Delayed choice experiment and disconnectedness of microscopic space

ABSTRACT. A brand new approach in the study of quantum experiment is introduced in this paper. The theoretical model of the delayed choice experiment is divided into two parts: micro-matter process model and spatial process model. People have been focusing only on micro-matter process. We focus on the details of the M-C (micro-to-current) space channel: the correspondence from micro-events to current events, the dependence of the validity check of the correspondence on extrinsic recursion invoking itself, the jurisdiction of current space to the micro-collapse. We show that the delayed choice experiment is just a global collapse experiment, and that the carrier of the coordinate difference in the micro-spatial channel is non-local. Consequently, it negates the existence of a common coordinate-difference carrier to micro-space and current space, and negates the connectedness between micro-space and current space. The purpose of this paper is, in terms of the delayed choice experiment, to show that the roots of the counter-intuition of quantum theory is the basic topological nature of space itself (disconnectedness) that forces microscopic matter to exhibit counterintuitive and non-causal features. We show that the delayed choice experiment supports the de-philosophizing Copenhagen interpretation.

1. Delayed choice experiment: we need the details in spatial channel in the depth direction

1.1. Is the root of the counter-intuition and non-causality of quantum theory matter form or space form?

People have been trying to find the roots of the counter-intuition and non-causality of quantum theory through experiments, such as delayed choice experiments. This paper is trying to answer: Did we make fundamental mistakes in dealing with quantum theory and experiments? This refers to: (1) people ignore the rigor of the expression of spatial process of quantum experiments and the necessity of the criterion of true and false quantum events, and (2) people, based on philosophical considerations, reject the possibility: the basic topological nature of space itself (such as disconnectedness) forces microscopic matter to exhibit counterintuitive and non-causal features.

1.2. The details in the micro-to-current spatial channel can not be ignored

The devils are in the details. In order to find the roots, we need the details of the correspondence between micro-events and current events in spatial channel in the depth direction. We refer to this spatial channel in the depth direction as the micro-to-current channel (abbreviated as M-C spatial channel). We reject the traditional view that the connectedness of the M-C spatial channel in the depth direction is self-evident, as the connectedness of astronomical depths (such as between the Earth and the galaxies) has been confirmed over thousands of years. We have given the definition of spatial disconnectedness in the depth direction and proved the disconnectedness [1]. The two keywords for the delayed selection experiment are: which path and both path. The experiment involves three spatial channels (see Fig.1b): the current spatial channel and the micro-spatial channel in the lateral direction, the micro-to-current spatial channel (M-C spatial channel) in the depth direction where the correspondence between

micro-events and current events occurs. This paper focuses on the details involving the disconnectedness of the M-C spatial channel in the delayed choice experiment. We will show that these details will overturn the traditional space theory.

1.3. False quantum event: rejecting the philosophical belief “we will know, we must know”

Physics ultimately is built on experiments, and the components of the experimental statement are physical events. For more than a century, the details of the M-C spatial channel and the criterion for true and false quantum events have never been rigorously studied. Mathematicians have rejected the philosophical belief "we will know, we must know" (it claims that any proposition can prove or disprove) in terms of undecidability theory. Similarly, we reject the arguing that some physicists may do: we allow false quantum events because "we (including future humans or intelligent being living in aliens and even wormholes) will know, we must know how to turn these events to be achievable events." Heisenberg and Bohr first made an assertion that quantum experiments are ultimately expressed in terms of non-microscopic forms (“all experiences must ultimately be expressed in terms of classical concepts”) [2][3]. We express this assertion as the Heisenberg-Bohr prohibition (criterion for false quantum event), which rules that the following events are false quantum events: (1) people use an operational microscopic reference system to verify a microscopic event that occurs within the micro-geometry; (2) There is operational signal responding that can traverse the micro-space and current space. Heisenberg-Bohr's assertions have been criticized by some as positivist statements. Instead, we will show that the prohibition leads to a change in the principles of quantum mechanics (especially the collapse of states) and to get rid of the dependence of the principles of quantum physics on philosophy. The purpose of this paper is to prove that the disconnection of M-C spatial channel, in fact, is the core of the delayed choice experiment, and the counter-intuition and non-causality of quantum phenomena originate from the disconnectedness of spatial channel in the depth direction.

2. Details in spatial channel in the depth direction in Stern-Gerlach experiment

Feynman pointed out in his lecture that the Stern-Gerlach experiment (S-G experiment) can stand as a prototype which can be generalized for the description of all quantum mechanical phenomena [4][5]. A common feature of S-G experiments and the delayed choice experiments is that they examine the spatial characteristics of micro-objects. We will show how people in S-G experiment ignore the disconnectedness of the micro-to-current spatial channel, and will generalize the result of S-G experiment for the delayed choice experiment.

2.1. Detail (1): connectedness of spatial channels in the depth direction and the most basic problem of quantum theory

S-G experiment provided the evidence of quantized spatial orientation of angular momentum of atomic-scale systems. There are two sorts of S-G experiments. (1) In the original experiment a beam of silver atoms from an oven was directed through magnetic field region, fell finally on a glass slide, and the splitting trace was showed. (2) In S-G (potassium) experiment (with potassium atoms instead of silver atoms), the beam of potassium atoms finally shows bimodal distribution of the dot signal on the ionization detector screen. It must be pointed out that the correspondence between the collapsed atoms and the current counterpart occurs in terms of M-C detector (ionization detector or cold glass slide); the current event (bimodal distribution or

splitting trace) produced by the correspondence cannot be interpreted by classical physics (Fig. 1a). We refer to the process before applying the M-C detector as the pre-quantum experiment, in which there is no correspondence between the atoms and the counterparts, and the silver (potassium) atoms are in a potential quantum-mechanical state. The expression that people have used since 1924 are as follows: a beam of silver atoms is deflected by varying magnetic field, struck a detector screen, and the screen reveals splitting points of accumulation rather than a continuous distribution. We don't think this statement is complete and accurate because of the lack of details within the space channel. As shown in Fig. 1b, the correspondence relates to the following spatial regions: (a) two lateral channels: the current spatial channel α and the micro-spatial channel β; (b) the spatial channel Θ in the depth direction (M-C spatial channel). To get qualitative details, let us compare the spatial channels of differential geometry with the M-C spatial channels. As shown in Fig. 2a, in order to express the relevance between the intrinsic geometry of the surface and the external geometry, the details geometer faces with are: the projection of the geodesics to the tangent plane, one-one mapping between the two geometries, connected path, relevance between the two coordinate systems (including compatibility and coordinate transformation). Likewise, for the correspondence from micro-events to current events in the M-C spatial channel, as shown in Fig. 2b, the details physicist must face with are: one-one mapping, spatial channel and corresponding path, compatibility of coordinate systems, connectedness between two spaces, and projection of micro-system into the current space. We propose the most basic problems that have been ignored by people:

(1) Is the correspondence between the silver (potassium) atoms and the dot signals of the screen one-one correspondence?

(2) We distinguish M-C collapse from micro-collapse as follows. The micro-collapse means that the internal angular momentum of each atom "collapses" within micro-channel β into well-defined up-spin or down-spin atom, and M-C collapse means that the micro-events in micro-channel β correspond to current events in current space, that is, the micro-events "collapse (project)" into current space. The M-C collapse makes the knowledge of micro-events to transform into the knowledge within the current geometry. (a) How can we obtain information about micro-events (micro-collapse) within β under the conditions of Heisenberg-Bohr's prohibition? If the validity check of the M-C correspondence is inoperable within the channel β, what is the significance of the validity? (b) If coordinate system of β is not intrinsic, how do we determine that it is compatible with coordinate system of α? Does the validity check support connectedness between region α and β? Obviously, if the validity check is extrinsic procedure only, the next question is, (c) Does the current geometry have jurisdiction over micro collapse?

(3) The spatial channel α, β, and Θ form a system with two options: (a) M-C collapse is a global collapse, that is, once the experiment is performed, all atoms in β are micro-collapsed. (b) M-C collapse is a local collapse, that is, the atoms at the entrance into the apparatus in Θ are sequentially collapsed. How do we experimentally prove whether the M-C collapse is local or global collapse?

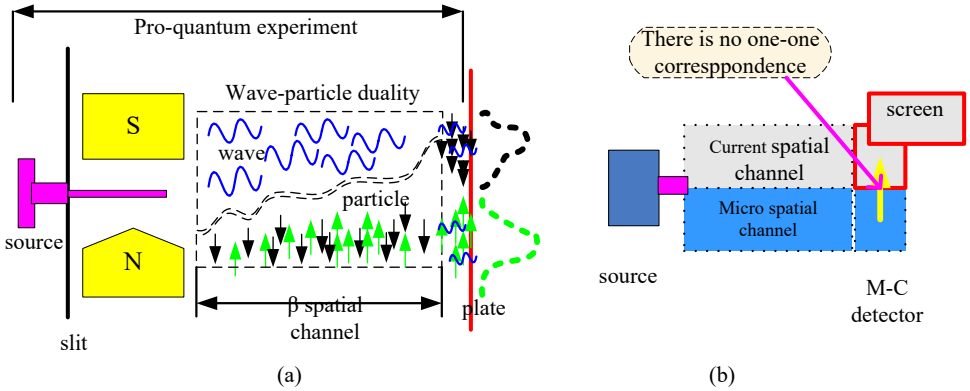

Figure 1 Space cnannels in the depth direction in the Steern-Gerlach experiment

2.2. Detail (1-2): Micro-system modeling and spatial process modeling

The S-G experiment can be used as a prototype for all quantum system, because it contains nearly all essentials of quantum mechanics, namely, space of state vectors, state collapse, transformation between orthogonal basis, and non-locality. However, our three questions above show that the complete model of the S-G experiment should consist of two parts: micro-system modeling and spatial process modeling. Quantum theory lacking spatial process modeling is incomplete.

2.3. Detail (2): No one-one correspondence between atoms and current events

(1) In S-G (potassium) experiment, the spin atom corresponds to the dot signal on the ionization detector screen, which is achieved by means of ionization and avalanche. We restore this correspondence to the process of two channels. (A) The potassium atoms reach the entrance into the detector in the micro-spatial channel β, collapse to one spin-direction eigenstate; (B) The collapsed potassium atom interacts with the media particles, by means of ionization and avalanche, the current event (dot signal) on the detector screen is produced. The potassium atom in β has no causal orbital. Due to the wave-particles duality, the atoms fly from the left end to the right end of β, similar to the double-slit experiment, there are several possibilities: several atoms have the same counterpart, and one atom has several counterparts. In addition, the state collapse allows the atom to appear instantaneously anywhere in β. Therefore, on the one hand, there is no one-one correspondence between the atoms at both ends of β; on the other hand, there is no one-one correspondence within the ionization and avalanche processes. (2) In S-G (silver) experiment, the spin-state silver atoms ultimately correspond to the deposited silver particles on the class slide. Similar to the S-G (potassium) experiment, the process is restored to two channels. (A) In the original S-G experiment, billions of silver atoms have wave-particle duality, silver atoms reach the entrance into the detector in β, and collapse; (B) In Θ silver atoms interact with other atoms to produce the current event (i.e., visible deposited silver particles). In summary, according to the principles of quantum mechanics, there is no one-to-one correspondence between microscopic events and current events in the spatial channel β and Θ.

2.4. Detail (3-1): the validity of the correspondence in the M-C spatial channel depends on extrinsic recursion

For more than a hundred years, people have believed that the M-C spatial channel Θ is a connected channel. However, we have proved that there is no the material carrier of coordinate

and coordinate difference common to current space and micro-space, so the two spaces are disconnected; and the correspondence between quantum events and the current events must be expressed as the extrinsic recursion process outside micro-geometry [1]. For S-G experiment, we give a brief description of the proof of the extrinsic recursion as follows. According to Einstein's theory, the current event is expressed by means of the current signal responding. Due to the Heisenberg-Bohr prohibition, the correspondence between potassium atoms and its counterparts (i.e., the dot signals) in the M-C detector cannot be directly confirmed by the signal responding traversing the two spaces. In the experiment all data are finally provided by current counterparts of the atoms, which are the signals of the detector screen. The theory that describes the correspondence between the atoms and its current counterpart is called micro-to-current theory that involves ionization, signal amplification, etc. Due to the Heisenberg-Bohr prohibition, the validity of this micro-to-current theory again requires experimental verification. Again, it involves new validity check, and so on. Thus, the validity check finally leads to a series that involves invoking itself. For this series physicist is able only to operate current reference system, and there are extrinsic data provided by current counterparts in current space only. We call this process extrinsic recursion. The terminating condition of the extrinsic recursion is that the series invokes all known quantum experiments, and the recursion concerns all quantum principles. The root cause of the extrinsic recursion is that the Heisenberg-Bohr prohibition does not allow the use of micro-scale signal responses to provide information exchange between the micro-space and the current space.

2.5. Detail (3-2): Comparison of M-C spatial channel with differential geometry

For the second basic question of Sec. 2.1, we have the following conclusions. (1) The validity of the correspondence is defined by the extrinsic recursion invoking itself. The extrinsic recursion does not make any contribution to the validity of the correspondence between quantum events and current events, but it guarantees that this correspondence is compatible with all known experiments. (2) The extrinsic recursion requires that only the current reference system be invoked in the correspondence, and other forms regarding the microscopic intrinsic coordinate system are not allowed to be used. Consequently, the quantized spatial orientation of angular momentum is an extrinsic expression in terms of invoking current reference system and extrinsic data, but not inherent micro-form. (3) The definition of the connectedness between the two spaces is that there is a non-empty intersection. However, the extrinsic recursion of the validity check of the mapping in M-C spatial channel negates the existence of a carrier of the coordinate difference common to the two spaces. Therefore, the M-C space channel is disconnected.

The above conclusions are surprising and completely contrary to traditional space theory. To illustrate the rationality of these conclusions, we compare M-C spatial channel with differential geometry in the details. As shown in Fig. 2c, for a surface embedded in a 3-dimensional Euclidean space R_3, we make a simulation of the Heisenberg-Bohr prohibition and extrinsic recursion as follows: (1) A geometer is defined to live only on a tangent plane. Without knowing the embedded and connected paths shown in Fig. 2a, only a discrete statistical projection of the local properties of the surface can be observed. It must be emphasized that for the geometer lived in R_3, those connected paths are internal paths; however, for geometer on tangent plane T_0, those paths are not observable. (2) The geometer on the tangent plane T_0 studies the surface properties, either through discrete projections on T_0 or from other tangent planes T_1, T_2, T_3, etc. (3) Finally, he developed a theory that expresses the properties of the surface based on invoking observations

and knowledge on the tangent planes. Let us make a comparison again. Suppose that an observer with a vector starts at a point on a sphere and is moved by a parallel propagation along a closed loop, and according to differential geometry, the observer usually finds that there is a discrepancy for the vector when he returns to the starting point. On the other hands, suppose that a current observer becomes a wizard who can turn into atomic size, and observes how the atoms struck a micro-scale screen, makes a record in micro-space. However, according the existing quantum theory, the observer finds that his record can be left unchanged when he returns to the human-laboratory. For scientists, it is not in accordance with scientific principles to ignore the non-exchangeability of observing systems. The reason why people have not considered the details of the non-exchangeability between spatial channels in quantum experiments is that, (a) geometer has never developed the disconnectedness between external and internal neighborhoods; (b) physicists believe the philosophical idea: the connectedness between the galaxy and the Earth can be extrapolated to the connectedness between the atom and the Earth in the depth direction.

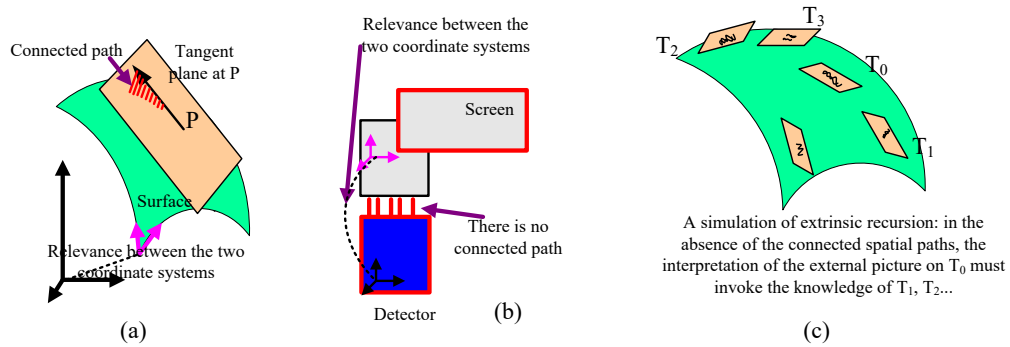

Figure 2 Comparison of geometry with physics

2.6. Detail (4): Jurisdiction of current space to the M-C space channel

2.6.1. Current space has jurisdiction over the current events

The current physical event within current geometry can only be expressed in terms of current reference system based on the current signal (light) response system. Of course, current space has jurisdiction over all current events.

2.6.2. Current space has jurisdiction over micro-collapse

We divide the correspondence from micro-events to current events into two stages: the micro-collapse of the superposition state, the correspondence between the collapsed micro-objects and their current counterparts. Suppose that there is such a micro-scale observer who observes the collapse of the state of a potassium atom and records one eigenvalue (spin-up or spin-down). Because the extrinsic recursion negates the information transmission from the micro-channel to the current channel, the information of the state collapse of the atoms cannot be transmitted to the current space one by one. At first glance, the current space seems to have no jurisdiction over the collapse of the superposition. However, current space still has jurisdiction over the micro-collapse (i.e., over the observer who observes the micro-collapse) as follows. (1) The extrinsic recursion forces micro-scale observer to use the scaling down current reference system for expressing the collapse. This requires that events involving spatial properties (spatial orientation) of atoms in the micro-channel can only be expressed by means of the scaling down current reference system. Exactly speaking, the spatial property (spin) can only be expressed by

the reference system of the current space. (2) The micro-scale observer is not qualified to consider the difference and transformation between the inherent reference system within micro-space and the current reference system.

2.6.3. Current space has jurisdiction over the correspondence in M-C spatial channel

In the second stage, the non-oneone correspondence from micro-object to the current counterpart ultimately produces an observable picture in current space. However, due to the extrinsic recursion, it is not a verifiable experimental fact that the micro-scale picture evolves into the current picture step by step in a connected spatial channel. Instead, people derive the micro-process in micro-channel in terms of the extrinsic data and invocation of the known extrinsic forms. In the simulation shown by Fig. 2c, In order to obtain the intrinsic characteristics of the surface, the observer on the tangent plane T_0 has always followed the hegemony of the tangent plane in his measurement process, that is, he is forbidden to enter the surface, and can only invoke the projection case on the T_1, T_2 and so on. Therefore, the current space has ineradicable jurisdiction over the form of the non-oneone correspondence.

2.6.4. Current space has hegemony over microscopic forms

The above discussion of the details shows that the extrinsic recursion makes the current space to have hegemony over microscopic forms. The hegemony means that (1) in terms of quantum experiments (including the M-C detector) the extended current reference system is applied to the micro-spatial channel, the collapse of the superposition of atoms into the corresponding eigenstates takes place; (2) non-oneone mapping from micro-channel to current channel is produced, the potential quantum mechanical form, which is described in terms of the scaling down current reference system, is converted into the current signal. This process is just M-C collapse (or M-C projection). The conversion of micro-events into current events does not violate the Heisenberg-Bohr prohibition because no signal system that traverses two spaces is used. The following notions are necessary: (a) M-C collapse involves two spaces, and the micro-collapse of the atoms occurs only in the micro-space; (b) The extrinsic recursion plays a decisive role in the correspondence. It means that the validity of non-oneone correspondence cannot be guaranteed by the exchange of signals traveling the two spaces, and can only be supported by extrinsic cases outside micro-space. We once again compare the spatial channel to differential geometry. For a surface embedded in R_3, space R_3 does not have jurisdiction over the expression of the intrinsic properties of the surface. However, by the extrinsic recursion the current space has jurisdiction over the microscopic form. (c) The third question in Sec. 2.1 is still not resolved.

These details about the space channel have overturned traditional space theory.

2.7. A corrections to the Copenhagen interpretation: quantum experiment causes M-C collapse

The core of the Copenhagen interpretation is “microscopic reality is restricted to observation”. We have shown that the micro-to-current spatial channel in the S-G experimental device (M-C detector) is disconnected, and that the current space (including current observation), by the extrinsic recursion, has hegemony over microscopic forms.. This result can be generalized to all quantum experiments. Thus, We should make the following amendments to the Copenhagen interpretation: “observation makes the superposition state (wave packet) to collapse (project) into an eigenstate" is modified to "by extrinsic recursion, quantum experiment (observation) makes the superposition state (wave packet) to micro-collapse (micro-project) into an eigenstate within micro-spatial channel, and makes the quantum system to M-C collapse (M-C project) into

current space."

3. Ineffectiveness of intrinsic operations of micro-events: criterion of false quantum experiments

3.1. Spatial process modeling requires the ineffectiveness of intrinsic operations of micro-events

The complete model of the S-G experiment consists of micro-system modeling and spatial process modeling. Unfortunately, people's attention has been focused on the former and the spatial process modeling is completely indifferent. The main point of spatial process modeling is as follows. The correspondence between micro events and current events is not one-to-one correspondence. The validity of the correspondence depends on the extrinsic recursion, and is limited to the extrinsic description in current space. The intrinsic operation of the micro-event is ineffective. The discussion in Sec. 2.6 shows that the ineffectiveness of intrinsic operations of micro-events is independent of human ability (arrangement of experimental devices), and the root cause is the disconnectedness of microscopic space.

3.2. Ineffectiveness of intrinsic operations of micro-event (1): Criterion of false quantum experiment

Physics is experimental science, and requires intelligent honesty. Honesty requires us to distinguish between true and false quantum experiments. We refuse to apply the philosophical belief "we will know, we must know" to quantum experiments. Based on the Heisenberg-Bohr prohibition, the following operations are ineffective: (a) to make a measurement in micro-region for obtaining numerical labels of micro-objects; (b) to make a measurement in micro-region for performing a collapse of superposition states into an eigenstate; (c) to complete a correspondence between micro-event and current event, by using the signal response system that traverses the two spaces to transmit the information of the micro-event to the current reference system. Fig. 2a and 2b show the three false quantum experiments as follows: (1) Type Ⅰ false quantum experiment: micro-objects is sent to a micro-scale detector S within the micro-spatial channel, and people obtain micro-data at S. (2) Type Ⅱ false quantum experiment: the micro-scale detector S is connected to a current detector S', and the micro-scale signals are amplified to convert one-to-one into the current signals in S'. (3) Type Ⅲ false quantum experiment: at each point in the micro-spatial channel, there is a type II false quantum experiment for each micro-object such that the micro-scale signals about it can be converted into the current signal in S'.

The necessary conditions for true quantum experiments are (as shown in Fig. 2c): (1) In terms of the current device the correspondence between micro-objects and current counterparts (such as the dot signal) is produced in the micro-to-current spatial channel; the micro-object in the micro-spatial channel is mathematically described through the scaling down current reference system. (2) The validity of the correspondence depends on the extrinsic recursion invoking itself, regardless of the operability of the micro-object within micro-space channel. The two elements of a true quantum experiment are M-C correspondence and extrinsic recursion. It is prohibited for the experimenter to become a wizard who can turn into atomic size, to observe and to make a record in micro-space, and then to return to the human laboratory without changing his record. Namely, it is prohibited to move the coordinate system on the current-micro-current loop because the related coordinate transformation is physically unrealizable.

Clearly, single state collapse that occurs only within micro-spatial channels is not a true quantum experiments.

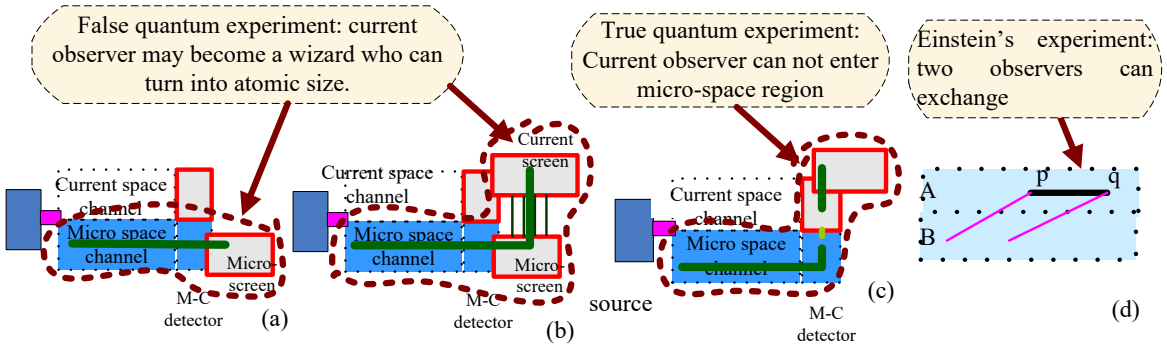

Figure 3 True and false quantum experiment

3.3. Ineffectiveness of intrinsic operations of micro-event (2): micro-collapse is produced by the derived measurement

The Heisenberg-Bohr prohibition prohibits people from taking microscopic numerical measurements in the microscopic area. However, the existing quantum theory has the following postulations involving micro-scale measurements (neglecting the case of degeneracy and continuous spectrum). (a) The result of an actual measurement A is only an eigenvalue of Ω_A corresponding A. (b) If the system is in the state $|\varphi\rangle$, then the probability that a measurement of A gives eigenvalue a_n is $|\langle a_n|\varphi\rangle|^2$. (c) If the system is in state $|\varphi\rangle$ before the measurement is made, then after the measurement has established the eigenvalue a_n for the operator Ω_A, the state is the normal projection of $|\varphi\rangle$ on eigenspace belonging to a_n. It must be emphasized that these postulates for eigenstate and basis transformation are derived from quantum experiments (including S-G experiment) within current geometry, which we call derived principles. These postulates are correct because they are derived from known experimental data, and conversely, the predictions derived from them are consistent with all quantum experiments. Therefore, the micro-collapse is produced by the derived measurement rather than real measurement. It must be emphasized again that honesty is the top priority for physicists. The following statement is not an honest experimental statement: the observer obtains an eigenvalue caused by a micro-collapse in the microscopic region, and transfers the information to the current screen through M-C spatial channel.

3.4. Einstein's space theory can apply to spatial channels in the depth direction

Let us compare Einstein's space theory with the spatial channel in the depth direction. As shown in Fig. 3d, for two current spatial channels, they correspond to inertial systems A and B respectively, which are connected. In Einstein's theory, observer within A can be exchanged into observer within B; for two events within A, by means of one-one mapping between A and B defined by light signal responding, people can develop the transformation formulas. However, he did not study the relevance between the microscopic reference system and the current reference

system in the depth direction. Therefore, his space theory can not apply to true quantum experiments for the following reasons. (1) Quantum experiments involving spatial properties of micro-objects (such as in S-G experiment and the delayed choice experiment) have the following characteristics in the depth direction: probability distribution of the current counterpart, non-onone correspondence, extrinsic recursion, and M-C collapse. (2) The experimental fact we face with is that the observer in the current space cannot be scaled down to the atomic scale like a wizard. He can only determine the validity of the non-oneone correspondence by the extrinsic recursion invoking itself. (3) The nonequivalence between the two observers indicates that the topological properties of the two spaces are not equivalent. The extrinsic recursion forces the observer to scale down his reference system when expressing behavior within the micro-channel, rather than exchanging the observer and his operations into the micro-channel. It is emphasized that the key words of the above statement are: "in the depth direction" and "non-exchangeable observers". We ask ourselves: What kind of space theory do we need to develop the new relationship between the two spaces? What experiments are needed to prove the new space relationship?

3.5. Schrödinger's cat experiment depends on micro-collapse and M-C spatial channel

As Feynman said, the S-G experiment is the prototype of all quantum systems. We extended the previous discussion to the Schrödinger's cat experiment. Schrödinger imagined that a cat, a flask of poison, a Geiger counter, radioactive material is placed in a sealed box. If Geiger counter detects radioactivity (i.e. a single atom decaying), the flask is shattered, releasing the poison, which kills the cat. There are two errors in this thought experiment as follows. (1) The first error is to assume the operability of state collapse within the micro-spatial channel, and that the micro-scale detector is connected to a current detector, and the micro-scale signals are amplified to convert one-to-one into the current signals in the current detector. Consequently, it is just a type Ⅱ false experiment shown in Fig.2b. According to the design of the experiment, if the observer does not observe, the state vector of the atom in the decay is $a|0\rangle + b|1\rangle$ that the cat would exist in the superposition state of being both alive and dead. If the observer opened the box (observed the system), the system would collapse into one configuration, the cat either alive or dead. We have already pointed out that state vector collapse in micro-space is inoperable and is a derived measurement. In the current space, there is only a statistical distribution on the detector. For S-G experiment, it is a meaningless to talk about the one-to-one correspondence between a single dot signal on the screen and a single collapse of the atomic state (equivalent to assuming that the observer becomes a wizard to become an atomic scale to detect a single micro-collapse). (2) The second error is to assume the connection path and signal exchange between micro-geometry and current geometry. The Geiger counter and the ionization detector are based on the same principle. Atomic decay is a micro-event that occurs in a microscopic space. Opening or not opening a box is the current event within the current geometry. The validity of the correspondence between the atomic decay and the current signal of the Geiger counter depends on the extrinsic recursion process of invoking itself. The connected path and the operational signal exchange do not exist.

4. Principle of global collapse experiment

4.1. Why we need global collapse experiment

For quantum theory, the spatial process from micro-events to current events is extremely important for three reasons. (1) If the M-C spatial process is disconnected, the existing unified theory including the Standard Model and the string theory loses legitimacy. (2) If the root of counter-intuition and non-causality of quantum theory is the disconnectedness, then the existing principles of quantum mechanics are incomplete, and the principle of the disconnectedness must be added. (3) If quantum experiment itself determines the process of microscopic collapse, then the Copenhagen interpretation will be correct. We need more evidence of the disconnectedness of the two spaces, and the delayed choice experiment will serve as a strong evidence of the disconnectedness.

4.2. Principle of global collapse experiment

The details of S-G experiment cannot judge global collapse and local collapse, and can not answer the third question we raised in Sec. 2. We now rephrase the third question as follows. The M-C collapse involves micro-collapse of a large number of atoms within micro-channel β. As shown in Fig. 4a, dividing β into n segments (say, 3 segments), then the third problem requires us to choose between the following three possible options: (1) All the atoms within β3 collapse, since they are at the entrance into the detector. (2) All atoms of β3 and some atoms of β1 and β2 collapse. (3) The global collapse takes place, that is, all the atoms of the micro-channel β collapse. According to quantum mechanics, the distribution involving the state collapse allows the non-locality, so atoms p and q (Fig. 4a) may be instantaneously appear at β3 segment, and options (2) and (3) are possible. The third problem is essentially asking, once the quantum experiment is carried out, whether all the atoms of the micro-channel β collapse. We need a new experiment to verify the global collapse. The principle of the global collapse is the non-locality of the micro-spatial channel, that is, there is no material carrier of coordinate difference common to the two spaces. The global collapse experiment is designed as follows: (1) Assume that for a quantum system, there are two possible extrinsic manifestations involving spatial properties, namely label 1 (self-interference or wave manifestation) and label 2 (non-self-interference or particle manifestation). (2) We verify that if the current screen displays label 1 (or 2) once the system collapses, the atoms in β1 segment (say, at point W as shown in Fig.4b) also have label 1 (or 2). The difficulty point of the experiment is that if the M-C detector is inserted in the β1 segment (say, at W), the micro-object will be forced to correspond to the current event at W, the original system will be destroyed, and thus the reliability of the experiment will be lost.

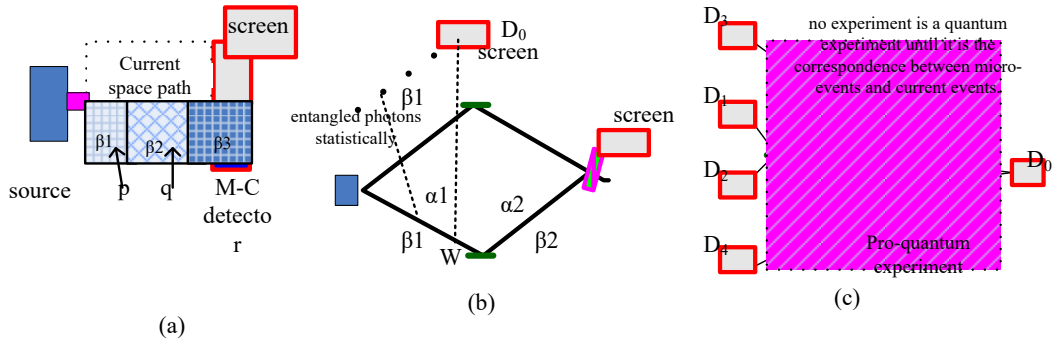

Figure 4 Micro-spatial channel in Delayed choice experiement

5. Delayed choice experiment is a global collapse experiment

5.1. Details of Delayed choice experiment

J.A.Wheeler, in 1978, proposed delayed choice thought experiment, which was later supported by some practical experiments. In the experiment, the micro-spatial channel is divided into two segments β1 and β2 such that after the particle had entered the segments β1, the delayed-choice is made to suddenly remove the detectors, then the M-C collapse takes place and the screen shows the spatial characteristics of the photons: self-interference or non-self-interference. Unfortunately, like S-G experiment, people overlook the details of the space channel.

Based on the analysis of known experiments, we give the details of the spatial channel as follows. (1) The current spatial channel α, micro-channel β and M-C channel Θ must be distinguished. (2) The correspondence between photons and current events takes place in terms of the medium process in the detector, is indirect, and not one-to-one correspondence. (3) Due to the Heisenberg-Bohr prohibition, the validity of the corresponding between micro-events and current events depends on extrinsic-recursion process invoking itself. The information about the micro-events of the photons in the experiment is finally provided by the current counterpart. Based on the above three points, Type I, type II and type Ⅲ false quantum experiments are unacceptable. That is, the following description of experiments must be rejected: imagine that the photons start from a source one by one and then struck a microscopic screen one by one (and convert the microscopic signals one-to-one into the current screen signal). (4) The spatial characteristics of photons are self-interference (closed) or non-self-interference (open), and M-C collapse causes the photons projecting into one of two characteristics. (5) The current space has hegemony over the microscopic forms. The spatial property of photons can only be expressed by the scaling down current reference system. The extrinsic recursion is decisive, it is impossible to verify the micro-scale process of the correspondence between micro-event and current signal of current screen.

5.2. Delayed choice experiment: “retroactive decide” or “global collapse”?

There are many interpretations for the delayed choice experiment. (1) “Retroactive decide” interpretation is accepted by many people. It implies an assumption that the channel β connects to the channel α, such that the flight of the photon within β corresponds to the flight of the pulse within α. As shown in Fig.5a, the experimental apparatus is changed by observer and M-C collapse is produced after the photons have passed the first segment β1, then the photons should reverse its original “decision” as to whether to be a wave or a particle and shown in the current screen. Namely, photon can retrocause "sense" observer’s choice (determining wave or particle manifestation), and adjusts its behavior to fit the wave or particle manifestation choice by observer. (2) This paper proposes “global collapse” interpretation (or “disconnectedness” interpretation). The basic assumption is that the channel β is disconnected to the channel α; the pulse can be interpreted as an ensemble involving photons, but the correspondence between pulse motion and photon flight cannot be established; photons are always in potential quantum mechanical state until M-C collapse is produced. As shown in Fig. 5b, once the experiment is carries out, by the non-oneone correspondence between the two spaces, the global collapse takes place in channel β, and a defined wave (or particle) manifestation is shown in the current screen.

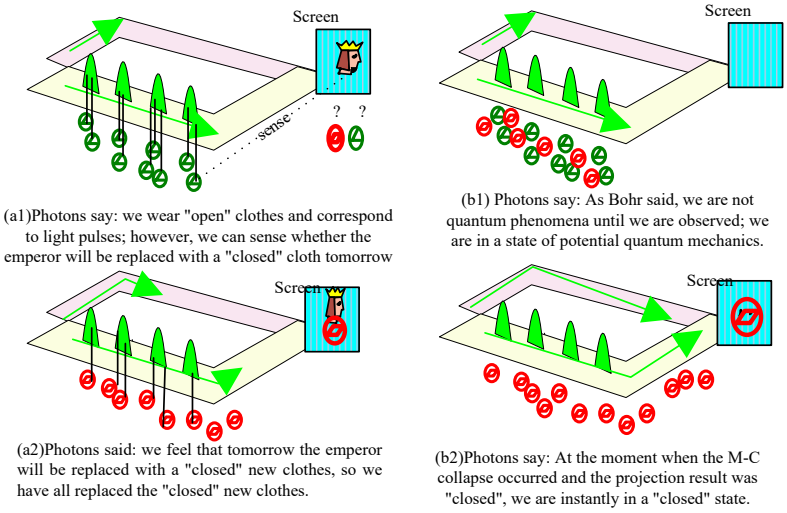

Figure 5 Comparison of “retroactive decide” with “global collapse”

5.3. Delayed choice quantum eraser experiment solves the difficult point

The delayed choice quantum eraser experiment, e.g., the experiment of Kim et al. is a fine version of D-C experiment. As shown as Fig.4a, an argon laser generates photons that pass through a double slit apparatus; a nonlinear optical crystal BBO converts the photons into entangled photons statistically. The signal photon diverge by the prism continues to the target detector D_0 that examined to discover whether the cumulative signal forms an interference pattern. The idler photons (the other entangled photons) through beam splitters and mirrors towards detectors D_1, D_2, D_3 and D_4. While the idler photons at D_3 or D_4 provide which-path information, no interference pattern can be observed for the signal photons at D_0. Likewise, while the idler photons at D_1 or D_2 do not provide which-path information, interference patterns can be observed for the signal photons at D_0. D_0, D_1, D_2, D_3, and D_4 are M-C detectors that provide a correspondence between micro-events and current events. The other part, which does not produce the correspondence between micro-events and current events, is the pre-quantum experiment within the current geometry. In particular, argon lasers and BBO are not the devices that produce micro-to-current correspondence. Similar to opening a window at W, the segment β1' creates an equivalent image of the segment β1 by statistical entanglement (as shown in Fig. 4b), detecting the spatial characteristics of the photons without destroying the original system. The results of the experiment should be interpreted as follows: Once the M-C correspondence is carried out, the quantum system collapses into pattern 1 (or pattern 2), and the entire system in β1' collapses into pattern 1 (or pattern 2).

5.4. Delayed choice experiment negates the common coordinate difference carrier to micro-space and current space

The definition of disconnectedness of two spatial regions is that there is no non-empty intersection, mainly no a common carrier of coordinates and coordinate differences. The delayed choice experiment as the "global collapse" experiment shows that the carrier of the coordinate difference in the micro-spatial channel is non-local. Consequently, it negates the existence of a common coordinate difference carrier to micro-space and current space, negates the connectedness between micro-space and the current space. In other words, on the one hand, the operational coordinate difference is provided by current reference system within current space;

on the other hand, in any quantum experiment, there is no material carrier of coordinate difference in the micro-spatial channel. The distinction between “global collapse” and “retrospective decision” is that for the latter, due to the connectedness between α and β, the non-locality (reverse causality) in channel β destroys the locality in current spatial channel α; for the former, the global collapse in β involves non-locality, but since α and β are not connected, the locality in current spatial channel α is not destroyed.

5.5. The decisive evidence for the "global collapse" experiment is disconnectedness

The details of the experiment do not support the "retrospective decision" interpretation. (1) The "retrospective decision" implies the assumption of connectedness between α and β, by which the pulse in α corresponds the defined photons in β, and the flight of the photons within β corresponds to the flight of the pulse within α. This assumption implies that there are common coordinate difference carriers to the two spaces. However, such an experiment is a type III false quantum experiment because it assumes that there is a type II false quantum experiment at every point in the micro-spatial channel. In fact, quantum mechanics does not require that photons within the first pulse to translate into the second pulse in the sense of classical physics. (2) Since the validity of the mapping between the channels α and β depends on the extrinsic recursion, there is no connected path between the micro-event and the current event, and it is impossible to determine the photons contained in a pulse as a wave packet and their spatial form of existence.

The principle of "global collapse" experiment is as follows. (1) α and β are not connected. (2) As shown in Fig. 5b, when we do not do quantum experiments, although the pulse would express the statistical result of the photon ensemble, the photon-system is in a potential quantum mechanical state; once a quantum experiment (i.e.,M-C collapse) takes place and spatial characteristics 1 (or 2) is projected, all photons within β instantaneously projected into a characteristics 1 (or 2). It is important to emphasize that these characteristics are extrinsic forms provided by detector, and the validity of the extrinsic forms depends on the extrinsic recursion. The "global collapse" interpretation is compatible with all details of the delayed selection experiment. Therefore, the delayed choice experiment is a "global collapse" experiment rather than a "retrospective decision" experiment.

6. Conclusions

6.1. Evidence for the disconnectedness between micro-space and current space

The S-G experiment and the delayed choice experiment, as well as all known quantum experiments, provide evidence for the disconnectedness between micro-space and current space. (1) S-G experiment, the delayed choice experiment, and quantum experiments involving spatial properties confirm non-oneone correspondence between micro-events and current events. (2) The S-G experiment, the delayed choice experiment, and each quantum experiment confirmed that the validity check of the correspondence depends on extrinsic recursion. Namely, the correspondence is governed by current space, and there is no operable path between micro-event and current event. (3) The delayed choice experiment means that, on the one hand, in current space, people use the intrinsic definition of coordinates and coordinate differences; on the other hand, people use the scaling down current reference system to describe non-local coordinates and coordinate differences in micro-space. Thus, there is no common geometric element in the two spaces, i.e., there is no common coordinate difference to the two spaces. The non-locality in the

micro-space, of course, does not conflict with the locality of the current space. It is not enough to prove that the root of the non-causality of quantum phenomena is the topological property of space. However, the above three items (non-oneone correspondence, extrinsic recursion, global collapse) are sufficient to prove the disconnectedness between the two spaces.

6.2. The principle of quantum mechanics is not limited to microscopic spatial channels.

In textbooks, theory of quantum mechanics is limited to the mathematical models that describe only microscopic systems. Our work proves that S-G experiments and delayed selection experiments as prototypes must include micro-system modeling and spatial process modeling. Consequently, the following statements must be the basic principles of quantum physics: (1) Current space is disconnected to micro-space, and any measurement in the microscopic region is inoperable. (2) The quantum mechanical process depends on the non-oneone correspondence in M-C spatial channel, the validity of the correspondence depends on the extrinsic recursion. (3) M-C collapse produces micro-collapse and must be described in terms of the scaling down current reference system. The collapse of the superposition state should be written as follows: The non-oneone correspondence in M-C spatial channel is produced such that the superposition state of micro-object collapses into a corresponding eigenstate in an inoperable way. The assumption that the micro-form remains invariant under the coordinate transformation on current-micro-current loop must be discarded because it lacks an experimental basis.

There should be more experiments to verify the global collapse. A proposed experiment is as follows. It is assumed that in the micro-spatial channel β, two convoys of microscopic objects (for example, C60) are sent from a source, so that the first and second C60 convoys are separated and respectively localized in the channels β2 and β1, and thus have the extrinsic label β2 and β1. In the M-C detector an interference pattern of the De Broglie wave associated with C60 will be formed. We may test whether the global collapse invalidates the localized markers β1 and β2 in the obtained extrinsic distribution.

6.3. Delayed choice experiment supports the Copenhagen interpretation

The Copenhagen interpretation (whose core is “reality is restricted to observation”) has been criticized as a philosophical interpretation. Through the detail analysis of the S-G experiment and the delayed choice experiment, we introduce the disconnectedness of spaces and make the de-philosophizing of the Copenhagen interpretation. The key to de-philosophizing is that we redefine quantum observations as the M-C projection (M-C collapse) produced by non-intrinsic correspondence from micro-space to current space. We show that the S-G experiment and the delayed choice experiment can be used as prototypes for all quantum experiments, which are consistent with "reality is restricted to observation", and require the following improvements to the Copenhagen interpretation. (1) The root of the non-oneone correspondence is not the so-called "interaction between measuring device and micro-object", but the disconnectedness between micro-space and current space. The measuring device (M-C detector) serves only as a medium for exciting the non-oneone mapping. (2) The non-intrinsic correspondence from the micro-space to current spaces (M-C collapse) is the only way to relate these two spaces. That is, if we do not do quantum experiments, the micro-objects within micro-space are in a potential quantum form, and the existence form of matter in micro-geometry does not need to be expressed. Once we do quantum experiments, the existence form of matter in micro-geometry is expressed (played) as a quantum form (as a projection to a scaling-down current reference system) in terms of the extrinsic recursion. The delayed choice experiment does not support the

evolution (e.g., decoherence) in connected spatial channels. Bohr's assertion "nothing is real unless it is observed" is correct, but we have improved it into a de-philosophizing form: "no quantum phenomenon is real until it is observed in current space in terms of M-C correspondence based on extrinsic recursion."

6.4. The ways to develop space theory

There are two ways to develop space theory: (1) not accepting the Heisenberg-Bohr prohibition, based on the virtual signal responding across the subatomic region and the current region, the theory of connected space and the universe theory are established, and it is assumed that future humans will prove the existence of this responding. (2) Accepting the Heisenberg-Bohr prohibition, physical theory based on the current signal responding and the extrinsic recursion within the current geometry, in which micro-observer and current observer are not equivalent, and the corresponding intrinsic characteristics are not equivalent, is established. The discussion in this paper denies the former and provides proof for the latter. Einstein's space theory is based on the lateral transformation of the coordinate systems, and the mapping between the two systems must be associated with the connected path. However, there is no connected path for the mapping from the microscopic coordinate system to the current coordinate system in the depth direction. Einstein's space theory is based on effective signal responding, it is not logical that its development will be supported by an ineffective signal responding.

REFERENCES

[1] Bowen Liu, Disconnectedness experiments negating the validity of the Standard Model, viXra:1807.0178.
[2] W. Heisenberg, Physics and Philosophy. Prometheus Books, New York, 1999.
[3] N. Bohr, Atomic theory and the description of nature. New York. 1934.
[4] Feynman, R.P., Leighton, R.B., Sands, M.: The Feynman Lectures on Physics: Quantum Mechanics, vol. III. Addison-Wesley, Reading (1965)
[5] Gerlach, W.; Stern, O. (1922). "Der experimentelle Nachweis der Richtungsquantelung im Magnetfeld". Zeitschrift für Physik. 9: 349–352.
[6] A.Eistein, The meaning of relativity, Princeton University Press, 1974
[7] Wikipedia. Schrödinger's cat, 2018.
[8] Wikipedia. Wheeler's Delayed Choice Experiment_files, 2018.
[9] Kim, Y.-H., Yu, R., Kulik, S.P., Shih, Y.H., Scully, M.O.: Delayed choice quantum eraser. Phys. Rev. Lett. 84(1) (2000)