

New Explanation on Essence of Quantum Phenomena and Interactions and the Gravitational Action in Cosmic Continuum Theory

Xijia Wang

College of Mathematics and Statistics, Hunan Normal University, Changsha, China, 410081

Abstract - According to the cosmic continuum hypothesis, the universe is a continuum consisting of an existence continuum and an existing dimension continuum. The existence of a continuum is composed of mass bodies, energy bodies, and dark mass bodies. The existing dimension of the continuum is composed of space, time, and dark space. Space, time, and dark space are the existing dimensions of mass bodies, energy bodies, and dark mass bodies. The coupling energy quantum is the quantum that acts as a link between particles, quantum, and dark particles. It can be deduced from the axiom system of Cosmic Continuum: the essence of interactions is the change of coupling energy quantum. The essence of quantum phenomena is the interaction between holographic particles. Among the four interactions, the only gravitation sources are the three existing mass, energy, and dark mass quantities. Other interaction sources are qualitative quantities that characterize the interaction, such as electric charge, color charge, and weak charge. Therefore, the change of the coupling energy quantum in gravity action will cause the change of the existing quantity, which will cause the corresponding change of the existence dimension time, space, and dark space. This is the physical mechanism of space-time bending revealed by Einstein in Relativity. The so-called gravitational wave is a phenomenon of energy radiation caused by the energy quantum change between particles, quantum, and dark particles. The coupling energy quantum change will only cause the corresponding changes in qualitative quantity of electric charge, color charge, and weak charge in other interactions.

Keywords - Cosmic Continuum; Axiomatic physics; Coupling energy quantum; Quantum non-locality; Gravitational action

I. INTRODUCTION

The goal of Cosmic Continuum Theory is to find an axiomatic solution to Hilbert's Sixth Problem. This theory does not use the existing physics laws directly as a logical premise but uses the mathematical continuum as a model to abstract the most basic axioms from various laws of physics and derive a unified and self-consistent physics theory, just like Euclid geometry[1]-[3].

On the last day of the 19th century, the famous British physicist Kelvin published the famous "Two dark clouds" when he looked into the prospect of physics in the 20th century. The so-called "Two dark clouds," one is the conflict between Michelson-Morley's experimental results and ether drift theory, and the other is the "ultraviolet disaster" caused by Black-body radiation theory[4]. Since the 20th century, with the advent of quantum theory and relativity, two dark clouds that Kelvin said were dispelled. However, due to the disharmony between the quantum theory and the logical basis of relativity theory, the sky of modern physics also appeared with numerous dark clouds such as wave-particle duality, quantum entanglement, dark matter, dark energy, and black holes[5].

When it comes to the birth of modern physics, one cannot but speak of the famous paper Einstein published in 1905, "On a Heuristic Viewpoint Concerning the Production and Transformation of Light." In this paper, Einstein gave a quantum interpretation of the photoelectric effect[6]. He got the following formula:

$$K_{\max} = h\nu - w \quad (1)$$

$$w = h\nu_0 \quad (2)$$



The maximum kinetic energy of the photoelectron h is Planck constant. The photons' energy with frequency ν and absorbed by electrons w are the electrons' work function and ν_0 is the limiting frequency that enables electrons to escape.

Einstein's light quantum interpretation of the photoelectric effect makes people realize that light has both waves and particles' dual nature. This discovery also made an important contribution to the development of quantum theory. However, we know that Einstein has always been skeptical about the logical basis of quantum theory. His struggle with the Copenhagen School has become a well-known public case in the history of science. The contradiction between quantum theory and relativity based on logic has also become the biggest obstacle to physics's unity [7]-[8].

In Cosmic Continuum Theory, the universe is a continuum consisting of an existence continuum and an existing dimension continuum. The existence of a continuum is composed of mass bodies, energy bodies, and dark mass bodies. The existing dimension of the continuum is composed of space, time, and dark space. Particles have mass inertia. Its existence dimension is space; quantum has energy inertia, and its existence dimension is time; dark particles have dark mass inertia, and their existence dimension is dark space. The cosmic continuum adopts the "4+x" dimensions model, space is 3-dimensional, and the time is 1-dimensional. The dark space has no known dimensions, so it is temporarily set as the x -dimensional[1]-[2],[9]-[10].

Based on Cosmic Continuum Theory's basic principles, this article reveals the unified nature of quantum phenomena and interactions.

II. RESEARCH METHODS

The research method of this paper is axiomatic proof. This article uses the fundamental concepts and axioms system in [1]. The following lemmas are cited in [1]. These lemmas will be used in later proofs.

Lemma 1: The existences are coupled with each other by energy, And in the presence of different structural

levels, the corresponding quantum from the role of convergence (Axiom in [1]).

Lemma 2: The change of energy is the cause of all cosmic system state changes. Let the change of energy occurring in a system of the universe be ΔE , and the corresponding change in the state of the universe's system be Δx , then $\Delta E \equiv \Delta x$. "≡" is the "equivalent" symbol (Axiom in [1]).

Lemma 3: An existence has a maximum speed, and an energy body's speed is the maximum speed (Proof see [1]).

Lemma 4: There are only three basic forms of existence: particle, quantum, and dark particle. There exist elementary particles m_{\min} , elementary quantum q_{\min} , and dark elementary particles d_{\min} . Let m_i , q_i , and d_i be particles, quantum and dark particles in a cosmic system A, respectively $m_i \geq m_{\min}$, $q_i \geq q_{\min}$, $d_i \geq d_{\min}$, $i = 1, 2, 3, \dots$ (Axiom in [1]).

Lemma 5: The existence quantity has its elementary unit e_{\min} (Proof see [1]).

Lemma 6: The existences in an isolated system keep the total quantity of existences unchanged. Set A is an isolated system, then $m_1 + E_1 + D_1 \equiv m_2 + E_2 + D_2$.

m_1 The size of system mass, energy, dark mass, respectively, in time t_1 t_2 (Axiom in [1]).

III. THE ESSENCE OF INTERACTIONS: THE CHANGE OF THE COUPLING ENERGY QUANTUM

For the convenience of description, the particle, quantum, and dark particles are collectively referred to as holographic particles, and the smallest holographic particle is referred to as elementary holographic particles. Correspondingly, all existence dimensions of time, space,

and dark space are called holographic dimensions.

Corollary 1: The change of the coupling energy quantum is the cause of the interaction between holographic particles.

Proof: According to Lemma 1, any holographic particle has its coupling energy quantum corresponding to the structural level. As the hologram particles move and change, the holographic particles' coupling energy quantum will change accordingly. According to Lemma 2, if the coupling energy quantum changes ΔE , then the holographic particle's state will undergo a corresponding change $\Delta E \equiv \Delta x$. According to Lemma 6, force means the action arising from the location change in space, time, and dark space of an existence caused by the change in energy. This shows that the movement and the change of the holographic particles make interactions between the hologram particles. According to Lemma 2, the change in energy is the cause of changes in the state of all cosmic systems. The change in the coupling energy quantum is the cause of the interaction between holographic particles. Q.E.D.

There are 4 fundamental interactions known to exist: the gravitational and electromagnetic interactions and the strong and weak interactions, but there are different opinions about the causes of the four interactions. For gravity, there are theories of universal gravitation, space-time curvature, and quantum gravity. People can only use different interpretations in different theories[11]-[12]. Corollary 1 gives a unified reason for the four interactions. Existing scientific findings indicate that bosons transmit all interactions. These bosons that transfer interaction are coupling energy quantum.

Corollary 2: The holographic particles have different magnitudes of coupling energy quantum in the different structural layers of the existences and can also have different kinds of interactions with the outside world at the same time.

Proof: For a holographic particle, it may be at some structural level of a different existence. For example, it is at some structural level in the universe and some atom's structural level. According to Lemma 1, the existing

bodies are connected through energy. At the different levels of the existing bodies' structure, they are connected by the corresponding coupling energy quantum. In this way, this holographic particle will have different magnitudes of coupling energy quantum simultaneously and can have different interactions with the outside world. Q.E.D.

For example, gravitation, electromagnetic, and weak force can be generated at the same time between the nucleus and electrons. Of course, these different interactions are not in order of magnitude. In the photoelectric effect, the effects of gravitation and weak force are completely ignored.

Corollary 3: The coupling energy quantum change direction determines the direction of interaction between holographic particles.

Proof: According to Lemma 2, the change of energy is the cause of all cosmic system state changes. According to Corollary 3, the coupling energy quantum change is the cause of the interaction between holographic particles. Therefore, the direction of interaction between holographic particles is determined by the coupling energy quantum change direction. Q.E.D.

Corollary 3 is very important, and it determines whether the interaction is attractive or repulsive. Interactions in nature have two directions: attraction or repulsion. The 4 interactions act as basic interactions that are the source of the force of attraction or repulsion. We now know that both strong and electromagnetic forces have both attractive and repulsive forces. Gravitational and weak forces have repulsive forces that still require experimental verification. Another meaning of Corollary 3 is that it reminds us to understand the opposite direction of energy change in interactions. For example, we are currently using positive and negative charges to explain the attraction or repulsion of the electromagnetic force and using the distance of the interaction to distinguish the attraction or repulsion of the strong force[13]-[15], this may not find the real reason for the change in the direction of energy change.

Corollary 4: Whether the interaction between holographic particles is a long-range or short-range force

depends on the corresponding structure level's requirements. The coupling energy quantum is located.

Proof: According to Lemma 1, the coupling energy quantum between holographic particles corresponds to the corresponding structural hierarchy. Therefore, the range of interaction between holographic particles also depends on the corresponding structure level requirements. When the corresponding structure level needs long-range force to support, the interaction between holographic particles is long-range force; when the corresponding structure level only needs short-range force support, the interaction between holographic particles is a short-range force. Therefore, Whether the interaction between holographic particles is a long-range force or a short-range force depends on the corresponding structure level's requirements where the coupling energy quantum is located. Q.E.D.

It is not difficult to find that the range of influence of strong and weak interactions is limited to atoms, limiting gravitational and electromagnetic interactions. According to Corollary 4, strong and weak interactions should be the interactions required by the atom's inner structural level. Gravitational and electromagnetic forces are the interactions required by the large-scale structural level of the universe.

Corollary 5: All interactions are the physical effects of changes of coupling energy quantum between holographic particles at the corresponding structural level of the cosmic system.

Proof: According to Corollary 1, the coupling energy quantum change is the cause of the interaction between holographic particles. According to Corollary 4, the holographic particles have different magnitudes of coupling energy quantum in the existences' different structural layers. They can also have different kinds of interactions with the outside world at the same time. The above two corollaries show that all interactions are the physical effects of coupling energy quantum changes between holographic particles at the universe's corresponding structural level. Q.E.D.

Corollary 5 shows that all interactions are of the same

nature and are structural forces; the difference is the universe's structural system's corresponding level.

IV. THE ESSENCE OF QUANTUM PHENOMENA: THE INTERACTION BETWEEN HOLOGRAPHIC PARTICLES

Corollary 6: All microscopic and macroscopic physical phenomena are the physical effects of interactions between holographic particles.

Proof: According to Lemma 2, the change of energy is the cause of all cosmic system state changes. Let the change of energy occurring in a system of the universe be ΔE , and the corresponding change in the state of the universe's system be Δx , then $\Delta E \equiv \Delta x$. According to Lemma 1, the existences are coupled with each other by energy, And in the presence of different structural levels, by the corresponding quantum from the role of convergence. And the existences is composed of holographic particles, the change in the coupling energy between the existences is the change of the energy quantum that connects the hologram particles. This shows that all the existences' changes are caused by changes in the holographic particles' coupling energy quantum. All microscopic and macroscopic physical phenomena result from existence changes, so all microscopic and macroscopic physical phenomena are the physical effects produced by the interaction between holographic particles. Q.E.D.

In the cosmic continuum, existence exists not in isolation but interconnection. The essence of interconnection is interaction.

Corollary 7: The photoelectric effect's work function $w = h\nu_0$ shows that the coupling energy quantum size between the atomic nucleus and the electron is $h\nu_0$.

Proof: According to Lemma 1, the coupling effect between the atomic nucleus and the electron is caused by the corresponding energy quantum. The work function is the work that needs to be done to overcome the effects of the coupling energy quantum. According to formula (1),

$K_{\max} = h\nu - w$, Assuming that w is to overcome the work done by n ($n \geq 2$) coupling energy quantum, then the photoelectric effect can also be excited by n photons, only to satisfy:

$$w = \sum_{i=1}^n h\nu_i \quad (3)$$

And $w = h\nu_0$ indicates that the photoelectric effect must be excited by ν_0 a photon whose frequency is greater than or equal to B . This shows that the assumption $n \geq 2$ does not hold. This shows that the coupling energy quantum size between the atomic nucleus and the electron is $h\nu_0$. Q.E.D.

Einstein's photoelectric effect equation reveals the particle properties of light and finds the mechanism that stimulates the photoelectric effect[6]. Corollary 7 shows that the limiting frequency is the coupling energy quantum frequency between the atomic nucleus and the electron.

Corollary 8: Wave-particle duality is the overall effect of holographic particles and their coupling energy quantum motions and changes.

Proof: According to Lemma 1, The existences are coupled with each other by energy, And in the presence of different structural levels, by the corresponding quantum from the role of convergence. So, any holographic particle has a coupling energy quantum. As the holographic particles move and change, this coupling energy quantum also follows movement and change. In this way, the coupling energy quantum will form a wave phenomenon corresponding to the holographic particle's motion and change. Because the movement and change of the holographic particle and the coupling energy quantum are a whole, affecting one aspect will affect the other, thus forming the strange physical phenomenon of wave-particle duality that we see. Q.E.D.

This inference reveals the nature of wave-particle

duality and subverts the existing understanding of quantum phenomena. Because in the past, our analysis of interference and diffraction of light did not take into account the photon's coupling energy quantum[16]-[19]. Corollary 8 tells us that the existence of wave-particle duality in all existences is the movement and change of holographic particles and their coupling energy quantum. Simultaneously, Corollary 8 shows that the elementary unit of existence is a holographic particle because the coupling energy quantum itself is also a holographic particle.

Corollary 9: Non-locality is the physical effect produced by the interaction between holographic particles.

Proof: According to Corollary 6, all microscopic and macroscopic physical phenomena are the physical effects of interactions between holographic particles. Non-locality is a physical phenomenon, so it is also the physical effect produced by the interaction between holographic particles. Q.E.D.

Corollary 9 means that non-locality is not a quantum-specific physical effect but rather a ubiquitous physical effect because there is an over distance relationship between all the existential bodies in the universe.

Corollary 10: Quantum non-locality is a non-local quantum physics phenomenon, and all non-locality causes are quantum non-locality.

Proof: According to Corollary 9: Non-locality is the physical effect produced by holographic particles' interaction. Quantum non-locality is a quantum physics phenomenon, so quantum non-locality is a non-local quantum physics phenomenon. According to Corollary 6, all microscopic and macroscopic physical phenomena are the physical effects of interactions between holographic particles. The non-locality of holographic particles is quantum, so all non-locality causes are quantum non-locality. Q.E.D.

Corollary 10 indicates that macroscopic non-localized physical phenomena are the overall effect of microscopic non-localized physical phenomena.

Corollary 11: The change of the entangled state changes the existences' state in the dark space caused by

the coupling energy quantum between holographic particles.

Proof: Quantum measurement causes a change in the coupling energy quantum between the quantum in the entangled state. Let the quantum measurement make the change in the coupling energy quantum as ΔE . According to Lemma 2, the state of the quantum system will change accordingly Δx , and $\Delta E \equiv \Delta x$.

In the cosmic continuum, Δx can be a state change in the space dimension and the time dimension, or it can be a state change in the dark space dimension:

$$\Delta x \equiv \Delta x_s + \Delta x_t + \Delta x_g \quad (4)$$

Among them, Δx_s , Δx_t and Δx_g are the state changes of a quantum system in space dimension, time dimension, and dark space dimension, respectively.

However, the change in quantum entanglement is instantaneous and superluminous [20]. According to Lemma 3, this situation cannot occur in space-time. That is to say, Δx in quantum entanglement is the state change of existence in the dimensions other than space and time, and this state change cannot be measured by speed. In the holographic dimensions, all dimensions other than time and space are classified as dark spaces, so the entangled state's change changes the state of the existences in the dark space caused by the coupling energy quantum between holographic particles. Q.E.D.

The dark space dimension is the existence dimension of the creation of the Cosmic Continuum Theory. We know that the first systematic space-time theory is a Newtonian classical theory in the history of physics. Newton believes that time and space are independent of each other and establish classic physics building on this understanding. But Einstein recognized that time and space are interrelated, and Newton's view of space-time is only applicable to low-speed reference systems. However, the quantum non-locality further breaks Einstein's view of space-time, and people cannot describe the phenomenon of quantum entanglement in 4-dimensional space-time[21]-[23].

Corollary 11 indicates : the state change in the space-time is localized, and the state change in the dark space is the so-called non-locality. In the holographic dimensions of the ""model, localization and non-locality are no longer contradictory. This may end the dispute between Einstein and the Copenhagen school.

V. THE PHYSICAL INTERPRETATION AND GEOMETRIC INTERPRETATION OF GRAVITATIONAL ACTION

We introduce the following concepts:

Term 1: Structural holographic particles refer to holographic particles corresponding to various interactions in the universe system's various structural levels.

For example, electrons are structural holographic particles of electromagnetic interaction.

Term 2: Structural quantity refers to the coupling energy quantum of a structural holographic particle corresponding to an interaction.

For gravitation, structural quantity is the existence quantity of graviton. According to corollary 1, the structural quantity of electrons in the photoelectric effect is equal to the work function.

Term 3: Elementary structural quantity refers to the minimum structural quantity of interaction.

From the structural quantity, the level of the structure of the universe corresponding to an interaction can be quickly judged. At the same time, the structural quantity gives a unified calculation standard for interaction. Take the law of universal gravitation and Coulomb's law as an example:

$$F = G \frac{m_1 m_2}{r^2} \quad (5)$$

$$F = K \frac{q_1 q_2}{d^2} \quad (6)$$

(5) is the universal gravitation formula, and (6) is the Coulomb force formula. Although the two are completely

identical in form, one uses mass, and one uses a quantity of electric charge, which is not uniform and not at one level. Because the charge itself is only one property of the particle, the quantity of electric charge is not the existence quantity. The structural quantity can completely unify the calculation criteria of the interaction.

Term 4: The source of action refers to the existence quantity or qualitative quantity that causes the Structural holographic particles to interact.

Among the four fundamental interactions, the source of action of gravitation is the existence quantity of mass, energy, and dark mass. Other interactions' source of action is the number of interaction characteristics, such as electric charge, color charge, and weak charge.

Corollary 12: Gravitation is an interaction between the elementary holographic particles, and its elementary structural quantity is equivalent to the elementary existence quantity.

Proof: According to Lemma 4, there are only three basic forms of existence: particle, quantum, and dark particle. There exist elementary particles m_{\min} , elementary quantum q_{\min} , and dark elementary particles d_{\min} . According to lemma 1, the existences are coupled with each other by energy, And in the presence of different structural levels, by the corresponding quantum from the role of convergence. Therefore, there is an interaction between the elementary holographic particles. According to Lemma 5, the existence of quantity has its elementary unit e_{\min} . Therefore, the elementary structural quantity of gravitation is equivalent to the elementary existence quantity e_{\min} . Q.E.D.

It can be seen from Corollary 12 that the existing quantity of graviton is the most elementary existence quantity. It is also at the most elementary level in the structural level of the universe system. This is why humans have not been able to detect graviton. The

structural quantity of gravitation is the existence quantity of the graviton.

Corollary 13: Energy radiation and exchange in interactions are produced by changes in structural holographic particles' structural quantity.

proof: In the interaction, if the frequency of the coupling energy quantum of the structural holographic particle changes is $\Delta\nu$, then the energy change is:

$$\Delta E = h\Delta\nu \quad (7)$$

According to Lemma 6, the existences in an isolated system keep the total quantity of existences unchanged. Set A is an isolated system, then $m_1 + E_1 + D_1 \equiv m_2 + E_2 + D_2$. m_1 The size of system mass, energy, dark mass, respectively in time, and the size of system mass, energy, dark mass, respectively. To maintain energy conservation in an isolated system, it is necessary to absorb or release a total energy amount ΔE . This will result in energy radiation or energy exchange between the structural holographic particles. Q.E.D.

Corollary 13 shows that gravitational wave radiation is produced by changes in the structural quantity level of elementary holographic particles, electromagnetic wave radiation is produced by changes in the structural quantity level of the electrons, boson exchange in strong and weak interactions is caused by changes in the structural quantity level of the nucleus.

Corollary 14 : The discovery of gravitational waves proves that gravitons exist.

Proof: According to Corollary 12, the structural quantity of gravity is equivalent to the existing quantity of graviton; and according to Corollary 13, gravitational waves are energy radiation phenomena caused by changes in the quantity level of the graviton. This shows that the discovery of gravitational waves indirectly proves the existence of gravitons. Q.E.D.

Is this contradictory to the theory of general relativity

that gravitational waves are caused by space-time bending? Not contradictory.

Corollary 15 : gravitational action can cause changes in time, space, and dark space.

Proof: According to Cosmic Continuum Theory, space is the existence dimension of mass body, time is the existence dimension of the energy body, dark space is the existence dimension of dark mass. Because the source of gravity action is existence quantity, the change of the structure's quantity level will cause the corresponding change of existence dimension itself. Q.E.D.

Length contract effect, time expansion, and space-time curvature are the macroscopic effects of Spatio-temporal changes caused by structural changes of gravitation. This is different from other interactions. Other interactions can only cause the existence to change in space, time, and dark space, but not the dimension itself.

Therefore, space-time ripple is the geometric interpretation of graviton [24]. The energy radiation phenomena caused by the graviton's quantity level change are the physical interpretation of gravitation waves. This shows that the geometric interpretation and physical interpretation of gravitational waves are unified in Cosmic Continuum Theory.

VI. CONCLUSION

Cosmic Continuum Theory attempts to integrate existing scientific discoveries into a logical and self-consistent unified axiomatization system to find a solution to Hilbert's sixth problem. The distinction between existence and existence dimension is an important idea for Cosmic Continuum Theory. By placing the existence in the dimension, we can sort out the singularity problem that has plagued us for a long time. Although we have not yet fully understood dark particles and dark space, the holographic dimension model of "4+x" has opened up new ideas for further exploring the mysteries of the universe beyond the space-time dimension. In the holographic dimension model of "4+x", the quantum non-locality is incorporated into the state change of the dark space dimension, thus eliminating the contradiction

between locality and non-locality. Coupling energy quantum is a core concept of Cosmic Continuum Theory. According to the Cosmic continuum hypothesis, the quantized universe is a continuum. All particles, quantum, and dark particles in the universe must be connected. Only in this way can the power set of all particles, quantum, and dark particles, be constructed to form the cosmic continuum. Coupling energy quantum plays this role. Quantum phenomena, such as photoelectric effect, wave-particle duality, quantum non-locality, and fundamental interactions, can all be interpreted in a unified way by changing the coupling energy quantum.

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