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An Infinite Dimensional Space-time Model of Equal Rights between Reference Systems

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Abstract: *A reference system can be established on any substance, and there are no two substances can establish the same space-time reference system. Physical laws have the same form in all reference systems. The four-dimensional space-time on microscopic particle is not curled up, but it is infinitely extended to the distance like the macro four-dimensional space-time. The relationships between the space-time are determined by the boundary conditions of reference systems.*

Keywords: *Infinite Dimensional Space-time, Equal Rights of Reference Systems, Space-time Relationship, Quantum Reality*

1. Introduction

Quantum theory has been established for about 100 years, but people still don't understand the profound essence behind quantum. Several alternative interpretations of quantum mechanics were proposed in the past, including the de Broglie–Bohm pilotwave approach, the many-worlds theory, and the geometrical interpretations. The failure to understand the quantum essence scientifically has hindered the rapid development of physics.

This paper puts forward an infinite dimensional space-time to try to describe the real world.

2. Introduce Two Hypothesis

2.1. Hypothesis 1: Equal Weight of Reference Systems

A reference system can be established on any substance, and physical laws have the same form in all reference systems, and no reference system has a superior position. It is still effective to extend it to the micro field.

In the theory of relativity, different reference systems have different space-time, which opens a corner of the curtain of the essence of space-time. Space-time u1 (x1, y1, z1, t1) and u2 (x2, y2, z2, t2) on two reference systems are independent and different from each other.

Any micro reference system, like the macro reference system, has an independent classical four-dimensional space-time. Macroscopic objects decrease in mass until they are as small as microscopic particles, and the four-dimensional space-time above them are preserved.

When studying a finite number of n reference systems, the number of space-time dimensions involved is N, and there is N=4n. The physical world can establish an infinite number of reference systems, so the universe has an infinite number of space-time dimensions.

2.2. Hypothesis 2: the Relationships between Reference Systems are Determined by Boundary Conditions

The relationships between different space-time can only be determined by boundary conditions of their reference systems, which generally have the following forms.

The momentum relationship between two space-time is a boundary condition, for example, in a vacuum in a laboratory, the wavelength is different because of the different momentum of particles. The potential energy relationship between two space-time is a boundary condition, for example, the distribution of electron clouds is different with different potential energy of electrons around the

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nucleus. The spatial constraint between two space-time is a boundary condition, for example, when a double seams become a single seam, interference becomes diffraction. When other reference systems are involved, the boundary conditions also change.

The boundary conditions between reference systems determine the elements in the coefficient matrix of Heisenberg matrix equation. The coefficient matrix determines the solution of Heisenberg equation, that is, the relationship between two space-time.

3. The Basic Properties

3.1. There are no Two Reference Systems with the Same Space-time

According to the theory of relativity, the space-time of reference systems with different speeds or masses are different. Only considering the rotation and revolution of the planet, two reference systems with identical space-time cannot be found, because you can't find two substances with strictly consistent speeds. In the microscopic field, a classical four-dimensional space-time can be established on any particle, but the classical space-time of different particles are independent of each other, and these different space-time can only be statistically related by boundary conditions.

Strictly speaking, what happens in two places at the same time in any reference system does not happen in the same two places at the same time in another reference system. Each reference system has its own independent classical four-dimensional space-time, and the differences of space-time are the real universal situation in the world; the same space-time are the illusion of people's perception and the approximate result.

3.2. Classical Space-time Application Scenarios in the Micro Field

Fluctuation is the most basic manifestation of the material world, and any classical space-time is approximated by fluctuating space-time. Space-time must be built around mass and energy.

When fluctuation has no significant effect on the research results, and it can be ignored, it can be regarded as a classic four-dimensional space-time. For example, when the special theory of relativity is established, is to establish different reference systems on different objects, ignoring the fluctuation, and still drawing valuable conclusions. Classical four-dimensional space-time can be established on any substance, but there is no strictly classical four-dimensional space-time.

When studying the fluctuation of hydrogen atom in potential well, the well width and wavelength are much larger than the diameter of hydrogen atom, so hydrogen atom and potential well should be regarded as two different four-dimensional space-time. When studying the energy level of electrons in hydrogen atoms, the energy level scale is comparable to the atomic diameter. At this time, electrons and protons must be studied separately as two different reference systems.

3.3. Multiple Reference Systems

Suppose that the experimenter emits photons into the potential well, which are detected by the experimenter after being bounced by the hydrogen atom, and then the position of the hydrogen atom is observed. This operation will lead to the change of the quantum behavior of the hydrogen atom. The behavior of exchanging quantum between reference systems is also a change of boundary conditions.

There are two microscopic particles A and B in the laboratory vacuum. when the distance between A and B is close enough, B particle can be regarded as a boundary condition when studying A particle. Therefore, in the eyes of experimenters, the more particles gather together, the weaker the fluctuation and the stronger the particle property.

4. Interpretation of Quantum Phenomena

4.1. The Dispute between Bohr and Einstein about Reality

Einstein supported locality, while Bohr opposed it [1]. Bohr believes that after a quantum event happens, if you don't measure it, the wave properties of quantum mechanics describe all physics. Measurement causes instantaneous collapse of the superposition state. Einstein believed that after the quantum event, the result had been determined, which was real and not related to measurement.

For example, a five-atom molecule X5 splits into two new molecules and then moves in two different directions. The new molecules may be X1 and X4, or a combination of X2 and X3.

Following Einstein's train of thought, the specific combination had been determined to be X2 and X3. Because Einstein was in the reference system of X3 (or X5 or X2), he saw everything that happened during the split and knew the result at that time.

Bohr believed that the results were uncertain until they were measured. This is because Bohr stands in the classic four-dimensional space-time of the laboratory reference system. Laboratory reference system and X3 reference system are two completely different classical four-dimensional space-time, which are completely independent of each other, and the state of each other's space-time can only be determined by boundary conditions.

After Bohr measured X2, he knew that X3 was composed of three atoms. This is because Bohr's measurement of X2 changed the boundary conditions of two space-time, and the relationship between the two space-time changed accordingly.

Einstein and Bohr were both right. They stood in different space-time and saw different sides of the same thing. Do the Bell inequality test in the laboratory reference system, and of course the result will prove that Bohr is correct. If the Bell experiment is done in the reference system where the particle is located, then Einstein is correct. Historically, the debate about whether light is a particle or a wave is also a debate about different sides of the same thing.

4.2. Double-slit Experiment

The double-slit experiment has been qualified by Feynman [2] as the only mystery of quantum mechanics. The first double-slit experiment using electrons was conducted in 1961 and was later demonstrated for C60 and larger molecules. In the experiment of electrons double-slit interference in the laboratory, one electron passed through two slits at the same time, forming an interference pattern on the receiving screen. An observer was placed behind the slits, trying to find out which slit the electron had just passed through, so the electron only passed through one slit, showing particle characteristics. This is an experimental phenomenon that puzzled scientists for many years.

Scientists observe the situation in laboratory reference frame space-time, as shown in Figure 1, when interference occurs, electrons pass through two narrow slits in a probabilistic form, and the electrons are no longer a physical entity, but mysteriously become separations.

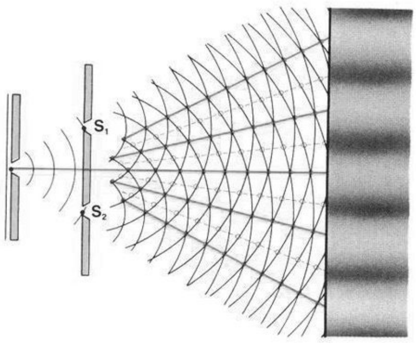

Figure 1: Double-slit experiment seen in the space-time of laboratory reference system.

The space-time of laboratory reference system and electronic reference system are two completely different classical four-dimensional space-time. In the electronic reference system, as shown in Figure 2, the slits in the laboratory reference system have obvious position uncertainty, and the double-slit screen is blurred, so it is impossible to distinguish which slit. In the space-time of the electron, the electron has gone through a continuous classical path and never crossed two slits at the same time, but the electron doesn't know which slit on the slit screen it passed. The uncertainty between electron and screen is the same. Finally, the boundary conditions change when it hits the receiving screen, and the two reference systems quickly approximate to the same classic four-dimensional time-space reference system. The position of the laboratory items is clear, and the electrons can look back at the slits on the double-slit screen, but they still don't know which slit they just passed through. In fact, in the space-time of the laboratory, electrons pass through two slits at the same time. Place an observer behind the double-slit screen. For the electron, a light beam appeared in the forward path to block the way. Therefore, the boundary conditions of two reference systems changed, and the quantum fluctuation relationship of two space-time changed. The electron can see the position of each slit on the double-slit screen clearly, and the trajectory of the electron is still a continuous classical path. This time, the electron knows which slit it has passed through.

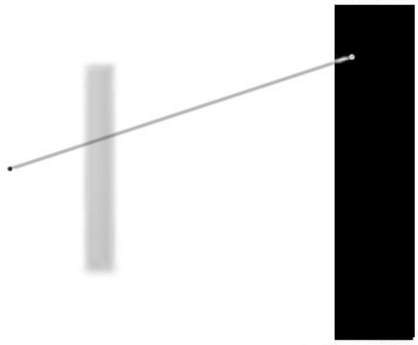

Figure 2: Double-slit experiment seen in the space-times of electronic reference system.

Here is another interesting experiment. After the electron passes through the slit, experimenter emits photons to the electron in a very short time to observe which slit the electron passed through. That is, current events whether can change history in the discussion of the delayed-choice experiment by Wheeler [3] and of the quantum eraser experiment.

When an electron passed through a double-slit screen, because of the uncertainty of the screen position, it can't tell which slit it passed through, but when it is suddenly irradiated by light, the two space-time boundary conditions change, and the electron immediately sees the slits behind it clearly, so the slit that the electron just passed through can be calculated in the electronic reference system. This is why observation changes history.

4.3. Quantum Entanglement

The two temporarily coupled particles C and D split, and then there is a correlation no substance how far apart they are, in which the quantum state of one particle changes and the state of the other changes instantaneously. This is hard to understand.

Although the reference systems are established on particles C and D respectively, they fluctuate with each other, but on the scale of coupled particles, the space-time of these two reference systems and the space-time of coupled particles can be approximately the same classical four-dimensional space-time. In C and D space-time, splitting event is a classical physical process. No substance how far apart, they all recorded the marks left by the split, such as left-handed rotation or right-handed rotation, which has objective reality.

After separation, C and D fluctuated rapidly and significantly with each other, becoming two independent space-time, and the marks left by the separation remained in their respective classical space-time. The laboratory belongs to the third independent classical space-time, and the spin direction of entangled particles in this space-time is entangled superposition state. When the experimenter measures the spin direction of C particle, he knows the spin direction of D particle. Because of measuring the information carried by C particle, the boundary conditions of both the laboratory reference system and the D particle reference system are changed. For the laboratory reference system, the spin information of D particle collapses from the wave superposition state to the classical state. In the space-time of D-particle reference system, the spin direction after splitting is in a certain state all the time.

5. Uncertainty between Reference Systems

In special relativity, the space-time established on the reference systems are equal to each other and independent. At present, there is no definite evidence for the existence of a special space-time reference system. In this paper, the reference system equality hypothesis is extended to micro domain. According to Einstein's thought experiment: when two carts in relative motion meet instantaneously, the clocks are

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matched, after separation, the carts send light signals to each other, and the space-time of the two carts are different according to the principle of constant speed of light. However, Einstein did not take into account the volatility of light, which is inherently uncertain.

Suppose the carts are far enough apart and empty enough that the boundary conditions between them are only light signals sent to each other, and nothing else, such as gravity, is considered. At this time, the space-time relationship between the two carts reference systems is determined by the characteristics of the photons exchanged between them, and the uncertainty of the positions of the trolley is limited by the wavelength of the photons exchanged. No substance how short the wavelength of the photon used for communication, the position uncertainty of the carts cannot be strictly removed, and the same uncertainty exists for the clock verification of the carts through the optical signal.

There is an important condition here: the relationship between two space-time on two carts depends on the properties of the photons exchanged between them. Each time a photon is exchanged between the carts, the space-time relationship of the two is redefined. When the wavelength of the exchanged photons is long enough, other boundary conditions such as the gravity between the carts cannot be ignored, and all boundary conditions collectively determines the space-time relationship between the two reference systems.

Space-time in special relativity is objectively independent, independent of whether photons are exchanged or not. However, if the wave properties of substances are considered, then the space-time relationship between reference systems is no longer objectively independent, but is affected by quantum exchange, that is, the boundary conditions of space-time determine the space-time relationship.

6. Speculation about the Unknown World

Observation and measurement are not the basic reasons for changing quantum behavior. Emit photons to the electrons in the double-slit interference experiment, but don't recycle them. If you don't recycle photons, it doesn't belong to observation or measurement, but the double-slit interference will still disappear, because it changes the boundary conditions of space-time. This prediction can be verified by experiments.

7. Conclusions

In summary, we have extended the principle of reference frames equal rights to the micro field, and introduced an infinite dimensional space-time model. It explained quantum phenomena such as quantum entanglement and double slit interference. Quantum mechanics involves two space-time reference frames that can be described using matrix theory, which is the essence of quantum wave behavior. The strong nuclear force involves at least three or more space-time reference frames. If time dimension differences are not considered, then at least ten space-time dimensions are required. The value of infinite dimensional space-time model should not only be in explaining existing quantum phenomena, but also in playing a positive role in the unified description process of the micro and macro worlds.

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