncertainty principle paradox is not affected by the existence of the phenomenon of quantum teleportation and quantum entanglement. The old interpretation of a series of experiments about particle capture has been changed by the principle of particle track left and the 3D regression analysis method. The new explanation supports the proof of the paradox of the uncertainty principle mutually. As long as the uncertainty principle paradox exists, the basis of the uncertainty relation only having statistical significance is insufficient. The concept of quantum decoherence and the collapse of the wave packet are not necessary, the probability interpretation is also a lack of basis, and the interpretation system, measurement and philosophy of quantum mechanics are likely to be at the end of subversion. We can do the electron diffraction experiment in the spark chamber or the cloud chamber, by letting the electrons pass through a slit one by one. Author prophecy: this can better verify the uncertainty principle paradox and discover the side effect of the electron diffraction experiment.

The interpretation of the uncertainty relation is an explanation of the point particle concept. It acquiesces in that the motion of an object particle can be described by the classical position and momentum. The existing explanation of the uncertainty relationship is to try to describe the micro-particle motion with position and momentum. This is inconsistent with non-local reality that is now recognized by quantum mechanics. In that case the object particles are non-point and non-local, both the position and momentum of the particle cannot be accurately measured, and there is no Heisenberg uncertainty interpretation. Wave packet collapse is an irrational assumption, and there is still no experimental evidence. In contrast, there exists negative experimental evidence such as secondary diffraction experiments. This paper illustrates that although the Heisenberg relationship exists, it cannot be used to represent the product of the uncertainty of the two conjugate physical quantities (*i.e.*, the Heisenberg relation is not an uncertainty relation). It is, at least, worthy of debate as to whether the particle motion observed by using the chamber and other equipment is the particle's distorted face (or a distorted face). Multi-world theory is like that; in the past, humans did not know the natural phenomenon and assumed that they were the god, the world and the nether world. The phenomenon is explained, but there is no reason, no evidence. It can be seen that the concept of non-point, non-locality and multi-world theory cannot deny the conclusion of this paper.

In summary, both the $rp=\hbar$ relation and the $\Delta p\cdot\Delta x\approx\hbar$ relation exist, but we cannot explain them using the method provided by Heisenberg, and Born *et al.* cannot promote it into the principle of uncertainty. The existence of the paradox of uncertainty principle has shaken the basic position of the uncertainty relation in quantum mechanics. As long as the principle of uncertainty is not reliable, the concept system of quantum mechanics can be subverted. The reason is that the existing quantum mechanical conceptual system has two major pillars: the uncertainty principle supported by the electron diffraction experiment and the state superposition principle supported by the interpretation of quantum entanglement experiments. As long as the two pillars fall, the building of the existing conceptual system of quantum mechanics will tilt. Moreover, Braginsky *et al.*[2] pointed out that the empirical chain and the logical chain in the experimental interpretation of quantum entanglement are incomplete. In short, how important is the uncertainty principle in quantum mechanics and how important is it to discuss the paradox of uncertainty? The discussion of the paradox of uncertainty relation does promote the birth of local realism quantum mechanics.[10] The logic defects and irrational behavior of the existing interpretation system of quantum mechanics are further exposed by pointing out the paradox of the uncertainty relation, and the rationality and beauty of local realism quantum mechanics have been foiled.

2.10. The Sources of Probability in Quantum Mechanics Are Incorrect

The Sections 9 and 10 in the declaration on the revolution of quantum mechanics has preliminarily explained this problem. The following is a more specific explanation.

In the theoretical narrative of quantum mechanics, there is often an inadvertent replacement of “both can be the A-state and can be the B-state” with “both to be probably the A-state and to be probably the B-state,” which can be further stealthily changed into a part in the A-state part in the B-state (even if there is only one particle in the system, as is the case). This behavior of stealthily changed concepts evolves the certainty of things into the randomness of things (this is often the source of probability in quantum mechanics). However, the state of things is affirmatory ultimately. This requires a superficial random collapse process to get things back to a certain state from a random state (*et*, *al*., the erroneous result caused by a stealthily changed concept is corrected to a normal orbit by a superficial collapsing action). The misconduct of the stealthily changed concept is so subtle that the famous scientist Weinberger did not see where the probability of quantum mechanics came from. Classification by source: there are two sources of probability in quantum mechanics. First is Born’s probability interpretation. Second is the principle of state superposition.

The Schrödinger equation is a linear equation, so, if both φ_1 and φ_2 are the solutions of the equations, then the linear superposition $\Phi=c_1\varphi_1+c_2\varphi_2$ of φ_1 and φ_2 is also the solution of the Schrödinger equation. C_1 and C_2 are plural. The physical meaning of the result is: if the possible states of the particles are described by the diameter of φ_1 and φ_2, their linear superposition Φ also describes the possible state of the system. The principle of state superposition is derived from this reasoning.

The reasoning described above is a big problem. First, there are many solutions to the linear wave equation, most of which are extraneous roots.

The state superposition principle is equivalent to the extraneous roots of the equation as the real roots. For example, for a single-particle system, there is only one solution to the wave function at one time, and the other solutions are all extraneous roots. Even if there are more than two solutions, the particle can only be in one of these states (at the same time a particle can only be in a certain state, but it cannot be in two different states at the same time or, at this point there is only one to be a real state—the state that the particle actually is in, the other state is empty—virtually no particle is in these states). In this case, there is a superposition between the real state and the empty state. It can be seen that the probability caused by the superposition principle is derived from "affirming that extraneous roots and real roots are equal rights, so that the descripted entity can be classified randomly." It can also be said that the probability of quantum mechanics is determined by the prior identification of the micro particles as non-local realism (even if there is only one particle in the system, all possible states are partially randomly occupied, without empty states).

"The formulation and application of the principle of superposition of quantum states" are to guide the results of the measurement with a hypothetical situation, rather than to sum up the assumptions based on the actual measurement results. The expression and interpretation of the principle of state superposition are as follows.

The superposition principle is a basic principle in quantum mechanics. It illustrates the nature of the wave function. If ψ_1 is an intrinsic state of the system, the corresponding eigenvalue is A_1, ψ_2 is one of the intrinsic states of the system, and the corresponding eigenvalue is A_2, according to the linear relationship of the Schrödinger equation, $\psi=C_1\psi_1+C_2\psi_2$ is also a possible existence state of the system ($\psi=C_1\psi_1+C_2\psi_2$ is one of the forms of expression of Eq. (9)). If you measure the observable quantity A in this state, the A values to have measured are both likely to be A_1 or A_2, and the corresponding probability ratio is $[|C_1|/|C_2|]^2$. The average value of A in three-dimensional full space is $<A>=\int \psi^*A'\psi \mathrm{d}x$ or the Dirac symbol $<\psi|A'|\psi>$. The ratio of the probability being $[|C_1|/|C_2|]^2$ is the theoretical source (theoretical basis) of the quantum mechanical probability interpretation.

In quantum mechanics, we use the state function (wave function) ψ as the probability amplitude to describe the state of a physical system. The principle of superposition is actually said to be: in quantum mechanics, the superposition rule is satisfied by the state function ψ as a probability amplitude. If people used the density matrix directly, or the path integral, and even the current popular matrix direct product state, maybe there is no state superposition principle. What can be described by a wave function is not necessarily a wave. The diffraction experimental phenomenon of microscopic particles can be explained by direction quantizing. The experimental results are shown from **Figure 2.2** to **Figure 2.5**. If these factors are considered, the principle of state superposition and the probability of quantum mechanics are not necessary.

A child was lost in the train station between Beijing and Tianjin. His family did not know where he was. They only know that he is not in Beijing and not in Tianjin (the conclusion of "50% may be in Beijing, 50% may be in Tianjin" is mathematically allowed). But the position of the child is not random (the child leaves the adult and goes on a train to Beijing or Tianjin, each of which is a determinism process). How does the probability come to be both 50% that this child is in Beijing and 50% that he is in Tianjin? It is the result of an analysis by a mathematical analysis tool, not a true one. Finally, the child was found in Beijing. This indicates that the previous mathematical analysis is not true. Finding the child in Beijing is definitely not the state which is 100% in Beijing collapsed from 50% in Beijing. No matter whether this child is found or not, his objective and definite position is only one—that is, in Beijing. Coherent superposition is conditional, so the realization of conditions described by the state superposition principle is also conditional.

Some people say that the statement of state superposition principle also holds true for the classical wave. However, for the classical wave, only ψ_1 and ψ_2 exist at the same time, they can be superimposed. Moreover, both the reason and the result are not random at all. Even if the superposition of micro-systems, the causal relationship is very clear, there will be no randomness. For example, the outer electron of a carbon atom is $2s^2 2p^2$. Hybridization between the s orbit and the p orbit can occur under the influence of the outside world. There are only three kinds of sp, sp^2 and sp^3 hybridization results. Instead of choosing these three hybrids randomly, the system determines one of the hybrids according to the environmental conditions. In this case, the probability $C_1^2/(C_1^2+C_2^2)$) is hard to appear. Solution linear equations will appear to increase the root, we must judge according to the specific situation which is the true solution, but not all solutions are regarded as randomly selected objects.

The above statement, "if ψ_1 is an intrinsic state of the system, ψ_2 is also an intrinsic state of the system" can be used to describe empty states. However, if we use it to describe real states and recognize that a system can simultaneously be in two states, we admit that a system can simultaneously be in these two states. It is equivalent to admitting that a person has two faces at the same time, and these two faces are his real face, because the eigenstate is a state of full representation, not a partial state. If there is only one objective real face of a particle (or a person), then, there must be one in the ψ_1 states and ψ_2 states of microscopic particles that is fictitious (or spare/alternate). The idea that a particle simultaneously has two different real faces was based on supposition (hypothesis). This hypothesis is also a hypothesis that microscopic particles have non-local-reality. Interpretation of the experimental results of the double-slit diffraction of electrons does not rule out the accompanying light effect most likely to occur. Even if it is not accompanied by the light effect, it can be explained by direction quantization. Therefore, it cannot be regarded as solid evidence of an object particle simultaneously having two different real faces. In addition, in the above statement, the person to propose the state superposition principle firstly recognized that the state superposition at first was just a possibility. The next words, "the A values to have measured are both likely to be A_1 or A_2, and the corresponding probability ratio is $[|C_1|/|C_2|]^2$", recognized state superposition to be inevitable (if the superposition does not occur, the measurement results are not statistical). For the superposition of states, there is a lack of the necessary logical transition from "possibility" to "inevitability". State superposition is also inevitable (hypothetical).

It may be said that micro particles can be divided (a particle can be in two different places at the same time). Using the context of quantum mechanics to describe this example, it is necessary to think that the lost child can be divided. This allows half the body of this child to be in Beijing and the other half to be in Tianjin. According to the principle of state superposition, the child has three possible states (these are also the three independent events): <1> 100% is in Beijing; <2> 100% is in Tianjin; and <3> his body is half in Beijing and half in Tianjin. However, quantum mechanics erased the first two possibilities for no apparent reason. This is neither logical nor conforming to the principle of state superposition. In other words, existing quantum scientists regard the possible superposition and "to can superposition" as an inevitable superposition (the superposition is the only state of the particle).

According to the state of the principle of superposition, event <3> is not an independent event ($\Psi = C_1\Psi_1 + C_2\Psi_2$). But the reality is that <1>, <2>, and <3> are independent events. This means that in the "system in several different states" events described in the state superposition principle are not independent events in theory, but applied in practice they are independent events. This is the paradox in the principle of state superposition. No matter whether we recognize the existence of this paradox, we cannot treat the probability of event <1> and event <2> as zero.

The above has criticized the uncertainty caused by the principle of state superposition. But I have not given full expression to one's views. I'll make some additions below. In quantum information, two basic states are often written as |A> and |B>. The linear superposition of |A> and |B> is *a*|A> + *b*|B>. The principle of superposition is that: if a system may be both in |A> and may be in |B>, it may also be in any *a*|A> + *b*|B>, and the latter state is called the "superposition state". Here *a* and *b* can take any number, and the only limit to them is that the sum of the square sum of their absolute values is equal to 1, that is, $|a|^2 + |b|^2 = 1$.

The above statement is a description of the existing quantum mechanics. If you do not look carefully, you cannot see the problem within it. In the cases mentioned above, the possible states of the system should be three or more: the first possibility is |A>, the second is |B>, and the third is *a*|A> + *b*|B>. However, the orthodox quantum scientists only admit that the state of this system can only be the third when applying the principle of superposition, and use $|a|^2 + |b|^2 = 1$, $|a|^2/(|a|^2 + |b|^2)$ and $|b|^2/(|a|^2 + |b|^2)$ to calculate the probability. You know, the third state is just derived from the first and second states (without the two states of the first and second there is no third state, even if their status is equal, you can't have the first two states). This is a serious mistake that people have made when applying the principle of superposition of states (as long as these three states are possible, $|a|^2 + |b|^2 = 1$ is wrong). If a=0 or b=0 is taken, that is the state where the superposition has not yet occurred. Both (a|A> + 0|B>) and (0|A> + b|B>) are the superposition of the real and the empty states. The logical problem of the superposition between the real state and the empty state is that the B state in the (a|A> + 0|B) state appears and does not appear (the probability of the B state is 0 and not 0). The three possible states correspond to the three solutions of the system wave function. In mathematics, there is no reason to avoid the first two solutions and only choose the third solution.

Another source of the probability of quantum mechanics is Born’s probability interpretation. At the beginning of Born's probability interpretation, most people think that it is ignorance of the structure and nature of micro particles by probability. As long as we have a deeper understanding of the structure and properties of microscopic particles, there is a new interpretation to substitute the probability one. As long as we change the probability interpretation to "the square of the modulus of the wave function is the energy density," this probability is eliminated. One of the reasons that people had to believe in the probability interpretation was that, for a single point particle system, the interpretation of energy density could be difficult. For a plane wave, the modulus of the wave function is the amplitude, and the square of the absolute value of the modulus is proportional to the energy density. Born's probability interpretation is inseparable from a ghost (if we use Born's probability interpretation, nuclear electronic movement can only be a ghost movement). As long as we use Kelvin's light knot model, we can avoid Born's probability interpretation.

References

[1] R. Tu (2017), *Journal of Modern Physics*, **8**, 1398-1469. https://doi.org/10.4236/jmp.2017.88088.

[2] Vladimir B. Braginsky,[1] Yuri I. Vorontsov,[2] Kip S. Thorne[3] (1980), Quantum Nondemolition Measurements. *Science,* 209, 547-557. http://science.sciencemag.org/content/209/4456/547.

[3] S. Kocsis, A. M. Steinberg, et al. (2011), Observing the Average Trajectories of Single Photons in a Two-slit Interferometer. *Science,* vol. 332, 1170.

[4] R. Mir, A. M. Steinberg, et al. (2007), *New. J. Phys*., 9, 287.

[5] Runsheng Tu (2013), The Formula Whose Shape Is Similar to a Heisenberg Relation Possesses the Double Meanings of Determinism and Indeterminism. *Infinite Energy,* no. **107**, 44-46. http://www.docin.com/p-765650007.html.

[6] Bell, J. S. (1966), On the Problem of Hidden Variables in Quantum Mechanics. *Reviews of Modern Physics,* **38,** 447. https://doi.org/10.1103/RevModPhys.38.447.

[7] He Zuoxiu (1989), Must the Measurement of Quantum Mechanics be "Subjective Intervention"? (Part one), *Studies in Dialectics of Nature,* vol. 5, no. 1, 8-18.

[8] He Zuoxiu (1989), Must the Measurement of Quantum Mechanics be "Subjective Intervention"? (Part two), *Studies in Dialectic of Nature,* vol. 5, no. 2, 1-12+75.

[9] von Neumann (1955), Mathematical Foundation of Quantum Mechanics, Chap. VI. Princeton, N. J.

[10] Runsheng Tu (2015), *Local Realism Quantum Mechanics*, 1-292. Lanham: American Academic Press.

CHAPTER THREE

THE LOGIC SYSTEM, INTERPRETATION SYSTEM, AND MEASUREMENT VIEW OF LOCAL REALISM QUANTUM MECHANICS

As we mentioned earlier, there are exit paradoxes in the uncertainty relation and the principle of state superposition. They cannot be the basic principle and theoretical basis of quantum mechanics. The reliable basis of quantum mechanics is the direction quantization law, the quantum inverse measurement theory and the model of the light knot object particulate structure. The theory of quantum inverse measurement determines the observable locality, reality and determinability. The direction quantizing law determines that non-locality and unrealistic interpretation can be used. The model of light knot particulate structure determines that the next-level structure of micro particles can have a significant impact on the interpretation system and mathematical form system of quantum mechanics. This chapter mainly introduces the classical mechanical derivation of the general Heisenberg relation and the establishment of the mathematical form system of quantum mechanics.

3.1. Background Analysis

At the beginning of quantum mechanics, the main obstacles in the theory to establish local realism quantum mechanics is the uncertainty principle rather than electron diffraction (but quantum entanglement is experimental obstacles). If there is no uncertainty principle, researchers can easily establish local realism quantum mechanics, and other appropriate interpretations of electron diffraction and quantum entanglement can be sought. Now, in order to restore the local realism of quantum mechanics we must first clear the theoretical obstacles of the uncertainty principle. A good foundation for removing the obstacles has been laid by founding the uncertainty principle paradox. This chapter solves many important problems in the existing quantum mechanics, and makes quantum mechanics very beautiful. Microscopic particles are localized entities whose energy is confined to a very small space by a wave transmits along a small closed path. The quotient of its intrinsic motion energy and the square of the velocity of light is its static mass. This is the nature of the wave-particle duality of non-pointed physical particles. De Broglie wave of the extranuclear electrons is a kind of wave shoot. Extranuclear electrons are the wave in the potential field. In the potential field, the form of the wave does not change, but the energy changes. The increased energy of waves in the potential field can be used as the classical mechanical energy of particles. E_H (here，$E_H=E_k+E_p$). Then, according to E_k or E_p, the apparent motion velocity υ_d, apparent momentum p_d, and apparent frequency v_d of the nuclear electrons can be calculated， and understand their form of apparent movement. The whole motion of the unbound state of electron is the veritable movement of its whole to be on the basis of the intrinsic motion. It is precisely because the motion of the extranuclear electron is converted to apparent motion as described above, and it wills certainly not radiate electromagnetic waves outward. According to the model of light-knot electronic structure, we can deduce the De Broglie relation, the Schrodinger equation, the D 'Alembert equation, the Klein-Gordon equation, the Dirac equation, the electron spin and the orbital spin expressions, and their operators.

Local realism quantum mechanics is a specific subset of non-local realism quantum mechanics where the uncertainty relations can be derived from classical mechanical formulas[1], and through which quantum mechanics can be compatible with classical mechanics. The significance of this discovery is on a par with the significance of discovering the uncertainty relationship itself. The concept of local realism quantum mechanics is stirring, with no event this exciting occurring in the field of physics in the last ninety years.

According to local realism quantum mechanics, we can derive quantum mechanical formulas that use the orbital concept and the wave equation simultaneously, thus removing a major theoretical barrier. By realizing individual quantum manipulations, we can essentially “catch” Schrödinger’s cat; that is we can clearly know if the cat is dead or alive when we observe the phenomenon of quantum entanglement. The experimental results of the 2012 Nobel Prize in physics provide a system that correctly measures and corrects for quantum decoherence, while still “catching” Schrödinger’s cat. The important concept from these results is that the nature of the controlled particles in a Paul trap is no longer associated with the observer, indicating that the observed object and the observer can be split. The research work of Ref. [1] is the theoretical basis for establishing local realism quantum mechanics, while the research work of Serge Haroche and David Wineland provides experimental proof that microscopic particles possess a causal association within a local reality. In contrast, mainstream quantum mechanics scientists deny this empirical status by using the concept of subjective "quantum decoherence" and "wave packet collapse."

The traditional method for applying quantum mechanics calculations of helium-like ions is an approximate semi-empirical method. This method is conjecture according to the known results. This process deviates from rigorous scientific process. As an alternative, I have established a local realism quantum mechanics method that uses fixed extranuclear electrons, and have used the atomic model with a phase trajectory to calculate the results for nine different molecules. In particular, calculations of the big double atomic molecules Na_2, K_2, and the asymmetrical molecule HF all contain the first excitation state. These calculated results are more consistent with experimental values than traditional theoretical calculations, and the "semi-empirical method hat" has been removed. The importance of these calculations rivals the significance of Schrödinger's calculations for the hydrogen atom. The proposed calculation results are consistent with experimental results, and the calculation method is based on a set of strict theoretical proofs. Thus, these results are unlikely to occur completely by chance, but rather reflect objective laws.

The theory of local realism quantum mechanics can be established according to the same premises as the calculations described by Ref. [2] (see Section 3.5). Therefore, continuing to say that both the calculated results in Ref. [2] and the theory of local realism quantum mechanics are the results of coincidence after the theoretical system for local realism quantum mechanics has been established violates the scientific spirit and the quality of integrity. You may ask why local realism quantum mechanics does not reveal the inherent laws of quantum mechanics and of material structures in general. Simply put, local realism quantum mechanics does not return to Bohr's theory, but it is a new theory that simultaneously contains the positive results of Bohr's old quantum theory and non-local realism quantum mechanics.

While string theory in general is strongly supported by current researchers and scientists in general, there is less support for the concept of large radius localized strings in the order of the radius of free electrons and protons, since the radius of free electrons and protons is very small.

However, the string used by the calculations in Ref. [2] is not the string of a free electron, but rather the string of an extranuclear electron, which means that a free electron string still coordinates with the electron radius. The key concept of local realism quantum mechanics is that the large ring structure of an extranuclear electron coordinates with established quantum mechanics theory (*i.e.*, we can use the orbital concept and wave functions at the same time).

The calculations in Ref. [2] used a local reality atomic structure model. A review of previous literature shows that there have been numerous attempts by scholars to build a theory establishing quantum mechanics with local realism. However, to date none of these attempts have been successful. As stated above, the orbit in such a model is not a ring of solid state entity, but is rather a set of closed strings completely surrounded by the wave propagation path—an annular phase trajectory of the local reality.

No matter how bizarre the hypothesis put forward in this chapter, as long as the number of basic assumptions is less than the original five, the same logical system for quantum mechanics can be established and the positive results of existing quantum mechanics theory can be retained, which means that this work is meaningful and worthwhile. Moreover, this work has successfully coordinated the relationship between quantum mechanics and classical mechanics, has improved the interpretation system of quantum mechanics, has improved the theoretical rigidity of quantum mechanics (*i.e.*, decreases the number of prerequisites and no longer requires intuitive imagination when establishing relativistic quantum mechanics) and greatly simplifies quantum mechanics calculations. These positive results using the unique premise presented in this work have achieved no less than a major upgrade of quantum theory.

Some people believe that local realism quantum mechanics conflicts with the experimental results produced by non-local realism quantum entanglement and so on. However, those experiments measure only part of the behavior of microscopic particles, while the behavior of microscopic particles in most situations can be a localized reality. A good analogy is human society. While few people have a specific function, this does not indicate that each person is the same in terms of life and behavior as all the other people. The specific performance of microscopic particles is the same. The indeterminate performance of measured microscopic particles does not contradict local realism quantum mechanics for two reasons: first, we can strictly prove that a formula of a form similar to a Heisenberg's relation possesses the double meanings of determinism and indeterminism;

and secondly, the statement “the behavior of microscopic particles when measured does not conform to determinism” cannot be strictly proved by experiment and we cannot be sure of its correctness. Additionally, non-local realism quantum mechanics is not without chinks in its own armor—the theory still cannot explain why atoms and molecules are so stable in dynamic processes. In fact, such a stability of atoms and molecules indicates that the electrons in the atoms and molecules are the localized reality.

At present, the quantum process of creating light from nothing (known as the Delsing experiment, or the experiment of the Swedish group[3-4]) still lacks a good explanation. One current theory is that it is the movement of a particle that creates the light. However, this explanation does not support the idea that the diffraction pattern of a particle beam obviously displays divergence of the localization particles, as this kind of diffraction pattern experiences a significant amount of “accompanying light” not diffracted only by localization particles.

The probability interpretation of quantum mechanics has created an extranuclear electron ghost that mysteriously appears and disappears at different space-points in a system, but does not actually exist in the real world. However, a true scientific system must remove these multi-purpose ghosts and eliminate the inconsistencies within the theoretical framework that these ghosts attempt to resolve. To achieve this goal, I have discovered a general Heisenberg relation, as well as a transformation condition between the general Heisenberg relation and the uncertainty relations. This discovery agrees well with the results of experiments showing the effect of accompanying light. Furthermore, the new relationship no longer causes quantum mechanics and classical mechanics to repel one another, constituting a powerful reason to pursue the new interpretation of quantum mechanics.

Quantum mechanics as a theory describes the atomic world, and successfully describes a wide variety of elementary particles. However, the theory was initially built on the basic theory of atomic structure; subsequent intensive development of elementary particle theory has not significantly influenced quantum theory or its growth within the framework of atomic structure theory. That is, you cannot reduce the number of basic assumptions in quantum theory using the atomic framework, enhance its logicality, or beautify the old theory. This lack of growth of a theory is not normal in science and technology. From this, we can draw at least two conclusions: first, there is a need to do more work to beautify quantum mechanics through the adoption of elementary particle theory. Attempts in this research direction will at least have value for idea exchange and discussion. Secondly, it is inadvisable to deny a theory that successfully beautifies quantum mechanics according to elementary particle structure theory, even though the idea can eclipse traditional quantum mechanics theory.

In this work, I do not use the traditional mode of a point electron surrounding a nucleus. Instead, I use an orbital concept that differs from traditional orbits by using the phase-orbit line to replace the orbit and the point electron. This processing mode is one of the most successful concrete operational methods for accommodating both classical mechanics and quantum mechanics simultaneously.

While almost all quantum mechanics textbooks speak to the basic principles of quantum mechanics, most students studying quantum mechanics at university for several years still would not be able to independently calculate the structure of a simple molecule. The results for even a relatively simple hydrogen molecule or helium atom are approximate results that can only be calculated using a computer. Furthermore, the logic system of quantum mechanics is not very strict, relying on a set of assumptions in order to establish a very abstract system. This phenomenon suggests that quantum mechanics theory possesses very serious deficiencies, and people should question its basic premises and concepts. The quantum mechanics method described by this book, on the other hand, is quite different from traditional quantum mechanics, using only a single basic assumption to establish a logical quantum mechanics system. Using the concepts and methods of quantum mechanics as provided by this work will allow people to calculate several molecules larger than H_2 in only a couple of hours.

The voices strongly dissatisfied with the existing theory of quantum mechanics are as follows: 1) Current quantum mechanics theory requires an extremely abstract group of five basic suppositions; 2) Quantum chemical calculations can only be semi-empirical; even the simplest calculations are logically not strict in logic and the process of getting a definite result is too complicated; 3) Current quantum mechanics theory is too abstract and far-fetched; 4) Quantum mechanics and classical mechanics are incompatible; 5) In-depth material structural theory has not been used to develop quantum mechanics; and 6) The union between quantum mechanics and the theory of relativity has not been truly realized. I have already proven that uncertainty relations actually contain the dual significance of determinism and non-determinism,[1] which results in the establishment of a new quantum mechanics logic system to contain the positive content of the old quantum mechanics system and make quantum mechanics compatible with classical mechanics. The proposed system enhances the beauty of quantum mechanics theory as well as simplifying quantum mechanics calculations, and eliminates all but the sixth of the above issues. The proposed explanation for quantum mechanics simply looks more natural and ideal. Note, however, that this new logical system of quantum mechanics does not need to overthrow the mathematical form system of current quantum mechanics theory, but simply requires a reconstruction of prevailing thought.

The existing quantum mechanics, which is essentially statistical quantum mechanics, is able to calculate atoms and molecules only by using the semi-empirical methods. Its basic hypothesis is abstract and has a lack of basis. Many scientists are dissatisfied or frustrated in understanding and the calculation method. Using the "structure model of phase trajectory" of a particle as the only assumption, a new logical system and a new concept system of quantum theory can be established. The interpretation system of quantum mechanics can be improved, the logic system of quantum mechanics can be beautified, and the calculation of quantum mechanics can be greatly simplified. Existing quantum mechanics is thus upgraded to local realism quantum mechanics which reserves the positive results of traditional quantum mechanics. The logical structure of local realism quantum mechanics is the same as the logical structure of existing quantum theory, and the basic concept and the basic premise of quantum mechanics are subverted.

3.2. The Proof of Compatibility between the Uncertainty Relation and the Classical Laws of Motion

This proof process is also the process of deriving the generalized Heisenberg relation based on classical laws of motion. This process and the discussion process of the paradox of uncertainty relation echo each other, and strongly support the concept of localized realism in quantum mechanics.

There is a deep divide between statistical quantum mechanics and classical mechanics, which makes it difficult to reconcile theory and experimental observations. It is difficult to call something a science when it still makes use of occasional "accidental" results. For the first 20 to 30 years of quantum mechanics study, researchers possessed a strong hope of finding one kind of transitional theory to go from classical mechanics to quantum mechanics (*i.e.* to find a way to make classical mechanics compatible with quantum mechanics). A generation of scientists has been disappointed repeatedly while waiting for this bridge to be built, and many have passed on without ever seeing that hope fulfilled. Now, a new generation of researchers holds little hope of finding this connection (or is expected to suppress this hope). However, the author provides a reason to rekindle this hope.

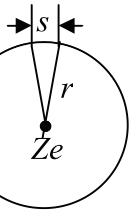


Figure 3.1. The relation between *s* and *r*

Quantum mechanics theory is built on the basis of specific electron orbits that exclude classical laws of motion, where the foundation to restrict electron orbits is the Heisenberg uncertainty principle and its nondeterministic significance. So long as the uncertainty principle is allowed to restrict electron orbits, no great revolution in quantum mechanics will take place. Note that readers of this work should not automatically deny the proposed theory of this work at this time, or be swayed by habitual thinking to reject such radical notions as proposed.

It has been said, "Beautiful things are simple things." I believe that succinctness is one kind of beauty. Even though the logic used in this work is relatively simple, still there is a rigorous process of logic derivation. In the history of science, there are many examples of using a concise method to describe profound problems. In addition, succinctness has always been a characteristic of classical mechanics, and if we are using classical mechanics as part of the foundation for quantum mechanics theory, then simplifying quantum mechanics is not only inevitable, but virtually a requirement.

3.2.1. Using the Classical Formula of Electron Deflection to Derive the Heisenberg Relation

In existing quantum mechanics concepts, the Heisenberg uncertainty relation is derived by using the factors of unrelated classical mechanics motion. However, this idea is only relevant because a microcosmic particle has volatility. From a logical viewpoint, using classical mechanics principles only, we can't obtain a formula whose shape likes a Heisenberg relation but its means are an uncertainty relation. If the Heisenberg relation can be derived using classical motion laws, we have to change the concept of quantum mechanics. Below, we look at the product between linear momentum and the motion trajectory radius of the extranuclear electron in classical mechanics pr. Extranuclear electrons follow classical mechanical movement and serve as the planetary atomic model. In a planetary model of the hydrogen atom, the electronic classical mechanics equation of motion[5] is shown in Eq. (3.1).

$$e^2/(4\pi\varepsilon_0 r^2)=m\upsilon^2/r. \tag{3.1}$$

For Bohr's hydrogen atom (shown in **Figure 3.1**), $r=a_0=\pi me^2/\varepsilon_0 h^2$. Substituting it into Eq. (3.1), we learn that the electronic moving speed is $\upsilon=\alpha c$. Substituting $m\upsilon^2=p\upsilon$ and $\upsilon=\alpha c$ into Eq. (3.1), results in Eq. (3.2).

$$pr=e^2/4\pi\varepsilon_0\alpha c. \tag{3.2}$$

Substituting $\alpha=e^2/2\varepsilon_0 hc$ and $\hbar=h/2\pi$ (*i.e.*, $e^2=4\pi\varepsilon_0\alpha c\hbar$) into Eq. (3.2) results in Eq. (3.3).

$$pr=\hbar. \tag{3.3}$$

The correctness of Eq. (3.3) may be examined from three aspects. First, we analyze the dimensions on both sides of the equation and examine whether they are the same. If they are not the same, then Eq. (3.3) must be wrong; if they are the same, this shows that Eq. (3.3) may be correct. Next, check whether the derivation process from Eq. (3.1) to Eq. (3.3) was conducted in accordance with accepted logic. Finally, use experiments r and other methods to verify the orbital angular momentum of the extranuclear electron in hydrogen atoms. This is accomplished by checking whether it equals $\hbar$. If so it demonstrates that Eq. (3.3) may be correct; if not Eq. (3.3) is wrong. In the classical mechanics range, Equation (3.3) reflects an electron moving around a nucleus where the product between the accurate linear momentum and the accurate curvature radius is about equal to $\hbar$. In Bohr's theory of the hydrogen atom, the orbital angular momentum of the extranuclear electron of the hydrogen atom is indeed $\hbar$ (measured in quantum mechanics it has been seen as spin angular momentum). In classical mechanics, the deflection experienced by an electron sweeping past nuclei is extremely similar in form. The commutation relation also has a classical meaning. Electrons, protons, and other charged particles moving in the electrical field all conform to Eq. (3.3). Though Eq. (3.3) is not difficult to understand, the left side of the equation represents the classic mechanical physical quantity, while the right side is the physical quantity related to quantum mechanics effects (*i.e.*, the physical quantity of microscopic particles). Therefore, Eq. (3.3) is the bridge between classical motion law and quantum mechanics. Its significance can be compared with the de Broglie relationship ($p=h/\lambda$).[6] Equation (3.3) has revolutionary influence on the measurement concept of quantum mechanics and contributes ground-breaking significance in understanding.

The Heisenberg relation is $\Delta x \cdot \Delta p_x \geq \hbar$, where, Δx is the slit width rather than a distance increment. There is the relation of $r \leq \Delta x$ in formula (3.3) (shown in **Figure 3.2**), Δp_x is the product between the linear momentum p and the sine of the deflection angle (*i.e.*, $\Delta p_x = p\sin\theta$). Note: for the particle to make a regular curve movement, $\Delta p = p\sin\theta$ is not the uncertainty value of the momentum, but the component value of the momentum which has appeared, in the normal line direction, according to a certain rule. For uniform circular motion, it is the radial component of momentum. If we want to write Eq. (3.3) in the form of $\Delta x \cdot \Delta p_x \geqslant \hbar$, we have $\Delta x \cdot \Delta p_x \geqslant \hbar\sin\theta$. $sin\theta$ is a pure number without units and is always less than or equal to 1, therefore, for a small 180 degree deflection, $\Delta x \cdot \Delta p_x \geq \hbar\sin\theta$ can be written as Eq. (3.4).

$$\Delta x \cdot \Delta p_x \approx \hbar. \tag{3.4}$$

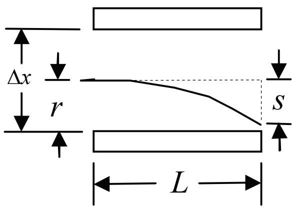


Figure 3.2. Electronic steam passes through the slit whose depth is L, the relation among L, s, r, φ and Δx.

Equations (3.3) and (3.4) are equivalent. They are both to show the law of electronic rays outside the nucleus obtained by using classical mechanics law, and they are both in the same form as the so-called uncertainty relation. The significance of this result stems from Eq. (3.3) and classical mechanics. For moving particles around the central charge, when velocity is $v \leq \alpha c$, the momentum and position of a particle can be measured simultaneously, and accurate linear momentum is smaller, and the accurate curvature radius is bigger (or linear momentum is bigger, and the curvature radius is smaller). When it is not measured, equations (3.3) and (3.4) are also tenable. This is the determinism meaning of Eq. (3.4). The other expressions of Eq. (3.4) meanings are shown in Table 3.1.

Visibly, the formula shaped like $\Delta x \cdot \Delta p_x \geq \hbar$, has double meanings in determinism and indeterminism. Which meaning does a specific action of a particle conform to? It depends on the environment experienced by the particle—if random interference cannot be eliminated, a particle shows indeterminism; if random interference is negligible, it is determinism (see **Figure 3.2**).

Obviously, the dimension of pr is [Js]; the dimension of $\hbar$ also is [Js]. For any classical curve movement, the dimension of the product between linear momentum p and the radius of curvature r is a direct ratio with Planck constant h (*i.e.*, $pr \propto \hbar$ or $pr = f(v)\hbar$). The key is to find the ratio (or function) between the two numbers. When the particle velocity is constant, $pr = f(v)\hbar$) can be written as:

$$pr = N\hbar. \tag{3.5}$$

Equations (3.3), (3.4), (3.5), and $pr = f(v)\hbar$ all belong to the general Heisenberg relation. Next, find the proportion coefficient as illustrated by examples. Suppose that an electron crosses over a slit at the speed of $Z\alpha c$; the charge on one side of the slit wall is $Q = Ze$ and the slit width is Δx.

As shown in **Figure 3.2**, the accepted force of an electron in an electric field is equal to e^2/r^2.

$$F = Ze^2/4\pi\varepsilon_0 r^2 \tag{3.6}$$

Here r is in the vertical distance between the slit wall and the electron beam. According to the basic laws of motion, we know that $F = ma$ and $s = (1/2)at^2$. Here, m is the mass of electrons and s is the distance of the freedom whereabouts of the electron. Given L is the depth of the slit, the spent time that the electron passed the slit is $\Delta t = L/v$ seconds. Using this, Eq. (3.7) can be obtained.

$$s = Ze^2L^2/4\pi\varepsilon_0 m\upsilon^2 r^2. \tag{3.7}$$

If the deflection angle of the electron beam is φ, and it is very small, knowing $sin\varphi \approx \tan\varphi = s/L$ then Eq. (3.8) is the outcome.

$$\sin\varphi \approx Ze^2L/4\pi\varepsilon_0 m\upsilon^2 r^2. \tag{3.8}$$

Equation (3.8) shows the relationship between L, r, υ and φ when an electron is swept across length s in a "uniform electrical field". If an electron beam is swept across the surface of a heavy nucleus, like a photon skimmed over a solar surface, where the electron beam deflects in the scope of $L \approx r$, then Equation (3.8) becomes Eq. (3.9).

$$r \cdot \sin\varphi \approx Ze^2/4\pi\varepsilon_0 m\upsilon^2. \tag{3.9}$$

Considering $m\upsilon^2 = p\upsilon$, $\alpha = e^2/2\varepsilon_0 h$ and $\hbar = h/2\pi$, Equation (3.9) becomes Eq. (3.10).

$$pr \approx (Z\alpha c/\upsilon\sin\varphi)\hbar. \tag{3.10}$$

Where $(Z\alpha c/\upsilon sin\varphi)$ is a coefficient without dimension, we want to find $f(\upsilon)$. Shown in Fig. 3.2, an electron passed the slit composed by the marshalling nucleus, $r \leq \Delta x$. Eq. (3.10) becomes $\Delta x \cdot sin\varphi \geq Ze^2/4\pi\varepsilon_0 m\upsilon^2$. Ordering $m\upsilon = p$, $psin\varphi = \Delta p_x$, we have Eq. (3.11).

$$\Delta x \cdot \Delta p_x \geq (Z\alpha c/\upsilon)\hbar. \tag{3.11}$$

Substituting the assumed electronic speed $\upsilon = Z\alpha c$ into the above formula results in $\Delta x \cdot \Delta p_x \geq \hbar$. Substituting $m\upsilon^2 = 2E = p\upsilon$ and $L \approx r$ into Eq. (3.7), we obtain $E = (Z\alpha c/2s)\hbar$. Considering $Z\alpha c = \upsilon$ and $L = \upsilon\Delta t$, $E = (Z\alpha cL^2/2r^2 s)\hbar$ becomes $E \cdot \Delta t = (L/2s)\hbar$. If $L/2s \approx 1$ (shown in **Figure 3.2**), Eq. (3.12) is obtained.

$$E \cdot \Delta t \approx \hbar. \tag{3.12}$$

Table 3.1. The analysis of characteristics of the general Heisenberg relation

No. of Eqs.	General Heisenberg relation	**Scale-up factor (function) $F=f(q, v)$**	**The value of v (or mv) when $F=f(q, v)=1$**	**The representation meaning**
3.11	$\Delta x \cdot \Delta p_x = F\hbar$	$F=2Z\alpha c/v$	v is approximately the speed of the electron outside the nucleus of an atom	The vertical distance to the particle beam is smaller; the particle beam deflection angle is larger.
3.12	$\Delta x \cdot \Delta p_x \geq (2Z\alpha c/v)\hbar$	$F=2Z\alpha c/v$	v is approximately the speed of the electron outside the nucleus of an atom	For uniform circular motion, the curvature increases as the radius decreases and vice versa.
3.13	$pr=(Z\alpha c/v)\hbar$	$F=Z\alpha c/v$	v is approximately the speed of the electron outside the nucleus of an atom	Under uniform circular motion, linear speed is invariable. As the radius decreases, the line momentum increases, and vice versa.
3.25	$\mathrm{M}=r_d p_d=r_d h/2\pi r_d=\hbar$	$F=1$ (or 1/2)	$v=2Z\alpha c$	The arc the particle passes through is a section of definite distance in the process of uniform circular motion: the particle's speed is higher (momentum and kinetic energy increase), while the time spent by the particle passing through this section of the arc decreases, and vice versa.

<table>
<tr><td>3.14</td><td>$E\cdot\Delta t=(L/2r)(Z\alpha c/\upsilon)\,\hbar$</td><td>$F=(L/2r)\times(Z\alpha c/\upsilon)$</td><td>$\upsilon$ is approximately the speed of the electron outside the nucleus of an atom</td><td>For curvilinear motion, the radius of curvature increases while the curvature decreases, and vice versa.</td></tr>
<tr><td>3.15</td><td>$r\cdot\Delta p_x=F\hbar$</td><td rowspan="2">$F=\frac{100}{\alpha}\frac{m\upsilon}{m_e c}\frac{\Delta s}{a_0}$</td><td rowspan="2">$m\upsilon$ is approximately the linear momentum of the electron outside the nucleus of an atom, (where the slit depth is the magnitude of the atomic radius)</td><td>The same with Eq. (3.14)</td></tr>
<tr><td>3.16</td><td>$E\cdot\Delta t=F\hbar$</td><td>The arc the particle passes through is a section of definite distance in the process of uniform circular motion: the particle's speed is higher (momentum and kinetic energy increase), while the time spent by the particle passing through this section of the arc decreases, and vice versa.</td></tr>
<tr><td>3.4</td><td>$\Delta x\cdot\Delta p_x\geq\hbar$</td><td>$F=1$</td><td>---</td><td>Assuming "when F≈1, random interference cannot be neglected," the phrase also expresses that momentum and position cannot be accurately measured</td></tr>
</table>

The physical meaning expressed by Eq. (3.12) is shown in **Table 3.1**. If $2s/L\leq1$, Equation (3.12) should be $E\cdot\Delta t\geq\hbar$. As mentioned above, an electron moving as defined using classical mechanics is also consistent with Eqs. (3.4) and (3.12).

The derivation process for Eqs. (3.4), (3.9), and (3.10) shows that instantaneous r can be an instantaneous radius of curvature as long as random interference does not occur, where Δp_x corresponds to the integral of an instantaneous curvature over a given time interval. Note that this relationship does not mean there is uncertainty in momentum, even if Δp_x is large enough. The reason is that the product between the curvature and the radius of curvature is a constant, and this constant may be large enough. When we give a moving particle a space restriction Δx, it will produce a momentum uncertainty Δp_x. Note：however, equations (3.6) and (3.12) do not always express uncertainty relationships. Eqs. (3.6) and (3.12) both dominate in that the product between the curvature and the radius of curvature is a constant, which means that localization of the moving particle and a particular orbit is allowed, when there is no random disturbance.

3.2.2. Derived According to the Motion Equation of Uniform Circular Motion in Bound State

The motion equation of the electron in the force field in which the central charge is Ze is $Ze^2/(4\pi\varepsilon_0 r^2)=mv^2/r$. Substituting $mv^2=2E=pv$, $\alpha=e^2/2\varepsilon_0 hc$ and $\hbar=h/2\pi$ into this equation, we may obtain $Er=Ze^2/(8\pi\varepsilon_0)=(Z\alpha c/2)\,\hbar$ and

$$pr=2Er/v=(Z\alpha c/v)\,\hbar. \tag{3.13}$$

Considering the motion distance of a particle is $s=v\Delta t$ for a very small time interval (shown in **Figure 3.1**), both of the two sides of $Er=(Z\alpha c/2)\hbar$ are multiplied by Δt and as arranged, we obtain

$$E\cdot\Delta t=(\Delta s/2r)(Z\alpha c/v)\,\hbar. \tag{3.14}$$

Equation (3.14) is corresponding with $\Delta x\cdot\Delta p_x\geq(Z\alpha c/v)h/\pi$ which is obtained from Eq. (3.11). It can express that the product between the radius and the momentum is a constant in the process of uniform circular motion.

3.2.3. Derivation of the Law of Curvature as Inverse to the Radius of Curvature

Curvature is directly inversely proportional to the radius of curvature (*i.e.*, the product of the curvature and the radius of curvature is 1). Consider the arbitrary motion of a curvilinear section, with a radius of curvature r, a bending degree with deflection angle θ (*i.e.*, the included angle between tangent and chord, or the angle of curvature). Note that when θ is very small, $\sin\theta$ can be used as an approximation for θ because θ (or $\sin\theta$) is directly related to the curvature when an arc length is fixed, *i.e.*, a larger curvature provides a larger θ (or $\sin\theta$). Now assume a particle passes through a slit, where the slit depth is equal to the chord length of the particle. For any given slit, the chord length is invariant. Suppose that the relationship between θ (or $\sin\theta$) and the curvature K is $\sin\theta=\Delta s\cdot K$ (where Δs is the chord length that is equivalent to the slit depth), which means $r\cdot\sin\theta=rK\cdot\Delta s=\Delta s$. We can then multiply both sides of $r\cdot\sin\theta=\Delta s$ by line momentum p to obtain $rp\cdot\sin\theta=p\cdot\Delta s=mv\cdot\Delta s$. The dimension of the momentum mv is [$\mathrm{Jm^{-1}s}$] and the dimension of Planck's constant is [Js], while the dimension of $p\cdot\Delta s$ is also [Js] to be the same as that of Planck's constant. This means $p\cdot\sin\theta=\Delta p_x$, $p\cdot\Delta s$ can be written as the product between F and the compound Planck constant (*i.e.*, $p\cdot\Delta s=F\hbar$), $rp\cdot\sin\theta=p\cdot\Delta s=mv\cdot\Delta s$ may be written a

$$r\cdot\Delta p_x=F\hbar, \tag{3.15}$$

Where, F is a function of zero dimension ($F=\frac{100}{\alpha}\frac{mv}{m_e c}\frac{\Delta s}{a_0}$), α is the fine structure constant ($\alpha=e^2/2\varepsilon_0 hc$), a_0 is the Bohr radius, m_e is the electronic mass, c is the speed of light, m is the mass of particle (unit is *kg*), and v is the line speed. When $v\leq(m_e a_0/100m\Delta s)\ \alpha c$, Equation (3.15) may become $r\cdot\Delta p_x\geq\hbar$; when $v\leq(m_e a_0/100m\Delta s)\ \alpha c$, Equation (3.15) becomes $r\cdot\Delta p_x\geq\hbar$; however, when $v\geq(m_e a_0/100m\Delta s)\alpha c$, Equation (3.15) instead becomes $r\cdot\Delta p_x\leq\hbar$. For the diffraction experiment of an electron passing through a slit, Δs is the slit depth. For the deflection when a photon passes over the solar surface, Δs is approximately equal to $2r$. If a charged particle sweeps across at distance r from the central charge, Δs is approximately equal to $2r$. Note that, even though both r and Δs are lengths, r is perpendicular to Δs and cannot be eliminated. The derivation process for Eq. (3.15) shows that a formula of the form $r\cdot\Delta p_x=F\hbar$ does not deny the existence of orbital motion, and is suitable for both macroscopic and microscopic systems. This equation poses a significant threat to the Copenhagen school of thought on the theory of quantum mechanics.

There is the relation of $\Delta s=v\Delta t$ when the distance of a particle's motion is very short. Substituting both $\Delta s=v\Delta t$ and $pv=2E$ into $r\cdot p\cdot\sin\theta=F\hbar$, we may obtain $[(Er\cdot\sin\theta)/\Delta s]\Delta t=F\hbar$. According to the definition of curvature $K=\lim_{\Delta s\to 0}\left|\frac{\Delta\theta}{\Delta s}\right|$ we can know: $\sin\theta\approx\theta$, $(\sin\theta)/\Delta s=K$ and $r\cdot K=1$ when Δs is very small. So $[(Er\cdot\sin\theta)/\Delta s]\Delta t=F\hbar$ may become

$$E\cdot\Delta t=F\hbar. \tag{3.16}$$

Perhaps, there are personal records that $\hbar$ in Eqs. (3.11) and (3.10) can be canceled with the $\hbar$ in the fine structure constant. If selecting this, Eqs. (3.11) and (3.10) restore Eq. (3.2), returning to the classical motion equation before deformation. This selection retraces one's steps. In fact, there are two other options to confirm logic: one is to choose $\upsilon=Z\alpha c$; the other is α=1/137. The two can avoid the retracing of one's steps and can achieve the goal—finding the relation between $\Delta x \cdot \Delta p_x$ and $\hbar$. Why do we choose certainty when the road of retrogression cannot achieve our goal? Backtracking cannot deny what's behind the two logical options.

The uncertainty principle paradox strongly supports the derivation process and the conclusion in this Section.

3.3. Analysis of the Essence and Applicable Scope of the General Heisenberg Relation

The relationships strictly derived in this work from classical laws of motion are uniformly known as the "Heisenberg relation", can't be known as "uncertainty relations," but should strictly be called the general Heisenberg relation. Although $F=f(q, \upsilon)$ in the above formulas is a function, it is also of zero dimension. This indicates that the relationships between the quantities on the left side of Eq. (3.6), and Eqs. (3.12) ~ (3.16) and Planck's constant are one kind of ideal proportional relationship, but this is not improvised. In fact, the uncertainty relation is only one special case when $f(q,\upsilon)\approx 1$ and random disturbances cannot be eliminated. A broader definition is given by Eq. (3.3), Eq. (3.6) and Eqs. (3.12) ~ (3.16), and they are the parts of the general Heisenberg relation.

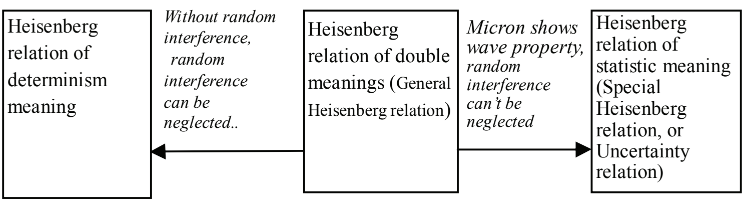


Figure 3.3. Heisenberg relation transmits between the two meanings of determinism and indeterminism.

Because Eq. (3.3), Eq. (3.6) and Eqs. (3.12) ~ (3.16) are obtained from classical laws of motion they are all functional relations that have deterministic significance (*i.e.* the set of equations allows for orbital motion). When a particle whose linear speed is invariable passes through a space of definite field intensity, without any interference, this may indicate: a) the product of curvature and the momentum is a constant; b) the product of the curvature and the curvature radius is a constant; c) if the deflection angle is very small, the product of the radius of curvature and the momentum component in the direction of the curvature radius is also a constant; and d) when the deflection angle is very small, the product of the deflection angle of a particle and the momentum component in the direction of the deflection radius is a constant. In all cases, this constant is proportional to Planck's constant. As a variation form of the classical laws of motion, each of these conditions may indicate: when the system isn't measured (or, in the process of the bound motion there is not random interference), the deflecting particle has the determination orbit. Most dramatically, the general Heisenberg relation may become an uncertainty relation of pure statistical significance when $F=f(q,v)\approx 1$, where the order of magnitude of the product on the left of the general Heisenberg relation is similar to Plank's constant. In this case, the form and meaning of the general Heisenberg relation become identical to the uncertainty relation. Only if we provide the environment where the interference isn't eliminated (*i.e.* providing a space limit for a particle beam or only using a specific shape of notch), the uncertainty relation can be obtained, so the standard uncertainty relation's tenet of uncertainty in measurements is created by the random interference and is thus not an inherent law of nature. So long as there is no random interference, we can accurately measure and predict the future behavior of an electron in quantum objects. Therefore, the uncertainty relation cannot always be the only basic principle used for conducting quantum mechanics calculations.

Obviously, the relationship for a form such as $\Delta x \cdot \Delta p_x \geq \hbar$ is not the only microcosmic movement that a system possesses, and a system may simultaneously express other configurations. For instance, a particle may have a certain orbit when we are not measuring that orbit, but exhibit the uncertainty relation when some interference is not calculated and eliminated in the measurement. So long as we are using the relationship $r \leq \Delta x$, the deflection angle of a single particle sweeping past a heavy nucleus can be accurately calculated. The old uncertainty relation does not have this function. Again, we cannot arbitrarily assume that Eq. (3.6) and Eqs. (3.12) ~ (3.16) only possess the Heisenberg interpretation (note: the Heisenberg interpretation equates to the indeterministic sense of the uncertainty relation). Instead, we use the attributes of “unitary statistic meaning”, “double meaning”, “non-statistical meaning”, “special sense” and “pure determinism” to discriminate the sub-classes of the general Heisenberg relation. This brings us to the following conclusion: the uncertainty relation and its sole statistical meaning as used by the Copenhagen interpretation of quantum mechanics are one exceptional case of the general Heisenberg relation under the premise of unintelligible random disturbances where the scale-up factor is $f(q,\upsilon)\approx 1$. Another way of stating this is that Heisenberg’s relation of sole statistical definition is caused by deviating from the general Heisenberg relation of the pure determinism meaning. This conclusion is visualized in **Figure 3.3.**

The deductions in the above section are the proof that the micro particles can do orbital motion, and there exists the relation of $pr=f(q,\upsilon)\hbar$. The physical significanc may have the same one of $pr=f(q,\upsilon)\hbar$. In section 1.3, we have proved the existence of the uncertainty principle paradox. The experimental results to capture microscopic particles using the cloud chamber and bubble chamber actually verified the uncertainty principle paradox. This suggests that, if there is no random interference, a micro particle only does railroad movement. Only if the random interference can’t be ignored, the particle's position randomly appears in the range of Δx, and the relation of $\Delta p_x \Delta x \approx \hbar$ determining the Δp_x is the momentum uncertainty (*i.e.*, only in this case, $\Delta px \Delta x \approx \hbar$ is the uncertainty relation. In other cases it is a classic expression of railroad movement rules). Together the uncertainty principle paradox and the derivation process in this section show that we can no longer use $\Delta x \cdot \Delta p_x \approx \hbar$ to deny orbital motion.

Heisenberg’s relation is both determinate and indeterminate. The relation also does not take into account random disturbances, something that makes the general Heisenberg relation suitable for microscopic systems. Since the diffraction of particles cannot be explained using the uncertainty relation, the uncertainty relation is not necessarily suitable for describing microscopic systems, even without random disturbances. The most direct conclusion of the general Heisenberg relation and the relationship between the general Heisenberg relation and the uncertainty relation is simply this: if you do not measure, the uncertainty relation cannot play a role, and $\Delta px \Delta x \approx \hbar$ is a classical motion law, while $pr=\hbar$ is suitable for describing the extranuclear electrons. This is the relationship between the general Heisenberg relation and the uncertainty principle.

3.4. Light Emerging out of Thin Air: a Quantum Effect Based on the Diffraction of Particles

The existence of making light from nothing shows that it is real for microscopic particles generated from nothing. At the same time, it shows that one of the easiest ways of making light from nothing is to create discrete fluctuations from "nothingness." For the interpretation of the universe, the scattered waves into a localized particle are a necessary process. The truth of the "the process of making light from nothing" determines that the pair of particles generated by the polarization of the vacuum spot is not a virtual particle pair but a real particle pair. The existing object particles and the newly generated particle pairs can interact. This interaction may be mistakenly interpreted as the strange nature of microscopic particles.

3.4.1. The Mechanism of Zero-point Energy for Making Light from Nothing

A most important tenet of quantum mechanics is the principle that the vacuum is not empty. Quantum theory predicts that the vacuum is actually the continuous generation and annihilation of the oceans by particles. Any spatial point in a vacuum may have the polarization to produce such particle pairs. Quantum theory states that these particles transform back and

Figure 3.4. Making light from nothing (stems from © Phil M Rogers/Alamy. Stiff.net and Nature News)

forth with myriad things in a vacuum. The existence of these particles is fleeting, often considered "subjunctive particles," yet it can still have a practical quantum effect and may catch a body moving at high-speed. Another quantum mechanics effect is the "Casimir force." This theory states that a mirror can obtain energy from a virtual photon falling on its surface, but then sends out that same energy as a real photon. That is, the movement of a material object at high speed can create photons because of this quantum effect. This "caught re-emitted light" (also known as created light, "emerges out of thin air" light, caught-retransmission light, or "accompanying light") is also referred to as an "accompanying light effect". This type of quantum effect may be observed occurring between a subjunctive particle and a material object. In other words, the movement of a piece of metal (or the movement of a particle) becomes a source of photons that may be surveyed from a vacuum. The difference between accompanying light and "bremsstrahlung" lies in the fact that bremsstrahlung is an electromagnetic effect (*i.e.*, the deceleration of a charged particle) while accompanying light is a quantum effect. Neutral particles do not exhibit bremsstrahlung when they decelerate, but may still transmit accompanying light. The strong and the weak between them are also entirely different.

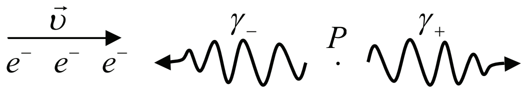


Figure 3.5. Polarization production of a pair of positive-negative energy photons (γ_+ and γ_-) at point *P*. Here, γ_- annihilates with electron e^- running in front, which becomes the following partner for the other light wave, and may in turn transform back to energy.

For decades, theorists have predicted that a similar accompanying light effect can be produced in a single mirror that is moving very quickly, and this has finally been observed. According to theory, a mirror can absorb energy from virtual photons on its surface and then re-emit that energy as real photons. However, this only works when the mirror is moving through a vacuum at near to the speed of light. This single mirror Casimir force is in fact strong enough at short distances for scientists to physically measure it and the Delsing experiment confirmed this. In the Delsing experiment, physicists at the Chalmers University of Technology circumvented this problem using a superconducting quantum interference device (SQID), a device extraordinarily sensitive to magnetic fields. The team fashioned a superconducting circuit in which the SQID effectively acted as a mirror. Passing a magnetic field through the SQID moved the mirror slightly, and switching the direction of the magnetic field several billion times per second caused it to "wiggle" at around 5% of the speed of light, a speed large enough to see the Casmir effect. The result was a shower of microwave photons shaken loose from the vacuum. The group's analysis showed that the frequency of the photons was roughly half the frequency at which they wiggled the mirror—as was predicted by quantum theory. (From Cornell University Library http://arxiv.org and Chalmers University of Technology.)

Virtual photon pairs are ubiquitous in a vacuum. Since moving a mirror at high speeds can indeed catch this fabricated light, moving particles at high speed should also be able to catch virtual photons as well. If a virtual photon pair was caught and launched by a high-speed particle, both sides would be well matched in terms of momentum. In this way, we can explain the diffraction phenomenon of particles according to caught-retransmission light emerging out of thin air.

3.4.2. Vacuum Polarization Produces Accompanying Light

Vacuum polarization is a characteristic of a quantum vacuum. Previously, it was believed that virtual particles were generated through indeterminacy during measurements in uncertainty relations. However, indeterminacy (*i.e.*, that something that cannot be exactly measured) is not universal, and indeterminacy during measurements is not a normal condition. An alternate view is that different energy densities can create virtual particles of different energies to separate and appear with real particles. In the spatial region around the visible portion of a black hole, negative energy particles produced by vacuum polarization can be captured by the black hole, while the positive energy particles will appear outside the event horizon and be visible (process II). This is Hawking's evaporation theory of black holes.

Are there potential energy wells in a vacuum, and if so, what are their potential depths? This is a question that still cannot be answered. Therefore, the concept of zero-point energy, which occurs according to the potential well model, does not correspond with the realistic conditions of a vacuum. Even if a vacuum possessed potential wells of limited length, zero-point energy is also caused by factors created by observation, as the quantum system has an intrinsic effect. Because the length l of a potential well is not zero, the value of $\lambda=2l/n$ is limited, while $p=h/\lambda$ gives non-zero momentum. So long as the momentum is not zero, the kinetic energy is also a non-zero value, which means the kinetic energy would be zero-point energy. Zero-point energy is positive energy; so if each scrap of a vacuum has some positive energy, then, there would be a vast amount of energy contained in cosmic space. However, dark energy has not been confirmed as this energy. If the entire vacuum has positive energy and the positive energy in one spot is removed, the space would become a piece of new vacuum again and more positive zero-point energy would spontaneously appear. Thus, any given volume of vacuum would potentially be a perpetual motion machine. The above reasons show that particles are not static, but do not indicate that there is non-zero energy in a vacuum.

If the mechanism producing light from nothing is of the second kind, then the light emitted in the Delsing experiment would only be the result of electromagnetic waves, which is a positive charge caused by the mirror vibration. Negative energy photons consuming some electrons on the mirror at the beginning cause the mirror to possess a positive charge. I suggest to the researchers at Delsing that they test to determine whether the mirror has such a positive charge.

If zero-point energy does not exist, then a vacuum is not a sea of energy. So where do the particles in a vacuum originate? Instead, polarization at a vacuum point produces a photon pair of positive-negative energy. Thus, experiments that create light from nothing in a vacuum are not finding zero-point energy, but simply finding that the annihilation of photon pairs with partially asymmetrical positive-negative energy is leaving a slight amount of positive energy in the form of photons. This is the same mechanism used by a black hole to produce light at the event horizon. Particles close to the horizon swallow the negative energy photons and end up in the black hole, leaving the positive-energy photon (the accompanying light) for particles that can still escape (see **Figure 3.5**). Regardless of whether the mechanism is zero-point energy or black hole evaporation, both processes would produce accompanying light.

When a proton passes through a twin slit at high speed, the resulting diffraction is caused by the particle's accompanying light, and not by the localization of the proton turning into a separate wave and potentially passing through both slits. The diffraction effect of other types of particles is also created by accompanying light.

The above discussion indicates that accompanying light is the reason for observed diffraction results rather than bremsstrahlung or localized wave-particle duality of high-speed particle streams passing through a slit, i.e. there is no uncertainty in the measurement. A localized fundamental particle can only display wave-particle duality in the particle's interior (however, a separate oscillator will generally display wave-particle duality).

Regardless of being the mechanism of zero-point energy or that of black-hole evaporation, both are acknowledged as the effect of accompanying light.

3.4.3. Other Experiments that Produce Accompanying Light

The asymmetrical annihilation of photon pairs of positive-negative energy is possible, but it is not a phenomenon that is easy to observe. However, there are conditions that can show this effect. Observation of a cathode ray in darkness still shows a shadow of the beam. This kind of shadow is potentially caused by accompanying light rather than an electron transition.

Some ideas in quantum mechanics will be affected by the discovery of the general Heisenberg relation. Those electrons and other particles exhibit wave-particle duality and uncertainty is currently the theoretical basis of quantum mechanics. Although the probability interpretation of quantum mechanics is a very forced analogy, it is still used as a basis for the theory, even though the analogy still undergoes continuous criticism. With the discovery of the general Heisenberg relation and the transformation relation between the general Heisenberg relation and the uncertainty relation and the accompanying light effect of real particles, it is necessary to carefully re-examine some of the basic tenets of quantum mechanics.

3.5. General Heisenberg Relation Affects the Basic Concept of Quantum Mechanics (Especially the Measurement Concept)

The generalized Heisenberg relationship is the broader Heisenberg relation. Its meaning is also more extensive. If we only choose the uncertainty relation in them, it is one-sided. If we exclude the significance of the relationship of uncertainty in the Heisenberg relation, it will be conducive to the establishment of the concept of reality. This section discusses the effect of the generalized Heisenberg relation on some important concepts.

3.5.1. General Heisenberg Relation Influences the Concept that Confined Electrons in Atoms and Molecules Which can only Correspond to Dispersed Electrons Passing through A Slit

Quantum mechanics thought “the micro particles in the measured condition are all the condition of random interference”, and the condition of the confined electrons in the atoms and molecules can only be in correspondence with this one. But, the general Heisenberg relation tells us that the condition of electrons in atoms and molecules is more similar to how an electron passing by a nucleus is influenced, and there is a world of difference between the two as to how an electron is randomly disturbed when it passes through a slit. The general Heisenberg relation permits a planetary model for atomic systems, and considers the idea that all functions of particles in a microcosm are randomly disturbed as arbitrary. Although the environment of an electron is somewhat intriguing within atoms and molecules, their movement is orderly, no matter whether the electron exists within a complex atom or a simple hydrogen atom. The emission spectrum when an electron jumps, the orbital magnetic moment, the orbital angular momentum, and the theory of distributed electrons have all proven that electron motion within atomic structures is orderly, and there is no sufficient reason to think that the motion is orderly only in a statistical sense. We cannot affirm that the electron in a hydrogen atom has been randomly disturbed around a nucleus. So long as order is accepted, and we deny that the entirety of a real particle has wave-particle duality, the past and the future of a particle can be exactly predicted.

3.5.2. General Heisenberg Relation Uses the Orbital Concept within the Atomic Structure

The existence of the non-statistical significance of the general Heisenberg relation means that using the uncertainty relation to transform from the general Heisenberg relation in specific cases to deny localization and the orbital motion of particles is invalid.

As the general Heisenberg relation is simultaneously suitable for both macrocosm and microcosm systems, the uncertainty relations are only an exceptional case of the general Heisenberg relation. Therefore, a relation such as $\Delta x \cdot \Delta p_x \geq \hbar$ is both deterministic and indeterministic, where there is at least a 50% possibility of permitting orbital motion. In atoms, the particle’s localization and orbital motion are precisely the way it avoids mutual disturbances between electrons. The viewpoint that electron diffraction is created by accompanying light, rather than that the electron itself possesses wave properties, permits the extranuclear localization of the electron. Quantum theory permits a particle in a quantum system to be either a complete wave or a completely localized particle. In other words, quantum theory itself cannot completely deny that electrons in atoms are a completely localized particle. What reason is there for atomic electrons to be completely separate waves one hundred per cent of the time? One argument is that a system is unstable when electrons in atoms only possess orbital motion. However, electricity is a separate wave with a similarly existing system stability problem (*i.e*., lacking a dynamic mechanism for system stability). I have already clarified the significance of the quantum effect of invalidating zero-point energy. Similarly for the hydrogen atom, the reason given that the electron in an atom is randomly disturbed is also very weak. In hydrogen atoms, physical quantities such as the certainty of momentum, the magnetic moment of the electron, and so on, as well as the ordered nature of the spectrum phenomenon, all suggest that the possibility of random disturbance is very small. So the question for the electron in a hydrogen atom becomes one of asking what can dictate the necessary random disturbance in its orbit. One possibility is that it is quantum entanglement causing the random disturbance with the nucleus.

The above analysis indicates that we have sufficient reason to use an atomic model that uses orbits. In this work, the atomic model with orbits is different from the planetary atomic model, the details of which can be seen in the concept of the phase-orbit line described later in this section.

We cannot deny that a football can possess orbital motion because of the falling point and the way even a football conforms to the statistical rule. In a similar situation, we cannot deny that subatomic particles have deterministic orbital motion where particles are then subject to random disturbances to conform to the statistical rule (i.e. are subject to deterministic disturbances). In quantum-mechanical calculations, the statistical rule and the potential energy function ($V=e^2/r$) are also used at the same time, supporting the idea that the point particle concept and the classical law of motion are still in effect. This concept also requires that the uncertainty relations are compatible with the classical laws of motion. So in the microcosm, do we use the statistical significance of Heisenberg's relation, or use its deterministic significance? This question is completely decided by the random disturbances of the system.

3.5.3. General Heisenberg Relation and the Idea that Measurement Can only Happen Directly

Current quantum mechanics theory states that only things that are directly touched can be measured. That is, quantum mechanics only acknowledges direct measurement results and does not acknowledge indirect measurements. People holding to this idea believe that even if they knew the beginning and end point of a particle, they still could not extrapolate the path of the particle between the two points. This kind of measurement concept comes from the idea that the orbital concept cannot be used in the microcosm pushed to its philosophical extreme. The condition of not using the orbital concept originates from Heisenberg's relation of single statistical meaning. A vicious circle has been formed between (a) Heisenberg's relation of single statistical meaning, (b) not using the orbital concept, and (c) measurements requiring physical contact. However, (b) depends on (a), and (c) depends on (b), but (a) needs (b) and (c) as proof. If (a) changes, the cornerstone of (b) and (c) has disappeared as well.

Previously, Eddington used the principle shown in Figure 3.6 when he confirmed optical fiber deflection as first predicted by Einstein. This also had the effect of accurately determining photon position and confirming the general theory of relativity at the same time. Why can this available method to confirm the general theory of relativity not be used to measure electron position? Some will say that the optical fiber deflection formula is confirmed for macroscopic systems, and is not applicable for microscopic systems. However, this is only supposition, and the equipment as shown in Figure 3.6 should be tried to determine electron position since the general Heisenberg relation and its theory suggest that the accurate position of electron r can be calculated by substituting the measured value of φ into Eq. (3.10), *i.e.*, $r \cdot sin\varphi = Ze^2/2\pi\varepsilon_0 mv^2$. The photosensitive spot of an electron on a target is a big spot. However, this kind of spot is very symmetrical and it is easy to calculate the spot's center, which is the position of the electron's impact.

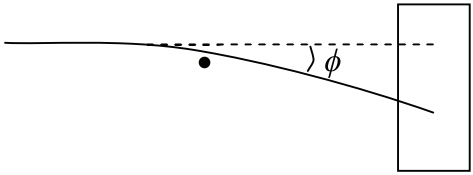


Figure 3.6. Accurately measuring the position of a particle that does not pass through a slit.

3.5.4. The General Heisenberg Relation and Using Δx→0 to Recognize that A Particle's Position Has Been Exactly Measured

Under microscopic conditions, a basic principle of quantum mechanics is the idea that both the position and the momentum of any micro particle cannot be accurately measured simultaneously, a concept known as the uncertainty principle. However, the discovery of the general Heisenberg relation, and its hypothesis that the diffraction pattern of a real particle is caused by its accompanying light, limit the validity of the uncertainty principle.

According to the inferential process of Eq. (3.11), the slit width Δx expresses the position uncertainty under controlled conditions. However, it is possible to express the accurate position of an electron passing gently and swiftly over a bare nucleus (or charged pillbox) not as Δx but as the distance r between a charged particle and the center of force in the measurement. Eqs. (3.10) and (3.11) indicate that there are at least two different ways to measure the incident position of a charged particle: one way is to manufacture the slit of $\Delta x \to 0$ and let the particle pass; the second way lets the particle skim over a regular electrical field space. Assuming that $\Delta x \to 0$ is the only way to accurately measure the position of a particle is wrong, using Eqs. (3.8)～(3.11), we can see $\Delta x \to 0$ simply means having the curvature radius approach zero (*i.e.*, the distance between the incident particle and the force source approaches zero). In this case, the slit disappears, which limits the measurement. Similarly, having $\Delta p_x \to 0$ (or $p \cdot \sin\theta \to 0$) indicates that the particle travels only on a straight path, which then assumes that only the particle's momentum can be accurately measured, a similarly absurd misunderstanding in terms of accurately measuring momentum.

Figure 3.6 indicates that two positions of the real particle have been measured accurately: the position passing over the nucleus and the point of impact on the target. Thus, do not think that the photosensitive spot of the particle hitting the target is the location of the particle itself. A strongly charged particle, such as a high energy proton, may also pass through the target and travel continuously forward.

3.5.5. General Heisenberg Relation and the Idea that the Behavior of A Particle in A Microscopic System Does not Experience Causal Relations

By thinking that micro particle systems are separate, or even assuming that micro particles are localized but still susceptible to probability, there is the assumption that a single particle will not exhibit consecutive displacement in a microscopic system. That is, there is no logical connection between the behavior of a particle and its subsequent behavior (*i.e.*, does not conform to a law of causality or mechanical determinism, but only to statistical law where the statistical result conforms to the law of causality). Since Heisenberg's relation does not actually explicitly deny orbital motion, the influence of the measuring instrument can be perfectly forecast according to causal effects in the microcosm. In other words, the general Heisenberg relation and the explanation of the accompanying light effect of the Delsing experiment permit the localization of a particle and also allow us to use the energy density to replace the probability density. Thus, any measurement with no random disturbance will show a causal relation for the particle's behavior in a microscopic system.

3.5.6. General Heisenberg Relation's Influence on the Concept of Inexact Measurements and the Reality of Measurements

There is willy-nilly behavior created by expanding the applicable scope of the uncertainty character of Heisenberg's relation (*i.e.*, expanding the concept to include any time where measurements do not occur). Heisenberg's relation assumes that the applicable scope of non-determinism continues both during measurement and when no measurement is occurring. According to normal logic, this idea collapses on itself. The idea that a real particle is non-localized is the basic error in this theory, which also saw energy density in a discrete space wrongly perceived using a probability density.

This error has hampered the development of the idea that the center of the energy density is the center of a free particle, or that the isodensity line of the maximum value of an energy density is the phase-orbital line of a particle. Both the probability in unit volume and the probability at a spatial point are still a probability, but they are not probability densities. Obviously, the concept of probability density itself poses a logical question, since if energy density is not a probability density, then the concept of a probability density is unnecessary. Energy density is related to a field distribution, so why correspond it to a probability? If someone were to say that a beast existed that did not conform to the laws of motion, and was only visible when it had been killed or trapped, who would believe them? Yet for extranuclear electrons, scientists who would not believe in gods or ghosts actually do regard the electron in this same fashion; as a solid particle when it is trapped, but which can mysteriously appear and disappear when free (*i.e.*, its behavior does not conform to causal effects).

3.5.7. A Method to Integrate Wave-particle Duality

There is a contradiction between the extension of a wave and the localization of a particle. People think that unification between wave and particle properties is beyond logic and above reason, forcing the use of words such as "monstrous" to describe micro particles. To date there has been no clear model for the wave-particle duality of micro particles, so theorists instead crowd together two different characteristics that contradict each other.

The deterministic half of Heisenberg's relation can provide some inspiration and clues for solving this contradiction. For example, we can draw inspiration from the orbital concept by supposing that a fundamental particle is constituted by the extension wave disseminating along a closed path, where the electron's orbital motion in atoms and molecules is the propagation path of the wave composed at the same time in a phase-orbit-line. This concept unifies the extension and localization of micro particles (for details see Section 3.4).

3.5.8. An Explanation of Certain Experiments and an Objective Look at the Present

This work does not completely deny the existence of wave-particle duality, but denies the probability interpretation and suggests that current quantum mechanics theory must be adjusted to explain the majority of experimental phenomena. The electron diffraction experiment (double slit), or experiments showing quantum entanglement and quantum decoherence,[7, 8] were conducted using an atomic beam in 1998. The results of these experiments, as well as each kind of "Schrödinger's cat" condition, can be explained by using the accompanying light effect. If the reader wishes, when random disturbance cannot be neglected, you may return to using traditional quantum mechanics theory. Alternatively, when non-learner interaction cannot be neglected, you may also use non-learner quantum mechanics theory.[9] However, other experiments that can be explained by legitimate quantum mechanics can also be explained by the theory derived in this work. Since we have now shaken off the fetters preventing orbital concepts, we can accept explanations for experimental phenomena and some objective conditions that are quite different from conventional quantum mechanics theory. The thought experiment designed by Einstein was experimentally proven in the 1980s. While the results did support existing quantum mechanics theory, they also drew out a series of new questions on quantum entanglement, quantum cryptographic transmissions and so on. Questions [10-11] of quantum measurement essence, and whether there is a contradiction with the theory of relativity, have also been raised. The conclusion that the uncertainty relation has both determinism and indeterminism as given by this work will possibly help to answer these questions that have arisen to explain existing experimental results.

3.6. Basic Supposition, Prediction, and Confirmation of Experimental Designs

Drawing inspiration from the substantive characteristics of the general Heisenberg relation, I propose a new basic supposition for quantum mechanics, which provides predictions and a means to test those predictions with a series of experiments.

3.6.1. The Single Basic Supposition: A Fundamental Photon Propagating along a Closed Path Constitutes a Localized Particle

Like your shoelaces or electrical cords, light can get twisted into knots. Now, scientists have used a computer-controlled hologram and theoretical physics to turn a light beam into pretzel-like shapes. For a closed light-knot, its inside form is a wave, but its whole may be static, and it possesses all the properties of real particles (its intrinsic motion mass $hí/c^2$ has changed into the static mass of its whole $m_0 = hí/c^2$).

The twisted feat not only led to some pretty cool images, but the results have implications for future laser devices, the researchers say.

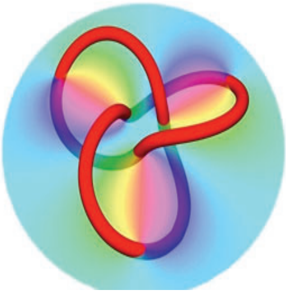


Figure 3.7. By reflecting a laser beam from a specially designed hologram (shown here as the colored circle), physicists created knots of dark filaments (represented by the colored knot). CREDIT: Mark Dennis.

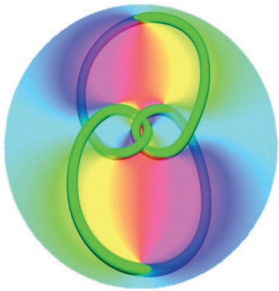


Figure 3.8. The bow-shaped light knots (More like a simple Chinese node). CREDIT: Mark Dennis.

"In a light beam, the flow of light through space is similar to water flowing in a river." said lead researcher Mark Dennis of the University of Bristol in England. Even though the light from something like a laser pointer travels in a straight line, it can also flow in whirls and eddies, Dennis explained.

These swirls of light are called optical vortices. Along the vortices the intensity of light reaches zero, or no light.

"The light all around us is filled with these dark lines, even though we can't see them", Dennis said. "Our work actually twists dark filaments within the light beam into knots."

The researchers knew these optical vortices could be created with holograms, which direct the flow of light. By using so-called fibered knot theory, a branch of abstract mathematics inspired by everyday knots, Dennis and his colleagues created customized holograms and reflected a regular laser beam from them.

"The hologram acts like a filter for incoming light, similar to the stained glass window in a church," Dennis told Live Science. "After going through a stained glass window, the light has taken on the pattern of colors of the window." But there's a difference: "Whilst the stained glass window manipulates color, the hologram manipulates the phase of the light wave."

So each point on the hologram, like a small pane of window glass, changes the point of the wave's cycle in that part of the light beam. They created a hologram that would change the phase of light so that it flowed around a dark knot.

Then, the team scanned a camera through the laser field to get images of the knots. (A computer program applied before the team had created the hologram essentially made the field around the dark knot appear bright.)

Their results, detailed online in January 2017 in the journal *Nature Physics*, are "firsts" for a couple of reasons. While so-called knot theorists have studied mathematical equations similar to dark knots, the new research created these knots with math functions that followed rules of propagating light. In addition, unlike other dark knots that have been created tangled up with other knots, Dennis and his colleagues produced isolated dark knots within the light beam, he said.

"For me, it shows how physicists can adapt existing pure mathematics, such as knot theory, and find it manifest in physical phenomena," Dennis said. "It also shows how finely we can control the flow and propagation of laser light using holograms. This degree of control is likely to find applications in future laser devices."

For those wanting to make their own knots, Dennis said all you would need is their hologram and a laser beam. This distorted process not only results in some very beautiful patterns, but also will have a significant impact for the future development of laser devices.

3.6.1.1. The Model of the Light knot Electronic Structure

One of the best ways to overcome the contradiction between extension and localization is to suppose that the wave propagates along a closed path. In this work, the path of the wave is a closed phase trajectory (this wave is a closed light-knot), while the whole of a closed light-knot is a localized particle (its whole may be an apparent static state and may possess static mass, to be changed from the intrinsic motional mass $h\nu/c^2$, its value is $m_0=h\nu/c^2$). The phase trajectory particle model in this work refers to a micro particle as a large closed circle of a vibrating string (it is a closed light-knot). I refer to this as a "big closed string," since compared with super string theory it is a very big closed string, but is in reality a closed light-knot. All particles may be constructed through different vibrations and movement of a big closed string. Based on hierarchical structure, all particles are composed of two kinds of strings: neutrino strings and strings with simple circular polarization. The model of big closed strings (or the model of a closed light-knot) is viable so long as the hypothetical foundation of big closed strings has a complex structure and is consistent with nature. Both superstring theory and the standard model of fundamental particles are only useful for explaining the existing experimental phenomena of fundamental particles. Neither theory is of substantive help to quantum mechanics for describing micro particles. This is a distinct lack and a mortal wound in their viability as theories. On the other hand, the fundamental particle structural model in this section does not have such a barrier towards explaining existing micro particle experimental phenomena, and can be of enormous help in completing quantum mechanics by providing an elementary quantum mechanics theory in the microcosm. The elementary photon used in this work may be a simple circularly polarized light quantum, or may also be a string of a secondary wavelet of a simple circularly polarized light quantum. If the reader does not see a connection between this theory and superstring theory, note that the light-knot described in this work is composed of superstrings. Thus, the string model at all magnitudes needs but one force to maintain system stability.

The big closed string for a light-knot assumes that there is a kind of attraction force between two points, where the direction of rotation of the radius of the vector is opposite in the simple circularly polarized light quantum. The form of this attractive force is similar to that of Coulomb's force, but the size is 200～300 times that of Coulomb's force, the range is shorter, and does not have polarity. Because it has the characteristic(s) of the nuclear force and exists primarily between fundamental particles, I call this force the “general nuclear force” for short. Zhou Hailin was thought to have discovered a new non-pole interaction.[12] However, the discovery that Heisenberg’s relation can possess both determinism and indeterminism provides an alternative explanation. Suppose a circularly polarized light quantum consists of k smaller fundamental photons. In this case, there is a mutual attraction between homogeneous fundamental photons due to the general nuclear force. Suppose the strength of the general nuclear force is N times that of the electromagnetic force, we can assume a linear approximation of the general nuclear force as

$F=-Nq^2/4\pi\varepsilon_0 R^2$. (3.17)

If we consider the mechanical balance of inertia for circular motion, the velocity of the whole motion of the free electron can be written as $\upsilon=5.85\alpha c$. $q=e/k$, $R=2r$. This then gives

$$\frac{N}{k^2}\frac{e^2}{4\pi\varepsilon_0(2r)^2}=\frac{m}{k}\frac{(5.85\alpha c)^2}{r}, \tag{3.18}$$

Where, m is the electron mass (or proton mass), and $2mc^2=h\nu$.

$2\pi r=\lambda=c/\nu$. (3.19)

Therefore

$N/k(5.85\alpha)^2=4\varepsilon_0 hc/e^2=2/\alpha\approx 274$, $N/k\approx 0.5$. (3.20)

This is a self-coupling effect. Its form will not be that simple. We need further study.

3.6.1.2. Electronic Momentum and Electronic Radius

It is well known that the intensity of the nuclear force is more than 100 times that of the electromagnetic force. So if we assume that $N\approx 137$, then $k\approx 274$. In other words, a free electron is composed of 274 secondary wavelets connecting and disseminating along the closed path (*i.e.*, 274 secondary wavelets constitute an electron or proton). These numbers provided for the constants (*i.e.*, 5.85, 137, and 274) are approximate numbers because the expression of the general nuclear force is approximate. Furthermore, the values chosen for these constants still require experimental verification. If you do not believe that such a general nuclear force exists, then you may think that the inner space in an electron is curving, and the fundamental photons in the interior of a charged particle can only travel a curved path. However, we can use space curve theory to describe such a nuclear interaction, which is another way that quantum theory and the theory of relativity unify with the general Heisenberg relation. We may also seek a fundamental proof of string theory. However, this work only treats the existence of string theory as necessary for the electronic structure model of the phase-orbit-line.

The goal of this section is to apply the electronic structure model of the phase-orbit-line. Within this model, the structure of a ground state hydrogen atom consists of a proton encircled by 274 secondary wavelets, where the radius of the closed string of a ground state electron r_d is

$$r_d=274\lambda/2\pi. \quad (3.21)$$

Here, λ is the wavelength of the γ-quantum whose energy is exactly the valve frequency and whose value is 1.2131548×10^{-12} *m*, the free electron radius is $1.2131548\times10^{-12}\div2\pi = 1.9\times10^{-13}$ *m*, so r_d=0.529×10^{-10} *m*. This result tallies with Bohr's radius of the hydrogen atom. Note also that the de Broglie wave of the electron in the hydrogen atom is a beat composed of 274 secondary wavelets. If we make $274\lambda=\lambda_d$, then Eq. (3.21) becomes $\lambda_d=2\pi r_d$. Here λ_d is the wavelength of the de Broglie wave of the electron in an atom. Obviously, the de Broglie wave is the hypothesized beat wave. Considering the de Broglie relations, we have

$$\lambda_d=h/p_d \quad (3.22)$$

Here p_d is the apparent momentum of extranuclear electrons without considering the intrinsic motion. Note that one simple circularly polarized light quantum is separated into 274 secondary wavelets and $v_d=274(A/A_0)^2v$. Therefore, For, a metastable free electron , $p_d=(A/A_0)^2p/274$, where p is the momentum of a fundamental photon and v is the frequency of a fundamental photon..

It is obvious that the above basic supposition can be a substitute for Bohr's hydrogen atom theory. The supposition also has several other advantages. ①This single supposition can be a substitute for the five essential basic suppositions in existing quantum mechanics theory. ② It can successfully explain the real situation of photon-electron transformations by altering the supposition that quantum mechanics has nothing to do with the internal structure of a fundamental particle. ③ It touches the essence of the fine-structure constant, electron spin, electronic pairing, and the de Broglie wave. Even if the basis of the general nuclear force is insufficient, the fact that one supposition can replace a group of (five) basic suppositions is at least worth taking seriously.

The basic premise of this section is that a fundamental particle consists of a big closed string. Using this supposition, we can now make use of the deterministic meaning of Heisenberg's relation to design some experiments to confirm this work's basic supposition.

3.6.1.3. Electron Pairing and Electron Spin

Free electron pairing results from the phase-orbit-line of two electrons closely coinciding (*i.e.*, overlapping). The two simple circularly polarized light quanta whose rotation directions of the vector radius are opposite come from the decomposition of a simple plane polarization light quantity, since the energy of a simple plane-polarized light quantum is Eq. (1.1). Thus, the energy of a simple circularly polarized light quantum is only half of the energy of a simple plane-polarized light quantum. For the simplest circular polarized light, $A/A_0=1$.

$$E=h\nu/2. \tag{3.23}$$

Note that the wave length is invariable when a simple plane-polarized light quantum decomposes into two simple circularly polarized light quanta, while the momentum is divided into two. Therefore, for the simple circularly polarized light quantum, When $A/A_0=1$, there is

$$p=h/2\lambda=mc. \tag{3.24}$$

Here, $\lambda=2\pi r$. The intrinsic motion of a free electron (*i.e.*, a fundamental photon encircling close to a phase-orbit-line, the wave is propagating along a closed path) is called the electron spin, while the spin angular momentum is $\mathrm{M_s}=rp=rh/\lambda$. Substituting $\lambda=2\pi r$ and $\hbar=h/2\pi$ into $\mathrm{M_s}=rh/\lambda$ we obtain

$$\mathrm{M_s}=\frac{1}{2}\hbar. \tag{3.25}$$

This kind of computed result is consistent with experimental results, and something that cannot be obtained using the classical planet model. In the classical planet model, the electron moves around the nucleus, and the angular momentum is $r_\mathrm{d}p=r_d mv=r_\mathrm{d}h/\lambda_\mathrm{d}$. Because there is no relation of $\lambda_\mathrm{d}=2\pi r_\mathrm{d}$ or a relation of $p=(h/2)/\lambda$ in the classical model, the planet model cannot obtain $\mathrm{M_s}=\hbar/2$ as result.

The viewpoint of this section is that the orbital angular momentum of an extranuclear electron is $\mathrm{M}=r_\mathrm{d}p_\mathrm{d}=r_\mathrm{d}h/2\pi r_\mathrm{d}=\hbar$, *i.e.* it is twice that of the electron spin angular momentum. Comparing $\mathrm{M}=rp=\hbar$ with Eq. (3.13), we can obtain the whole motion speed of an extranuclear 1s electron to be $v=Z^*\alpha c$. This verifies the concept of a main quantum number n:

$$\upsilon_{ns} = n Z^{*} \alpha c. \tag{3.26}$$

The electronic spinning magnetic moment is

$$\mu_s = -\frac{e}{2mc} M_s = -\frac{e}{4mc} \hbar . \tag{3.27}$$

Likewise, the orbital magnetic moment of a $1s^1$ electron is

$$\mu = -\frac{e}{2mc} M = -\frac{e}{2mc} \hbar . \tag{3.28}$$

3.6.1.4. The Atomic Phase-orbit-line Structure (or the Atomic Structure for Light knot)

According to the atomic structural model of protons and electrons in this work (as described in Section 3.5.1), the phase-orbit-line of the *s* electron in atoms and molecules is a circle constituted by a circular section of string, with $274n^2$ wavelets uniformly distributed in the circle. However, it is important to note that each wavelet is not a point, but a section of the string. Thus the movement of such an extranuclear electron is the rotation of such a string circle as a whole. This results in the following:

- The magnetic moment produced by the circular motion of a big string electron is the orbital magnetic moment;
- Extranuclear electron pairing results from the phase-orbit-lines of two electrons completely overlapping;
- The atomic structure for a phase-orbit-line may also be called the atomic structure for a big closed string.

The general nuclear force also exists between electrons and the electronic interior.

3.6.2. Predictions for the Basic Supposition and the Designs for Experimental Confirmation

According to the electronic structure model proposed in this work: 1) the rotation direction of the electromagnetic radius vector of circularly polarized light displays two different polarities; 2) the optical fiber of basic circularly polarized light deflects in a strong magnetic field (or electric field); 3) a basic circular polarization photon can make a conductor produce induced charge like an electrostatic field; 4) a high energy circularly polarized light of single polarity may decay into a single electron and a proton (or a positive electron and antiproton), but they do not always decay into particle-antiparticle pairs; 5) electron collisions can potentially dislodge circularly polarized light of the same polarity; and 6) a high energy minimalist circularly polarized light quantum possibly produces the diameter mark in a cloud chamber, a bubble chamber, or a spark chamber. We can thus design experiments to confirm each of these six predictions.

There is a distinction between the magnetic moment of a ground state electron and the magnetic moment of a free electron. The deflection of an electron ray in a magnetic field is not always normal, and can be altered by the electronic magnetic moment. When an electron rotates at high speed, the electron moment does not immediately reflect that change. When the electron does not turn over, its deflection in the magnetic field is the result of the electric charge acting in concert with the magnetic moment. Thus, an electron rotating at high speed in an electron beam may increase its electronic mass.

As shown in Figure 3.8, the hydrogen molecule ion should also have a non-aero orbital magnetic moment—the particle beam must also deflect a hydrogen atom the same as in the Stern-Garlach experiment.[13]

3.6.2.1. The Experiment to Confirm Induction of Light Electric Field

Connect two pieces of conducting material with a very high sensitivity ammeter. Let the conductor pieces move along in a certain direction within an electric field space of circularly polarized light, and observe whether an electrical current is produced. Also, examine whether the circularly polarized light has two polarities. This experiment may confirm predictions 1 and 3 described in Section 3.6.2.

3.6.2.2. Confirmation Experiment for Deflection of an Optical Beam of Simple Circularly Polarized Light in a Magnetic Field and of the Diameter Mark of a Circularly Polarized Photon in a Cloud Chamber

Emit a simple circularly polarized light beam into a cloud chamber, bubble chamber or spark chamber that contains a magnetic field (or electric field). Observe the diameter mark of the beam and its deflection.

This experiment may confirm prediction 2 described in Section 3.6.2.

3.6.2.3. Decay Experiment of Circularly Polarized Light

Let a simple circularly polarized photon whose energy surpasses the valve frequency sweep past a heavy nucleus, and search for electrons or positive electrons transformed by the photon. This experiment may confirm prediction 4 described in Section 3.6.2.

3.6.2.4. Unusual Electronic Annihilation Experiment

Using a collider, produce an electron-electron (or positron-positron) collision. The energy divides into two regions of $<1800m_0c^2$ and $>1800m_0c^2$ (where m_0 is the electronic rest mass). Observe whether the collision produces circularly polarized light.

3.6.3. The Relation Between the Quantization of the Direction and the Quantization of the Angular Momentum and the Tentative Idea of its Verification Experiment

Angular momentum is the vector product of displacement and momentum

$$L = r \times p. \tag{3.29}$$

$$dL = pdr + rdp. \tag{3.30}$$

If the line momentum of particle movement remains essentially unchanged, then, there is $dL=pdr$ where $\overrightarrow{dr}$ is perpendicular to the direction of movement of the particles. When a particle with uniform circular motion moved ds distance, the particle moved to the axis dr distance, we all know that there is the following relationship.

$$dr/ds = \sin\theta. \tag{3.31}$$

When the change of dL is discontinuous, the change of dr is also discontinuous and the change of θ is also discontinuous. In this way, angular momentum quantization will appear as the quantization of the particle's direction of motion. When electrons pass the nucleus at high speed, the above conditions are met, and direction quantization is very likely to occur.

As long as we do not believe the collapse of the wave package, the experiment that can be represented as **Figure 1.5** is one of the experiments that verify the direction quantization. It is best to use a combination experiment to verify the direction of quantization. If one electron that passed through one of the two slits was observed using the experiment shown in **Figure 6.1**, it is demonstrated that the experiment shown in **Figure 1.5** is a manifestation of directional quantization. The reason is that the experiment shown in **Figure 6.1** has denied electronic discretization and non-physicality.

3.6.4. Experiment that Electrons Sweep Past the Surface of a Bare Nucleus

Using a laser to fix one (or two) proton(s), let an electron sweep past the proton surface (or pass through the space between two protons). Measure the deflection angle of the electron ray and compare to the results as predicted by Eqs. (3.5) and (3.11). This would also prove that both the momentum and the position of a particle could be exactly measured (details in **Figure. 3.6**).

3.7. Using the Model of the Light knot Electronic Structure to Establish the Mathematical Form System of Local Realism Quantum Mechanics [14-15]

In this section, I use the proposed structural model of a fundamental particle to derive a new quantum mechanics postulate and to beautify quantum mechanics theory. The results of this section will provide a method to beautify quantum mechanics and provide deeper insight into quantum mechanics. Nobody believes that any scientific conclusion constitutes a final understanding of a topic, particularly for understanding the fundamentals of matter. Thus, we need not deny useful suppositions.

The basic supposition of the previous chapter stated that the electron is encircled by a simple circular polarized light quantum. In a potential field, the wave's energy is variable but the waveform itself is invariable. Therefore both the wave of a free electron and an electron in a potential field are described by

$$\psi = ae^{-i2\pi(\nu t - x/\lambda)} \quad (3.32)$$

Making a suitable partial differential to Eq. (3.32), we may obtain

$$\frac{\partial}{\partial x}\psi = i\frac{2\pi}{\lambda}\psi, \tag{3.33}$$

$$\frac{\partial^2}{\partial x^2}\psi = -(\frac{2\pi}{\lambda})^2\psi, \tag{3.34}$$

$$\frac{\partial}{\partial t}\psi = -i(2\pi\nu)\psi, \tag{3.35}$$

$$\frac{\partial^2}{\partial t^2}\psi = -(2\pi\nu)^2\psi. \tag{3.36}$$

Due to the change of wave energy in the potential field and the form of wave unchanged, therefore, the motion of the particles in the potential field still conforms to Eqs. (3.32)~(3.36). If the intrinsic motion of the extranuclear electrons is not considered and only the overall apparent motion of the particles is considered, the fluctuation of the particles is the motion of the De Broglie wave.According to De Broglie's assumption, the wave form of the particle is still Eqs. (3.32)~(3.36). From another perspective, this feature is even more irrefutable. The existing quantum mechanics holds that (3.32) is applicable to the de Broglie's wave. Then, Eqs (3.32)~(3.36) are also applicable to de Broglie's wave. That is, for the description of de Broglie's wave (only consider the overall movement of particles without considering the intrinsic motion of the particles), λ and v in Eqs (3.33)-(3.36) ought to be replaced by λ_d and v_d. Below we mainly discuss this apparent movement of particles.

The potential energy function of a ground hydrogen atom is

$$E_p=e^2/4\pi\varepsilon_0 r_d=e^2/2\varepsilon_0\lambda_d. \tag{3.37}$$

Where $\lambda=2\pi r$. In the potential field, the energy of the wave changes but the form of the wave is unchanged (the original knot changes into a bound beat connected by many wavelets). Therefore, the bound light-knot in the extranuclear electron can both be described by using a wave and by using a particle.

For the free electron to be composed of a closed light-knot, its inside form is a wave, but its whole may be static, and it possesses all the properties of object particles. For convenience, in a beat wave, the subscript "*d*" of the beat-length λ_d and the apparent momentum $p_d=mv$ can be abbreviated (Note: here, p_d is the momentum of the particle's overall motion, and it is also the momentum of the wave corresponding to de Broglie's wave). In the balanced system, the Virial theorem establishes. Considering $\alpha=e^2/2\varepsilon_0 hc$ and Eq. (3.37), we have $E_k=-E_p/2=h\alpha c/\lambda_d$. Comparing $E_k=h\alpha c/\lambda_d$ and the classic relationship of energy-momentum $E_k= p_d^2/2m$, and considering $\upsilon=\alpha c$ & $p_d=m\upsilon$, results in $\lambda_d=h/m\upsilon$. This is the de Broglie relation. It is no longer an independent supposition, but is now strictly derived using classical momentum-energy relation, the $\upsilon=\alpha c$ in Bohr's Hydrogen atom model and the expression of the fine-structure constant. Considering $p_d=h/\lambda_d$ and $p_d=m\upsilon$ can be abbreviated. In the balanced system, the Virial theorem establishes. Considering $\alpha=e^2/2\varepsilon_0 hc$ and Eq. (3.37), we have $E_k=-E_p/2=h\alpha c/\lambda_d$. Comparing $E_k=h\alpha c/\lambda_d$ and the classic relationship of energy-momentum $E_k=p^2/2m$, and considering $\upsilon=\alpha c$ and $p=m\upsilon$, result in $\lambda_d=h/m\upsilon$. This is the de Broglie relation. It is no longer an independent supposition, but is now strictly derived using the classical momentum-energy relation, $\upsilon=\alpha c$ in Bohr's Hydrogen atom model and the expression of the fine-structure constant.

There seems to be some confusion here. Let me make a list and clarify it.

Table 3.2. Comparison of intrinsic motion description form and orbital motion description form of electrons

Cantatas	**Describe the intrinsic motion of an electron**	**Describe the orbital motion of electrons (that is, describing the overall motion of bound electrons).**
Radius	r—Intrinsic motion radius	r_d—Orbital motion radius
wavelength	$\lambda=2\pi r$	$\lambda_d=2\pi r_d$
frequency	ν—The frequency of circular polarized light	ν_d—Wave beat frequency
Speed	c	$\upsilon=Z^*\alpha c$. Here, υ is an apparent speed
Momentum	$p=\frac{1}{2}h/\lambda=mc$	$p_d=h/\lambda_d=m\upsilon$
Total energy	$E=(A/A_0)^2h\nu$	$\sqrt{m^2c^4+p^2c^2}$

Kinetic energy	$E= hv$	$E_k= hv_d= p_d^2/2m$ $=(h/\lambda_d)^2/2m=(2\pi/\lambda_d)^2\ (\hbar^2/2m)$
Wave equation	$\psi = ae^{-i2\pi(vt-x/\lambda)}$ $\frac{\partial}{\partial x}\psi = i\frac{2\pi}{\lambda}\psi$ $\frac{\partial^2}{\partial x^2}\psi = -(\frac{2\pi}{\lambda})^2\psi$ $\frac{\partial}{\partial t}\psi = -i(2\pi v)\psi$ $\frac{\partial^2}{\partial t^2}\psi = -(2\pi v)^2\psi$	$\psi = ae^{-i2\pi(v_d t-x/\lambda_d)}$ $\frac{\partial}{\partial x}\psi = i\frac{2\pi}{\lambda_d}\psi$ $\frac{\partial^2}{\partial x^2}\psi = -(\frac{2\pi}{\lambda_d})^2\psi$ $\frac{\partial}{\partial t}\psi = -i(2\pi v_d)\psi$ $\frac{\partial^2}{\partial t^2}\psi = -(2\pi v_d)^2\psi$
Angular momentum	$M_s=rp=\hbar/2$	$M=r_d p_d=\hbar$
Interrelation	$r=r_d/274\ n^2$, $\lambda=\lambda_d/274$.	
	For the electrons of 1s, there is $\upsilon=Z^*\alpha c$	
	For the overall apparent motion of nuclear electrons, momentum and kinetic energy have no strict quantitative relationship with the momentum and energy of the simplest circularly polarized photons.	

For describing the bound state electrons, whether we omit the subscript *d*, we use the form of C column in table 3.2. We will omit the subscript *d* at the right time.

Considering $p=h/\lambda_d$ and $\hbar=h/2\pi$, we can obtain

$$E_k=(h/\lambda_d)^2/2m=(2\pi/\lambda_d)^2(\hbar^2/2m)=h\alpha c/\lambda_d=h\upsilon/\lambda_d=hv_d. \quad (3.38)$$

Substituting Eq. (3.38) into Eq. (3.34), there is

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi = E_k\psi. \quad (3.39)$$

Considering $E_k=E-V$, Eq. (3.39) becomes

$$[-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}+V]\psi = E\psi\,. \tag{3.40}$$

Comparing and Eqs. (3.35), (3.39) and the $E_k=h\nu_d$ im Eq.(3.38), we can obtain

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi = i\hbar\frac{\partial}{\partial t}\psi. \tag{3.41}$$

Both Eqs. (3.40) and (3.41) are Schrödinger's equation, both $i\hbar\frac{\partial}{\partial t}=\hat{H}$ and $-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}=\hat{H}$ are Hamilton operators. The classical momentum-energy relations are $p^2=2mE_k=(mv)^2$. Substituting this relation into Eq. (3.38), we obtain $2mE_k=(h/\lambda_d)^2=p_d^2$ and $p_d=h/\lambda_d$. The second equation $p_d=h/\lambda_d$ is the de Broglie equation (for convenience, subscript "d" had been abbreviated in p_d and λ_d, and "d" is hidden in the following discussion.). This confirms that the de Broglie wave is simply one kind of hypothesized wave (It is a real wave beat. Where, the hypothesized wavelength is $n^2\times274$ times that of the real wavelength). Thus, the de Broglie relation is no longer an independent supposition, but is now strictly derived using the equations derived in this work. Substituting the de Broglie equation into Eq. (3.33) and using $p=h/\lambda$, we get

$$-i\hbar\frac{\partial}{\partial x}\psi = p\psi,\ \hat{p}=-i\hbar\frac{\partial}{\partial x}. \tag{3.42}$$

Substituting $E_k=p^2/2m$ into Eq. (3.39), results in

$$-\hbar^2\frac{\partial^2}{\partial x^2}\psi = p^2\psi,\ \hat{p}^2=-\hbar^2\frac{\partial^2}{\partial x^2}. \tag{3.43}$$

Equations (3.42) and (3.43) have given the momentum operator and a momentum square operator separately.

Substituting $E_k = h\alpha c/2\lambda$ into Eq. (3.33), we find that

$$-i\hbar\alpha c\frac{\partial}{\partial x}\psi = E_k\psi. \tag{3.44}$$

Substituting Eq. (3.42) and $E_k = E - V$ into Eq. (3.44), we find that

$$c\alpha\hat{p}\psi + V\psi = E\psi \,. \tag{3.45}$$

Equation (3.45) is the Dirac equation in the potential field.

Substituting $h\nu = \pm\sqrt{m^2c^4 + p^2c^2}$ into Eq. (3.35), results in

$$h\nu = \pm\sqrt{m^2c^4 + p^2c^2}\,. \tag{3.46}$$

Eq. (3.44) − Eq. (3.46) results in

$$c\alpha\hat{p}\psi + (\pm\sqrt{m^2c^4 + p^2c^2} - E_k)\psi = i\hbar\frac{\partial}{\partial t}\psi\,\cdot \tag{3.47}$$

Because the difference between relativistic kinetic energy and the total energy is mc^2, therefore, so long as we take the quality in E for $\pm m$, Eq. (3.47) may be changed to

$$c\alpha\hat{p}\psi + \beta mc^2\psi = i\hbar\frac{\partial}{\partial t}\psi \tag{3.48}$$

where $\beta = \pm 1$. Note that Eq. (3.48) is the Dirac equation of a free particle. If the energy and negative energy worlds are symmetrical in the universe, but both negative energy and negative quality do not have any significance in the energy world, then Equations (3.46) and (3.47) separately can only be

$$i\hbar\frac{\partial}{\partial t}\psi = \sqrt{m^2c^4 + p^2c^2}\,\psi, \tag{3.49}$$

and

$$c\alpha\hat{p}\psi + mc^2\psi = i\hbar\frac{\partial}{\partial t}\psi. \tag{3.50}$$

Substituting $h\nu = \pm\sqrt{m^2c^4 + p^2c^2}$ (or $h\nu = \sqrt{m^2c^4 + p^2c^2}$) into Eq. (3.36), we can obtain

$$-\hbar^2\frac{\partial^2}{\partial t^2}\psi = \left(m^2c^4 + p^2c^2\right)\psi. \tag{3.51}$$

Equation (3.52) may be obtained by Eq. (3.51)÷c^2−Eq. (3.43):

$$-\frac{\hbar^2}{c^2}\frac{\partial^2}{\partial t^2}\psi + \frac{\hbar^2\partial^2}{\partial x^2}\psi = m^2c^2\psi. \tag{3.52}$$

Equation (3.52) is just Klein-Gordon's equation. When m=0, Equation (3.52) becomes:

$$\left[-\frac{1}{c^2}\frac{\partial^2}{\partial t^2} + \frac{\partial^2}{\partial x^2}\right]\psi = 0. \tag{3.53}$$

Equation (3.53) is just D′Alembert's equation.

Taking ψ=M_s=(½)$\hbar$ and substituting it into Eq. (3.33), $\hat{M}_s = -ir\frac{\hbar}{2}\frac{\partial}{\partial x}$ may be obtained. For the simplest circular polarization light, $2mc^2=h\nu$, $2\pi r=\lambda$, $c=\lambda\nu$. Hence

$$\hat{M}_s = -i\frac{\hbar^2}{4mc}\frac{\partial}{\partial x}. \tag{3.54}$$

Equation (3.54) is an important equation: it is the spinning operator of a free electron. For the extranuclear electron, the angular momentum of the whole movement of the phase-orbit-line is

$$\mathrm{M} = rp = rh/2\pi r = \hbar = 2\mathrm{M}_s. \tag{3.55}$$

Using the same method (it is the same as the method to derive Eq. (3.54)), we can obtain

$$\hat{M} = -i\frac{\hbar^2}{2mc}\frac{\partial}{\partial x}. \tag{3.56}$$

Equation (3.56) is the operator of orbital angular momentum. Considering Eqs. (3.27), (3.28), (3.54) and (3.56), we have:

$$\hat{\mu}_s = i\frac{e\hbar^2}{8m^2c^2}\frac{\partial}{\partial x}, \tag{3.57}$$

$$\hat{\mu} = i\frac{e\hbar^2}{4m^2c^2}\frac{\partial}{\partial x}. \tag{3.58}$$

The probability interpretation of quantum mechanics does not offer such a clear picture of electron-spin.

Equations (3.18), (3.37) and (3.38) result from the orbital concept, while Eq. (3.32) comes from using the wave function. The de Broglie relation, the Schrödinger equation, the Dirac equation, and the logical system of quantum mechanics all simultaneously use the orbital concept and the wave function. By simultaneously using the orbital concept and the wave function for the random motion of non-multi-particle systems, the probability density is equal to the field energy density. In extranuclear electron localization circumstances, a probability interpretation is not theoretically true, but the computed results for energy are still correct. Obviously, the probability interpretation is only inaccurate for systems with no random disturbances, but still offers appropriate energy statistics. This work certainly does not negate such a statistical explanation.

3.8. The Significance of the Work

The model of photonic junction electronic structure shows that the basic particles' objective existence is independent of man's consciousness. If one such particle can appear in two places at the same time, it violates the law of conservation of energy. There is no logical support for the splitting of a photonic junction.

The model introduced by this work fits the facts and existing experimental results of quantum mechanics in numerous ways where current quantum mechanics theory falters:

(1) Calculating spin angular momentum and spinning magnetic moment of an electron

According to the electronic structural model of a big closed string as described in this work, we can directly calculate the spin angular momentum and spinning magnetic moment of an electron that agree well with experimental results.

(2) Computing an atomic radius

Using the electronic structural model of a big closed string as described in this work, we can easily compute the radius of an s electron in the outermost layer of an atom. This would also define the atomic radius.

(3) Determining the nuclear spacing and dissociation energy of some small molecules

The ability to calculate some small molecules is a significant application and a convincing achievement of the atomic molecular structure model described in this work.

(4) Explain the phenomenon of diffraction experiment of microscopic particles

According to direction quantization rather than wave-particle duality explains the micro particle diffraction experiment phenomenon.

(5) Micro particle magnetic experiment

The magnetism and electron spin of a micro particle have been explained using the big closed string electronic structure model developed in this work.

(6) Explained the establishment and source of quantum mechanics

This chapter uses a single basic supposition to obtain comparable results achieved by using the five basic suppositions of standard quantum mechanics theory. This accomplishment indicates that this work's theoretical model accords with existing quantum mechanics in terms of mathematical logic (i.e. the two theoretical mathematical formal systems are compatible).

(7) Determining the accurate motion track of microscopic particles

This work proves that the center of a micro particle track is the correct route of the particle. This result is much more logical than the particle dispersion explanation used by traditional quantum mechanics theory.

(8) Description of the characteristic of nuclear force

The nuclear force is 100 times more powerful than the electromagnetic force, has nothing to do with electric charge polarity, and is a short-range force. The general nuclear force proposed by this chapter possesses these same properties.

(9) Photon decay and pair annihilation

The existing standard model theory of fundamental particles (i.e. the Higgs' mechanism) does not explain how quarks are produced when a photon decays to become a proton. This work easily explains photon decay and pair annihilation.

(10) Solves the contradiction between the particle and wave properties of a particle

In existing quantum mechanical theory, there is a contradiction between a microparticle's wave properties and its particle properties. The existing model avoids this contradiction by not using these two attributes at the same time. Fortunately, the large-scale closed-string particle structure model described in this book determines that particle property and wave property of a particle are no longer contradictory.

Thus, all these results together, if coincidental, would be a coincidence of extremely low probability. This low probability indicates that the model described in this work imparts a true description of quantum mechanics.

References

[1] Runsheng Tu (2013), The Formula Whose Shape Is Similar to a Heisenberg Relation Possesses the Double Meanings of Determinism and Indeterminism. *Infinite Energy,* 18(107), 44-46.

[2] Runsheng Tu (2013), Using an Extranuclear Electron as a Large-scale Elastic Ring, the Results Are Very Interesting. *South Asian Academic Research Journals,* 3(4), 12-24.

[3] C. M. Wilson, *et al*. (C. M. Wilson, G. Johansson, A. Pourkabirian, J. R. Johansson, T. Duty, F. Nori, P. Delsing). Observation of the Dynamical Casimir Effect in a Superconducting Circuit. Cornell University Library. 24 May 2011. Preprint at http://arxiv.org/abs/1105.4714.

[4] Ni Guangjing, Cheng Suqing (2005), *Advanced Quantum Mechanics* (Third Edition). Shanghai: Fudan University Press (in Chinese).

[5] S. Dürr, T. Nonn, G. Rempe (1998), Origin of quantum-mechanical complementarity probed by a `which-way' experiment in an atom interferometer. *Nature,* 395(6697), 33-37.

[6] Geoff Brumfiel (2011), Moving mirrors make light from nothing. *Naturenews*, 3 June 2011. Preprint at

http://www.nature.com/news/2011/110603/full/news.2011.346.html.
[7] Pang Xiaofeng (2009), *Nonlinear Quantum mechanics*. Beijing: Electronics Industry Press.
[8] Shao-Ming Fei, Sergio Albeverio, Adan Cabello, Naihuan Jing, and Debashish Goswami (2010), Quantum Information and Entanglement. *Advances in Mathematical Physics*, Special Issue.
[9] Sun Changpu (2006), *Quantum Mechanics Survey Question and Quantum Information*. Preprint at http://www.vtimes.net/bbs/dispost.asp?boardid=10&postid=184, (2009). http://blog.sciencenet.cn/home.php?mod=space&uid=212815&do=blog&id=271791 (in Chinese).
[10] Wang Guowen (2009), *The error and disaster of wave function collapsing supposition*. Preprint at http://blog.sciencenet.cn/home.php?mod=space&uid=212815&do=blog&id=271791.
[11] Sun Changpu (2010), New Progress of Foundational Aspects in Quantum Mechanics. *Physics,* 30(5), 310-321. Preprint at http://www.docin.com/p-185206150.html (in Chinese).
[12] Tan Tianrong (1995), Quantum mechanics realism really didn't lose. *Journal of Wugang Workers' College,* 7(4), 61-69 (in Chinese).
[13] Zhou Hailin, (1998), Binding Force in Wave-particle Interaction [J]. *Nuclear Fusion and Plasma Physics,* 18(1), 11-16.
[14] Runsheng Tu (2000), One kind of plan to beautify quantum mechanics. *Journal of Shandong Normal University* 15(1), 31-33 (in Chinese).
[15] Runsheng Tu (1998), A concise description way of quantum mechanics. *Journal of Ningsia Institute of Technology* (*Natural Science*), 10(1), 117-123 (in Chinese).
[16] P. A. M. Dirac (1978), *Direction in Physics*. New York: John Wiley.
[17] L. J. Wang, A. Kuzmich & A. Dogariu (2000), Gain-assisted superluminal light propagation. *Nature,* 406, 277-279.

CHAPTER FOUR

THE SUCCESSFUL APPLICATIONS FOR LOCAL REALISM QUANTUM MECHANICS: THE NATURE OF COVALENT BOND AND QUANTITATIVE ANALYSIS OF MECHANICAL EQUILIBRIUM FOR SEVERAL MOLECULES

With local realism quantum mechanics established, we can describe an extranuclear electron as simply a large-scale elastic ring with an elastic phase trajectory. Several small molecules can thus be strictly calculated through the logical method of establishing an accurate mechanical equilibrium equation describing the molecular structure, then solving the strict solutions of this mechanical equation and the corresponding wave equation. The results (bond length and dissociation energy) are in good agreement with observed results—*i.e.*, if it is only coincidence, there should not be such a high probability of agreement between calculated and observed results. The method of local realism quantum mechanics is no longer the semi-empirical method. The method to calculate the electron pairing energy uses a linear regression of the ionization energy obtained through experiment. Nonetheless, it is exciting that there are diatomic molecules such as Na_2, K_2 and asymmetric HF molecules that possess a non-zero non-bonding electron number in the calculation examples. Moreover, the molecular structures are very intuitive, and the calculation method is much simpler than existing methods.

Reference [1] establishes the theoretical system describing local realism quantum mechanics, which is a quantum mechanics model whose logic system is exactly the same as existing quantum mechanics theory except that the probability interpretation has been eliminated. In local realism quantum mechanics, volatility and the nature of a particle are compatible; the transition between classical mechanics and wave mechanics is no longer a sudden process, but a process of gradual change.

From the structure diagram of the hydrogen molecular ion (Figure 4.1), we can see that the bonding electron moves between the two hydrogen nuclei, no superluminal interaction—the extranuclear electron is local. If the bonding electron between the two nuclei is the phase trajectory ring, the relationship between each particle is exact causation; this extranuclear electron must be in reality. Thus, the bonding electrons are always in two nuclei (or atomic cores) for the covalent molecular bonds calculated in this work, which means that the molecules can achieve a mechanical equilibrium state and the mechanical equilibrium equations have a specific solution. Reference [2] has proven that the uncertainty relation possesses a double meaning of determinism and indeterminism, which raises the stakes for local realism quantum mechanics; even if the proof for local realism quantum mechanics is insufficient, this chapter also shows that the results are very interesting when we use an extranuclear electron as a large-scale elastic ring.

Local realism quantum mechanics scientists think: the structure of a ground hydrogen-atom structure is that there is a proton in the center of a phase-trajectory electronic ring.[1] Therefore, an electron that rotates around a nucleus is equivalent to an entity ring that rotates outside the nucleus. The planetary motion of the point electron in the Bohr model of the hydrogen atom has been replaced by the rotation of a phase-trajectory electronic ring. Since the mass and charge of the electron are distributed in the ring, the calculation method of hydrogen atoms can be the same as Bohr's planetary model. As the phase-trajectory ring is enclosed by a quantum of circularly polarized light and is an electromagnetic wave, the Schrödinger method for solving the wave equation is applied to calculate the hydrogen atom. The calculations in this book are based on the calculation of hydrogen-like ions. The molecular structures shown by **Figures 4.1** and **4.2** are the classic framework. Although there are one or two electrons outside the nucleus, they are entirely independent of quantum entanglement and quantum teleportation. Visibly, an extranuclear electron in the movement process is neither superluminal, nor can it be divided from the environment (that is, there are precise causal associations between an extranuclear electron and the surroundings rather than the presence and movement in the peculiar way of indeterminism). In the molecule shown by **Figures 4.1** and **4.2**, there is the process of quantum teleportation, and even the quantum entanglement phenomenon also did not affect the intramolecular interaction. This determines that the method used by this chapter is the method of local realism.

Local realism quantum mechanics does not use the probability interpretation of a wave function in a stable quantum system. If we assume the admittance of an electron described by a minimal circularly polarized quantum, then the phase trajectory of the extranuclear electron, in the absence of random disturbances, is an elastic large-scale ring, which we refer to as an electronic ring. Thus, electron pairing occurs when two single electron rings completely coincide. For example, the hydrogen atom is an atom whose extranuclear electron is a lone electron ring whose movement is equal to the ring-like electric charge rotation. This movement produces a non-zero magnetic moment, where the magnetic moment caused by the electron spin remains and is partly offset by the nuclear spin magnetic moment. Note that this magnetic moment can be observed macroscopically. This hypothesis relates to some current research works[3–5] as well as to a number of previous studies.[6–16]

4.1. The Calculation of Pairing Energy of Electrons

The difference in ionizing energy for the two electrons in the electronic pair comes from the interaction between the two electrons; in the electronic pair, the ionization of the first electron requires interaction with another electron and the nucleus at the same time, but the ionization of the second electron only requires the nucleus. This means that the difference in ionizing energy is the interaction energy between the two paired electrons. In the past, this energy has been referred to as the infinitesimal disturbance energy, and has been an energy term of some annoyance. However, in local realism quantum mechanics, it can be solved by known ionization energy (we take the helium atom as an example: Ee-e=I_2-I_1 = $54.41778eV - 24.58741eV = 29.83037eV$). Its approximate value is Ee-e $\approx 15Z^*/n^2$. The precise formula may be obtained by means of the following method:

(a) Lists the relation form of the difference in ionizing energy between two electrons of the n=1 energy level of various elements [ΔI($1s^2$)] to the effective nuclear charge number (see Table 4.1 and **Figure 4.1**).

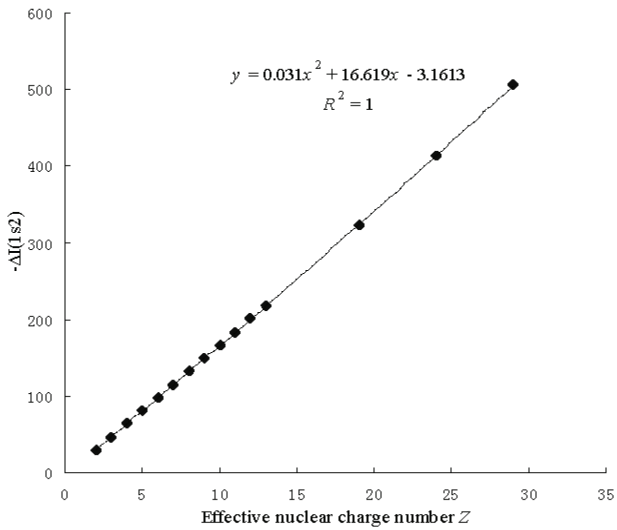


Figure 4.1. The relations of “the interaction energy between two $1s^2$ electrons” and “the effective nuclear charge number”

(b) Extracts the regression equation

$$\Delta I_{\text{paired electron}} = 0.031Z^{*2} + 16.619Z^{*} - 3.1613. \quad (4.1)$$

(c) Use $E_{\text{e-e}}$ to express the interaction energy between the two paired-electrons outside the nucleus (their size equal mark opposite with the dissociation energy of paired electrons), promotes from n=1 to n=n (n is the natural number and also is the principal quantum number).

$$E_{\text{e-e}} = (0.031Z^{*2} + 16.619Z^{*} - 3.1613)/n^2. \quad (4.2)$$

Table 4.1. The relations between the ionizing energy of two 1*s*^{2} electrons and the effective nuclear charge number

Z^*	2	3	4	5	6	7	8	9
$\Delta I(1s^2)$, *eV*	29.848	46.8141	63.8120	80.8506	97.9063	114.974	132.123	149.205
10	**11**	**12**	**13**					
166.371	183.591	200.858	218.166					
19					**24**			**29**
323.187					413.158			505.224

For a molecule, Z^* may be ΣZ^*. When Z^*=0, $E_{\text{e-e}}= -3.1613/n^2$ is the pairing energy of electrons, and $E_{\text{e-e}}= -3.1613eV$ is the pairing energy of free electrons. In order to confirm the accuracy of Eq. (4.2), substituting Z=11 into Eq. (4.2), results in $E_{\text{e-e}}[\text{Na}(1s^2)]$= 183.399*eV*. This is the difference between the I_{10} and the I_{11} of the sodium element. The actual value is $I_{11}-I_{10}$= 183.591*eV*.

The pairing energy of a free electron is $\Delta= -3.1613eV$. This pairing energy is very usual in superconductor theory

4.2. Several Atoms and Molecules to Be Calculated by the Method of Local Realism Quantum Mechanics

The logic system underpinning local realism quantum mechanics and existing quantum mechanics theory is the same, where local realism quantum mechanics contains all of the positive aspects from original quantum theory and current quantum mechanics. In looking at structure, the original researchers of quantum theory believed that the position and movement properties of electrons were different for atoms and molecules. Thus, because of the same underlying logic system, Schrödinger's methods and Bohr's method are still available in local realism quantum mechanics to calculate the energy of the hydrogen atom. This is the source of the value for the hydrogen atom energy $E_{\text{H}}=-13.606Z^2/n^2$. The following calculations are carried out according to the hydrogen-like ions.

4.2.1. Hydrogen Atom, Helium Atom and Negative Hydrogen-Ion

The potential energy function of an electron in a hydrogen atom is $V=Ze^2/r=e^2/r$, the ground state energy is $E_H=-13.606Z^2/n^2=-13.606eV$. For a helium atom in the ground state, the spins of the two electrons are opposite, *i.e.* they are an electron pair, and so become a double electric ring. If only the interaction between electrons and nuclei is considered, the potential energy function of the double electron in a helium atom is $V=-2Ze^2/r$, and the potential energy function of the single electron is $V=-Ze^2/r$. In the ground state helium atom, the sum of the energy of the two electrons (the interaction energy between the nucleus and the electrons) is $E_{n\text{-}e}=-2\times13.606Z^2/n^2=-108.848eV$. Thus, the energy of each electron is $54.424eV$ without distinction. The radius of the phase trajectory circle for each of the two $1s$ electrons is equally large, and one electron does not have to shield the other.

For the helium atom, the paired energy of $1s^2$ electrons is $E_{e\text{-}e}(\text{He})=29.848eV$ (it is obtained by Eq. (4.1) or substituting $n=1$ into Eq. (4.2)). After solving the calculation of electron pairing energy, it is easy to calculate the helium atom:

$$E(\text{He})=E_{n\text{-}e}(\text{He})+E_{e\text{-}e}(\text{He})=-108.848eV+29.831\ eV=-79.000eV$$

where, $E_{n\text{-}e}(\text{He})=(2Z^2/n^2)(E_H)$. The experimental value of the helium atom is $78.98eV$. The relative error is (79.00–78.98)/79.00=0.03%. The computational method of the helium atom will be used frequently in the future. The structure of the $H^-(1s^2)$ ion is similar to that of the helium atom, therefore, the ground state energy of the two electrons is $E[H^-(1s^2)]=-13.606\times2+13.489=-13.723eV$). Another kind of hydrogen negative ion is $H^-(1s^12s^1)$, the radius of the electron ring of $H^-(1s^1)$ is $r(1s)=a_0$, the radius of the electron ring of $H^-(2s^1)$ is $r(2s)=2^2a_0$, when the two electronic rings are in the identical plane, interaction between the two electrons is $E_{e\text{-}e}=e^2/(4-1)a_0=9.0707eV$. The energy of $H^-(1s^12s^1)$ is $E[H^-(1s^12s^1)]=-13.606+9.0707=-4.54(eV)$. Because the spinning of a $1s^1$ electron is the opposite of that of the electron of $2s^1$, therefore, the orbital magnetic moment of the hydrogen negative ion $H^-(1s^12s^1)$ is also zero.

4.2.2. Hydrogen Molecular Ion

According to the above atomic structure model, we also know the structure of some small molecules. For example, the structure of the hydrogen molecule-ion is that both sides of a phase-orbit-line ring have a proton respectively (seen in **Figure 4.2**). It is also a mechanical balance system, and the mechanical balance equation of state in the two nuclei connection direction is

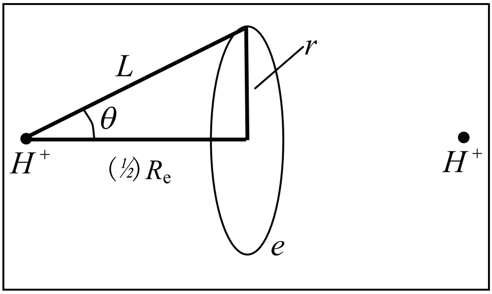


Figure 4.2. Hydrogen molecule-ion

$$\begin{cases} R_e = 2L\cos\theta \\ \dfrac{e^2}{L^2}\cos\theta = \dfrac{Ze^2}{R_e^2} \end{cases} \quad (4.3)$$

This equation is obtained by the quantum being local, the quantum being in reality, electromagnetics and geometry. It cannot be obtained by existing quantum mechanics. The general solution of this equation is

$$\theta = \arccos\left(\sqrt[3]{Z^*/4}\right). \quad (4.4)$$

Where Z^* is the effective nuclear charge number of one side in the symmetrical covalent molecule. Both Eqs. (4.3) and (4.4) are the situation of the covalent molecule for the single bonding electrons. For the covalent molecule where the bonding electrons are paired, they become $2(e^2/L^2)\cos\theta=Ze^2/R_e^2$ and $\theta = \arccos\left[\sqrt[3]{Z^*/8}\right]$ separately. In this example Z=1, θ=50° 57'10" (*i.e.*, 50.953°). The total potential energy function of H_2^+ is $V=-2(e^2/L)+e^2/R_e=-1.2063(e^2/L)$. Computation treated as a hydrogenic ion, the energy is $E(H_2^+)=-19.799eV$. The electronic potential energy function in H^{2+} is $V_e=-2e^2/L=-2\sin\theta(e^2/r)=-1.553(e^2/r)$. Similarly the computation treated as a hydrogenic ion, the corresponding energy is $E_e(H_2^+)=-32.826eV$. The difference between $E(H_2^+)$ and $E_e(H_2^+)$ is the interaction energy between nuclei: $e^2/R_e=E(H_2^+)-E_e(H_2^+)$, the nuclear separation of diatomic molecules can be calculated by the following formula:

$$R_e = \frac{Z_a^* \times Z_b^*}{E_e - E} \times 27.212 a_0 . \tag{4.5}$$

Therefore, $R_e(H_2^+)=2.0889a_0\approx1.107\times10^{-10}\ m$. The dissociation energy of H_2^+ is

$D_e(H_2^+) =-E(H_2^+) -I(H) =19.799eV-13.606eV=6.193eV$.

The corresponding experimental values are $R_e(H_2^+)=1.06\times10^{-10}m$ and $D_e(H_2^+)=2.79eV$. The bonding electrons do not pair. In the hydrogen molecular ion, the spinning magnetic moment is not zero, and there is the magnetic moment interaction between the two nuclei, making the hydrogen molecular ion become an asymmetrical molecule. Computing to treat it as the symmetrical molecule the error is inevitably big. This causes the accurate degree of the calculating result for the hydrogen molecular ion to be inferior to that of the hydrogen molecule.

The excited state energy and the bond length of the hydrogen molecular ion can also be calculated. As seen from Eq. (4.4), the angle θ is only related with the bonding electronic number and the nuclear charge number, but has nothing to do with the energy level. Therefore, the angle θ in excited state H_2^+ is the same as the one in the ground state H_2^+. The corresponding energy is the $1/n^2$ time of the one in the ground state. $E=-4.950eV$, $E_e=-8.207eV$. Substituting these two into Eq. (4.5), may result in

$R_e[H_2^+{}_{(excited)}]=4.428\times10^{-10}m$, and
$D_e[H_2^+{}_{(excited)}] = 4.950eV-13.6eV=-8.65eV$.

4.2.3. Hydrogen Molecule

The mechanical structure of a hydrogen molecule (H_2) is very similar to that of the hydrogen molecular ion (H_2^+), but the phase-orbit-line between the two nuclei is a dielectronic ring. The solution of the equation of the mechanical equilibrium state in the system is $\theta=\pi/3$. The interaction between electrons to be not temporarily considered is convenient to calculate the nuclear distance. The total potential energy function of the system is $V=-4e^2/L+e^2/R_e=-3e^2/L$. Calculating to regard it as a helium-like ion (*i.e.*, two hydrogenic ions of $V=-(3/2)e^2/L$), the corresponding total energy is $E=-1.5^2(e^2/2a_0)\times 2=-61.227eV$). In H_2, the potential energy of the pure electrons is $V_e=-4e^2/L=-4(\sin\theta)e^2/r=-3.4641e^2/r$. Calculating to regard it as a helium-like ion, the corresponding electronic energy is $E_e=-2\times 1.73205^2(e^2/2a_0)=-81.636eV$. Similarly we have: $e^2/R_e=E-E_e=20.409eV$, $R_e=1.3333a_0\approx 0.71\times 10^{-10}$ *m*. Since the two electrons in the ground state of H_2 and the two electrons in H_e have the same environment (n=1, Z=2), then the interaction energy of the two electrons in H_2 also is $E_{e\text{-}e}(H_2)=29.830eV$. So the dissociation energy of H_2 is

$$D_e=-E_e-E_{e\text{-}e}(H_2)-I(H)=61.227eV-29.830eV-13.606eV\times 2=4.186eV\approx 4.19eV.$$

The corresponding experimental values are: $D_e=4.75eV$, $R_e=0.74\times 10^{-10}$ meters.

The first excited state of H_2 is the state in which one of its ground state bonding electrons was stimulated to the 2*s* energy level. Its symbolic representation is $H_2(1s^1 2s^1)$. The bonding electrons have constituted two concentric circles to be in among two protons. Its mechanical balance equation is

$$\begin{cases} R_e = 2L_1\cos\theta_1 \\ R_e = 2L_2\cos\theta_2 \\ \dfrac{e^2}{L_1^2}\cos\theta_1 + \dfrac{e^2}{L_2^2}\cos\theta_2 = \dfrac{Ze^2}{R_e^2} \\ r_2 = L_2\sin\theta_2 \\ L_2\sin\theta_2 = n^2 L_1\sin\theta_1 \end{cases} . \tag{4.6}$$

The last equality is obtained according to the relations between the radius of the phase-orbit-line ring and the main quantum number ($r_n=n^2 r_{\text{ground state}}$). This equation set has the solution. Substituting the first equality and the fifth equality separately the second equality and the third equality may eliminate R_e,

$$\begin{cases} 4\cos^3\theta_1 + 4\cos^3\theta_2 = Z \\ \tan\theta_2 = n^2\tan\theta_1 \end{cases}. \qquad (4.7)$$

Let conθ_1=x, conθ_2=y, considered Z=1, n=2, we have: $x^3+y^3-0.25=0$; $x^2+63x^2y^2-64y^2=0$, x graphed as y, resulting in the intersection point of the two curves. Hence, conθ_1=0.62652, conθ_2=0.15982; θ_1=51.206°, and θ_2=80.8035°. The interaction between electrons to be not temporarily considered is convenient to calculate the nuclear distance. The total potential energy function of the system is $V=-2e^2/L_1-2e^2/L_2+(e^2/R_e)=-1.5e^2/L_1-1.5e^2/L_2$. Calculating to regard it as a helium-like ion (*i.e.*, two hydrogenic atoms of $V=-(3/2)e^2/L$), $E_1=-1.5^2e^2/2a_0=-30.614eV$, $E_2=-(1.5^2e^2/2a_0)/n^2=-7.653eV$, the total energy of this system is $E(1s^1+2s^1)=-38.267eV$. The potential energy of pure electrons in $H_2(1s^12s^1)$ is

$$V_e=-2e^2/L_1-2e^2/L_2=-(2\sin\theta_1)e^2/r_1-(2\sin\theta^2)e^2/r_2$$
$$=-1.73205(e^2/r_1)-1.73205(e^2/r_2).$$

Calculating to regard it as a helium-like ion, the corresponding electronic energy is

$$E_e(1s^1+2s^1)=-1.73205^2\frac{e^2}{2a_0}-1.73205^2\frac{e^2}{2n^2a_0}$$

$$=-40.818eV-10.204eV=-51.022\ eV.$$

Likewise we have: $e^2/R_e=E-E_e=12.755eV$, substituting it into Eq. (4.5), $R_e[H_2(1s^12s^1)]=2.1334a_0\approx1.13\times10^{-10}m$ can be obtained. The interaction energy of the two electrons in $H_2(1s^12s^1)$ is $E_{\text{e-e}}=e^2/3r_1=2e^2/3R_e\tan\theta_1=6.836eV$. The dissociation energy is

$$D_e[H_2(1s^12s^1)]=-38.267eV+6.836eV+2\times13.606eV=4.22\ eV.$$

The chemical bond in the excited state hydrogen molecule $H_2(1s^12s^1)$ is a duplet bond formed by two single electrons.

If the molecular structure shown in **Figures 4.2** and **4.3** is stable, so, the molecule of "part of the electron cloud or wave function overlaps between the two atoms" described by existing valence bond theory is unstable (the mechanical equilibrium state cannot be achieved).

4.2.4. Helium Molecule-ion He_2^+ and Helium Molecule He_2

The structure of He_2^+ is extremely similar to that of H_2^+. When the ground state helium atom ionizes, the nuclear charge number felt by the electron that has fled (effective nuclear charge number) may be calculated (supposing that the inner electron doesn't rearrange). According to the central field model, the calculation formula of the first ionization energy is $I_1(\text{He})=(Z^*)^2(e^2/2a_0)$. Substituting $I_1(\text{He})=24.587eV$ into it, results in $Z^*=1.3443$. Regarding He^+ as a point charge whose effective nuclear charge number is 1.3443, the solution of the equation of the state of mechanical equilibrium in the system is $\theta=45.9527°$. The interaction between electrons to be not temporarily considered is convenient to calculate the nuclear distance. The total potential energy is $V=-2\times1.3443e^2/L+1.3443^2e^2/R_e=-1.38897e^2/L$. Calculating to regard it as hydrogenic atoms, the corresponding electronic energy is $E=-1.38897^2e^2/2a_0=-26.249eV$. The potential energy of bonded electrons in He_2^+ is $V_e=-(2\times1.3443)e^2/L=-(2\times1.3443\sin\theta)e^2/r=-1.9325e^2/r$, calculating to regard it as hydrogenic atoms, the corresponding bonding electronic energy is $E_e=-1.9325^2e^2/2a_0=-50.812eV$. The interaction energy between the two He^+ ions is

$$1.3443^2e^2/R_e=50.812eV-26.249eV=24.563eV,$$
$$R_e=2.0019a_0=1.06\times10^{-10}m.$$

The dissociation energy of He_2^+ is $D_e=-E-I_1(\text{He})=26.249eV-24.587eV=1.662eV$. The corresponding experimental values are: $R_e=1.08\times10^{-10}$m, $D_e=3eV$. If considering electron-pairing energy, we may do some revision.

The two electrons for the opposite spin to pair give out energy, this kind of energy actually is the electron-pairing energy Δ. According to $\Delta I_{\text{paired electron}}=0.031Z^{*2}+16.619Z^*-3.1613$, we know that $\Delta I_{\text{paired electron}}=-3.1613eV$ when $Z^*=0$. This is the electron-pairing energy $\Delta=3.1613eV$ (the positive value is expressed to give out energy). The superconductivity theory that is becoming popular has used this kind of interaction. When $Z^*=0$, the extranuclear electron is just a free electron, $\Delta=3.1613eV$ is also electron-pairing energy. The ionization energy needed by the first electron in an electron-pair dissociating is the sum of the work done to remove the first electron and the electron pairing energy Δ. Thus we have $24.587eV=(Z^*)^2e^2/2a_0+3.1613eV$, so that, $Z^*=1.25488$. Substituting $Z^*=1.25488$ into Eq. (4.4), results in $\cos\theta=0.679486$, $\theta=47.1965°$, and sinθ=0.733688. We also have the following corresponding results (for the succinct form see the second line in Table 4.2):

V=−2×1.25488e^2/L+1.25488$^2e^2/R_e$=−1.35100e^2/L;
E=−1.35100$^2e^2/2a_0$=−24.834eV;
V_e=−2×1.25488e^2/L=−(2×1.25488sinθ)e^2/r=−1.84138e^2/r;
E_e=−1.84138$^2e^2/2a_0$=−46.134eV;
$E_{e\text{-}e}$=1.25488$^2e^2/R_e$=46.134eV−24.834eV=21.300eV,
R_e=2.01183a_0=1.07×10^{-10}m;
D_e=−E−I_1+Δ=24.834eV−24.587eV+3.1613eV=3.408eV.

The corresponding experimental observations are: R_e=1.08×10^{-10}m, D_e=3eV.

We examine the stability of helium molecule He_2. Substituting Z^*=1.2674 into $\theta = \arccos\left[\sqrt[3]{Z^*/8}\right]$, results in θ=57.2416º. For other computed results, see the third line in Table 4.2. The dissociation energy being a negative value is expressed to give out energy when it dissociates, He_2 cannot freely exist under the normal condition. The mechanical balance equation has the solution indicated that He_2 may exist in the extra energy's environment (e.g. has glare to shine or high temperature).

4.2.5. Lithium Molecule Li_2

The structure of Li_2 is similar to that of H_2, yet the two bonded electrons are in the energy level of n=2. The first ionization energy of Li is I_1(Li)=5.39172eV. According to the central field model we know: that the calculation formula of the first ionization energy is 5.39172eV= $(Z^{*2}/2^2)e^2/2a_0$, $Z^*_{[\text{Li}(1s)]}$=1.2590. In a very similar way, the computed results are R_e=2.56×10^{-10}m, D_e=1.19eV (see Table 4.2). The corresponding experimental values are: R_e=2.67×10^{-10}m, D_e=1.06eV.

4.2.6. Lithium Molecule Na_2

The structure of Na_2 is similar to that of Li_2 and H_2, yet the two bonding electrons are in the energy level of n=3. The first ionization energy of Na is I_1(Na)=5.13908eV. According to the central field model we know: 5.13908eV= $(Z^*/n)^2e^2/2a_0$, $Z^*_{[\text{Na}(1s)]}$=1.84374. D_e=16.013−6.516 −5.13908×2=−0.78eV. Other computed results are R_e=5.08×10^{-10}m (see the 10th line in Table 4.2). The corresponding experimental values are:

R_e=3.8×$10^{-10}m$, D_e=3116cm^{-1}=0.37eV. The sodium atomic radius should be the electronic ring radius of the outermost layer. According to the first ionizing energy, we may estimate the radius of a sodium atom. The potential energy of the $3s^1$ electron in a sodium atom is 2 times its total energy: $Z^*e^2/r_{[Na(4s1)]}$ =2×5.13908eV. There is $r_{[Na(4s1)]}$ =1.8437(13.606/5.13908)a_0=2.57×$10^{-10}m$.

4.2.7. Potassium Molecule K_2

The structure of K_2 is similar to that of Na_2, Li_2 and H_2, yet the two bonded electrons are in the energy level of n=4. The first ionization energy of K is I_1(K)= 4.34066eV. According to the central field model we know: 4.34066eV=$(Z^*/n)^2e^2/2a_0$, $Z^*(K^+)$=2.2593. Other computed results are R_e=8.52×$10^{-10}m$ and D_e=0.314eV (see the 11th line in Table 4.2). The corresponding experimental values are: R_e=4.8×$10^{-10}m$, D_e=4457cm^{-1}=0.55eV. From $Z^*e^2/2r_{[K(4s1)]}$=4.34066eV, we know the radius of potassium atom $r_{[K(4s1)]}$=2.2593(13.606/4.34066)a_0=3.75×$10^{-10}m$. The error source coming from the effective nuclear charge number felt by the bonding electron in the molecule is inaccurate.

4.2.8. Ground State Hydrogen Fluoride Molecule HF

Hydrogen fluoride HF is a symmetric molecule, but it may also achieve the mechanical balance state, the bonding electron is an electron provided by the hydrogen atom. Its structure is similar to that of the hydrogen molecular ion. The mechanical balance state equation and the relation between the sides and angles of HF are

$$\begin{cases} (e/L_a)^2\cos\theta_a = Z_b^*(e/R_e)^2 \\ (e/L_b)^2\cos\theta_b = Z_a^*(e/R_e)^2 \\ L_a\sin\theta_a = L_b\sin\theta_b \\ R_e = L_a\cos\theta_a + L_b\cos\theta_b \\ R_a = L_a\cos\theta_a \\ R_b = L_b\cos\theta_b \end{cases} \tag{4.8}$$

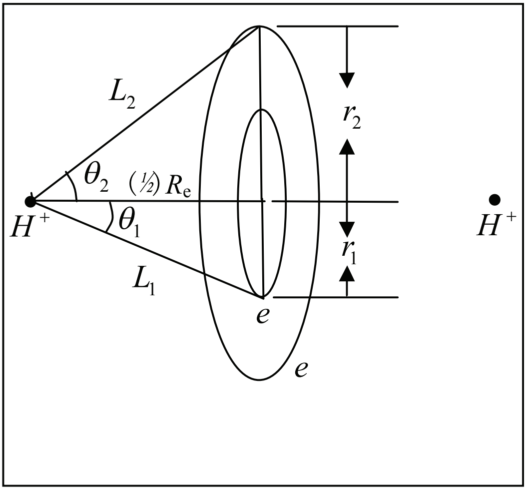


Figure 4.3. Hydrogen molecule H_2 of excited state.

The two independent equations may be obtained by substitution

$$\begin{cases} \left(\cos\theta_a + \sin\theta_a \cos\theta_b / \sin\theta_b\right)^2 = Z_b^* / \cos\theta_a \\ Z_a^*(\cos\theta_a - \cos^3\theta_a) = Z_b^*(\cos\theta_b - \cos^3\theta_b) \end{cases} \quad (4.9)$$

Let $\cos\theta_a = x$, $\text{con}\theta_b = y$, the above equations can become:

$$\begin{cases} x\left(x + y\sqrt{\frac{1-x^2}{1-y^2}}\right)^2 = Z_b^* \\ Z_a^*(x - x^3) = Z_b^*(y - y^3) \end{cases} \quad (4.10)$$

The first ionization energy of F is $I_1(\text{F})=17.42282eV$. According to the central field model we know: $17.42282eV=(Z^*/n)^2(e^2/2a_0)$, $Z^*_{\text{F}^+}=2.2632$, $Z^*_{\text{F}}=2.2632-1=1.2632$. Considering $Z_a^*=1$, $Z_b^*=1.2632$, based on Eq. (4.10), x graphed as y, we may obtain the intersection point of two curves resulting in: $\theta_a=\theta_H=61.900°$, $\theta_b=\theta_F=37.200°$. Owing to the bonding electron in HF being provided by atom H, so $n=1$. For other computed results, see Table 4.2. The corresponding experimental values are:

R_e=0.92×10^{-10}m, D_e=5.7eV.

4.2.9. Ground State Sodium Hydride NaH

In the different energy level, electron pairing is quite difficult, the bond of Na—H is a one-electron bond, and the bonding electron is in the energy level of n=1. It is provided by a hydrogen atom. The one side of the molecule's structure is similar to H_2^+. $Z^*_{\mathrm{Na}^+}$ =1.84374, Z^*_{Na} =1.84374−0.85000 =0.99374. The state equation of mechanichal balance is Eq. (4.8). For this molecule NaH, the concrete form of Eq. (4.10) is

$$\begin{cases} x\left(x + y\sqrt{\frac{1-x^2}{1-y^2}}\right)^2 = 0.99374 \\ (x - x^3) = 0.99374(y - y^3) \end{cases} \tag{4.11}$$

x graphed as y, we may obtain the crossover coordinate and θ_a=θ_H=50.5340º, θ_b=θ_M=51.4697º. The calculation results for the energy and the distance between two nuclei are as in Table 4.2. The value in the literature is D_e=10131.58cm^{-1}=1.25eV. The calculation results about NaH are only indicated: under the model in this book, the system of NaH may achieve balance, using the same asymptotic method there is hope of an approach to obtain a reasonable result.

Table 4.2. The calculation results for the ground state HF molecule and so on.

Contans	Z^*	θ_a, º	θ_b, º	$-V$	$-E$, eV	$-V_e$	$-E_e$, eV	$E_{e\text{-}e}$, eV	$R_e\times10^{-10}$, m	D_e, eV
H_2^+	1	50.953	50.953	$1.2063e^2/L$	19.799	$1.553e^2/r$	32.826	---	1.107	6.193
$H_2(1s^2)$	1	π/3	π/3	$2\times1.5e^2/L$	61.227	$2\times1.73205e^2/r$	81.636	29.830	0.71	4.19
$H_2(1s^12s^1)$	1	51.206	80.8035	$1.5e^2/L_1$ $+1.5e^2/L_2$	38.267	$2\times1.73205e^2/r_2$	51.022	6.836	1.13	4.22
HF	1.2632	37.200	61.900	$1.092318e^2/L_H$	16.234	$1.645856e^2/r$	36.857	---	0.883	2.628
$HF_{improved}$	1.4132	32.47024	65.4662	$1.067957e^2/L_H$	15.518	$1.668408e^2/r$	37.873	---	0.912	1.9
He_2^+	1.25488	47.1965	47.1965	$1.35100e^2/L$	24.834	$1.84138e^2/r$	46.134	---	1.07	3.408
He_2	1.2674	57.2416º	57.2416º	$2\times1.7927e^2/L$	87.453	$2\times2.2537e^2/r$	136.214	38.988	0.851	−4.751
Li_2	1.2590	57.3229	57.3229	$2\times1.7840\ e^2/L$	21.653	$2\times2.1155\ e^2/r$	30.562	9.675	2.56	1.19
Na_2	1.84374	52.186	52.186	$2\times2.3013\ e^2/L$	16.013	$2\times2.81406\ e^2/r$	25.6578	3.042	5.08	−0.78
K_2	2.2593	48.998	48.998	$2\times2.5586\ e^2/L$	11.1343	$2\times3.41015\ e^2/r$	19.781	2.139	8.52	0.314
NaH	0.99374	51.4697	0.5340	$0.745293e^2/L_H$	13.471	$1.48294\ e^2/r$	29.921	---	0.871	−0.127

4.2.10. Conclusion

The old theory of covalent bonds assumes that two electron clouds overlap in between the two nuclei. However, this structure is not sufficient to overcome the powerful force of internuclear repulsion, and so the theory predicts that the molecule should be unstable most of the time. The accurate calculation results in this chapter show that it is only the bonding electron that is always in between the two atoms (as shown in **Figures** 4.2 and **4.3**), allowing for the observed stability of the molecule.

Compared with the old valence bond theory, the theory described by this work offers several advantages. First, the molecular structure is simple and clear and we can accurately quantify the mechanical equilibrium state. Second, the calculation method is very simple, the logic is strong and does not require a tentative function, and the theory removes any requirement for a semi-empirical approach. Finally, the theory implies a sufficient stability of covalent molecules so that they can withstand analysis by mechanical and kinetic means.

Many people believe that the standard model theory has many loopholes, and as such cannot be used as an absolute standard to invalidate other theories. This chapter does not support the standard model theory. Is the method introduced in this chapter a new development direction for quantum chemistry? Can you put forward any other reasonable suggestions for solving the electronic shape of p, d and f?

Finally, this author asks readers to help accomplish two things. The first is to judge whether the calculated case in this chapter is a successful application of local realism quantum mechanics. The second thing, if possible, is to implement the verification experiments and the predictions in reference [1].

References

[1]. Runsheng Tu (2013), Trying to Establish Local Realism Quantum Mechanics. *Int. J. Modern Theo. Physics*, 3, 118-152. http://www.modernscientificpress.com/journals/IJMTP.aspx.

[2]. Runsheng Tu (2013), The Formula Whose Shape Is Similar to a Heisenberg Relation Possesses the Double Meanings of Determinism and Indeterminism. *Infinite Energy*, 107, 44-46.

[3]. Runsheng Tu (1999), The uncertainty relation has the determinism and the indeterminism double meaning. *Journal of Shandong Normal University* (*Natural Science Edition*), 3, 64-65.

[4]. Runsheng Tu (2000), One kind of plan to beautify quantum mechanics, *Journal of Shandong Normal University*, 1, 31-33.

[5]. Runsheng Tu (1998), A concise description way of quantum mechanics. *Journal of Ningsia Institute of Technology* (*Nature science*), 1, 117-123.

[6]. N. Guangjing & C. Suqing (2005), Advanced quantum mechanics (Third Edition) [491] Shanghai: Fudan University Press.

[7]. S. Dürr, T. Nonn, & G. Rempe (1998), *Nature*, 395, 33.

[8]. P. Xiaofeng (2009), *Nonlinear quantum mechanics* [317]. Beijing: Electronics Industry Press.

[9]. S. Changpu (2006), Quantum Mechanics Survey Question and Quantum Information. http://www.vtimes.net/bbs/dispost.asp?boardid=10&postid=184.

[10]. W. Guowen (2009), The Error and Disaster of Wave Function Collapsing Supposition. http://blog.sciencenet.cn/home.php?mod=space&uid=212815&do=blog&id=271791.

[11]. Tang Tianrong (1995), Quantum Mechanics Realism Really Didn't Lose. *Journal of Wugang Workers' College*, 4, 61-69.

[12]. Z. Hailin (1998), Binding Force in Wave-particle Interaction. *Nuclear Fusion and Plasma Physics,* 1, 11-16.

[13]. C. M. Wilson, et al. (2011), Observation of the Dynamical Casimir Effect in a Superconducting Circuit. http://arxiv.org/abs/1105.4714.

[14]. X. Youchang, & S. Meicheng (1979), *Structure chemistry* [47]. Beijing: People's Education Press.

[15]. L. D. Lendau (1990), *Quantum mechanics: Theoretical physics concise course* (Vol. 2), 231-233. [Fulin, L.] [1-324]. Advanced Education Press.

[16]. R. Tu (2016), The principle and application of experimental method for measuring the interaction energy between electrons in atom. *Int. J. Sci. Rep.*, 2(8), 187-200.

[17] R. S. Tu (2014), Some Successful Applications for Local-Realism Quantum Mechanics: Nature of Covalent-bond Revealed and Quantitative Analysis of Mechanical Equilibrium for Several Molecules. *Journal of Modern Physics*, 5, 309-318. http://dx.doi.org/10.4236/jmp.2014.56041.

CHAPTER FIVE

THE PRINCIPLE AND APPLICATION OF THE EXPERIMENTAL METHOD FOR MEASURING THE INTERACTION ENERGY BETWEEN ELECTRONS IN ATOMS

In past times, the calculation of the interaction energy between electrons in atoms has been a headache. Now the trouble has finally been eliminated. Some new regularity about the ionization energy of elements has been found (including the relationship between ionization energy and the atomic number. Among them, the most important is the relationship between the ionization energy and the interaction energy between electrons). The relationship between “the interaction energy of electron-electron, atomic energy” and the nuclear charge number has been summed up. The experimental principle of measuring the interaction energy of electrons is established. The fitting calculation method of quantum mechanics is invented. The energy of Carbon, Nitrogen, Neon and other atoms was calculated by using the new method of quantum mechanics.

In the textbooks and the Internet, all introductions about ionization energies are the introductions for the qualitative rules about the first ionization energy, and take the old road of Mendeleev (imitating his thinking mode): the search for the periodic variation regularities of the first ionization energy. I broke through Mendeleev's thinking pattern and have found that there are other laws of ionization energy. They are the very useful quantitative regularities (the linear relationship and nonlinear relationship can be used to calculate the interaction energy between electrons and atomic energy).

The concrete form of interaction of electron-electron in atoms and molecules is considered as an unknown in existing quantum mechanics. At present, in atoms and molecules, the concrete form of interaction between electrons can only be estimated and forecast. Even if it is the calculation of the same atoms, different authors have different testing functions, cannot be unified, and generally believe that their own testing function is best. In calculating an atom or a molecule with a number of electrons, we can generally only give an empirical trial function for an approximate calculation. On the basis of establishing the test function, a subjective factor plays an important role. Its essence is mainly to conduct an exploratory improvisation of the calculation results close to the known experimental data. The calculation result of this method is more accurate and the loss of its significance is greater. There is a difficult balance of the accuracy of the calculation results and the significance of the method of calculation. At this point, so many years have passed without a major breakthrough. In the existing quantum mechanics method, the most famous are the calculus of variations and the perturbation method (sometimes associated with the two methods and stepwise correction). In the process of the quantum mechanical calculation of atoms and molecules, the most troubling thing is to calculate the interaction energy between electrons. The calculation of the interaction energy between the paired electrons is more difficult (the interaction between the paired electrons has been out of the law of electromagnetism). In order to solve the most difficult problem, I have written this chapter. The literature indicates that still no one uses quantum mechanics to accurately calculate the energy of carbon atoms. The authors sum up the quantum mechanics method without a trial function. In this chapter, I will give the readers the calculation process by using this quantum mechanics method.

Can we directly measure the interaction energy between the electrons in atoms and molecules by means of the experimental method? No one has done this before. This chapter will provide the principle of this experimental method.

In this chapter, the energy unit is KJ/mol. Just in some illustrations, the unit on the Y-axis is MK/mol, because the energy is too large.

5.1. Experimental Principle of Measurement of the Interaction Energy between the Electrons in Atoms

This is to explore the relationship between the electronic interaction energy and the nuclear charge. There are some regularities hiding in the data of interaction energy. As long as there is careful thinking, these rules can be summed up.

In a helium atom, what is the difference between the ionization energy of the two 1*s* electrons? The ionization of the first electron requires interaction with another electron and the nucleus at the same time (the corresponding energy to be marked as $I_1=E_{e\text{-}n}+E_{e\text{-}e}$. Here, $E_{e\text{-}n}$ is the interaction energy between electron and nucleus, and $E_{e\text{-}e}$ is the interaction energy between electrons), but the ionization of the second electron only requires the nucleus (the corresponding energy to be marked as $I_2=E_{e\text{-}n}$). This means that the difference in ionizing energy is the interaction energy between the two paired electrons ($I_1-I_2=(E_{e\text{-}n}+E_{e\text{-}e})-E_{e\text{-}n}=E_{e\text{-}e}$) (metering it with dissociation energy). So, we have obtained the calculation formula of the interaction energy of paired electron $1s^2$:

$$E_{e\text{-}e}(1s^2)=\Delta I(1s^2)=L_{\text{last second}}-I_{\text{last first}}. \tag{5.1a}$$

This is also the working principle for using the experimental method to measure the interaction energy between $1s^2$ electrons. If it is metered with system energy, it must be a positive value. The general formula for the application of the $2s^2$ electron for each element is

$$E_{e\text{-}e}(2s^2)=\Delta I(2s^2)=I_{\text{last 3rd}}-I_{\text{last 4th}}. \tag{5.1b}$$

$I_{Z-Z-3}-I_{Z-Z-4}=(I_{Z-Z-1}-I_{Z-Z-2})/2^2$ is possible. Where, Z is the nuclear charge number, n is the principal quantum number which is also the energy series. If metering with ionization energy, $E_{e\text{-}e}$ is negative; it indicates that the system release energy is released when the two paired s electrons are dissociated. If metering with system energy, the $E_{e\text{-}e}$ is a positive value, it indicates that these two electrons repel each other. For the two paired electrons in a helium atom, $E_{e\text{-}e}=I_2-I_1=5250.5-2372.3=2878.2$ (KJ/mol) (here, metering it with system energy. If metering it with dissociation energy, it must be a negative value). The law expressed by Eq. (5.1) can be promoted to "the difference of the ionization energy of any two adjacent electrons is the interaction energy of the two electrons". But this promotion must follow the following conditions: before and after the ionization, the structure of the atomic core inside the two electrons is unchanged. We can use the following method to find some patterns in the data of interaction energy.

5.1.1. The Calculation Method for the Pairing Energy of Free Electrons

The relationship between the pairing energy of $1s^2$ electrons and the number of the nuclear charge and the ionization energy can be obtained by the following method.

(a) Lists the relation form of the difference $\Delta I(1s^2)$ of ionizing energy between two $1s$ electrons to the effective nuclear charge number (see **Table 5.1** and **Figure 5.1**). In this paper, the interaction energy between electrons is positive in the list and the illustrations.

Table 5.1. The relations between the differences in the ionizing energy of two 1*s* electrons of number 1-26 elements and the nuclear charge number

Ele.	He	Li	Be	B	C	N	O	F
Z	2	3	4	5	6	7	8	9
$\Delta I(1s^2)$, KJ/mol	2878.20	4516.90	6157.90	7800.90	9446.00	11093.4	12748.0	14396.2
Ne	Na	Mg	Al	Si	P	S	Cl	Ar
10	11	12	13	14	15	16	17	18
16052.5	17714	19380	21050	22727	24404	26090	27766	29461
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Cu
19	20	21	22	23	24	25	26	29
31183	32912	34633	36364	38094	39863	41617	43361	48747

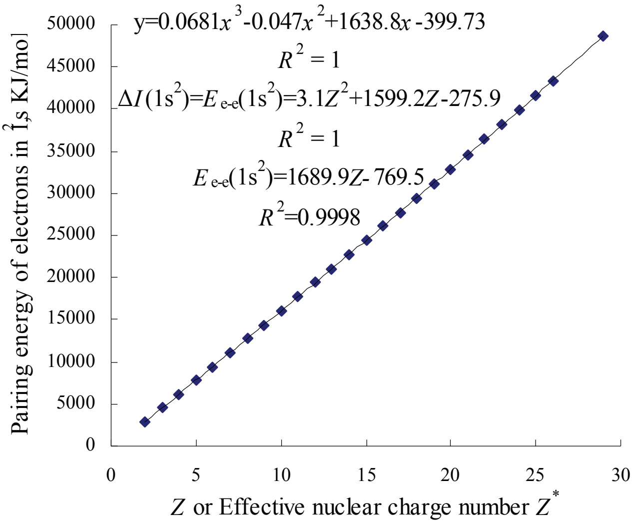


Figure 5.1. The relationship between the interaction energy inside the $1s^2$ electrons and nuclear charge number Z.

Table 5.2. Relationship between the electrons paired energy (KJ/mol) in $2s^2$ electron pair and the effective nuclear charge number

Ele.	Z	$I_{last\ 3rd,}$	Z^*	$E_{e\text{-}e}(2s^2)$	Ele.	Z	$I_{last\ 3rd,}$	Z^*	$E_{e\text{-}e}(2s^2)$
Be	4	1757.1	2.31386	857.6	Cl	17	78095	15.4259	5754
B	5	3659.7	3.33934	1232.6	Ar	18	88576	16.4284	6103
C	6	6222.7	4.35439	1602.2	K	19	99710	17.4304	6310
N	7	9444.9	5.36460	1969.9	Ca	20	111711	18.4496	6811
O	8	13326.5	6.37230	2337.0	Sc	21	124270	19.4590	7270
F	9	17868	7.37864	2703.9	Ti	22	137530	20.4709	7630
Ne	10	23069.5	8.38412	3070.5	V	23	151440	21.4812	8040
Na	11	28932	9.38918	3436	Cr	24	166090	22.4962	8390
Mg	12	35458	10.3943	3805	M	25	181380	23.5089	8880
Al	13	42647	11.3994	4174	Fe	26	195200	24.3881	7100
Si	14	50502	12.4049	4540	Co	27	214100	25.5415	9600
P	15	59024	13.4107	4914	Ni	28	231490	26.5586	10090
S	16	68216	14.4172	5286	Cu	29	249660	27.5812	10560

(b) Extracts the regression equation [$\Delta I(1s^2)=E_{e\text{-}e}(1s^2)$].

$$\Delta I(1s^2)=E_{e\text{-}e}(1s^2)=1689.9Z-769.5. \quad (5.2a)$$

$$\Delta I(1s^2)=E_{e\text{-}e}(1s^2)=3.1Z^2+1599.2Z-275.9, \quad (5.2b)$$

$$\Delta I(1s^2)=E_{e\text{-}e}(1s^2)=0.0681Z^3-0.047Z^2+1638.8Z-399.73. \quad (5.2c)$$

Using the same way to deduce Eq. (5.2), we can list Table. 5.2 and obtain **Figure 5.2** and Eq. (5.3)—the relationship between the electron paired energy in a $2s^2$ electron pair and the nuclear charge number (eliminate the two points of the Potassium element and the Iron element. The figure is similar to **Figure 5.1**).

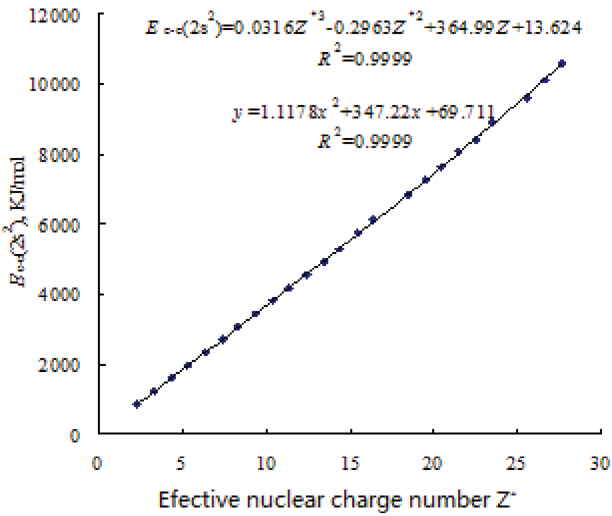


Figure 5.2. The relationship between the interaction energy inside the $2s^2$ electrons and the effective nuclear charge number Z^* (or Z).

$$E_{e\text{-}e}\,(2s^2)=1.1178Z^{*2}+347.22Z^*+69.711. \quad (5.3a)$$

In the same sub layer of atoms, the energy difference of the electrons in a different main layer is n^2 times. Therefore, if the effective nuclear charge numbers are the same, we have $(I_{last\ 3rd}-I_{last\ 4th})=(I_{last\ 1st}-I_{last\ 2nd})/n^2$.

According to this relationship, we can promote Eq. (5.3a). Using $E_{e\text{-}e}[X(ns^2)]$ to express the interaction energy between the two paired electrons outside the nucleus (their size equal mark opposite with the dissociation energy of paired electrons) promotes from n=2 to n>2 (n is the principal quantum number). $E_{e\text{-}e}$ ($2s^2$) is multiplied by 2^2 to return to n=1, then divided by n^2 so as to be suitable for the case of n≥2:

$$E_{e\text{-}e}\,[X(ns^2)]=2^2(1.1178Z^{*2}+347.22Z^{*}+69.711)/n^2. \qquad (5.3b)$$

Eq. (5.2b) is a better fit than Eq. (5.2a) (perhaps, $E_{e\text{-}e}(1s^2)=0.0681Z^{*3}-0.047Z^{*2}+1638.8Z^{*}-399.73$ is better than others). The relationship between the interaction energy of electron-electron and the number of the nuclear charge may be linear. The difference between the two equations may be rooted in the ionization energy data and the drawing tool. We have no good reason to say that Eq. (5.2b) is not set up. So, the three formulas are used by me. I will list them and their promotion, which will be chosen by the readers. For molecules, the Z^* in Eq. (5.3) may be ΣZ^*. In order to confirm the accuracy of Eq. (5.2b), substituting Z^*=11 into Eq. (5.2b), results in $E_{e\text{-}e}[Na(1s^2)]$=17690.4KJ/mol. The experimental value is the difference between I_{10} and I_{11} of the sodium element: $I_{11}-I_{10}$=17714.0MJ/mol. When Z^*=0 and n=1, $E_{e\text{-}e}(1s^2)$=−275.9MJ/mol is the pairing energy of two free electrons. It can be expressed by Δ. That is, the pairing energy of a free electron is Δ=−275.9KJ/mol. This pairing energy is very useful in superconductor theory. A principle and method for the measurement of the electron pairing energy are obtained when Eqs. (5.1) to (5.3) are obtained. The experimental method corresponding to this experimental principle is the measurement of the interaction energy between electrons with the method of measuring ionization energy.

5.1.2. The Relationship between the Pairing Energy in 2s² Electrons and the Number of the Nuclear Charge and the Atomic Number

When applying Eq. (5.3) to calculate the ns^2 (n≥2) electron pair, the results have errors, the error sources are: the error of calculation results of the effective nuclear charge number; the error of ionization energy data; and the defect of the constructing tool. It is necessary to find out the law of the interaction energy between $2s^2$ electrons directly.

We calculate the effective nuclear charge acting on the $2s^2$ electron according to the last third of the ionization energy: $I_{\text{last 3rd}}$=1312.75 $(Z^*)^2/2^2$ (similarly hereinafter). This algorithm does not consider the size effect of the atomic kernel, and has some errors. We can calculate $\Delta I(2s^2)$ according to Eq. (5.1). The calculation results are shown in the 4th column in Table 5.2. The linear regression equation is obtained according to the data in Table 5.3.

$$E_{\text{e-e}}(2s^2)=371.69Z-639.24. \quad (5.4a)$$

The method to extend Eq. (5.4a) to the ns^2: Eq. (5.4a) multiplied by 2^2, so that it applies to $1s^2$ electronics, and then divided by n^2.

$$E_{\text{e-e}}(ns^2)=(371.69Z-639.24)\times 2^2/n^2. \quad (5.4b)$$

Similarly, the relationship between energy and the effective nuclear charge number Eq. (5.5) can be obtained by applying Tab. 5.3.

$$E_{\text{e-e}}(2s^2)=364.53Z^*+14.501. \quad (5.5)$$

Note: Eq. (5.5) is a simplified form of Eq. (5.3); Eq. (5.4) is completely different from Eq. (5.3), and they do not mix. In the application process, the use of the Eq. (5.4) calculation is simpler. If you can only use the effective nuclear charge, we have to use Eq. (5.5) or Eq. (5.3). If it is used for the calculation of molecules, Eqs. (5.3) and (5.5) are more useful than Eq. (5.4).

Table 5.3. The relationship between [$E_{e\text{-}e}(2s^2)$ and $E_{e\text{-}e}(1s^2\text{-}2s^1)$] and the effective nuclear charge number Z^* [here $E_{e\text{-}e}(2s^2) = \Delta I(2s^2)$] .

Elements	Be	B	C	N	O	F	Ne	Na	Mg	Al
Z^*	2.3139	3.3394	4.3544	5.3646	6.3724	7.3787	8.3842	9.3893	10.3944	11.3994
$E_{e\text{-}e}(2s^2)$	857.6	1232.6	1602.2	1969.9	2337	2703.9	3070.5	3436	3805	4174
$E_{e\text{-}e}$ $(1s^2\text{-}2s^1)$	3493.9	4545	5592.1	6636.3	7677.6	8715.3	9749.4	10778.8	11801.1	12816.9

Table 5.4. The relationship between "the interaction energy of electron-electron" and the number of the nuclear charge (energy unit: KJ/mol)

Elements ↓	Z ↓	$E_{e\text{-}e}(1s^2\text{-}2s^1)$	$E_{e\text{-}e}(2s^2)$ $=\Delta I(2s^2)$	$E_{e\text{-}e}(1s^2\text{-}2p^1)$	$E_{e\text{-}e}(2s^2\text{-}2p^1)$	$E_{e\text{-}e}(p^{\uparrow\uparrow})$ (in $2p^2$)	$E_{e\text{-}e}(p^{\uparrow\uparrow})$ (in $2p^3$)	$E_{e\text{-}e}(p^{\uparrow\downarrow})$ (in $2p^4$)	$E_{e\text{-}e}(p^{\uparrow\downarrow})$ (in $2p^6$)
Li	*3*	*2433.5*							
B	4	3493.9	857.6						
Be	5	4545.0	1232.6						
C	6	5592.1	1602.2	1892.4	7569.7	1266.1			
N	7	6636.3	1969.9	2300.6	9202.5	1722.1	1453.7		
O	8	7677.6	2337.0	2707.0	10827.9	2168.7	1912.2	2074.4	
F	9	8715.3	2703.9	3112.1	12448.5	2615.0	2357.3	2676.2	
Ne	10	9749.4	3070.5	3516.2	14064.7	3056.0	2806	3249	2727.2
Na	11	10778.8	3436	3918.8	15675.0	3504	3259	3811	3221.1
Mg	12	11801.1	3805	4319.6	17278.5	3950	3691	4390	3716.6
Al	13	12816.9	4174	4722.2	18888.7	4388	4139	4947	4200.0
Si	14	13822.9	4540	5119.8	20479.2	4848	4591	5507	4689.7
P	15	14818.4	4914	5446.5	21785.9	5311	5045	6033	5169.3
S	16	15800.3	5286	5911.3	23645.0	5750	5533	6556	5639.3
Cl	17	16751.5	5754	6296.7	25186.8	6244	6051	7107	6115.7
Ar	18	17757.1	6103	6683.0	26732.1	6719	6546	7651	6598.7
K	19	18766.0	6310	7079.2	28316.8	7180	6950	8220	7093.3
Ca	20	19564.4	6811	7455.1	29820.3	7690	7420	8780	7590.0

5.1.3. The Relationship between the Interaction Energy of Two Spin-parallel 2*p* Electrons and the Nuclear Charge Number

When an element is ionized, and the second layer is left with two 2*p* electrons, the two 2*p* electrons are in the same spin as the non-pairing state [expressing it with $2p^{\uparrow\uparrow}$ or $p^{\uparrow\uparrow}$(in $2p^2$)]. Using the above train of thought, the following formula can be summed up.

$$E_{e\text{-}e}(p^{\uparrow\uparrow})(\text{in } 2p^2)=\Delta I(2p^{\uparrow\uparrow})=(I_{\text{last 5th}}-I_{\text{last 6th}}). \quad (5.6)$$

According to Eq. (5.6), the calculation results are shown in the 7th column in Table 5.4. The linear regression equation is obtained according to the nuclear charge number and the data shown in the 7th column in Tab. 5.4 (shown in Fig. 5.3).

$$E_{e\text{-}e}(p^{\uparrow\uparrow})(\text{in } 2p^2)=455.6Z-1495.7, \quad (5.7a)$$

According to $E_{e\text{-}e}(p^{\uparrow\uparrow})$(in $2p^2$) we calculate the average distance between the two single $2p^{\uparrow}$ electrons. The interaction energy increases with the increase of the effective nuclear charge number, the average distance between electrons is smaller and smaller, and the distance between the 2*p* electron and the nucleus is also getting smaller and smaller.

When an atom is ionized only three 2*p* electrons are left, the interaction energy between the three spin-parallel 2*p* electrons is $E_{e\text{-}e}(p^{\uparrow\uparrow})(\text{in } 2p^3)=I_{\text{last 6th}}-I_{\text{last 7th}}$. The data of $E_{e\text{-}e}(p^{\uparrow\uparrow})$(in $2p^3$) of a Nitrogen-like ion are shown in the 8th column in Table. 5.4. Using the same method, we can obtain

$$E_{e\text{-}e}(p^{\uparrow\uparrow})(\text{in } 2p^3)=459.9Z-1798.2. \quad (5.7b)$$

Table 5.5. The relationship between $E_{e\text{-}e}(2p^{\uparrow\uparrow})$(in $2p^2$) and the effective nuclear charge number Z^*.

Elements	C	N	O	F	Ne	Na	Mg	Al	Si	P
Z^*	2.6674	3.7350	4.7707	5.7954	6.8141	7.8293	8.8426	9.8518	10.833	11.873
$E_{e\text{-}e}(p^{\uparrow\uparrow})$	1266.1	1722.1	2168.7	2615.0	3056.0	3504	3950	4388	4848	5311

If the number of nuclear charges is replaced by the effective nuclear charge number (see the Tab. 5.5), Eq. (5.8) can be obtained.

$$E_{\text{e-e}}(p^{\uparrow\uparrow})(\text{in } 2p^3)= 1.5382Z^{*2}+416.77Z^{*}+144.71. \quad (5.8)$$

All relationships between the electron interaction energy and the number of effective nuclear charge are beneficial to the calculation of the molecules.

5.1.4. The Relationship between "the Interaction Energy between a 2s^1 Electron and 1s^2 Electrons" and the Number of the Nuclear Charge

The positive-negative symbols are easy to mistake, therefore. Note! $E_{\text{n-e}}$ is negative; $E_{\text{e-e}}$ is positive, or we meter some terms with absolute value at an appropriate time. The interaction energy between a 2s^1 electron and 1s^2 electrons is equal to $|2E_{\text{n-e}}(1s^1)+E_{\text{n-e}}(2s^1)|-\Sigma I_{\text{last 1st-3rd}}$ (the absolute value of the differences between the sum of the energies of the Schrödinger equations and the sum of the ionization energy of the three electrons), again subtracting $E_{\text{e-e}}(1s^2)$ (the paired energy of 1s^2):

$$E_{\text{e-e}}(1\text{s}^2\text{-}2s^1)=-(I_{\text{last 1st}}+I_{\text{last 2nd}}+I_{\text{last 3rd}})-2E_{\text{n-e}}(1s^1)-E_{\text{e-e}}(1s^2)-E_{\text{n-e}}(2s^1). \quad (5.9)$$

If it does not consider the relativistic effect, its value is $E_{\text{n-e}}(2s^1)=Z^2E_{\text{H}}/n^2=-13.606Z^2/n^2$. The case of $E_{\text{n-e}}(2p^1)$ is also the same. Considering $E_{\text{e-e}}(1s^2)=\Delta I(1s^2)=I_{\text{last 1st}}-I_{\text{last 2nd}}$, both $2E_{\text{n-e}}(1s^1)$ and $E_{\text{n-e}}(2s^1)$ are negative, Eq. (5.9) becomes

$$E_{\text{e-e}}(1\text{s}^2\text{-}2\text{s}^1)=-2E_{\text{n-e}}(1s^1)-E_{\text{n-e}}(2s^1)-(I_{\text{last 1st}}+I_{\text{last 2nd}}+I_{\text{last 3rd}})-I_{\text{last 1st}}+I_{\text{last 2nd}}.$$
$$=-2E_{\text{n-e}}(1\text{s}^1)-E_{\text{n-e}}(2s^1)-2I_{\text{last 1st}}-I_{\text{last 3rd}}.$$

If the relative effects are all considered, $I_{\text{last 1st}}$ is equal to $-E_{\text{n-e}}(1s^1)$, resulting in

$$E_{\text{e-e}}(1s^2\text{-}2s^1)=|E_{\text{n-e}}(2s^1)|-I_{\text{last 3rd}}. \quad (5.10)$$

Where, the interaction of $I_{\text{last 3rd}}$ requires the nucleus and the 1s^2 electrons, yet $E_{\text{n-e}}(2\text{s}^1)$ is only the interaction between a 2s^1 electron and the nucleus. Thus, $|E_{\text{n-e}}(2s^1)|-I_{\text{last 3rd}}$ is the interaction energy between a 2s^1 electron and 1s^2 electrons. The first item on the left in Eq. (5.10) is the theoretical result of quantum mechanics. It determines that Eq. (5.10) is the quantum mechanical method. The interaction energy between $1s^2$ electrons and two $2s^1$ electrons is to multiply the $2E_{e\text{-}e}(1s^2\text{-}2s^1)$:

$$E_{e\text{-}e}(1s^2\text{-}2s^2)\ =2E_{e\text{-}e}(1s^2\text{-}2s^1)=2[|E_{n\text{-}e}(2s^1)|-I_{last\ 3rd}]. \quad (5.11)$$

Taking the lithium atom as an example, the interaction between a $2s^1$ electron and a $1s^2$ electron is $E_{e\text{-}e}(1s^2\text{-}2s^1)=|E_{n\text{-}e}(2s^1)|-I_{last\ 3rd}$=2952.0−520.2=2431.8 (KJ/mol).

The data of a Li-like ion obtained according to Eq. (5.10) are listed in the 3rd column in Table 5.4. The linear regression equation is obtained according to the nuclear charge number and the data in the third column in Tab. 5.4.

$$E_{e\text{-}e}(1s^2\text{-}2s^1)=1022.6Z-537.44,\ \text{(Elements 3-18)}; \quad (5.12a)$$
$$E_{e\text{-}e}(1s^2\text{-}2s^1)=-3.1394Z^2+1088.5Z-816.86,\ \text{(Elements 3-18)}. \quad (5.12b)$$

The relationship between $E_{e\text{-}e}(1s^2\text{-}2s^1)$ and the number of the effective nuclear charge can be obtained according to the data in Tab. 5.3:

$$E_{e\text{-}e}(1s^2\text{-}2s^1)=0.062Z^{*2}+1023Z^*+2188.3. \quad (5.13)$$

Where, $E_{n\text{-}e}(2p^1)=-1.31275Z^2/n^2$. The data in the 5th and 6th columns in Table 3 can be drawn by applying the data of ionization energy and Eqs. (5.14) to (5.16). The linear regression equation is obtained according to the data in the 5th column in Tab. 5.3.

5.1.5. The Relationship between "the Interaction Energy between a $2p^1$ Electron and $2s^2$ Electrons" and the Number of the Nuclear Charge

Considering Eq. (5.10), the relationship between this interaction energy and ionization energy is that the interaction energy between a $2p^1$ electron and the inside of four electrons ($1s^2$ and $2s^2$) minus the interaction energy between $1s^2$ and $2p^1$ is:

$$E_{e\text{-}e}(2s^2\text{-}2p^1)=|E_{n\text{-}e}(2p^1)|-I_{last\ 5th}-|E_{e\text{-}e}(1s^2\text{-}2p^1)|,$$

and

$$E_{e\text{-}e}(1s^2\text{-}2p^1)=E_{e\text{-}e}(2s^2\text{-}2p^1)/2^2. \quad (5.14)$$

Considering Eq. (5.14), $E_{e\text{-}e}(2s^2\text{-}2p^1)=|E_{n\text{-}e}(2p^1)|-I_{last\ 5th}-|E_{e\text{-}e}(1s^2\text{-}2p^1)|$ becomes

$$E_{e\text{-}e}(1s^2\text{-}2p^1)=\{|E_{n\text{-}e}(2p^1)|-I_{last\ 5th}\}/(2^2+1); \quad (5.15)$$
$$E_{e\text{-}e}(2s^2\text{-}2p^1)=2^2\{|E_{n\text{-}e}(2p^1)|-I_{last\ 5th}\}/(2^2+1). \quad (5.16)$$

Where, $E_{n\text{-}e}(2p^1)=-1.31275Z^2/n^2$. The data in the 5th and 6th columns in Table 3 can be drawn by applying the data of ionization energy and Eqs. (5.14) to (5.16). The linear regression equation is obtained according to the data in the 5th column in Tab. 5.3.

$$E_{e\text{-}e}(1s^2\text{-}2p^1)=397.39Z-467.4. \quad (5.17)$$

The curves are shown in **Figure 5.3**.

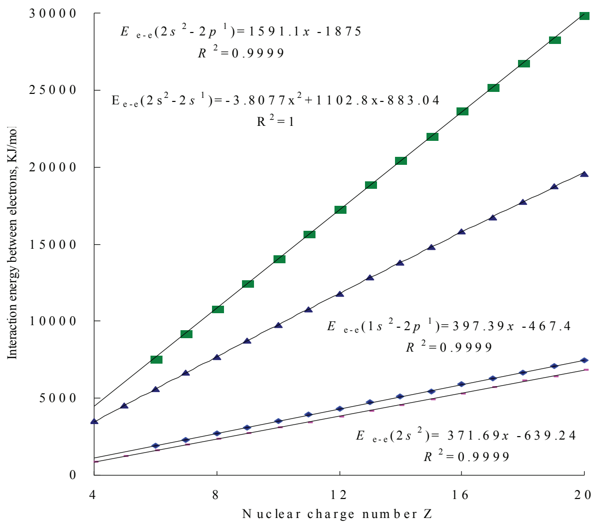


Figure 5.3. The relationship between the interaction energy of the electrons in 2nd layers and the nuclear charge number.

5.1.6. The Relationship between "the Interaction Energy Inside $2p^{\uparrow\downarrow}$ Electrons" and the Number of the Nuclear Charge

After the $\mathbf{2}p^4$ electrons of an Oxygen atom or oxygen-like cores are losing two electrons, the configuration of $2p$ electrons from $\mathbf{2}p^{\uparrow\downarrow}$-$\mathbf{2}p^{\uparrow}$-$\mathbf{2}p^{\uparrow}$ comes to $\mathbf{2}p^{\uparrow}$-$\mathbf{2}p^{\uparrow}$-$\mathbf{2}p^{0}$. A $2p^{\uparrow\downarrow}$ electron pair is destroyed, without increasing the single electron. It is in accordance with the condition of promotion of Eq. (5.1).

$$E_{\text{e-e}}(p^{\uparrow\downarrow})(\text{in } 2p^4)=\Delta I(2p^{\uparrow\downarrow}) = I_{\text{last 7th}}-I_{\text{last 8th}}. \tag{5.18}$$

This is the rule of electron paired energy in $2p^4$ electrons configuration. It can be extended to the case of n>2. For the oxygen atom, according to Eq. (5.18), the calculation result is 2074.4KJ/mol. Under Eq. (5.18) we can list the data in the 9th column in Table (5.3) and Eq. (5.19).

$$E_{\text{e-e}}(p^{\uparrow\downarrow})(\text{in } 2p^4)=554.2Z-2297.3. \tag{5.19}$$

Here, $2p^4$ expresses that $p^{\uparrow\downarrow}$ is an electronic pair of the arrangement in $2p^4$.

After $2p^5$ in a Fluorine atom or a Fluorine-like atomic kernel loses two electrons, the electron arrangement of $2p$ electrons changes into $2p^{\uparrow}$-$2p^{\uparrow}$-$2p^{\uparrow}$from $2p^{\uparrow\downarrow}$-$2p^{\uparrow\downarrow}$-$2p^{\uparrow}$. The two $\mathbf{2}p^{\uparrow\downarrow}$ electron pairs have been destroyed; two single electrons have been added. It does not conform to the popularization condition of Eq. (5.1). In this case we are temporarily unable to directly calculate the electronic pairing energy. We can calculate the energy of the Fluorine atom and the Fluorine-like atomic kernel by means of the method to be introduced. After the total energy of a Fluorine atom is calculated, we can deduce $E_{\text{e-e}}(p^{\uparrow\downarrow})(\text{in } 2p^5)$.

After $2p^6$ in an atom or an atomic kernel loses two electrons, the arrangement of $2p$ electrons changes into $2p^{\uparrow\downarrow}$-$2p^{\uparrow}$-$2p^{\uparrow}$from $2p^{\uparrow\downarrow}$-$2p^{\uparrow\downarrow}$-$2p^{\uparrow\downarrow}$. The two $2p^{\uparrow\downarrow}$ electron pairs have been destroyed; two spin parallel electrons have been added. Although it does not conform to the popularization condition of Eq. (5.1), but there are other rules to follow. If the arrangement of $2p$ electrons in an atomic core is $2p^{\uparrow\downarrow}$-$2p^{\uparrow\downarrow}$-$2p^{0}$, Ilast 10th−Ilast 9th is the imaginary electronic pairing energy. It needs to add a pair of $2p^{\uparrow\downarrow}$ electrons and reduce two electrons when the arrangement of $2p$ electrons in the atomic core is restored to $2p^{\uparrow\downarrow}$-$2p^{\uparrow\downarrow}$-$2p^{0}$ from $2p^{\uparrow\downarrow}$-$2p^{\uparrow}$-$2p^{\uparrow}$. The variation of the corresponding interaction energy is $E_{\text{e-e}}(2p^{\uparrow\downarrow})-E_{\text{e-e}}(2p^{\uparrow\uparrow})$. In this way, we have:

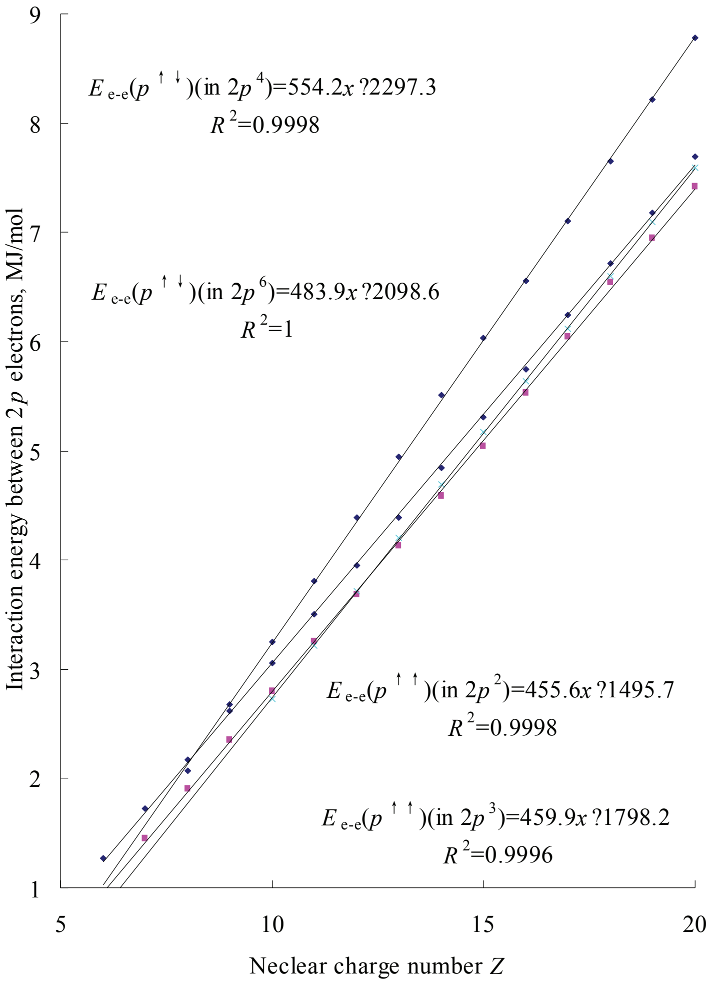


Figure 5.4. The relationship between the interaction energy of 2*p* electrons and nuclear charge number.

$$\Delta I(2p^{\uparrow\downarrow})_{\text{2 pairs of electrons}} = 2E_{e\text{-}e}(2p^{\uparrow\downarrow}) - E_{e\text{-}e}(2p^{\uparrow\uparrow});$$
$$E_{e\text{-}e}(2p^{\uparrow\downarrow})_{\text{2pairs of electrons}} = [\Delta I(2p^{\uparrow\downarrow}) + E_{e\text{-}e}(2p^{\uparrow\uparrow})]/2$$
$$= (I_{\text{last 9th}} - I_{\text{last 10th}} + I_{\text{last 5th}} - I_{\text{last 6th}})/2. \quad (5.20)$$

This is the average value of two pairs of 2 $p^{\uparrow\downarrow}$ electrons which were separated. The rest of the $2p^4$ lost two electrons, which can be calculated by Eq. (5.18): $E_{\text{e-e}}(2p^{\uparrow\downarrow})=\Delta I(2p^{\uparrow\downarrow}) = I_{\text{last 7th}}-I_{\text{last 8th}}$. The average pairing energy of 3 pairs of electrons in $2p^6$ is

$$E_{\text{e-e}}(p\uparrow\downarrow)(\text{in } 2p^6)$$
$$=[\Delta I(2p^{\uparrow\downarrow})+E_{\text{e-e}}(2p^{\uparrow\uparrow})]/3$$
$$=[(I_{\text{last 9th}}-I_{\text{last 10th}})+(I_{\text{last 7th}}-I_{\text{last 8th}})+(I_{\text{last 5th}}-I_{\text{last 6th}})]/3. \quad (5.21)$$

According to Eq. (5.21), we can obtain the data in the 10^{th} column in Tab. 5.3 and Eq. (5.22).

$$E_{\text{e-e}}(p\uparrow\downarrow)(\text{in } 2p^6)=483.9Z-2098.6. \quad (5.22)$$

The curves are shown in **Figure 5.4**.

5.1.7. Exploration of the Mechanism of Electron Pairing

Previously it has only been known that there is a similar attraction between proton and proton. Since the existence of a short-range stronger electromagnetic force between electrons, then electron pairing is actually overlapping. There also is stronger attraction between electrons. But is its nature completely the same as the one between protons? This problem also needs to be explored. The authors consider they are the same. They are all short-range forces, the strengths have something to do with the size of the free particle—the smaller the size, the greater the intensity. Revealing deeper mechanisms needs to be completed by everybody.

There is stronger attraction between electrons when they are very close or overlapping. It shows that an electron is not a point particle. When the electromagnetic interaction is discussed, the classical electromagnetic theory takes charge as a point particle. The non-point particle is not in conformity with the classical electromagnetic theory necessarily. Since the short-range strong attraction between like charges is widespread, the infinite interaction between like charges to be very near would not exist. So, the problem of energy divergence does not exist. An electron has both the characteristic of non-point and that of overlapping. It can express that the electron is a wave in essence. In the process of the experiment, it is easy to realize the mutual transformation between an electron and an electromagnetic wave.

The exploration of the above shows that exploration on the nature of the electronic structure and the interaction between the electron and the electron is the growth point of new theory.

The study of the nature of the interaction energy between electrons that this book contains is the sort of significant conceptual advance in understanding or methodology that will be of immediate interest to a broad readership of researchers in the physics community.

5.2. Statistical Law of the Ionization Energy of Elements and Its Application

This is also the law of the relationship between "atomic energy and atomic core energy" and "ionization energy and atomic number" and their application.

Eqs. (5.2) (5.3), (5.5), (5.7), (5.8), (5.12), (5.13), (5.17), (5.19) and (5.22) are the results of the statistics. In this section, we will continue to introduce some of the results of regression statistics and apply them to the calculation of the energy of atoms and ions. First, we introduce a small application which is not important, and then introduce important applications.

5.2.1. Correction of the Effective Nuclear Charge Number, Check the Ionization Energy Data

The number of the effective nuclear charge experienced by the outer layer electron is always an estimate value. This is very bad for the calculation of the valence electrons. As long as the data of ionization energy are accurate, the effective nuclear charge number can be very accurately calculated according to the statistical law of this research.

Substituting the relationship between the ionization energy of the Mg element and electron pairing energy $I_{11}-I_{12}=713.00=E_{e\text{-}e}(3s^2)$ into $E_{e\text{-}e}(3s^2)= (0.0681Z^{*3}=0.047Z^{*2}+1638.8Z^*-399.73)/3^2$, can obtain Z^* $(Mg^{2+})=4.1574$, the effective nuclear charge number for 3s electrons. According to the relation of $I_2=Z^{*2}/n^2$, the calculated value is 3.1537. The J. C. Slater experience is 3.2. To make sure that this correction is meaningful, the accuracy of the measurement of ionization energy must improve.

The calculation results of $|E_{n\text{-}e}(2s^1)|-I_{last\ 3rd}$ have a certain rule. But the Iron element has a large deviation. It is estimated that $I_{last\ 3rd}$ of Fe is incorrect (it should not be 195200KJ/mol and should be 197400KJ/mol or so). $E_{e\text{-}e}(2s^2)$—a Z curve can be drawn according to the data in Table 2. The point of the 19th element also deviates from the fitting of the straight line. It is estimated that the $I_{last\ 3rd}$ or $I_{last\ 4th}$ of the K element is incorrect (their difference should be about 6410KJ/mol, not 6310KJ/mol).

5.2.2. Development of the New Quantum Mechanics Calculation Method: Regression Equation Method (or Fitting Curve Method)

5.2.2.1. One by one calculation of electronic energy and the interaction energy between electrons

(a) The energy of the negative hydrogen ion and the helium atom

Substituting Z=1 and n=1 into Eq. (5.2c), the negative hydrogen ion energy can be obtained:

$$E[H^-(1s^2)]=2E_{n\text{-}e}(H)+E_{e\text{-}e}[H(1s^2)]=-2624.0+1239.09=-1384.9 \text{ (KJ/mol)}.$$

It is slightly lower than the energy of a ground state hydrogen atom, and shows that this system has certain stability.

According to Eq. (5.2c), we can also calculate the ground state energy of a helium atom conveniently:

$E_{e\text{-}e}(He)^{(0)}=E_{n\text{-}e}(He)+E_{e\text{-}e}[He(1s^2)]=-10502.00\text{KJ/mol}+2878.23$ KJ/mol $=-7623.77$ KJ/mol. Relative error is (7623.77–7622.8)/7622.8=0.0013%.

(b) The energy of the Lithium atom and the energy of the Beryllium atom

The energy of the ground state lithium atom = (the interaction energy between the two 1s electrons and the nucleus) + (the interaction energy between a 2s electron and the nucleus) + (the interaction energy between the two 1s electrons)+ (the interaction energy between the $1s^2$ electrons and the $2s^1$ electron). The calculation in front of the two terms is relatively simple. The calculations following the two terms are respectively based on Eq. (5.2c) and Eq. (5.12) (ionization energy data are not needed, directly substituting Z=3 into the two regression equations). The calculation results are:

$E(\text{Li})^{(0)} = -2\times3^2\times1312.75-3^2\times1312.75/2^2+4518.09+2443.93$
$= -23629.6-2953.70+4518.09+2443.93$
$= -19621.3$ (KJ/mol).

The corresponding experimental value is –19633.3KJ/mol. The relative error is 0.06%. For more computational examples, see the first calculation method of Carbon, Nitrogen and Neon in the next section (that is, Section 5.2.2.2).

5.2.2.2 Transverse regression analysis method for each element spread along the atomic cores

Eq. (5.2) is suitable for the calculation of the energy of the $1s^2$ elements in all atoms. Referring to the lithium atom, the energy of the ground state carbon atom is

$$E(\text{C})^{(0)}=2E_{\text{n-e}}(1s^1)+2E_{\text{n-e}}(2s^1)+2\text{E}_{\text{n-e}}(2p^1)+E_{\text{e-e}}(1s^2)+E_{\text{e-e}}(2\text{s}^2)+2E_{\text{e-e}}(1s^2\text{-}2s^1)$$
$$+E_{\text{e-e}}(2p^{\uparrow\uparrow})+2E_{\text{e-e}}(1s^2\text{-}2p^1)+2E_{\text{e-e}}(2s^2\text{-}2p^1). \quad (5.23)$$

The calculation in front of the three terms is relatively simple (establishing the potential energy function and the Schrödinger equation for the hydrogen-like ions, then a calculation of them. This is also the standard method of basic quantum mechanics theory). Use Eq. (5.2b) to calculate $E_{\text{e-e}}(1s^2)$， use Eq. (5.4a) to calculate $E_{\text{e-e}}(2s^2)$, use Eq. (5.12) to calculate $E_{\text{e-e}}(1s^2\text{-}2s^1)$, use Eq. (5.7) to calculate $E_{\text{e-e}}(2p^{\uparrow\uparrow})$, use Eq. (5.17) to calculate $E_{\text{e-e}}(1s^2\text{-}2p^1)$, and use Eq. (5.14) and Eq. (5.17) to calculate $E_{\text{e-e}}(2s^2\text{-}2p^1)$. This results in $E(\text{C})^{(0)}=-99263.7$ (MJ/mol). The experimental value is −99390.3 MJ/mol. The relative error is 0.13%. The calculation of each term in Eq. (5.23) is based on an equation which has only Z of the independent variable. They can be set for a coefficient matrix of 3 columns of 9 lines (see Tab. 5.6). Thus, a combined formula of calculation can be obtained:

$$E(\text{Carbon-like ion})^{(0)}=-3938.262Z^2+8434.99Z-8042.96. \quad (5.24a)$$

Table 5.6. The coefficient matrix of the assemblage of energy equation of the Carbon-like ions

Terms	Z^2	Z	Z^0
$2E_{n\text{-}e}(1s^1)$	−2625.508		
$2E_{n\text{-}e}(2s^1)$	−656.377		
$2E_{n\text{-}e}(2p^1)$	−656.377		
$E_{e\text{-}e}(1s^2)$	3.1	1599.2	−275.9
$E_{e\text{-}e}(2s^2)$		371.69	−639.24
$E_{e\text{-}e}(p^{\uparrow\uparrow})(\text{in } 2p^2)$		455.6	−1495.7
$2E_{e\text{-}e}(1s^2\text{-}2s^1)$		2045.2	−1074.88
$2E_{e\text{-}e}(1s^2\text{-}2p^1)$		794.78	−934.8
$2E_{e\text{-}e}(2s^2\text{-}2p^1)$		3179.12	−3739.2
Σ	−3938.262	8445.59	−8159.72

Summing up Eq. (5.24a) is more troublesome. In practice, this method is generally not used. However, the process of deriving Eq. (5.24a) can tell us about the specific circumstances of the interaction between electrons. A regression equation can be obtained by using the 8 data in front of Si in the 5th column in Table 5.8.

$$-E(\text{C-like ion})^{(0)}=-\Sigma I(\text{C-like ion}).$$
$$=2.6Z^3+3896.7Z^2-8376.5Z+8805.1, \text{ (8 points)} \tag{5.24b}$$

Add 16 elements (see the 5th column in Table 5.8) to get Eq. (5.24c).

$$-E(\text{C-like ion})^{(0)}=-\Sigma I(\text{C-like ion})$$
$$=3.9Z^3+3.8298Z^2-7426.5Z+4918.4, \text{ (24 points).} \tag{5.24c}$$

Eq. (5.24a) is closer to Eq. (5.24b). It indicates that, in this work, the analytical methods and results about the interaction of electrons in atoms are correct basically. At least, it can indicate that the research directions of the interaction energy between electrons in atoms are correct. The difference between Eq. (5.24a) and Eq. (5.24b) reminds us: the error of the ionization data must be further reduced; more careful calculation of the interaction energy between electrons is required; better drawing tools should be used; and relativistic effects cannot be considered. If there is no inference process deriving Eq. (5.24a), we don't know that the quadratic term in Eq. (5.24b) is the interaction energy between the electrons and the nucleus both the first power term and the constant term in Eq. (5.24b) are the interaction energy between electrons. The energy of Carbon atoms obtained by directly using (5.24c) is −99074.6KJ/mol. The relative error is 0.3%. These Carbon-like ions N^{+}、O^{2+}、F^{3+} and Ne^{4+} and so on, can also be calculated by means of the same method.

The calculation of the Neon atom is the same as that of the Carbon atom; only the coefficients of the terms of the interaction energy that involved the $2p$ electron should be changed.

$$E(\mathrm{Ne})^{(0)}=2E_{\text{n-e}}(1s^1)+2E_{\text{n-e}}(2s^1)+6E_{\text{n-e}}(2p^1)+E_{\text{e-e}}(1s^2)+E_{\text{e-e}}(2s^2)+2E_{\text{e-e}}(1s^2\text{-}2s^1)+[12E_{\text{e-e}}(2p^{\uparrow\uparrow})+3E_{\text{e-e}}(2p^{\uparrow\downarrow})]+6E_{\text{e-e}}(1s^2\text{-}2p^1)+6E_{\text{e-e}}(2s^2\text{-}2p^1). \qquad (5.25)$$

Where, the item $3E_{\text{e-e}}(2p^{\uparrow\downarrow})$ cannot be calculated by the formula of the electron pairing energy in $2p^4$, which should be calculated according to Eq. (5.22) and the value is 8221.2KJ/mol. We use Eq. (5.2b) to calculate $E_{\text{e-e}}(1s^2)$, use Eq. (5.4a) to calculate $E_{\text{e-e}}(2s^2)$, use Eq. (5.4a) to calculate $E_{\text{e-e}}(2s^2)$, and the results were as follows: 16026.1 KJ/mol and 3077.66KJ/mol. We use Eq. (5.12b) to calculate $2E_{\text{e-e}}(1s^2\text{-}2s^1)$ and the result is 19508.4KJ/mol. We use Eq. (5.17) to calculate $6E_{\text{e-e}}(1s^2\text{-}2p^1)$ and the result is 21039KJ/mol. We use Eqs. (5.14) and (5.17) to calculate $6E_{\text{e-e}}(2s^2\text{-}2p^1)$ and the result is 84156 KJ/mol. We use Eq. (5.7b) to calculate $12E_{\text{e-e}}(2p^{\uparrow\uparrow})$ and the result is 33609.6KJ/mol. The first three terms in Eq. (5.25) are calculated according to the quantum mechanics theory method and the result is −525101.6KJ/mol. Substituting these results into Eq. (5.25), results in $E(\mathrm{Ne})^{(0)}=-$ 339473.7KJ/mol. The relative error is 0.2%. The energy of the sum of the ionization energies does not represent the experimental values of the ground state Neon atom. Because, after the first, second and third electrons ionize, the interior of the atoms is an entirely electronic rearrangement. In the process of the electronic rearrangement, the energy exchange between the atomic core and the environment occurs. This is the author's understanding of the calculation of the energy of the Neon atom. The conclusion, that “the sum of the ionization energy is not necessarily equal to the total energy of the atom,” is the other significance to explore the calculation method of the Neon atom. The energy of Neon-like ions of ground state can all be calculated by using Eq. (5.25).

Table 5.7. The coefficient matrix of the assemblage of energy equation of the Neon-like ions

Terms	Z^2	Z	Z^0
$2E_{n\text{-}e}(1s^1)$	−2625.508		
$2E_{n\text{-}e}(2s^1)$	−656.377		
$6E_{n\text{-}e}(2p^1)$	−1969.131		
$E_{e\text{-}e}(1s^2)$	3.1	1599.2	−275.9
$E_{e\text{-}e}(2s^2)$		371.69	−639.24
$12E_{e\text{-}e}(p^{\uparrow\uparrow})$(in $2p^2$)		5518.8	−21578.4
$3E_{e\text{-}e}(p\uparrow\downarrow)$(in $2p^6$)		1451.7	−6295.8
$2E_{e\text{-}e}(1s^2\text{-}2s^1)$		2045.2	−1074.88
$6E_{e\text{-}e}(1s^2\text{-}2p^1)$		2384.34	−2804.4
$24E_{e\text{-}e}(2s^2\text{-}2p^1)$		9537.36	−11217.6
Σ	−5247.916	22908.29	−43886.22

The calculation of each term in Eq. (5.25) is based on an equation which has only Z of the independent variable. They can be set for a coefficient matrix of 3 columns of 10 lines (see **Table 5.7**). Thus, a combined formula of calculation can be obtained:

$$E(\text{Neon-like ion}) = -\Sigma I_{(\text{Neon-like ion})}$$
$$= -5247.916Z^2 + 22908.29Z - 43886.22. \quad (5.26a)$$

A group of data of the nuclear charge number and energy of the Ne-like ion is listed in the 7th Column in **Table 5.8.** Drawing them for an atomic number can obtain the regression equation for this set of data (shown in **Figure 5.5**):

$$-E(\text{Neon-like ion})^{(0)} = \Sigma I(\text{Neon-like ion})$$
$$= 303.3Z^2 - 24185Z + 50318, \text{ (6 points)}. \quad (5.26b)$$

Add 14 elements to get Eq. (5.26c).

$-E(\text{Neon-like ion})^{(0)}=\Sigma I(\text{Neon-like ion})$
$=5463.3Z^2-29593Z+91091$, (20 points). (5.26c)

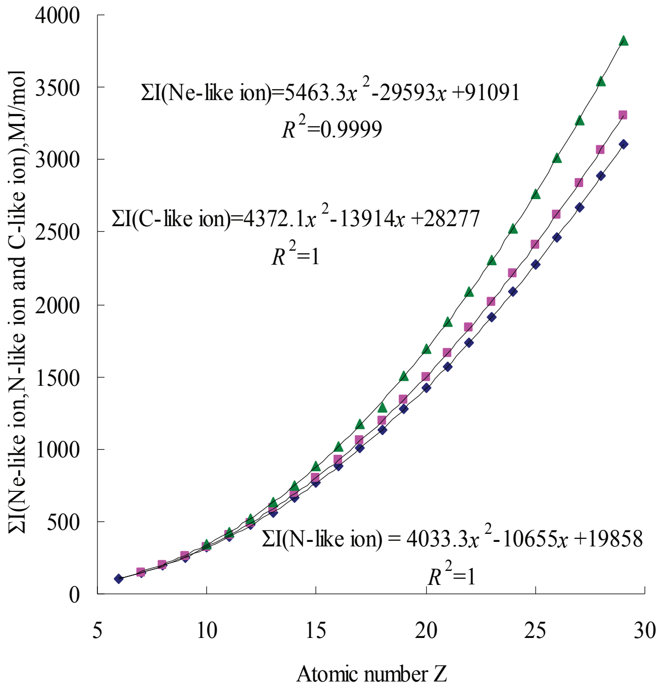


Figure 5.5. The relationship between the ion energy of "Nitrogen-like, Carbon-like and Neon-like ions" and the nuclear charge number (or atomic number)

According to Eq. (5.26), the energy of Neon-like ions can be easily calculated (energy unit: KJ/mol). The energy of Mg^{2+} is calculated by using Eq. (5.26c) resulting in −522690.2KJ/mol. The experimental value is −523764.2 KJ/mol. The relative error is 0.2%. Eq. (5.26a) is relatively close to Eq. (5.26b). It shows that the analytical methods and results about the interaction between electrons in atoms or molecules in this work are correct, once again.

Readers can experience the above two calculation methods taking the

Nitrogen atom as an example. The calculation of the ground state Nitrogen atom is the same as the carbon atom:

$$E(\mathrm{N})^{(0)}=2E_{\text{n-e}}(1s^1)+2E_{\text{n-e}}(2s^1)+3E_{\text{n-e}}(2p^1)+E_{\text{e-e}}(1s^2)+\mathrm{E}_{\text{e-e}}(2s^2)$$
$$+2E_{\text{e-e}}(1s^2\text{-}2s^1)+3E_{\text{e-e}}(2p^{\uparrow\uparrow})\ 3E_{\text{e-e}}(1s^2\text{-}2p^1)+3E_{\text{e-e}}(2s^2\text{-}2p^1). \qquad (5.27)$$

ΣI (N-like ion) values in the 6th column in Tab. 5.8 are available for use. Drawing the values for atomic numbers results in:

$$-E(\text{N-like ion})^{(0)}= 4310.2Z^2-12215Z+17751, \text{ (12 points)}; \qquad (5.28a)$$
$$-E(\text{N-like ion})^{(0)}= 4033.3Z^2-10655Z+19858, \text{ (23 points)}. \qquad (5.28b)$$

Substituting the atomic number (which also is the nuclear charge number) into Eq. (5.28a) or Eq. (5.28b), you can obtain the energy of the Nitrogen atom.

5.2.2.3. Longitudinal Regression Analysis Method of Atomic Energy

This method can be divided into two kinds of situations, such as piecewise fitting and non-subsection fitting.

(a) Longitudinal piecewise regression analysis by period

Drawing the data in the 8th column in **Tab. 5.8** for atomic number *Z*, Fig. 5.6 can be obtained (the fitting situation of its curve is shown in **Figure. 5.7**). **Figure 5.7** shows the best piecewise fit by the period. The sum of the interaction energy between the electrons and the nucleus in the atom is $\boldsymbol{\Sigma Z^2/n^2}$. The sum of ionization energy in an atom is $\boldsymbol{\Sigma I}$. The data in the 8th column in Table 5.8 show the difference between them. For the ground state atom in second periodic elements, drawing $\boldsymbol{\Sigma Z^2/n^2-\Sigma I}$ for *Z*, Fig. 5.7 and Eq. (5.29) can be obtained.

$$E_{\text{e-e}}\text{ (in atom)}=182.98Z^3-21.137Z^2$$
$$+462.9x+806.91, \text{ (Elements 3-10)}; \qquad (5.29)$$

Table 5.8. The relationship between "energy of some atoms and atomic cores" and the atomic numbers

Ele.	Z	$\Sigma Z^2/n^2$	ΣI(atom)	ΣI(C-like ion)	ΣI(N-like ion)	ΣI(Ne-like ion)	$\Sigma Z^2/n^2-\Sigma I$
Li	3	26583.3	19633.3				6950.0
Be	4	52510.2	38511.9				13998.3
B	**5**	90251.8	64739.9				25511.9
C	**6**	141777.4	99390.3	99390.3			42387.1
N	**7**	209056.1	143382.9	141980.6	143382.9		65673.2
O	**8**	294056.9	197195.9	192493.7	195882.0		96861.0
F	**9**	398749.0	262040.5	250934.9	256985.3		136708.5
Ne	10	525101.6	338821.0	317295.0	326666.0	338821.0	186280.6
Na	11	653022.2	426461.1	391596.0	404950.0	425965.3	226561.1
Mg	12	798154.4	525952.6	473839.0	491859.0	523764.2	272201.8
Al	13	961374	637383	564120	587446	632244	323990
Si	14	1143555	761101	662187	691474	751150	382454
P	15	1345573	897876	768331	804236	880806	447697
S	16	1568303	1047791	882502	925679	1021126	520512
Cl	17	1812622	1211346	1004672	1055731	1171905	601301
Ar	18	2079412	1381933	1134837	1194480	1292678	697498
K	19	2346485	1580397	1273033	1341983	1505813	766088
Ca	20	2632802	1785893	1419533	1498423	1689053	846909
Sc	21	2966988	2005570	1573963	1663453	1882943	961402
Ti	22	3326428	2240432	1736554	1837254	2087429	1086434
V	23	3713363	2491224	1907334	2020034	2302954	1222119
Cr	24	4127302	2731814	2086393	2211693	2529303	1395463
M	25	4569569	3040968	2273497	2412097	2766777	1528601
Fe	26	5041048	3318898	2466861	2619461	3013161	1722123
Co	27	5542611	3658305	2672893	2840293	3274972	1884277
Ni	28	6075133	3992411	2884876	3067576	3544676	2082691
Cu	29	6639492	4345619	3105423	3304223	3826923	2293836

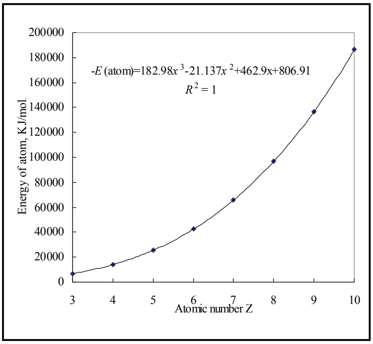


Figure 5.6. The relationship between the interaction energy of electron-electron in atoms in the 2nd period and the atomic number

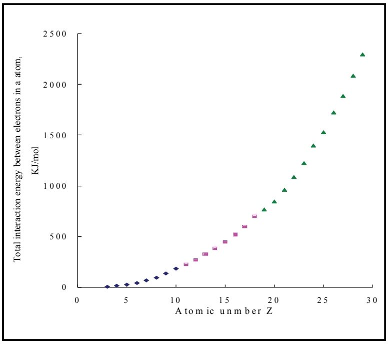


Figure 5.7. The relationship between the interaction energy of electron-electron in atoms and the atomic number

The energy of an atom equals the sum of total energy of the atom and the interaction energy of electron-electron. For verification, we take nitrogen and oxygen as the example. Substituting Z=7 into Eq. (5.29), results in $E_{e\text{-}e}(\mathrm{N})^{(0)}$=62762.14−1035.713+3240.3+806.91=65773.3 (KJ/mol). Substituting Z=8 into Eq. (5.29), results in

$$E_{e\text{-}e}(\mathrm{O})^{(0)}=93685.76-1352.768+3703.2+806.91=96843.1\ (\mathrm{KJ/mol}).$$

$E(\text{atom})^{(0)}=-\Sigma \boldsymbol{Z}^2/n^2$+(the sum of the interaction energy between electrons in an atom). The energy of the ground state Nitrogen atom and Oxygen atom respectively is: $E(\mathrm{N})^{(0)}$=−209056.1+65773.3=143282.8 (KJ/mol). The experimental value is −143382.9KJ/mol, the relative error is 0.07%; $E(\mathrm{O})^{(0)}$=−294057.0+96843.1=−197213.9 (KJ/mol). The experimental value is −197195.9 KJ/mol, the relative error is 0.01%.

Using the same method to dispose of the atoms of the elements in the 3rd period and 4th period, we have:

$$E_{e\text{-}e}(\text{in atom})=0.2012Z^3-4.838Z^2+78.158Z-316.03,\ (\text{Elements 11-18});\quad (5.30)$$

$$E_{e\text{-}e}(\text{in atom})=-0.1548Z^3+17.055Z^2-394.45Z+3159.7,\ (\text{Elements 25-29}).\quad (5.31)$$

The difference between Eq. (5.32) and Eq. (5.33) is Eq. (5.29). The significance of establishing Eqs. (5.29) to (5.31) is found and electronic configuration rules in the atom are verified from them.

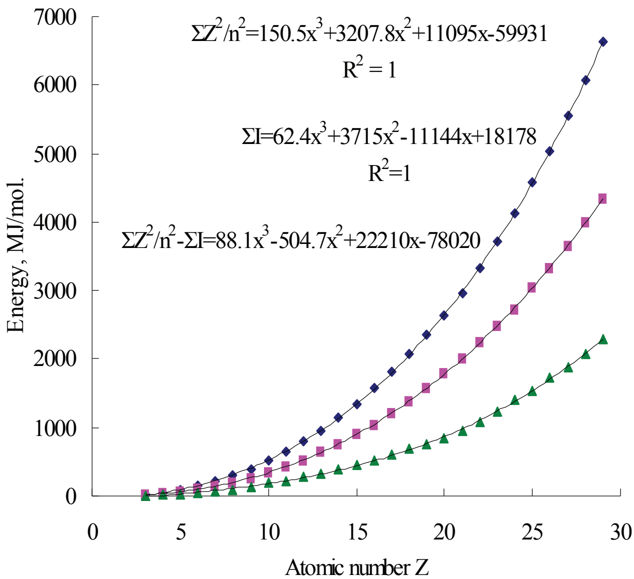


Figure 5.8. The relationship between the total energy of an atom and atomic order number.

(b)Transverse regression analysis method spread along the atomic number not segmented

Drawing $\boldsymbol{\Sigma Z^2/n^2}$ for Z, and drawing ΣI for Z (shown in Fig. 5.8), we can obtain:

$\Sigma Z2/n^2$=150.5Z^3+3207.8Z^2+11095Z−59931, (Elements 3-29); (5.32)
−E(atom)=ΣI=62.4Z^3+3715Z^2−11144Z+18178, (Elements 3-29). (5.33a)
−E(atom)=ΣI=62.3Z3+3719.9Z2–11226Z+18572, (Elements 4-29).(5.33b)
−E(atom)=ΣI=62.9Z^3+ 3685.6Z^2–10637Z+15552, (Elements 5-29).(5.33c)
−E(atom)=ΣI=49.4Z^3+4186.5Z^2−16439Z+35457, (Elements 4-18). (5.33d)

The accuracy of the correlation coefficient of the mapping tool is not enough, the merits of the regression equation cannot be judged according to them. We have to use this stupid way of calculating relative error to choose the best regression equation. Take the fluorine atom as an example, substituting Z=9 into Eq. (5.33a), we can obtain

$$-E(\mathrm{F})^{(0)}=45489.6+300915-100296+18178=264286.6 \text{ (KJ/mol)}.$$

The experimental value is $E(\mathrm{F})^{(0)}=-262040.5$ KJ/mol. The relative error is 0.9%. Substituting Z=9 into Eq. (5.33b), we can obtain

$$-E\ (\mathrm{F})^{(0)}=45416.7+301311.9-101034+18572=264266.6 \text{ (KJ/mol)}.$$

The relative error is 0.9%. Substituting Z=9 into Eq. (5.33c), we can obtain $-E(\mathrm{F})^{(0)}=45854.1+298533.6-95733+15552=264206.7$ (KJ/mol). The relative error is 0.8%. Substituting Z=9 into Eq. (5.33d), we can obtain $-E(\mathrm{F})^{(0)}=36012.6+339106.5-147951+35457=262624.6$ (KJ/mol). The relative error is 0.2%. The greater the atomic number, the greater the error of the ionization energy, so, the more points to be involved, the worse is the fitting effect.

The quantum mechanical calculation method above can be called the regression equation method (or fitting curve method).

5.2.3. Regression Equation Perturbation Method or Fitting Perturbation Method: Improvement of the Traditional Perturbation Method

If somebody is obsessed with the traditional perturbation method, we also have a way. The method is to combine the regression equation with the perturbation method. The principle is: the known term of interaction energy between electrons in the system was greatly increased in regression analysis, the energy of the unknown term is greatly reduced, and at this point, the results using the perturbation method are better than those of the traditional method.

Way one

This assumes there is a smaller error using Eq. (5.33) to calculate the energy of the atom. Eq. (5.33) can be boiled down to a potential energy function, the error can be boiled down to a perturbation term, and then we can calculate.

Way two

The potential energy functions are divided into three categories: the first category is the potential energy of pure electrons; the second category is the interaction potential energy between electrons known by the method in this chapter; and the third category is a perturbation term. Take the Oxygen atom as an example.

$$E(\mathrm{O})^{(0)}=[2E_{\text{n-e}}(1\mathrm{s}^1)+2E_{\text{n-e}}(2\mathrm{s}^1)+4E_{\text{n-e}}(2p^1)]+[E_{\text{e-e}}(1s^2)+E_{\text{e-e}}(2s^2)+2E_{\text{e-e}}(1s^2\text{-}2s^1)+5E_{\text{e-e}}(2p^{\uparrow\uparrow})+4E_{\text{e-e}}(1s^2\text{-}2p^1)+4\mathrm{E}_{\text{e-e}}(2s^2\text{-}2p^1)\ ]+E_{\text{e-e}}(2p\uparrow\downarrow) \quad (5.34)$$

The first part is expressed by using a few $-aZe^2/r$ (notice the difference in the main quantum number and the coefficient of the difference). The second part is expressed by using bZ^*e^2/r_{ab}. We do not need to make a concrete form. The third part of the potential energy function can be written in the form of $\lambda e^2/r$. This part is the sum of the relativistic effect, the volume effect and the penetration effect. Relative to the total energy, the $\lambda e^2/r$ is very small.

5.3. Discussion on the Significance of the Relationship between the Ionization Energy and the Interaction Energy of Elements

The research results presented in this chapter have three highlights: (a) some new rules about the ionization energy of elements have been found, the relationship between "the interaction energy of electron-electron, atomic energy" and the nuclear charge number have been summed up; (b) the experimental principle of measuring the interaction energy of electrons is established; and (c) the method of fitting quantum mechanics has been invented. These highlights have enlarged human knowledge.

The results of this chapter may not only increase human knowledge, but also have a wide range of applications. Accurately calculating the energy of a complex atom with a simple method is the dream of mankind. But, in the last hundred years, this dream has not been realized. In this chapter, we have achieved this dream. Eq. (5.33) and the regression equation for calculating the energy of the atom core can make the *ab initio* calculation in the quantum chemical method no longer required. The combination of the regression equation method (fitting method) and the perturbation method can make the subjective factors in the traditional perturbation method greatly reduced. Since we can calculate the interaction energy between electrons in the atom, we can calculate the average distance between electrons. The experimental principle and the method of measuring the interaction energy between electrons are also the principle and method of measuring the average distance between electrons.

We need to do further work as follows: measure out more accurate and more ionization energy values; fit out more regression equations of atom-like ions (of the 107 elements, at least 100 of the regression equations of the atom cores need to be fitted); list the complete regression equations of the atom core for researchers to use; after the outer electron ionization, study the influence of the inner electron rearrangement upon the measurement of atomic energy.

In addition, we'd better extend the theory and methods of these principles to the calculation of the molecules [3, 4, and 5]. We can measure the free electron pairing energy. Using the analysis for the ionization data, we can further study the electronic arrangement. We can use the same principle and method to find the interaction regularities between electrons in the *d* sub layer and *f* sub layer. We can establish the concept of "average distance between electrons".

The literature classification of this chapter: a cross discipline of quantum chemistry and quantum mechanics, belonging to the basic research in the application of quantum mechanics. In this regard, human beings have not had a major breakthrough in many years. This is also an important factor which gives rise to the interest of more scientists.

References

[1] John A. Dean (1999), *Lange's Handbook of Chemistry,* 564-566 (15th Edition). New York: McGraw-Hill, Inc.

[2] Huachang Li (2007), *Practical Handbook of chemistry*, 17-19. Beijing: Chemical Industry Press.

[3] Runsheng Tu (**2013**), Using an Extranuclear Electron as a Large-scale Elastic Ring, the Results Are Very Interesting. *South Asian Academic Research Journals*, 3(4), 12-24.

[4] Runsheng Tu (2014), Some Successful Applications for Local-Realism Quantum Mechanics: Nature of Covalent-bond Revealed and Quantitative Analysis of Mechanical Equilibrium for Several Molecules. *Journal of Modern Physics*, **5**, 309-318.

[5] Runsheng Tu (2015), *Local Realism Quantum Mechanics*, 1-224. Salt Lake City: American Academic Press.

[6] R. S. Tu (2014), Some Successful Applications for Local-Realism Quantum Mechanics: Nature of Covalent-bond Revealed and Quantitative Analysis of Mechanical Equilibrium for Several Molecules. *Journal of Modern Physics*, 5, 309-318. http://dx.doi.org/10.4236/jmp.2014.56041.

CHAPTER SIX

THE BASIC EXPERIMENT DESIGN OF LOCAL REALISM QUANTUM MECHANICS

First, this is the design of the verification experiment for QIMT. It is also the design of the verification experiment for Tu's view of the measurement of quantum mechanics.

The main predictions of QIMT: there is the measurement method that has no interference on the measured particles, the intrinsic state of microscopic particles can be observed without damage (the 3D regression curve of charged particle tracks in the cloud chamber and spark chamber is the accurate motion path of the particle); both state superposition and coupling are conditional, the free microscopic particle and partially bound microscopic particle do not overlap with their shadow, and the superposition of the homologous conjugated particles must meet the harsh conditions (state superposition is not unconditional and universal); the experimental results of quantum entanglement can be explained in this way—the quantum state is not changed with the measurement of the first particle, the states of the twinborn second particle are not newly formed, but the original state has always been like this; the uncertainty principle sometimes exists as a logical contradiction and is not universally applicable; and the electron diffraction experiment can be explained by directional quantization. Designs in this section are in order to test these predictions to constitute a new measurement view of quantum mechanics and QIMT. In Reference [1], the energy and size of more than 10 atoms and small molecules have been successfully calculated by using the quantum mechanical model of localized realism. It is another proof of the point of view in this book.

Such verification experiments must be in line with these two conditions: first, they must contain the independent process only if there is information inverse transmission (that is, they must contain the process of measurement of target particles without interference, or the interference strength is less than the ability of target particles to resist interference); and second, the existence or disappearance of the superposition of quantum states is easily observed.

In 1974, Professor Pier Giorgio Merli used electrons to do Yang's Interference experiment by double-slit (one of the "Which-way" experiments). In that experiment, it is only the common way that there is serious interference used by monitoring electrons.[2][3][4] It is necessary to replace all other monitoring methods (in particular, the monitoring methods are consistent with the conditions of quantum inverse measurement) to re-test. If the results of experiments are the same under a variety of monitoring methods, we can be sure that human consciousness can affect the behavior of electrons. Otherwise, the conclusion is too hasty. In the experiments described below, the monitoring method was changed to a cloud chamber, a spark chamber, and electrodes.

Except for particles emitted by radioactive material, artificial high-speed particles are all subjected to an accelerated process by the instrument. This acceleration process is a generalized measurement process (the process in which the measured particles are affected by the instrument). However, the particles coming out of the end of the accelerator still have the diffraction behavior of embodying quantum properties. This indicates that the measurement (or local measurement) does not necessarily lead to the collapse of the wave packet, and can meet the conditions of quantum inverse measurement. Previous experiments do not allow for further validation of this conclusion. Therefore, we designed a series of experiments in order to expediently verify the concept of quantum inverse measurement.

Local Realism Quantum mechanics denies the existence of quantum decoherence process and its reverse process, and predicts that particles exiting the accelerator can still diffract. Local realism quantum mechanics has denied the collapse of the wave packet. It is predicted that two slits will be dug on the screen of the first electron diffraction, so that the magnified secondary diffraction will occur and the most obvious secondary diffraction phenomenon can be observed. The closed electron diffraction experiment of double slit will also be completed successfully. Except these few experiments, I also designed the following experiments.

6.1. The Electron Diffraction Experiment in a Cloud Chamber or a Spark Chamber

The thickness of the cloud track is about 10^{-3}mm in a chamber. The distance between the two slits in the diffraction experiment by double slit is about 0.2 mm. We do the electron diffraction experiment in the chamber and should be able to observe which slit an incident electron passes through. If we have observed which slit an incident electron passes through, and the diffraction pattern can be observed at the same time, it is equivalent to having caught Schrödinger's cat under the quantum entanglement which does not occur. If we do electron diffraction experiments in the spark chamber (or cloud chamber), or embedded in a cloud chamber between the screen and the slit in the device of an electron diffraction experiment, we are able to find out whether Schrödinger's cat can be caught in the quantum coherent state. By doing electron diffraction experiments in an applied electric field, observing the displacement and deformation of the diffraction pattern under the condition of the change of the electric field intensity, we can judge whether the diffraction is caused by the electron wave directly or by directional quantization.

If the diffraction is indeed caused by the accompanying light, that the diffraction was measured could not show that the particle was in a quantum coherent state. Both the superposition principle and the concept of wave-particle duality lack an experimental basis. The principle of superposition and the concept of wave-particle duality not always being established (not universally applicable) are the requirement and prediction of QIMT. If the electronic double-slit diffraction experiment is done in a cloud chamber or a spark chamber, the result must be one of those in **Table 6.1**. If the experiment is combined with an electron diffraction experiment in an applied electric field, its verification capability is stronger.

Table 6.1. Situation analysis of the electron diffraction experiment in the cloud chamber or spark chamber

<table>
<tr><th>Case</th><th>Possible observed phenomena</th><th>Problem showed by phenomenon</th><th>Verification condition for QIMT</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Not only able to observe the movement track of an electron, and observed diffraction phenomenon (and the interference fringes), at the same time, able to observe which slit an incident electron passes through (an electron can't pass through two slits at the same time).</td><td>The measurement action does not lead to the coupling between the measured electron and the instrument, and does not destroy the original motion state of the measured electron. The influence (interference) of the instrument on the measured electron can be ignored (the ability to resist the interference of quantum superposition states is not zero). In short, such measurements did not lead to the collapse of the wave packet and quantum decoherence. Electrons are always localized and in reality, and there is no need to collapse.</td><td>No interference measurement can be realized. Namely, there is the observation of non-distortion (there is quantum inverse measurement). The process and results where the instrument affects the particle are asymmetrical with that of the particle's influence over the instrument.</td></tr>
<tr><td colspan="2">The observation result that an electron can't pass through two slits at the same time shows that the diffraction to have interference fringes is likely to be caused by the Direction Quantization. Both the superposition principle and wave-particle duality are not universally applicable for matter particles.</td></tr>
<tr><td>2</td><td>The movement track of the electron can be observed, but any diffraction phenomenon cannot be observed.</td><td>Using a cloud chamber to measure a moving electron, destroyed the original state of motion of the electron, and led to the collapse of the wave packet and quantum decoherence.</td><td>The effect of the cloud chamber on the measured electron is not zero. The measurement by using the cloud chamber cannot be used to validate QIMT.</td></tr>
</table>

3	The diffraction phenomenon can be observed, but any movement track of the electron cannot be observed.	This does not accord with the function of the chamber. If this is the case, then the electrons are really turned into the things of a superposition state of non-wave and non-particle.	The experiment using the cloud chamber to capture charged particles is not in line with the quantum inverse measurement conditions.

Note: let the electrons pass one by one through the double slit for the observation of the occurrence of the phenomenon.

Through the analysis of the verification experiment of the quantum inverse measurement, we get another important conclusion of QIMT: it can achieve continuous inverse measurement, it does not change the quantum state of the measured particles before and after the measurement, and the obtained state is the state that the measured particle is not distorted.

Electron diffraction experiments in other media are designed as follows. You can also let the electron first penetrate a very thin (40 nm) section of silicon wafer or a layer of air, and then pass through a slit, and do the electron diffraction experiments. If diffraction can still occur, it means that the measuring instrument does not necessarily destroy the quantum state.

Local realism Quantum mechanics predicts that by placing a cloud chamber between the slit and the screen, one can see the traces of the clouds and see the diffraction phenomenon.

6.2. A Longitudinal Electrode or Magnet Is Mounted at the Exit Side of the Slit

Even if the micro particles can understand people's consciousness, they will not have the corresponding change before the human consciousness acting on it. In particular, current measurements do not affect the particle's past behavior. Based on this concept, we consider observing after the particles pass through the double-slit. The method is, mounting vertical electrodes or a magnet at the exit-end

In 1897, in order to test the properties of cathode rays, Joseph John Thomson made a Crookes' cathode ray tube, and installed a pair of metal electrodes *D* and *E* in the middle of it. The author used this method, but installed an easily mobile magnet or a pair of electrodes in the exit-end of the electronic diffraction apparatus. The magnetic field and electric field can offset the cathode ray and lead to it not deflecting light. A comparison of the diffraction pattern of two cases, one with an added vertical electromagnetic field and one without it, can lead to the judgment that the diffraction is caused directly by the electron itself as particles or by the de Broglie wave.

In 1974, the Italian physicists Pier Giorgio Merli, Gian Franco Missiroli, and Giulio Pozzi repeated the experiment using single electrons and a biprism (instead of slits), showing that each electron interferes with itself as predicted by quantum theory.[2] In 2002, the single-electron version of the experiment was voted "the most beautiful experiment" by readers of *Physics World*. The reason may be that monitoring measurement destroys the direction quantization.

The experiment designed by me here is to use the principle that "the current interference does not affect the past experience of the particles" and to observe the situation when the electrons pass through the slits. Compared with the previous experiments of electrons crossing double slits, the situation is exactly the same when the electron beam is incident on the double slits. Just after the electron beam passes through the slit is not the same. It speculates that electrons are incidental and pass through whichever slit by means of measuring electrons through whichever slit.

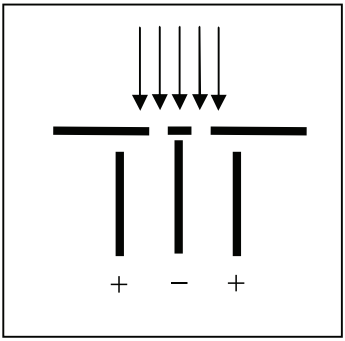


Figure 6.1. A double slit electron diffraction device with an electrode separator. The electrode is only a piece of plate, and the anode is the two plates together with a wire.

This experiment is an extension of closed-circuit electron diffraction experiments. This experiment and the electron diffraction experiment in the spark chamber can confirm each other.

With certain practices, such as that shown in Figure 6.1, the inserted metal foil is too narrow to act as the cathode of an electrode, and the two sides of the metal foil act as the mounted anode. The distance between the two slits is generally 0.2 mm. The middle electrode can be used with a thickness of no more than 0.2 mm of a sheet. Let the electrons pass through the double slit virtually one by one. Subsequently, if the electrons pass through the left slit, they will deflect to the left; alternatively if the electrons pass through the right slit, they will deflect to the right. As long as the electrode is short enough, the diffraction is caused by the accompanying light, and residual diffraction should also be observed. If the diffraction is a direct result of the electron itself, the diffraction pattern cannot be observed (or the diffraction fringe of serious distortion can be observed). To distinguish which side an electron specifically passes through can also deny the phenomenon of electronic volatility, thereby denying that diffraction can be caused by the fluctuation of an electron. This experiment can prove whether an electron changes its direction and becomes a point particle at the moment it arrives at the screen. Don't think these experiments are simple. In fact, they can be used to verify QIMT and test the view of the measurement and interpretation system of existing quantum mechanics.

The authors do not have the ability to do the experiments of my own design. The acute sub reader can immediately test (for example, take a shoe-shaped magnet to act on an existing electron diffraction instrument, and see if it can cause the deformation of the diffraction fringe). The readers who can apply for funds can carefully do the experiments designed by this work. No matter what the experiment results, they are of great significance: if the experimental results deny QIMT, they will provide more and more evidence for the principle of superposition, the uncertainty principle and the concept of wave-particle duality and are conducive to the elimination of doubt for the existing quantum mechanics, to reduce unnecessary controversy; however, if the experimental results confirm QIMT, they would subvert the measurement and interpretation system of existing quantum mechanics.

6.3. Covering the Screen with a Piece of Glass, which a Photon can Penetrate but an Electron Cannot, in Front of the Screen

Insert the glass to conduct the experiment: if the diffraction pattern appears only on the glass, but does not appear on the screen behind, this result indicates that the diffraction is directly caused by the electrons as particles; alternatively if the diffraction pattern appears only on the screen behind, this shows the diffraction is caused by the accompanying light or de Broglie wave.

6.4. Covering the Screen with a Piece of Metal Foil, which an Electron can Penetrate but a Photon cannot, in front of the Screen

Insert the metal foil to conduct the experiment: if the diffraction pattern appears only on the metal foil, but does not appear on the screen behind, this shows that the diffraction is caused by accompanying light; alternatively if the diffraction pattern appears only on the screen behind, this result shows that the diffraction is directly caused by the undulatory property of an electron.

6.5. Discuss and Predict

If the experimental results are in line with the expectation that electrons do not cross two different slits at the same time, then the view that the electron is unrealistic is not correct. Experiments to verify the model of the light knot electronic structure can also be found. High-energy photons can decay into electronic pairs; the annihilation between positive and negative electron pairs can completely become photons. The two experiments are the proof. Experiments that measure the polarity and induced charge of a circularly polarized light quantum can validate this electronic model because the light-knot electronic structure model predicts that the simplest circularly polarized photon (or its sensing effect) has a polarity.

References

[1] R. S. Tu (2014), Some Successful Applications for Local-Realism Quantum Mechanics: Nature of Covalent-bond Revealed and Quantitative Analysis of Mechanical Equilibrium for Several Molecules. *Journal of Modern Physics*, 5, 309-318. http://dx.doi.org/10.4236/jmp.2014.56041.

[2] P. G. Meili, G. F. Missiroli, and G. Pozzi (1976), On the statistical aspect of electron interference phenomena. *American Journal of Physics*, 44, 306-307.

[3] Rodolfo Rosa (2012), The Merli-Missiroli-Pozzi two-slit electron-interference experiment. *Phys. Perspect*., 14, 178-105.

[4] S. Kocsis, B. Braverman, S. Ravets, M. J. Stevens, R. P. Mirin, L. K. Shalm, and A. M. Steinberg (2011), Observing the Average Trajectories of Single Photons in a Two-Slit Interferometer, *Science*, 332, 1170-1173.

[5] B. Hensen, H. Bernien, A. E. Dréau, A. Reiserer, N. Kalb, M. S. Blok, J. Ruitenberg, R. F. L. Vermeulen, R. N. Schouten, C. Abellán, W. Amaya, V. Pruneri, M. W. Mitchell, M. Markham, D. J. Twitchen, D. Elkouss, S. Wehner, T. H. Taminiau, R. Hanson (2015), Loophole-free Bell inequality violation using electron spins separated by 1.3 kilometres. *Nature* **526***,* 682-686.

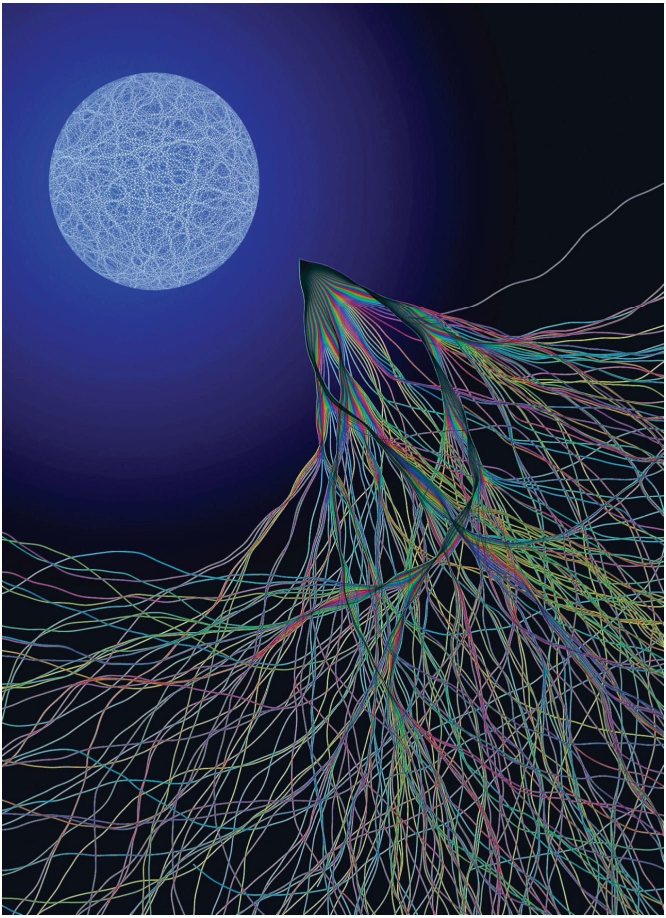
Appendix A

The Trouble with Quantum Mechanics

Steven Weinberg
JANUARY 19, 2017 ISSUE
http://www.nybooks.com/articles/2017/01/19/trouble-with-quantum-mechanics/

The physicist Eric J. Heller's Transport XIII (2003) was inspired by electron flow experiments conducted at Harvard. According to Heller, the image "shows two kinds of chaos: a random quantum wave on the surface of a sphere, and chaotic classical electron paths in a semiconductor launched over a range of angles from a particular point. Even though one is quantum mechanical and the other classical, they are related: the chaotic classical paths cause random quantum waves to appear when the classical system is solved quantum mechanically."

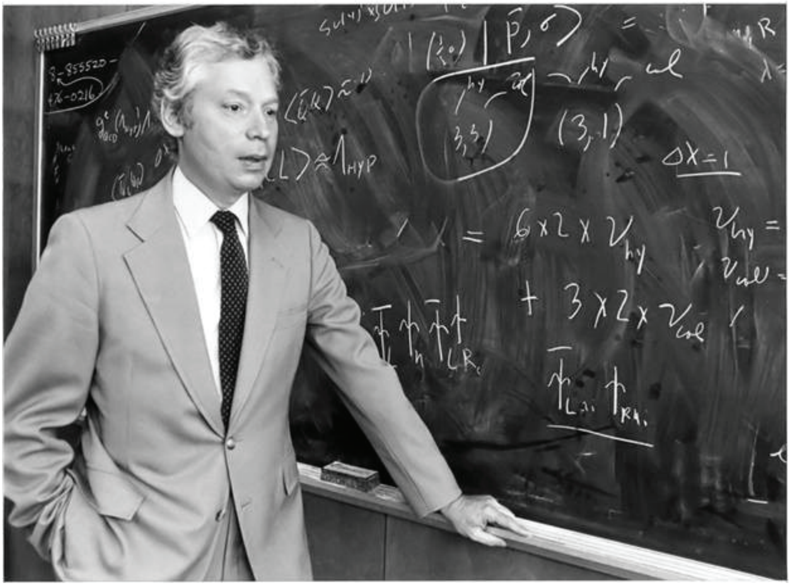
The development of quantum mechanics in the first decades of the twentieth century came as a shock to many physicists. Today, despite the great successes of quantum mechanics, arguments continue about its meaning, and its future.



Eric J. Heller

1.

The first shock came as a challenge to the clear categories to which physicists by 1900 had become accustomed. There were particles—atoms, and then electrons and atomic nuclei—and there were fields—conditions of space that pervade regions in which electric, magnetic, and gravitational forces are exerted. Light waves were clearly recognized as self-sustaining oscillations of electric and magnetic fields. But in order to understand the light emitted by heated bodies, Albert Einstein in 1905 found it necessary to describe light waves as streams of massless particles, later called photons.



Then in the 1920s, according to theories of Louis de Broglie and Erwin Schrödinger, it appeared that electrons, which had always been recognized as particles, under some circumstances behaved as waves. In order to account for the energies of the stable states of atoms, physicists had to give up the notion that electrons in atoms are little Newtonian planets in orbit around the atomic nucleus. Electrons in atoms are better described as waves, fitting around the nucleus like sound waves fitting into an organ pipe.[1] The world's categories had become all muddled.

Worse yet, the electron waves are not waves of electronic matter, in the way that ocean waves are waves of water. Rather, as Max Born came to realize, the electron waves are waves of probability. That is, when a free electron collides with an atom, we cannot in principle say in what direction it will bounce off. The electron wave, after encountering the atom, spreads out in all directions, like an ocean wave after striking a reef. As Born recognized, this does not mean that the electron itself spreads out. Instead, the undivided electron goes in some one direction, but not a precisely predictable direction. It is more likely to go in a direction where the wave is more intense, but any direction is possible.

Probability was not unfamiliar to the physicists of the 1920s, but it had generally been thought to reflect an imperfect knowledge of whatever was under study, not an indeterminism in the underlying physical laws. Newton's theories of motion and gravitation had set the standard of deterministic laws. When we have reasonably precise knowledge of the location and velocity of each body in the solar system at a given moment, Newton's laws tell us with good accuracy where they will all be for a long time in the future. Probability enters Newtonian physics only when our knowledge is imperfect, as for example when we do not have precise knowledge of how a pair of dice is thrown. But with the new quantum mechanics, the moment-to-moment determinism of the laws of physics themselves seemed to be lost.

All very strange. In a 1926 letter to Born, Einstein complained: Quantum mechanics is very impressive. But an inner voice tells me that it is not yet the real thing. The theory produces a good deal but hardly brings us closer to the secret of the Old One. I am at all events convinced that he does not play dice.[2]

As late as 1964, in his Messenger lectures at Cornell, Richard Feynman lamented, "I think I can safely say that no one understands quantum mechanics."[3] With quantum mechanics, the break with the past was so sharp that all earlier physical theories became known as "classical."

The weirdness of quantum mechanics did not matter for most purposes. Physicists learned how to use it to do increasingly precise calculations of the energy levels of atoms, and of the probabilities that particles will scatter in one direction or another when they collide. Lawrence Krauss has labeled the quantum mechanical calculation of one effect in the spectrum of hydrogen "the best, most accurate prediction in all of science."[4] Beyond atomic physics, early applications of quantum mechanics listed by the physicist Gino Segrè included the binding of atoms in molecules, the radioactive decay of atomic nuclei, electrical conduction, magnetism, and electromagnetic radiation.[5] Later applications spanned theories of semiconductivity and superconductivity, white dwarf stars and neutron stars, nuclear forces, and elementary particles. Even the most adventurous modern speculations, such as string theory, are based on the principles of quantum mechanics.

Many physicists came to think that the reaction of Einstein and Feynman and others to the unfamiliar aspects of quantum mechanics had been overblown. This used to be my view. After all, Newton's theories too had been unpalatable to many of his contemporaries. Newton had introduced what his critics saw as an occult force, gravity, which was unrelated to any sort of tangible pushing and pulling, and which could not be explained on the basis of philosophy or pure mathematics. Also, his theories had renounced a chief aim of Ptolemy and Kelvin, to calculate the sizes of planetary orbits from first principles. But in the end the opposition to Newtonianism faded away. Newton and his followers succeeded in accounting not only for the motions of planets and falling apples, but also for the movements of comets and moons and the shape of the earth and the change in direction of its axis of rotation. By the end of the eighteenth century this success had established Newton's theories of motion and gravitation as correct, or at least as a marvelously accurate approximation. Evidently it is a mistake to demand too strictly that new physical theories should fit some preconceived philosophical standard.

In quantum mechanics the state of a system is not described by giving the position and velocity of every particle and the values and rates of change of various fields, as in classical physics. Instead, the state of any system at any moment is described by a wave function, essentially a list of numbers, one number for every possible configuration of the system. [6] If the system is a single particle, then there is a number for every possible position in space that the particle may occupy. This is something like the description of a sound wave in classical physics, except that for a sound wave a number for each position in space gives the pressure of the air at that point, while for a particle in quantum mechanics the wave function's number for a given position reflects the probability that the particle is at that position. What is so terrible about that? Certainly, it was a tragic mistake for Einstein and Schrödinger to step away from using quantum mechanics, isolating themselves in their later lives from the exciting progress made by others.

2.

Even so, I'm not as sure as I once was about the future of quantum mechanics. It is a bad sign that those physicists today who are most comfortable with quantum mechanics do not agree with one another about what it all means. The dispute arises chiefly regarding the nature of measurement in quantum mechanics. This issue can be illustrated by considering a simple example, measurement of the spin of an electron. (A particle's spin in any direction is a measure of the amount of rotation of matter around a line pointing in that direction.)

All theories agree, and experiment confirms, that when one measures the amount of spin of an electron in any arbitrarily chosen direction there are only two possible results. One possible result will be equal to a positive number, a universal constant of nature. (This is the constant that Max Planck originally introduced in his 1900 theory of heat radiation, denoted h, divided by $h/4\pi$.) The other possible result is its opposite, the negative of the first. These positive or negative values of the spin correspond to an electron that is spinning either clockwise or counter-clockwise in the chosen direction.

But it is only when a measurement is made that these are the sole two possibilities. An electron spin that has not been measured is like a musical chord, formed from a superposition of two notes that correspond to positive or negative spins, each note with its own amplitude. Just as a chord creates a sound distinct from each of its constituent notes, the state of an electron spin that has not yet been measured is a superposition of the two possible states of definite spin, the superposition differing qualitatively from either state. In this musical analogy, the act of measuring the spin somehow shifts all the intensity of the chord to one of the notes, which we then hear on its own.

This can be put in terms of the wave function. If we disregard everything about an electron but its spin, there is not much that is wavelike about its wave function. It is just a pair of numbers, one number for each sign of the spin in some chosen direction, analogous to the amplitudes of each of the two notes in a chord.[7] The wave function of an electron whose spin has not been measured generally has nonzero values for spins of both signs.

There is a rule of quantum mechanics, known as the Born rule, that tells us how to use the wave function to calculate the probabilities of getting various possible results in experiments. For example, the Born rule tells us that the probabilities of finding either a positive or a negative result when the spin in some chosen direction is measured are proportional to the squares of the numbers in the wave function for those two states of the spin.[8]

The introduction of probability into the principles of physics was disturbing to past physicists, but the trouble with quantum mechanics is not that it involves probabilities. We can live with that. The trouble is that in quantum mechanics the way that wave functions change with time is governed by an equation, the Schrödinger equation, which does not involve probabilities. It is just as deterministic as Newton's equations of motion and gravitation. That is, given the wave function at any moment, the Schrödinger equation will tell you precisely what the wave function will be at any future time. There is not even the possibility of chaos, the extreme sensitivity to initial conditions that is possible in Newtonian mechanics. So if we regard the whole process of measurement as being governed by the equations of quantum mechanics, and these equations are perfectly deterministic, how do probabilities get into quantum mechanics?

One common answer is that, in a measurement, the spin (or whatever else is measured) is put in an interaction with a macroscopic environment that jitters in an unpredictable way. For example, the environment might be the shower of photons in a beam of light that is used to observe the system, as unpredictable in practice as a shower of raindrops. Such an environment causes the superposition of different states in the wave function to break down, leading to an unpredictable result of the measurement. (This is called decoherence.) It is as if a noisy background somehow unpredictably left only one of the notes of a chord audible. But this begs the question. If the deterministic Schrödinger equation governs the changes through time not only of the spin but also of the measuring apparatus and the physicist using it, then the results of measurement should not in principle be unpredictable. So we still have to ask, how do probabilities get into quantum mechanics?

One response to this puzzle was given in the 1920s by Niels Bohr, in what came to be called the Copenhagen interpretation of quantum mechanics. According to Bohr, in a measurement the state of a system such as a spin collapses to one result or another in a way that cannot itself be described by quantum mechanics, and is truly unpredictable. This answer is now widely felt to be unacceptable. There seems no way to locate the boundary between the realms in which, according to Bohr, quantum mechanics does or does not apply. As it happens, I was a graduate student at Bohr's institute in Copenhagen, but he was very great and I was very young, and I never had a chance to ask him about this.

Today there are two widely followed approaches to quantum mechanics, the "realist" and "instrumentalist" approaches, which view the origin of probability in measurement in two very different ways.[9] For reasons I will explain, neither approach seems to me quite satisfactory.[10]

3.

The instrumentalist approach is a descendant of the Copenhagen interpretation, but instead of imagining a boundary beyond which reality is not described by quantum mechanics, it rejects quantum mechanics altogether as a description of reality. There is still a wave function, but it is not real like a particle or a field. Instead it is merely an instrument that provides predictions of the probabilities of various outcomes when measurements are made.

It seems to me that the trouble with this approach is not only that it gives up on an ancient aim of science: to say what is really going on out there. It is a surrender of a particularly unfortunate kind. In the instrumentalist approach, we have to assume, as fundamental laws of nature, the rules (such as the Born rule I mentioned earlier) for using the wave function to calculate the probabilities of various results when humans make measurements. Thus humans are brought into the laws of nature at the most fundamental level. According to Eugene Wigner, a pioneer of quantum mechanics, "it was not possible to formulate the laws of quantum mechanics in a fully consistent way without reference to the consciousness."[11]

Thus the instrumentalist approach turns its back on a vision that became possible after Darwin, of a world governed by impersonal physical laws that control human behavior along with everything else. It is not that we object to thinking about humans. Rather, we want to understand the relation of humans to nature, not just assuming the character of this relation by incorporating it in what we suppose are nature's fundamental laws, but rather by deduction from laws that make no explicit reference to humans. We may in the end have to give up this goal, but I think not yet.

Some physicists who adopt an instrumentalist approach argue that the probabilities we infer from the wave function are objective probabilities, independent of whether humans are making a measurement. I don't find this tenable. In quantum mechanics these probabilities do not exist until people choose what to measure, such as the spin in one or another direction. Unlike the case of classical physics, a choice must be made, because in quantum mechanics not everything can be simultaneously measured. As Werner Heisenberg realized, a particle cannot have, at the same time, both a definite position and a definite velocity. The measuring of one precludes the measuring of the other. Likewise, if we know the wave function that describes the spin of an electron we can calculate the probability that the electron would have a positive spin in the north direction if that were measured, or the probability that the electron would have a positive spin in the east direction if that were measured, but we cannot ask about the probability of the spins being found positive in both directions because there is no state in which an electron has a definite spin in two different directions.

4.

These problems are partly avoided in the realist—as opposed to the instrumentalist—approach to quantum mechanics. Here one takes the wave function and its deterministic evolution seriously as a description of reality. But this raises other problems.

Erwin Schrödinger; drawing by David Levine

The realist approach has a very strange implication, first worked out in the 1957 Princeton Ph.D. thesis of the late Hugh Everett. When a physicist measures the spin of an electron, say in the north direction, the wave function of the electron and the measuring apparatus and the physicist are supposed, in the realist approach, to evolve deterministically, as dictated by the Schrödinger equation; but in consequence of their interaction during the measurement, the wave function becomes a superposition of two terms, in one of which the electron spin is positive and everyone in the world who looks into it thinks it is positive, and in the other the spin is negative and everyone thinks it is negative. Since in each term of the wave function everyone shares a belief that the spin has one definite sign, the existence of the superposition is undetectable. In effect the history of the world has split into two streams, uncorrelated with each other.

This is strange enough, but the fission of history would not only occur when someone measures a spin. In the realist approach the history of the world is endlessly splitting; it does so every time a macroscopic body becomes tied in with a choice of quantum states. This inconceivably huge variety of histories has provided material for science fiction,[12] and it offers a rationale for a multiverse, in which the particular cosmic history in which we find ourselves is constrained by the requirement that it must be one of the histories in which conditions are sufficiently benign to allow conscious beings to exist. But the vista of all these parallel histories is deeply unsettling, and like many other physicists I would prefer a single history.

There is another thing that is unsatisfactory about the realist approach, beyond our parochial preferences. In this approach the wave function of the multiverse evolves deterministically. We can still talk of probabilities as the fractions of the time that various possible results are found when measurements are performed many times in any one history; but the rules that govern what probabilities are observed would have to follow from the deterministic evolution of the whole multiverse. If this were not the case, to predict probabilities we would need to make some additional assumption about what happens when humans make measurements, and we would be back with the shortcomings of the instrumentalist approach. Several attempts following the realist approach have come close to deducing rules like the Born rule that we know work well experimentally, but I think without final success.

The realist approach to quantum mechanics had already run into a different sort of trouble long before Everett wrote about multiple histories. It was emphasized in a 1935 paper by Einstein with his coworkers Boris Podolsky and Nathan Rosen, and arises in connection with the phenomenon of "entanglement."[13]

We naturally tend to think that reality can be described locally. I can say what is happening in my laboratory, and you can say what is happening in yours, but we don't have to talk about both at the same time. But in quantum mechanics it is possible for a system to be in an entangled state that involves correlations between parts of the system that are arbitrarily far apart, like the two ends of a very long rigid stick.

For instance, suppose we have a pair of electrons whose total spin in any direction is zero. In such a state, the wave function (ignoring everything but spin) is a sum of two terms: in one term, electron A has positive spin and electron B has negative spin in, say, the north direction, while in the other term in the wave function the positive and negative signs are reversed. The electron spins are said to be entangled. If nothing is done to interfere with these spins, this entangled state will persist even if the electrons fly apart to a great distance. However far apart they are, we can only talk about the wave function of the two electrons, not of each separately. Entanglement contributed to Einstein's distrust of quantum mechanics as much or more than the appearance of probabilities.

Strange as it is, the entanglement entailed by quantum mechanics is actually observed experimentally. But how can something so non-local represent reality?

5.

What then must be done about the shortcomings of quantum mechanics? One reasonable response is contained in the legendary advice to inquiring students: "Shut up and calculate!" There is no argument about how to use quantum mechanics, only how to describe what it means, so perhaps the problem is merely one of words.

On the other hand, the problems of understanding measurement in the present form of quantum mechanics may be warning us that the theory needs modification. Quantum mechanics works so well for atoms that any new theory would have to be nearly indistinguishable from quantum mechanics when applied to such small things. But a new theory might be designed so that the superpositions of states of large things like physicists and their apparatus even in isolation suffer an actual rapid spontaneous collapse, in which probabilities evolve to give the results expected in quantum mechanics. The many histories of Everett would naturally collapse to a single history. The goal in inventing a new theory is to make this happen not by giving measurement any special status in the laws of physics, but as part of what in the post-quantum theory would be the ordinary processes of physics.

One difficulty in developing such a new theory is that we get no direction from experiment—all data so far agree with ordinary quantum mechanics. We do get some help, however, from some general principles, which turn out to provide surprisingly strict constraints on any new theory.

Obviously, probabilities must all be positive numbers, and add up to 100 percent. There is another requirement, satisfied in ordinary quantum mechanics, that in entangled states the evolution of probabilities during measurements cannot be used to send instantaneous signals, which would violate the theory of relativity. Special relativity requires that no signal can travel faster than the speed of light. When these requirements are put together, it turns out that the most general evolution of probabilities satisfies an equation of a class known as Lindblad equations.[14] The class of Lindblad equations contains the Schrödinger equation of ordinary quantum mechanics as a special case, but in general these equations involve a variety of new quantities that represent a departure from quantum mechanics. These are quantities whose details of course we now don't know. Though it has been scarcely noticed outside the theoretical community, there already is a line of interesting papers, going back to an influential 1986 article by Gian Carlo Ghirardi, Alberto Rimini, and Tullio Weber at Trieste, that use the Lindblad equations to generalize quantum mechanics in various ways.

Lately I have been thinking about a possible experimental search for signs of departure from ordinary quantum mechanics in atomic clocks. At the heart of any atomic clock is a device invented by the late Norman Ramsey for tuning the frequency of microwave or visible radiation to the known natural frequency at which the wave function of an atom oscillates when it is in a superposition of two states of different energy. This natural frequency equals the difference in the energies of the two atomic states used in the clock, divided by Planck's constant. It is the same under all external conditions, and therefore serves as a fixed reference for frequency, in the way that a platinum-iridium cylinder at Sèvres serves as a fixed reference for mass.

Tuning the frequency of an electromagnetic wave to this reference frequency works a little like tuning the frequency of a metronome to match another metronome. If you start the two metronomes together and the beats still match after a thousand beats, you know that their frequencies are equal at least to about one part in a thousand. Quantum mechanical calculations show that in some atomic clocks the tuning should be precise to one part in a hundred million billion (10^{-17}), and this precision is indeed realized. But if the corrections to quantum mechanics represented by the new terms in the Lindblad equations (expressed as energies) were as large as one part in a hundred million billion of the energy difference of the atomic states used in the clock, this precision would have been quite lost. The new terms must therefore be even smaller than this.

How significant is this limit? Unfortunately, these ideas about modifications of quantum mechanics are not only speculative but also vague, and we have no idea how big we should expect the corrections to quantum mechanics to be. Regarding not only this issue, but more generally the future of quantum mechanics, I have to echo Viola in Twelfth

Night: "O time, thou must untangle this, not I."

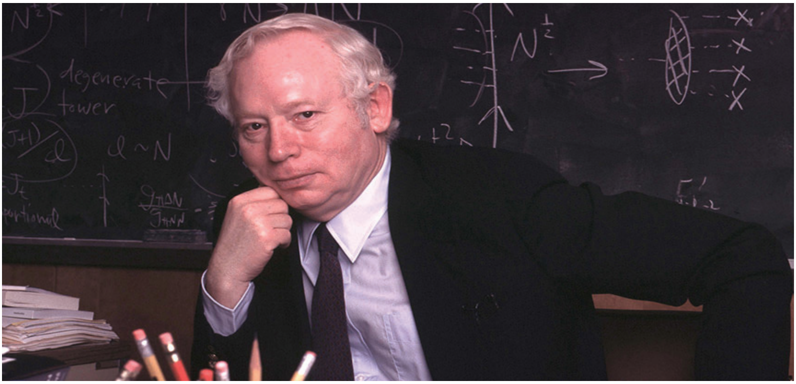
Notes and References

1. Conditions on sound waves at the closed or open ends of an organ pipe require that either an odd number of quarter wave lengths or an even or an odd number of half wave lengths must just fit into the pipe, which limits the possible notes that can be produced by the pipe. In an atom the wave function must satisfy conditions of continuity and finiteness close to and far from the nucleus, which similarly limit the possible energies of atomic states. ↩
2. Quoted by Abraham Pais in "Subtle Is the Lord": The Science and the Life of Albert Einstein (Oxford University Press, 1982), p. 443.
3. Richard Feynman, The Character of Physical Law (MIT Press, 1967), p. 129.
4. Lawrence M. Krauss, A Universe from Nothing (Free Press, 2012), p. 138.
5. Gino Segrè, Ordinary Geniuses (Viking, 2011).
6. These are complex numbers, that is, quantities of the general form a+ib, where a and b are ordinary real numbers and i is the square root of minus one.
7. Simple as it is, such a wave function incorporates much more information than just a choice between positive and negative spin. It is this extra information that makes quantum computers, which store information in this sort of wave function, so much more powerful than ordinary digital computers.
8. To be precise, these "squares" are squares of the absolute values of the complex numbers in the wave function. For a complex number of the form a+ib, the square of the absolute value is the square of a plus the square of b.
9. The opposition between these two approaches is nicely described by Sean Carroll in The Big Picture (Dutton, 2016).
10. I go into this in mathematical detail in Section 3.7 of Lectures on Quantum Mechanics, second edition (Cambridge University Press, 2015).
11. Quoted by Marcelo Gleiser, The Island of Knowledge (Basic Books, 2014), p. 222.
12. For instance, Northern Lights by Philip Pullman (Scholastic, 1995), and the early "Mirror, Mirror" episode of Star Trek.
13. Entanglement was recently discussed by Jim Holt in these pages, November 10, 2016.
14. This equation is named for Göran Lindblad, but it was also independently discovered by Vittorio Gorini, Andrzej Kossakowski, and George Sudarshan.
15. The Trouble with Quantum Mechanics, Steven Weinberg, The New York Review of Books, January 19, 2017 Issue.
http://www.nybooks.com/articles/2017/01/19/trouble-with-quantum-mechanics/.

APPENDIX B

WHY QUANTUM MECHANICS MIGHT NEED AN OVERHAUL

By Tom Siegfried
3:37pm, November 4, 2016



Nobel laureate Steven Weinberg, a physicist at the University of Texas at Austin, was once happy with quantum mechanics. But now he thinks that some more general theory may be needed to resolve long-standing disputes about the meaning of quantum mechanical math.

Nobel laureate Steven Weinberg says current debates suggest the need for anew approach to comprehend reality

SAN ANTONIO—Quantum mechanics is science’s equivalent of political polarization.

Voters either take sides and argue with each other endlessly, or stay home and accept politics as it is. Physicists either just accept quantum mechanics and do their calculations, or take sides in the never-ending debate over what quantum mechanics is actually saying about reality.

Steven Weinberg used to be happy with quantum mechanics as it is and didn't worry about the debates. But as he has thought about it over the years, the 83-year-old *Nobel laureate* has reassessed.

"Now I'm not so sure," he declared on October 30 in San Antonio at a session for science writers organized by the *Council for the Advancement of Science Writing*. (Disclosure: I am a member of the CASW board.) "I'm not as happy about quantum mechanics as I used to be, and not as dismissive of its critics."

One reason Weinberg thinks there's a need for a new chapter in the quantum story is that those who think everything is fine with quantum mechanics take different sides in the debates about it.

"It's a bad sign in particular that those physicists who are happy about quantum mechanics, and see nothing wrong with it, don't agree with each other about what it means," Weinberg says.

Quantum mechanics stirred up consternation from its beginnings. More than a century ago, physicists such as Max Planck, Albert Einstein and Niels Bohr showed that standard 19th century physics was inadequate for explaining various features of heat, light and atoms. By the 1920s, other physicists, including Werner Heisenberg, Erwin Schrödinger, Paul Dirac and Max Born, developed those early realizations into the full-fledged quantum mechanical math that today lies at the foundation of physical understanding of just about everything. Quantum mechanics, Weinberg noted, is the "basis of our understanding of not only atoms, but also atomic nuclei, electrical conduction, magnetism, electromagnetic radiation, semiconductors, superconductors, white dwarf stars, neutron stars, nuclear forces and elementary particles."

But quantum theory's explanatory power has come at a substantial price: the need to accept counterintuitive weirdness about reality that many physicists, including such pioneers as Einstein and Schrödinger, refused to accept.

One such objectionable aspect was the quantum rejection of Newtonian determinism, the belief that all events are fully determined by preceding circumstances. You can calculate exactly where a baseball will land, for instance, if you know its velocity and direction when it gets hit by a bat. Quantum mechanics, to the contrary, imposes a probabilistic element into the description of natural processes. When an electron bounces off an atom, no one can predict exactly which direction the electron will go; quantum mechanics just permits you to calculate the odds that it will go in one direction or another. A mathematical formula called the wave function provides the instructions for calculating where an electron is likely to be—when you make a measurement of the electron, you are most likely to find it where its probability wave is most intense. Repeated measurements would find a range of results corresponding to the probabilities that the quantum math specifies.

Einstein objected, saying God does not play dice. He further objected to another weird aspect of quantum mechanics, involving its description of pairs of particles separated at birth. Two photons emerging from a single atom, for instance, could fly very far apart yet share a single quantum description; making a measurement on one can reveal something about the other, no matter how far away it is.

Attempts to explain these conundrums fall into two broad categories, Weinberg said: "instrumentalist" and "realist." Instrumentalists contend that the wave function is merely a tool for calculating the results of experiments—there's no way to know anything more about reality. Devotees of the realist approach contend that the wave function is a real thing out in the world, evolving over time, and at a fundamental level it is responsible for what's really happening.

Weinberg finds the instrumentalist view unattractive. It's "so ugly to imagine that we have no knowledge of anything out there—we can only say what happens when we make a measurement," he says. "The instrumentalist approach takes the attitude that we just don't know what's going on out there."

On the other hand, the realist view does say what's going on "out there," but at the cost of enormous complexity, in the form of a countless number of independent streams of reality. "What's going on out there is a wave function that is progressing with time in a perfectly deterministic but incredibly complicated way," Weinberg says. In this view, all possible outcomes of quantum processes (that is, everything) come to pass in one stream or another (even though nobody is aware of any of the other streams, or "histories").

Weinberg would prefer a reality with one history. But apart from that preference, the realist approach does not explain why measurement results observe the rules of quantum probabilities. If everything actually does happen in the various histories, there seems to be no reason why the quantum rules for probability would apply inside any one stream.

So Weinberg thinks there might be something beyond quantum mechanics, a deeper theory that introduces probabilities at a fundamental level, rather than requiring a human to make measurements to get the probabilities to show up. And there is a line of research attempting to generalize quantum mechanics along those lines. But so far a compelling theory that succeeds in generalizing quantum mechanics does not exist.

Perhaps a replacement for today's quantum theory will come together any time now. Or perhaps not. "Maybe it's just the way we express the theory is bad," Weinberg says, "and the theory itself is right." Or possibly a surprise is in store.

"There's always a third possibility," Weinberg said, "that's there's something else entirely, that we're going to have a revolution in science which is as much of a break with the past as quantum mechanics is a break from classical physics. That's a possibility. It may be that a paper from a graduate student tomorrow morning will lay it out. By definition I don't know what that would be."

In any case, Weinberg observed, there's a danger in evaluating any theory in terms of contemporary philosophical prejudices. Newtonian gravity, Weinberg noted, was itself regarded as unacceptable by many scientists of his era.

"Newton's theory … seemed unpalatable to his contemporaries," Weinberg said. Newtonian gravity was action at a distance, with no tangible pushing or pulling guiding the planets in their orbits. That "seemed like the introduction of an occult element into science, and was rejected for that reason by the followers of Descartes," Weinberg said. Furthermore, "the force of gravitation was something that couldn't be deduced from fundamental philosophical considerations and was rejected in part for that reason by the followers of Leibniz." And Newton also did away with the dreams of Kelvin and others to deduce the size of planetary orbits from fundamental principles.

Yet over time, Newton's theory compiled an impressive list of successes (much like quantum mechanics has).

"By the end of the 18th century, it was perfectly clear to everyone that Newton's theory was correct, or at least a spectacularly successful approximation," Weinberg said. "We can take the lesson that it's not really a good idea to hold new physical theories too strictly up to some preexisting philosophical standard. We have to go with it and see where it takes us—and see whether or not perhaps we have to change our philosophical standards."

https://www.sciencenews.org/blog/context/why-quantum-mechanics-might-need-overhaul

Appendix C

Pull the Quantum Mechanics Back to the Mortal World from the Ghostdom

Local realism quantum mechanics is the theory that states it is possible to be consistent with locality and realism at the same time, and like classical mechanics it allows statistics and determinism to work well together. This result is expected by the early founder of quantum mechanics.

Einstein and his successors believed that if there is a perfect theory in the world, then this theory should be determinism. However, existing quantum mechanics is considered to be not this kind of theory. Although the evolution of the wave function can be determined by the Schrödinger equation, the wave function itself is not a physical quantity. Using Born's explanation, the amplitude of the wave function represents the probability, but quantum mechanics can only predict the probability of this system in the future. However, Einstein and other writers were dissatisfied with this description. In their view, quantum mechanics can only make predictions regarding probability due to a lack of certain variables in the theory. Once these variables are included, quantum mechanics can be upgraded into a theory that conforms to determinism. However nobody knows what these variables are and thus they are called hidden variables.

De Broglie first proposed the hypothesis of the "guided wave". Bohm's hidden variable theory is an enhanced version of de Broglie's "guided waves", but he changed the so-called "guided waves" into the concept of quantum potential. In his description, an electron or photon is always a real particle, and regardless of whether it is observable or not, it has a definite position and momentum. However, an electron addition has certain properties such as normal electromagnetic potential, as well as the so-called "quantum potential". This is actually something similar to fluctuation, which develops according to the Schrödinger equation, and spreads around in the electron. However, the effect produced by quantum potential has nothing to do with its strength, and is only down to its shape, which means it can extend to the end of the universe without attenuation.

According to Bohm's theory, an electron must be imagined to be one kind of thing: it is essentially a classical particle. However there is a potential field that diverges from the electronic center, as the potential field permeates into the entire universe and is well aware of its surrounding environment all the time. It therefore provides timely guidance to the electron's change of behavior patterns that vary according to changes in the surrounding environment. In particular, if one tries to measure the specific position of an electron, there is firstly an interaction between the measuring instrument and the quantum potential of the electron. This effect means that the electron itself is undergoing subtle changes, and this type of change is predictable.

This "quantum potential" appears like a specter that has super powers. Local realism quantum mechanics theory does not emphatically seek this "ghost wave guide" and "quantum potential", and does not go deeply into the hidden variable theory. Therefore, the fact that it has been verified that the hidden variable theory is untenable does not mean that it has been verified that local realism quantum mechanics is untenable. If the hidden variable doesn't exist, then the fact that inequality (Bell's inequality), which is derived by assuming that the hidden variable exists, is untenable, only explains that the hidden variable does not exist. It does not show that quantum theory is untenable, as it does not demand the hidden variable. Therefore, denying the hidden variable theory does not mean denying local realism quantum mechanics. It is proved by the Aspect experiment that quantum entanglement does not need a hidden variable to be used as a causal link.

If an electron in the decoherent state revolves around the nucleus like a planet, then the product of the linear momentum and curvature radius of the electron is $pr=\hbar$ (The experimental results also confirmed that the orbital angular momentum of the electron in a hydrogen atom is $\hbar$. The explanation of Bohr hydrogen atom instability cannot deny that $rp=\hbar$ is one of the classic motion equations of an electron). It extremely resembles Heisenberg's uncertainty relation $\Delta p \cdot \Delta x \geq \hbar$ in form, and $\Delta p \cdot \Delta x \geq \hbar$ can be deduced from this. By multiplying the two sides of $pr=\hbar$ with $\sin\theta$, $p\sin\theta=\Delta p$ is obtained (note: for the particle to make a regular curve movement, $\Delta p=p\sin\theta$ is not the uncertainty value of the momentum, but is the component value of the momentum which has appeared, in the normal line direction, according to a certain rule. For uniform circular motion, it is the radial component of momentum). Thus, there is $r \cdot \Delta p=\hbar\sin\theta$, because $\sin\theta$ is always smaller than or equal to 1. In this way, the inequation $r \cdot \Delta p \geq \hbar$ is obtained. If the electron passes through the slit whose width is

Δx, the effective distance of the electron affected by the slit wall is less than Δx (*i.e.*, $r \leq \Delta x$). So, we have the relation of $\Delta x \Delta p \approx \hbar$. Thus, the so-called uncertainty relation was deduced from the classical cause-effect relation $pr=\hbar$ (For details, see: Runsheng Tu (2013), The Formula Whose Shape Is Similar to a Heisenberg Relation Possesses the Double Meanings of Determinism and Indeterminism. *Infinite Energy*, **107**, 44-46. http://www.docin.com/p-765650007.html). According to orbital motion equations we can derive the formula whose shape is similar to the uncertainty relation. The results show that the relationship of $\Delta p \cdot \Delta x \approx \hbar$ cannot deny the existence of the motion track of a microscopic particle. The behavior of a micro particle to conform to the relation of $\Delta p \cdot \Delta x \approx \hbar$ cannot decide that the micro particle state is descripted only by the wave function $\psi(x, t)$, and not by the classical state function $f(r, p)$. The above argument is at least: because $\Delta p = p\sin\theta$ is not always the momentum uncertainty value, $\Delta p \cdot \Delta x \approx \hbar$ as the uncertainty relation is not universal.

The above discussion shows that "Δp and Δx cannot equal zero simultaneously" is not equivalent to "Δp and Δx have definite value simultaneously". No matter in what way is deriving the relation of $\Delta p \cdot \Delta x \approx \hbar$ (or the one of $pr=\hbar$), "that Δp and Δx (or p and r) have definite value simultaneously" may be allowed. In other words, for the $\Delta p \cdot \Delta x \approx \hbar$, if Δx is a position uncertainty, Δp is the momentum uncertainty; if Δx is a determined orbital radius (or curvature radius), Δp is the accurate line momentum. So, $\Delta p \cdot \Delta x \approx \hbar$ itself has a double meaning, the relation of $\Delta p \cdot \Delta x \approx \hbar$ itself does not deny the orbital motion. If we want to use $\Delta p \cdot \Delta x \approx \hbar$ to deny orbital motion it must also be with the help of the assumptions that the microscopic particles have ghost stature or "the micro-particle in quantum state is always in the stochastic process, and that has spontaneous uncertainty". Is the uncertainty of the quantum spontaneous or caused by the random disturbance of the outside world? Can't we guess the answer only using the experimental method?

Without the uncertainty relation and the probability interpretation, the logic system of quantum mechanics can be established. The logic system established by this way belongs to determinism, but whether the quantum mechanics established by this way belongs to the local realism, must be based on how to explain the electron diffraction experiment and Aspect's experiment. Quantum has the characteristics of non-reality and non-local, so must those of quantum mechanics also be non-reality and non-local? This problem must be revisited. If you retain the past wrong and think that the application scope of quantum theory is infinite, then quantum mechanics must explain all characteristics of quantum. Quantum entanglement is not needed in the preconditions of quantum mechanics; quantum mechanics cannot describe the specific process of quantum entanglement. This shows that: quantum entanglement law is outside the application scope of quantum mechanics, regardless of the success or failure of Aspect's experiment, it has nothing to do with the quantum mechanical property.

Does it ever come to your mind that quantum mechanics also has a limited application scope in the microscopic world? Even large objects are suitable for teleportation (for instance, some people with supernatural power can move large objects with thought). To describe such a phenomenon, it is required that the theory of information communication and traceless matter transfer has a wider application scope (this is the so-called teleportation mechanics that is not yet published). Since quantum mechanics cannot describe the process of quantum entanglement and quantum teleportation, these two experiments are irrelevant to quantum mechanics. This indicates that quantum entanglement and quantum teleportation cannot be used to determine the properties of quantum mechanics. There is no sufficient evidence for proving that quantum mechanics can describe all features of microscopic particles. Given the fact that quantum mechanics cannot describe all states and behavior of microscopic particles, it is not real to believe that the current application scope of quantum mechanics can cover every aspect of the microscopic world.

The interpretation of directional quantization is the side effect of the diffraction experiment of electrons and other particles. In the electron diffraction experiments, it is just possible that the diffraction is caused by directional quantization. The quantum entanglement in Aspect's experiment is outside the application scope of quantum mechanics, and isn't related with the characteristics of quantum mechanics. The interpretation for directional quantization diffraction and the conclusion that the application scope of quantum mechanics is limited can smooth out or easily solve some major problems in quantum mechanics.

After assiduously studying for nearly thirty years, the author has created a solid theoretical foundation for local realism quantum mechanics, found irrefutable experimental evidence, and made a series of new prophecies. The theory has also been constructed by using a solid chain of argument and a logical framework which is complete and robust. If someone has established local realism quantum mechanics and has realized its successful applications, then the negation could not be based on the previous reasons (the reasons will lose their validity). In the previous reasons, one is the electron diffraction experiment and another is Aspect's experiment.

The above discussion together with the evidence provided within this book shows that the reader has four good reasons to believe in local realism quantum mechanics.

Firstly, local realism quantum mechanics has been established, it retains all the advantages of the existing quantum mechanics, and has the advantages of having been regularly applied.

Secondly, local realism quantum mechanics allows statistics and decision theory to coordinate with each other, and does not need hidden variables (see the fourth reason). Therefore, both denying the hidden variable theory and admitting the validity of statistics do not equate to denying local realism quantum mechanics.

Thirdly, the specific process of quantum entanglement is not described by quantum mechanics, it is outside the applicable range of quantum mechanics, and relates to quantum characteristics rather than the properties of quantum mechanics. Therefore, both the experimental results of quantum entanglement and the verification of Bell's inequality are not associated with the question of whether quantum mechanics accord with reality and determinism.

Fourthly, Delsing's experiments show that a photon can come out of thin air. The diffraction experiment of the microscopic particles of electrons, and other related experiments, all showed that real particles in the process of movement led to photons coming out of thin air, and diffraction is caused by the photons emanating from nothing, instead of the real particles themselves. Therefore, the diffraction experiments of the material particles of electrons and similar experiments cannot deny that local realism quantum mechanics meets the viewpoint of determinism and statistical requirements.

As long as we keep a sober mind, it is not difficult to find: the thing of non-locality and non-reality is a ghost; the quantum mechanics in the nature of non-locality and non-reality is just the quantum theory of Ghost properties (*i.e.*, the quantum mechanics in ghostdom). Non-local realism quantum mechanics needs a "quantum stochastic process [which] cannot be terminated" and "quanta have a ghostly figure" to be maintained. The role of the occurrence of ghosts has the function of ghosts. In other words the micro particles in the space of spacelike come and go like a shadow. In the space of space-like, to the observer it seems that the micro particles are the ghost in the underworld. Establishing local realism quantum mechanics just makes quantum mechanics go back to the mortal world from ghostdom. Most questioned must be the quantum theory of Ghost properties rather than a local realism quantum mechanics. However, the authorities judge local realism quantum mechanics taking the quantum theory in the nature of non-locality and non-reality as the standard. Perhaps someone will say that the experiments of electron diffraction and quantum entanglement have been proven, that quantum has the nature of non-locality and non-reality. However, the quantum and having the characteristics cannot indicate quantum mechanics as also having the characteristics of non-locality and non-reality (*i.e*., things belonging to the quantum are not necessarily belonging to quantum mechanics).

The experiments for determining the properties of quantum mechanics (non-local realism or indeterminism) include electron diffraction, quantum entanglement and quantum teleportation (the last was devised in recent years). However, what are needed for establishing the theoretical framework of quantum mechanics are five basic assumptions (there are some different groups, but we only discuss the groups most commonly used). These five basic assumptions are totally irrelevant to quantum entanglement and quantum teleportation. Only the "normalization of integral for the wave function over the full space" in the first basic assumption is influenced by the electron diffraction experiment and its Copenhagen interpretation. Without the normalization of integral, the logic system of quantum mechanics can still be established. That is to say, the logic system of quantum mechanics may be completely irrelevant to these three experiments. Only the interpretation system and measurement viewpoint of quantum mechanics are connected with the three types of experiment. It is to put the incidental before the fundamental by saying that the interpretation system and measurement viewpoint of quantum mechanics determine the properties of the logic system of quantum mechanics. In fact, the interpretation system and measurement viewpoint of local realism quantum mechanics can be established as well (I have already achieved this: Runsheng Tu (2013), Trying to Establish Local Realism Quantum Mechanics. *Int. J. Modern Theo. Physics*, **3**, 118-152. http://www.modernscientificpress.com/journals/IJMTP.aspx). Local-realism quantum mechanics has some successful applications (Runsheng Tu (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**, 309-318. http://dx.doi.org/10.4236/jmp.2014.56041). The current concept of quantum mechanics can be dated back to 90 years ago. It is the right time to change the way of thinking.

The ideal theory for Einstein should be deterministic, as well as local and realistic. All of these three traits are indispensable. Locality means non-discreteness or non-superluminal. Realism means the reparability between the observer and the observed object. The experiment by Aspect discovered the first instance that violates Bell's inequality. Thus, people tend to believe that the simultaneous existence of determinism, locality and realism is impossible. Now it seems that this conclusion about quantum mechanics is too hasty. The reason is that there must be a necessary condition and two sufficient conditions when drawing this conclusion: there are the ghosts of non-locality and non-reality; that the application scope of the quantum mechanism is the entire microscopic world, the basic prerequisite of quantum mechanics should be related to quantum entanglement, and quantum mechanics can describe the process of quantum entanglement. Obviously, these three conditions are not easy to satisfy (the ghost did not exist in the world; and there is no content about quantum entanglement in the basic premise of quantum mechanics. In the sense of philosophy, quantum mechanics is not likely to be universal even in the microscopic world). The analogy with Newton mechanics: the scope of application of Newton mechanics can't cover the entire macro world, so why can the application scope of quantum mechanics cover the entire microscopic world? Existing quantum mechanics both cannot describe the process of quantum entanglement and quantum teleportation, and cannot describe the process of quantum decoherence, wave packet collapse and subjective intervention. In one sentence, neither can quantum mechanics describe the individual processes of these two experiments (due to the limited application scope of quantum mechanics, it is not suitable to describe the process of quantum entanglement). Quantum entanglement and quantum teleportation may only be described by teleportation mechanics that has not been published yet.

Although there are arguments for the two opposing views, however, the logic system of quantum mechanics is perfect. The orthodox quantum mechanics researchers have considered that it has withstood the test for more than half a century. Sadly, in the explanation on the basis of quantum mechanics theory, both in physics and in philosophy, there are significant differences in principles (even for the innermost orthodox quantum mechanics researchers, there are still many differences). Under the premise of preserving the existing quantum mechanical logic system, who can eliminate the disagreement (differences) in principle about the explanation and measurement view on quantum mechanics and who has achieved great success? One of the important reasons for the internal contradictions not being resolved in a long time is the lack of practical and convincing discrimination experiments. At present, the Aspect experiment to verify Bell's inequality has proved to be a good judgment experiment. However, the combination of Bell's inequality and the Aspect experiment not only has the logical loophole in the design thought, but also has the logical loophole in the concrete detail (it denies only that the "hidden variable theory" is invalid in the process of quantum entanglement, but it is not the determinism, the locality and the reality to be invalid in the behavior of non-quantum-entanglement. You know, quantum mechanics is not used for the description of the concrete process of quantum entanglement). All the experiments test Bell's inequality (or the local reality of quantum mechanics has the existence of a locality loophole and a detection-efficiency loophole). Careful investigation has no difficulty in finding that there is a default assumption in the derivation of the Baer inequality: the observation quantity of quantum mechanics is the statistical average of the latent variable, assuming that the latent variable has a probability distribution. A few scholars can certainly construct the model of the maintenance of local realism. Even though both the establishment of Baer's inequality and the experimental verification of Bell's inequality have no problems, "Bell's inequality and Bell's theorem" are only related to the nature of quantum and not directly related to the nature of quantum mechanics. In a word, the existing experiments are not yet available to make a final decision on quantum mechanics and local realism.

It is believed that the diffraction phenomenon in the electron diffraction experiment is caused by the photons made from nothing (or/and collision). That the square of the modulus of the electromagnetic wave function is energy density (probability interpretation abandoned) can be restored, which has little impact on the five basic assumptions of quantum mechanics. There is no longer the need to seek the normalization conditions. The full-space integration of the square of the modulus of the wave function provides an energy value.

To sum up, the factors that are distancing quantum mechanics from non-local realism are as follows: (1) neither the probability interpretation in the electron diffraction experiment nor the relevant rules of quantum entanglement and quantum teleportation are needed for establishing the logic system of quantum mechanics; (2) there is the paradox of uncertainty principle, and the expression resembling the uncertainty relation can be strictly derived from the classical equation of motion; (3) the double-slit diffraction experiment can be explained as the result of directional quantization; (4) the experiment by Serge Haroche and David Wineland proved that Schrödinger's cat can be caught without entering the decoherent state of quantum; (5) scientists can tie the light into a knot. One such knot is a perfect unity of discrete wave and local particle; and (6) the basic prerequisite of quantum mechanics does not mention quantum entanglement and quantum teleportation. Neither can quantum mechanics describe the individual processes of these two experiments (due to the limited application scope of quantum mechanics, it is not suitable to describe the process of quantum entanglement). Quantum entanglement and quantum teleportation may be only described by teleportation mechanics and this has not been published yet.

Does it ever come to your mind that quantum mechanics also has a limited application scope in the microscopic world? Even large objects are suitable for teleportation (for instance, some people with supernatural power can move large objects with thought). To describe such a phenomenon, it is required that the theory of information communication and traceless matter transfer has a wider application scope (this is the so-called teleportation mechanics that is not yet published). The phenomenon of the hidden transmission of large objects cannot deny that classical mechanics meets the reality. Similarly, the transmission of the hidden states of micro particles also cannot deny that quantum mechanics satisfies the reality.

The wave function involved in quantum mechanics is $\psi = ae^{-i2\pi(\nu t - x/\lambda)}$. The wave function of the simple circularly polarized light has such a form. Now that this wave function is used in quantum mechanics, we cannot say that this wave function does not apply to the simple circularly polarized light entirely. The fact that the high-energy gamma quantum can decay into positronium supports our choice of "is". In the past, people tended to choose the word "resemble", but now we choose "is". Then the square of the modulus of the wave function is the energy density in electromagnetism. Even if we choose the word "resemble", we have no reason to completely deny that "the square of the modulus of the wave function is energy density". The question is why the words "probability density" were chosen to explain this. Such a choice may be only justified by the efforts to achieve consistency with the results of the electron diffraction experiment, lacking a solid theoretical basis. When a hydrogen atom in the ground state is calculated according to the Schrödinger equation, a spherical shell composed of the maximum points of probability will be obtained. If the electromagnetic field is considered to originate from this spherical shell, then the probability density calculated is completely identical to the original energy density. That is, as long as we admit that the wave function used is the wave function of the electromagnetic wave, then the probability distribution calculated by the Schrödinger equation is the energy distribution. The high-energy gamma quantum decays into positronium, and the annihilation of the positive/negative particle results in the production of a photon. These facts predispose our choice of "is" between "resemble" and "is".

To sum up, Born has chosen the interpretation that the square of the wave function is the “probability density”, and the evidence is not sufficient. In other words, the vulnerability of the probability explanation is great: if the module of the square of a wave function is the probability density, what is the wave function? We can’t say that the wave function has not physical meaning (or if it is the square root of the probability density)! The concept of probability amplitude is a freak, and the electromagnetics does not hold it. If the wave function to be used is the wave function of the simplest circularly polarized light, then its module should be the amplitude.

The law of the unity of opposites is the fundamental law of the universe. It is basic philosophy law for both sides of a contradiction to be both unity and opposites. Locality and discrete (non-locality), reality and non-reality, determinism and non-determinism are the three basic contradictions. These three pairs of contradictions cannot be inconsistent with the basic law of the unity of opposites. However, in the field of quantum mechanics, researchers think that these three pairs of contradictions are absolutely opposite, that there is no room for compromise (believing that both sides of the contradiction are incompatible, the mortal world and the ghostdom being two that are separate, the conversion between them is non causal events suddenly). In order to cover the violation of the basic law of Philosophy, they invented the concepts of "quantum decoherence" and "wave packet collapse" (and "subjective intervention") for sophistry.

All the right things and the convincing things are real. All the non-real things are the imaginary things (or the hyperplasia things in mathematical method). In the microscopic world, since locality and non-locality (discrete), reality and non-reality, determinism and non-determinism can achieve unity, quantum mechanics is probably not a non-local realism theory as it cannot completely exclude determinacy. At least there is the gradual transition from classical mechanics to quantum mechanics, or there is a substantial part of the crossover. It cannot be an accurate description of objective reality that only "the transition between quantum mechanics and classical mechanics" can be described as a mutation theory.

If someone has established local realism quantum mechanics and has realized its successful applications, then the negation could not be based on the previous reasons (the reasons will lose their validity). In the previous reasons, one is the electron diffraction experiment and another is Aspect's experiment.

It is easy to observe the compliance of a large number of microscopic particles to classical law of motions. However, these experimental facts will never have the chance of serving as evidence once the concepts of wave packet collapse, quantum decoherence and subjective intervention come into play. In the experiment by Serge Haroche and David Wineland, the position and momentum of stationary particles in the well conform to determinism, and also show the features of quantum entanglement. Schrödinger's cat can be caught without entering the states of quantum decoherence. The results do not support the Heisenberg uncertainty principle.

There are two major obstacles in the establishment of local realism quantum mechanics: in theory, it is considered that the uncertainty relation has only the meaning of non-determinism: in the experiment, a single electron through the double slit can produce interference. The author of this book has removed these two obstacles well (respectively, by way of the accompanying light effect and that the Heisenberg relation has a double meaning of determinism and indeterminism). The quantum mechanical model introduced in this book is that of local realism that a particle and a wave are highly uniform. It is a veritable quantum mechanics of local realism.

People have a strong dissatisfaction with quantum mechanics: <1> it requires a very abstract set of five basic hypotheses; <2> in addition to the calculation of the most simple system, the quantum mechanical method can only be a semi-empirical method, and too complicated (*i.e*., it is not strictly a logical method); <3> the interpretation of the quantum mechanics system is too abstract and far-fetched (both the quantum coherence and the collapse of the wave packet are sudden, non-gradual change, unpredictable and with non-logicality. The process of turning the particles into a full wave or turning the wave into particles is a sudden process related to the subjective desire); <4> quantum mechanics is incompatible with classical mechanics, and is the statistical theory of non-determinism; <5> the deep material structure theory does not play a role in quantum mechanics; and <6> the combination of quantum mechanics and relativity is not really realized. The establishment of local realism quantum mechanics is the dream of the older generation of scientists. The author proves that the Heisenberg relation has a double meaning of determinism and non-determinism. A new quantum mechanics theory system, which contains the positive achievements of the old quantum mechanical system—local realism quantum mechanics, is established by the way that quantum mechanics and classical mechanics are mutually compatible. The interpretation system of existing quantum mechanics can be greatly improved, the logic system of quantum mechanics can be greatly beautified, and the calculation of quantum mechanics can be greatly simplified. It can eliminate the first five kinds of discontents in the above discontents, so that can make the quantum mechanical interpretation system look more natural and more ideal. Note: the author only beautifies the quantum mechanical logic system to upgrade it, without needing to bulldoze and rebuild it completely (*i.e.*, the traditional quantum mechanics is thus upgraded). Just the interpretation system, the measurement view and the philosophy of non-local realism quantum mechanics were overturned.

Particle changes from small to large or from large to small can be gradiently changed. However, the transformation between the microscopic particles in the "wave and particle properties" or "quantum coherent states and the quantum decoherence states" can only be abrupt. This is very inconsistent; they do not accord with the philosophy law from quantitative change to qualitative change. Since the Heisenberg relation can be obtained by the classical equations of motion, there is a wide range of organic connection between classical mechanics and quantum mechanics and this has a smooth transition. Since it has become the repulsion between the uncertainty principle and the classical motion law to compatibility, the concept and the wave function can be used simultaneously in calculations of quantum mechanics.

Opening a quantum mechanics textbook, almost all of them use a lot of space to explain the basic principles of quantum mechanics. Students who have been studying quantum mechanics in university for several years are unable to calculate a simple molecule independently. Even if calculating the hydrogen molecules and helium atoms which are relatively simple, approximate results can only be obtained by the application of an approximate method and computer. The practical application of quantum mechanics is just using its basic principle and its basic idea. The logic of quantum mechanics is not very strict, it is necessary to set up a very abstract system with the help of a set of hypotheses. The methods used in this book are very different from the traditional methods of quantum mechanics. Someone who has a certain basis can in only a few hours calculate several molecules that are bigger than H_2 with a tight logical method, and the logical system of quantum mechanics can be firmly imprinted in the brain. Local realism quantum mechanics has advantages in application profit: quantum mechanics and classical mechanics can be compatible, and we can simultaneously use the concept of the orbit and the wave function to calculate quantum mechanics.

The author established the phase trajectory of the atomic model (a causal model of local-reality, it is also called the atomic model of a light knot). The traditional method for applying quantum mechanics calculations of helium-like ions is an approximate semi-empirical method. The temptation is to guess or improvise the correct result, which deviates from rigorous scientific process. As an alternative, I have established a local realism quantum mechanics method that uses fixed extranuclear electrons, and have used the atomic model with a phase trajectory to calculate the results for nine different molecules. In particular, calculations of the big double atomic molecules Na_2, K_2, and the asymmetrical molecule HF all show a single excitation. These calculated results are more consistent with experimental values than traditional theoretical calculations, and the "semi-empirical method hat" has been removed. The importance of these calculations rivals the significance of Schrödinger's calculations for the hydrogen atom. The proposed calculation results are consistent with experimental results, and the calculation method is based on a set of strict theoretical proofs. Thus, these results are unlikely to occur completely by chance, but rather reflect objective laws.

The idea of not being able to measure accurately and the uncertainty principle have both been strongly challenged.

POSTSCRIPT: BASIC THOUGHT, PROCESS AND SIGNIFICANCE OF ESTABLISHING LOCAL REALISM QUANTUM MECHANICS

Before 1983, the author was also bound by the traditional idea of quantum theory. Getting rid of that bondage was also a relatively long process for me. I know the textbook is very strange to say microcosmic particles. In particular, the way of movement of an extranuclear electron is said to be peculiar (I did not know the concept of quantum entanglement at that time). I spawned the desire to figure out the mystery of it. One day in 1983, I suddenly realized that "if a human feels a thing to be strange, the thing is unknown to human beings, and to explore this kind of thing is likely to achieve significant results". We cannot consider that the nature of the thing in following others blindly is peculiar (unusual). The peculiar thing is the nature of the self-styled exploration of the right path. If we consider the peculiar thing as the nature of things, we ourselves have sealed the right path of exploration. That is, on this day, I turn the direction of my exploration from electrochemistry to quantum mechanics. At the beginning, I am also skeptical of some quantum mechanics concepts only. There is conflict between the ideas produced constantly by the author according to careful thinking and the concepts that have been accepted by the masses. The author believes that being logical is not wrong, thus strengthening the belief to question quantum mechanics. When the ideas of local realism and the concept of non-local realism are in conflict, the author's approach is to "temporarily ignore the concept and the so-called experimental evidence and the logical reasoning of the non-local realism, after local realism quantum mechanics is established then talk about it later." After a long time of thinking, finally all the concepts of the quantum mechanics of non-local realism have been broken. The process of exploration is as follows: I assume that the existing theory does not exist, and on this premise think about "what should the structure of the most stable atomic molecule look like"; then I look for the concrete form of this structure; finally, I found the theoretical basis and experimental basis for this structure. Of course, the work of demonstrating the shortcomings of the existing interpretation of quantum mechanics is run through.

At the birth of quantum mechanics, many scientists disliked the non-local-reality of quantum mechanics; Einstein didn't accept the statistical performance and non-local-reality of quantum mechanics at his death. Most physicists still adhere to making a classical reality opinion as the prerequisite and hope to rebuild the description to causal determinism of atomic objects. People think that, the current quantum mechanics is just a temporary phenomenology theory and not complete, in the future it will be replaced by a new theory with determined value and solving the quantum paradox. Later, most physicists gave up the original idea due to

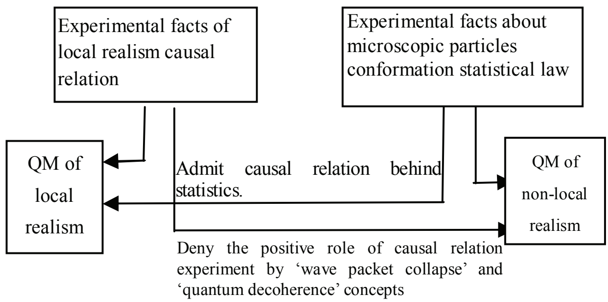


Figure 3. Experiment facts of local realism causal relation and experiment fact of non-local realism QM exist at the same time, the nature of quantum theory always has two choices.

not finding such local realism quantum mechanics. However, the measurement concept and interpretation system of quantum mechanics give up the standard of the truth correspondence theory and is still unsatisfactory. Quantum mechanics has been popular for nearly a century against this background. The new scientists have to accept the status quo of quantum mechanics. In the behavior of microscopic particles, there actually are the experimental evidences of the "local reality causal relation", but some orthodox quantum mechanics schools use some subjective interpretation to deny the positive role of such experimental facts. These subjective interpretations include: the interpretation of the uncertainty relation; Born's probability interpretation; the interpretation of the non-real wave-particle duality of the experiment results of microscopic particle diffraction; the subjective interpretation of quantum decoherence and wave packet collapse, and the interpretation of "subjective involvement". One specific prerequisite assumption can be used to eliminate these subjective interpretations, and can establish, logically, local realism quantum mechanics to retain the positive results of the quantum mechanics of non-local realism. One of the important judgment experiments of upgraded quantum mechanics is the electron diffraction experiment of adding a magnetic field at the side of a narrow gap.

The two factors blocking scientific development are: the concept factor and the technical factor. Generally, the technical issues can be solved after solving the concept (or guideline, research direction) issues. After confirming the thinking of "believing the direct conclusion of the A experiment and rediscovering the interpretation of the B experiment", one of the most urgent technical issues is "how to explain the uncertainty relation and wave-particle duality". The technical issue can be solved if it derives the uncertainty relation from the classical motion equation.

I am a junior college graduate of chemistry education major and my school has no courses in quantum chemistry. However, the teaching materials of *Inorganic Chemistry* and *Physical Chemistry* simply introduce the uncertainty relation, wave-particle duality, electron cloud concepts and chemical bonds quantum theory. When I first came in contact with quantum mechanics, I didn't believe that "microscopic particles are non-local-reality". I first doubted the "Ehrenfest Theorem" and didn't understand it, it thinks that when the physical particle's wavelength is infinitely small, it will conform to the motion law of Newtonian mechanics. We can know from the energy equation of the wave $E=hv$ that, when the wavelength is infinitely small, the frequency must be infinite, the energy of the wave will be infinite and the volatility should be stronger but not disappear (I think that should not have volatility in the situation without vibration or the vibration frequency is infinitely small). Some very authoritative writings said that Ehrenfest proved his theorem and I am confused. If an electron only appears on a certain point outside a nuclear at a moment, it is difficult for the hydrogen molecule to have strong dynamic stability. This is the second question confusing me during the period of school.

I am very clear that we think something is strange because we lack an understanding of it. All textbooks say that the motion of the extranuclear electron is very strange. The performance of wave-particle duality is also very strange. The existence of two cases makes me pleased secretly: the lack of people's understanding of microscopic particle characteristics leaves plenty of space for my exploration of them; the more people believing books' knowledge, the greater chance that I, Tu Runsheng can get an opportunity for major breakthroughs. Therefore, I bought *Quantum*

Chemistry, written by Ira N. at my own expense to study by myself.

I believed that the motion law of the extranuclear electron should be very simple. The facts of the high-energy γ-quantum being able to decay to a positron and electron help me believe that the electron is composed of a minimalist circularly polarized light quantum. Then I evolved this belief into a hypothesis. However, I didn't boldly announce this hypothesis due to not solving the superluminal motion of the extranuclear electron. In 1987, I proposed the opinion that the extranuclear electron is a large-scale elastic ring during a quantum chemistry meeting in China. In 1988 I issued this opinion in *Huanggang Normal College Journal*. At that time I just tried to look at the results, avoided the property of assumed local reality's electronic ring and the electron pair problem was not solved. Though I calculated the hydrogen molecule later, but it was just a calculation method and not a formed systematic new theory. If an electron consists of a polarized light quantum, calculated according to its energy, the radius of a free electron is very small. But the radius of an extranuclear electron ring is larger (at least 274 times that of a free electron). The radius of the electron is how great? The time that the author was disturbed about this problem is not long ago; the author found that using the Huygens principle can solve this. The superluminal problem of extranuclear electron motion was later proved that is not a superluminal electron.

In 1986, I think of such a problem, regardless of the limitations of the existing theory of quantum mechanics: what is the most stable structure of atoms and molecules? According to the electromagnetic theory, the stable structure of the hydrogen atom should be that the ring electron rotates outside the nucleus and does not emit the electromagnetic wave (that is, Saturn's structure). The most stable structure of hydrogen and hydrogen molecular ions should be the wheel-structure (an electronic ring is in the middle, two nuclei are on the two sides, like the wheels of a wheelbarrow). It is obvious that as long as the radius of the ring of the hydrogen atom outside the nucleus is the radius of the Bohr, the ionization energy is also 13.6 electron volts. I calculated the dissociation energy and bond length of the hydrogen molecular ion according to the wheel structure of the equilibrium state. The calculated results are in agreement with the experimental data. It was great encouragement for me. Although at the time, there were people at Huazhong Normal University who laughed at my idea (no one was talking to me at the time, no one gave me a point, only I was laughed at). I did not solve these questions by myself: what is the specific form of the electronic ring? Why is it so big? Why does it not send out electromagnetic waves? I insist on this way of thinking, and those questions remain to be solved later (that is, unless absolutely compelled, I will not give up this idea). There are also many problems in the interpretation of the Copenhagen school. Using Bonn's probability interpretation to explain the stability of hydrogen atoms and hydrogen molecules is thermodynamically very scarce, and in dynamics it is impossible to speak (when the dot electron deviates from the two nuclei, it is the time when the hydrogen is unstable. The fact is that most of the time electrons will deviate from the midpoint of the two-nucleus connection. We can only mask this contradiction with the ghostly wave-particle duality). The first step, as long as the new point of view is no more serious than this problem.

I have always been interested in the transition between photonics and electronics. Scientists are evading the details of this process, preferring to describe it with the ghostly character of wave-particle duality. I think that, for the unification between waves and particles, the most harmonious way is that the wave propagates along the very short closed path to form the entity whose whole is locality. This is the structure model of the elementary particle for a light-knot (it solves the problem that the electron ring does not emit electromagnetic waves outwards). I didn't know at the time that Kelvin had this idea. I am convinced that there is no longer any particle structure that is more harmoniously-unified than the light-knot particle structure model in nature. I find that $\Psi = A\exp\{-i2\pi(\nu t - x/\lambda)\}$is not a wave function of plane polarized light but a wave function of the simplest circularly polarized light. Thus, I proposed the assumption that the simplest circularly polarized photons with energies exceeding the valve frequency propagate along the closed path to form electrons (see **Figure 4**). This is Tu's light-knot electronic structure model. According to this electronic structure model, we can accurately calculate the electron spin angular momentum (the value is $\hbar/2$). With this kind of electronic model as the only prerequisite, we can establish the mathematical formal system of quantum mechanics. This was probably completed by 1998.

Subsequently, I soon discovered that the atomic radius of the Bohr hydrogen atom is 274 times the radius of the light-knot radius of a free electron, and the electron ring radius of the excited hydrogen atom is 274 n^2 times the Bohr radius. 274 is exactly 2 times the reciprocal of the fine structure constant. As long as every point is the sub-wave source, as said by Huygens' principle, is changed into "a mother wave only 274 points can be a secondary source", the size of a nuclear electronic ring can be explained by Huygens' principle. This shows that it is possible to describe the microscopic system by using the thought method of localized realism.

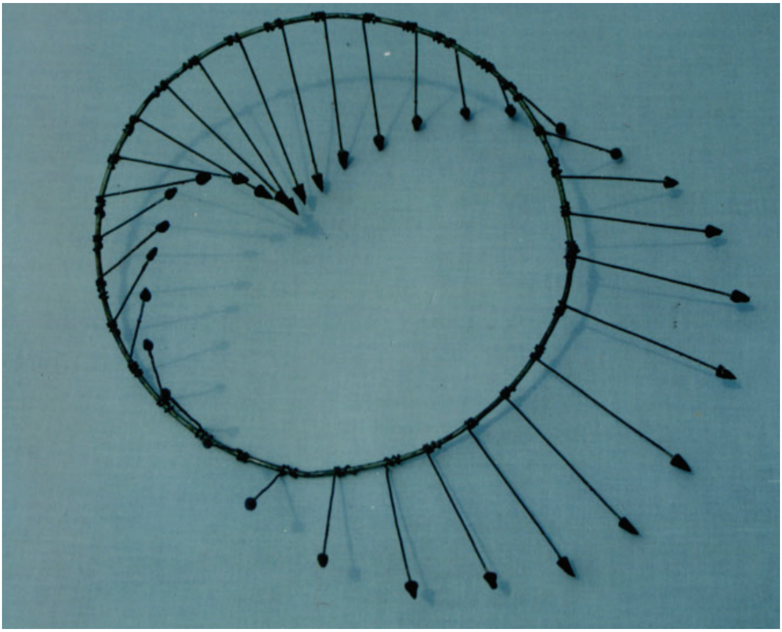


Figure 4. A circularly polarized photon encloses a localized particle

When free electrons become extranuclear electrons, a process described by Huygens' principle occurs (the radius of the electronic ring expands $274n^2$ times, and the internal energy is constant). The problem of the size of the electronic ring is solved. Inside the electron pair, the interaction between the two electrons is a problem. However, I use empirical methods such as regression-wide equations to obtain the empirical value of the interaction energy between electrons. In this way, the dissociation energies and bond lengths of a series of atoms and molecules containing pairs of electrons, such as hydrogen molecules and helium ions, can be calculated. The calculated results are consistent with the experimental values. This reinforces my belief in localized realism quantum mechanics. However, my two problems are still the phenomenon of quantum entanglement and wave-particle duality. The uncertainty relation is another problem. In 1998, I found that the relationship of uncertainty could be derived from the classical mechanics of mechanics. However, this does not completely eliminate this problem.

In 2015, I proved that there is a paradox in the uncertainty relationship:

if the position of a particle can be measured continuously and accurately, it is impossible for momentum to be measured at the same time. In 2016, I put forward the theory of quantum inverse measurement.

2017 was an exciting year for me. By careful analysis, at the beginning of the year, I found that the explanation of quantum entanglement exists in a logical cycle. At the end of the year, I also put forward the direction quantized interpretation of the phenomenon of the electron diffraction experiment, and demonstrated that the source of the probability of quantum mechanics is not reliable. At this point, a complete theory of local realism quantum mechanics was established. The general process is to tentatively find the application of local realism quantum mechanics, and then slowly find the theoretical basis and experimental basis for the local realism quantum mechanics and establish the theoretical framework.

The headache for the author is that for a long time the results of establishing localized realism were not recognized by the authorities. It is very difficult to change the established concept of orthodox quantum physicists.

Later, I realized that the new theory may only be quickly recognized by the academic community if it is possible to make experimental results that are consistent with the new theory and that are incompatible with the present explanation of quantum mechanics. However, I am engaged in amateur studies without that condition, only staring. I hope publishers consider some of the sales effects and consider less whether the results are in line with the orthodox theory. After the formation of considerable book sales, if the book is correct, it is likely to break through the academic wall.

If the ideas in this book are correct, they will have huge influence on the theory of material structure (especially the theory of elementary particle structure), cosmology and the theory of fundamental interaction.