Journal of Applied Mathematics and Physics, 2023, 11, 823-840
https://www.scirp.org/journal/jamp
ISSN Online: 2327-4379
ISSN Print: 2327-4352

The Historical Logic on the Basic Theory of Physics—A Summary on the Cosmic Continuum Theory

Xijia Wang

Geophysical Society of Hunan Province, Changsha, China
Email: xijiawang@hunnu.edu.cn

How to cite this paper: Wang, X.J. (2023) The Historical Logic on the Basic Theory of Physics—A Summary on the Cosmic Continuum Theory. *Journal of Applied Mathematics and Physics*, **11**, 823-840.
https://doi.org/10.4236/jamp.2023.113055

Received: March 3, 2023
Accepted: March 28, 2023
Published: March 31, 2023

Copyright © 2023 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/

Open Access

Abstract

Any scientific system has a unified basic theory. But physics has no unified basic theory in the modern sense. Classical mechanics, relativity and quantum mechanics have their own basic concepts, categories and principles, so none of them can be regarded as true basic theories of physics. Cosmic Continuum Theory holds that the continuity and discreteness of the universe are fundamental issues related to the unification of physics. Because the contradiction between quantum non-locality and local reality is the fundamental obstacle to the unification of physics, while locality and non-locality correspond to the continuity and discreteness of physical reality respectively. The cosmic continuum theory introduces mathematical continuum and axiomatic ideas to reconstruct the basic theory of physics, and by the correspondence of existence and its dimensions to achieve the unification of the essence of physical reality, by introducing the cosmic continuum hypothesis to achieve the unification of the continuity and discreteness of physical reality, by introducing axiomatic methods to achieve formal unification of the foundations on physics. From the perspective of Cosmic Continuum, classical mechanics, relativity and quantum mechanics are no longer the basic theories of physics, but three branch theories of physics that are respectively applicable to macroscopic, cosmoscopic and microcosmic systems.

Keywords

Cosmic Continuum, Axiomatization of Physics, Foundation of Physics, Hilbert's Problems, Scientific Paradigm

1. Introduction

By inheriting and developing the theories of modern thinkers from Copernicus

to Galileo, Newton founded classical mechanics in the 17th century and laid a unified physical foundation [1]. In 1900, Kelvin pointed out that there are still "two dark clouds" in the physics sky. The first dark cloud he mentioned mainly refers to the contradiction between the results of the Michelson-Morley experiment and the theory of ether drift; the second dark cloud he said mainly refers to the "ultraviolet catastrophe" that appeared in the black body radiation theory [2]. What Kelvin did not expect was that the "two dark clouds" directly led to the advent of the two theories of modern physics, relativity and quantum mechanics [3] [4]. Einstein explained the gravitational field as the curvature of space-time in the general theory of relativity, thus completely abandoning the concept of ether and sweeping away the "dark cloud" of ether drift. And Planck discovered that the energy body is composed of energy quanta, just as the mass body is composed of elementary particles, and this discovery swept away the "dark cloud" of the "ultraviolet catastrophe".

However, after the "two dark clouds" were swept away in the 20th century, physics did not have a unified foundation. Classical mechanics, relativity and quantum mechanics have their own basic concepts, categories and principles. More "dark clouds" appear in the physics sky: such as quantum non-locality, space-time diversity, unity of force, as well as dark matter, dark energy, black holes and singularities, positive-antimatter asymmetry, and more.

In order to build a new unified foundation for physics, Einstein and the Copenhagen School have launched a debate for more than half a century around "whether God throws dice" [5] [6]. In 1935, Einstein, Podolsky, and Rosen published a paper titled "Can quantum-mechanical description of physical reality be considered complete?", proposing the EPR paradox, highlighting the completeness of local realism and quantum mechanics conflict between [7]. But the EPR paradox was later ruthlessly overthrown [8]. In 1964, Bell proposed a powerful mathematical inequality that offered the opportunity to decide experimentally between quantum non-locality and Einstein's local realism. To date, Bell's inequality has been falsified by various experiments, meaning that the predictions of local realism claimed by Einstein do not conform to quantum mechanical theory. The battle between Einstein and the Copenhagen School is just the tip of the iceberg of the incongruity between the fundamental theories of physics. After Einstein's death, researches on grand unified theory, Kaluza-Klein theory, loop quantum gravity, string theory, superstring theory, M-theory, etc. appeared one after another.

While quantum non-locality has been demonstrated, the problem remains unsolved. One cannot help but ask, in physics, why should the same universe be described by three different theories of classical mechanics, relativity and quantum mechanics? Three theories cut a complete, unified universe into three seemingly unrelated pieces: one is the macroscopic world, which is described by classical mechanics; the other is the cosmoscopic world, which is described by general relativity; the third is the microscopic world, which is described by quantum mechanics. Why can't it be described by a unified basic theory of

physics? Physics calls for a unified fundamental theory.

Coincidentally, in 1900, when Kelvin delivered a speech on "two dark clouds" in physics, Hilbert also gave a speech entitled "Mathematical Problems". Hilbert put forward 23 problems based on the results and development trends of mathematical research in the 19th century, which were called Hilbert's mathematical problems in history [9]. The question is, if the universe is a continuum, can the axiomatization of physics be achieved?

The Cosmic Continuum Theory integrating the oriental scientific thinking of holistic, unified and inclusive, put forward the idea that the universe is a unified, continuous and complete whole, and by the correspondence of existence and its dimensions to achieve the unification of the essence of physical reality, by introducing the cosmic continuum hypothesis to achieve the unification of the continuity and discreteness of physical reality, by introducing axiomatic methods to achieve formal unification of the foundations on physics [10]-[22].

2. The Correspondence Existence and Its Dimension: Unity of the Essential of Physical Reality

Physics is nothing more than science that studies the basic laws of physical reality and its structure, change, and motion. The analysis on the basic theory of physics mainly has two aspects: one is the description of physical reality, and the other is the description of physical motion.

Kuhn believes that breakthroughs in the scientific paradigm led to the scientific revolution [23]. In other words, the scientific revolution needs to break through the existing scientific paradigm. In the history of physics, the existing fundamental scientific theories have been established in accordance with Western scientific traditions. Cosmic Continuum Theory tries to break through the western scientific paradigm and builds on the eastern scientific tradition.

Holistic, unity and inclusiveness are typical ways of thinking in the Eastern scientific tradition represented by Classic of Changes. The opening book of Yi Zhuan·Hexagram Order said: "There is heaven and earth, and then everything is born [24]." Put heaven and earth before all things, and treat all things as a unified whole. Cosmic Continuum Theory re-understands both physical reality and physical motion with holism, unified, and inclusive thinking.

Since the establishment of classical physics theories, there have been many descriptions of physical reality, but what really affects the development of physical theories, I think that there are two categories of physical existence, namely mass and energy. The so-called physical existence refers to the essence of physical reality. The category of physical existence has gradually entered the human vision with the deepening of the understanding of the category of physical reality, and every progress in the cognition of physical existence will give birth to a new theory of physics.

The cognition of physical reality in classical mechanics mainly established the physical existence category of mass. Mass is the first definite existence quantities in physical reality. Without the concept of mass, there would be no classical

physics. In classical mechanics, mass is the quantity of matter, and all other quantities such as momentum, angular momentum, heat, electricity, and energy are subordinate to mass. In ancient times, there was no distinction between mass and weight. It was the advent of the concept of mass that cleared the final barriers for the establishment of Newton's laws of motion and the law of universal gravitation. Newton obtained the following two key equations. 1) Newton's second law of motion: $F = ma$. Where F is force, m is mass, and a is acceleration. 2) Law of universal gravitation: $F = G\frac{m_1 m_2}{r^2}$. Where F is the universal gravitation, G is the gravitational constant, m_1 and m_2 are the masses of the two objects, and r is the distance between the two objects.

The cognition of physical reality in Modern physics mainly established the physical existence category of energy. Energy is the second identified category of physical existence in physical reality. Without the concept of energy, there would be no modern physics. In classical physics, energy is generated by the motion of matter. But relativity found that energy is actually a kind of moving mass, and mass is a kind of static energy. Energy is a physical existence parallel to mass, and the two can be transformed into each other. In the theory of relativity, Einstein gave the corresponding relationship when mass and energy are transformed: Where E is the energy, m is the mass, and c is the speed of light. It shows that if a mass body m is transformed into an energy body E, the size of the energy body E is mc^2.

In quantum mechanics, Planck found that an energy body is composed of energy quanta, just as a mass body is composed of elementary particles. It was this discovery that wiped out the "dark cloud" of the "ultraviolet disaster". Planck gives the following equation: $E = h\upsilon$. Where E is the energy quantum, υ is the frequency of the energy quantum, and h is the Planck constant.

The cognition of physical reality in Cosmic Continuum Theory mainly establishes the category of physical existence. Without the concept of existence quantity, there would be no Cosmic Continuum Theory. Cosmic Continuum Theory deduces dark particles from the frequency boundary value $\upsilon_{\max}$ ($\upsilon_{\max} = \frac{1}{t_p}$, t_p is Planck time). This new physical existence exists in the form of dark masses [17]. Therefore, in addition to the mass body and energy body, there is also a physical existence logically parallel to them: the dark mass body.

According to the paradigm of existing physical theories, if the physical existence category of dark mass is established, a physical theory applicable to the dark space of the universe can be established. However, if this is done, it will not solve the problem of unification of physics, but will only add a physical theory that is parallel to the three physical theories. Therefore, Cosmic Continuum Theory abandoned the existing physical theoretical paradigm and chose the oriental scientific paradigm of thinking of holistic, unity and inclusiveness. The method is to combine mass, energy, and dark mass into the existence quantity, and collectively refer to all mass bodies, energy bodies, and dark mass bodies as

existence. In this way, physics' cognition of physical existence has been promoted from phenomena to essence.

In the cosmic continuum, dark energy is actually gravitational field energy. In addition to gravitational force, a gravitational field energy also produce an expansion force. Because the singularity of the universe continues to erupt outwards, the gravitational field energy radiate outward with the singularity as the center, thereby generating the expansion force [22].

The description of physical motion has evolved with the development of fundamental theories of physics. The Mathematicians believes that all mathematical systems are descriptions of nature, and all natural systems can be described by mathematics. In fact, the same physics theory can be described by different mathematical tools, which is why mathematics and physics always develop each other. However, the Physicists believe in facts more. They believe that mathematical theories that conform to physical facts are truly reliable. Therefore, different physics theories will always choose the mathematical tool that is more suitable for them.

In classical mechanics, physical motion is the motion of objects, that is, a mass body. Objects are 3-dimensional, and Euclidean geometry is an excellent tool for describing the movement of objects in 3-dimensional space. Since the law of conservation of mass is an iron law pursued in the era of classical mechanics, there is no change in mass of an object in motion. The mass of the object does not change during the movement, and the gravitational force to which the object is subjected will not change, so there will be no space bending. Moreover, even from the perspective of modern physics, in macrocosmic system, the error in describing physical motion by Euclidean geometry is not large.

The relativity mass-energy equation breaks the law of the conservation of matter of classical mechanics, and the principle of material immortality is replaced by the law of mass-energy conservation. In this way, the mass no longer remains unchanged during the movement, but will change with the change of energy. The gravitation of an object in motion will also change. In this case, using Euclidean geometry to describe the motion of an object would be complicated and cumbersome. Einstein solved this problem by finding Riemann geometry. Riemann geometry is a type of non-Euclidean geometry, also called "elliptical geometry", which is a kind of positive curvature geometry. The spacetime in Riemann geometry is curved and conforms to the principle of general relativity.

Experiments show that in the large scale cosmic system, general relativity better describes the motion of objects; if it is described by classical mechanics, it will get almost wrong results. Taking the motion of light as an example, light rays will bend in the gravitational field, but this kind of bending is not obvious at the macrocosmic system. But in the large-scale universe system, the bending of light in the gravitational field Effects (such as the effect of gravitational lensing) will become apparent. This is why classical theory is based on Euclidean geometry and general relativity is based on Riemann geometry.

Quantum mechanics introduced wave-particle duality, and established physical theory of microcosmic system. In order to quantitatively describe the state of microscopic particles, wave function is also introduced. The square of the module of wave function corresponds to the probability density that microscopic particles appear somewhere. And the probability density of micro particles appearing everywhere has obvious physical meaning, so the wave function represents a kind of probability wave [25].

The cognition of physical motion in Cosmic Continuum Theory mainly establishes the physical category of existence dimension. Cosmic Continuum Theory found that space and time are the dimensions of existence of mass and energy, respectively. Space changes with the change of mass body. Without change in mass, there is no change in space; changes in space are all caused by changes in quality. Time changes with the change of energy body. Without change in energy, there is no change in time; changes in time are all caused by changes in energy.

The question is, if the existence dimension of the mass body is space and the existence dimension of the energy body is time, what is the existence dimension of the dark mass body? In this way, Cosmic Continuum Theory deduced the existence dimension of dark space beyond time and space.

We know that space has 3 dimensions and time has 1 dimension, and classical theory is based on three-dimensional space, and relativity is based on 4-dimensional space-time. However, it is not clear exactly how many dimensional the dark space is, because dark matter is still an unknown domain. Therefore, the dark space can only be temporarily set to the x dimension. In this way, Therefore, Cosmic Continuum Theory obtains a "$4 + x$"-dimensional universe model. The cosmic continuum does not exclude the Euclidean geometric space of classical mechanics and the Riemann geometric space model of relativity, nor the probability theory model of quantum mechanics.

3. Cosmic Continuum Hypothesis: Unity of Continuity and Discreteness

The space-time bending of the theory of relativity denies the existence of the gravitational transmission medium ether, and successfully establishes the foundation of physics on the geometric system. But this does not stop people from continuing to explore the physical causes of gravity. Among the four kinds of interactions, except for gravity, people have found bosons that transmit interactions, so people also believe that there are bosons that transmit gravitational effects, which are so-called gravitons. The graviton hypothesis swept away the last barrier to quantum theory; at least in theory, the quantization hypothesis has no obstacles. Quantized physical reality means the discreteness of the universe, and the wave function in quantum mechanics represents the fluctuation of probability that describes the discreteness. Quantum mechanics breaks the understanding of the continuity of the universe in classical mechanics and relativity, and also destroys the unified foundation of physics. And that's exactly why Einstein

fought the Copenhagen School.

Is the universe continuous or discrete? This is a fundamental question concerning the unity of physics. Therefore, although there are countless "dark clouds" in the sky of physics, from the perspective of the unity of physics, in the final analysis, there are "two dark clouds". The first dark cloud is "quantum non-locality", that is, the so-called "Does God play dice?" The second dark cloud is "diversity of space-time", that is, the incongruity between absolute space-time, relative space-time, and the quantization of space-time. Because locality and non-locality correspond to the continuity and discreteness of physical reality, respectively, and space-time is a mathematical description of the existence dimension of physical reality. Therefore, sweep away these "two dark clouds" and physics will reproduce the clear sky.

In mathematics, continuous is relative to discrete. Continuous means uninterrupted. On the number line, the real number line is the unbroken line, so it is called the continuum. Because the interval has similar properties, the interval is also called the continuum. The same can be extended to two-dimensional continuum, three-dimensional continuum and so on.

In 1874, Cantor introduced the concept of cardinal numbers based on the "1-1 correspondence" principle. Cantor proved that the cardinal number of the continuum, C, is equal to the cardinal number of the power set of the natural number set, $2^{\aleph_0}$, where $\aleph_0$ is the cardinal number of the natural number set. Cantor arranges the cardinal number of infinities from small to large as $\aleph_0, \aleph_1, \cdots, \aleph_a, \cdots$. Among them, a is an arbitrary ordinal number, which means that the cardinal number of the natural number set, $\aleph_0$, is the smallest infinity cardinal number. Cantor conjectured: $2^{\aleph_0} = \aleph_1$. This is the famous Continuum hypothesis (CH), which is Hilbert's first problem. For any ordinal a, $2^{\aleph_a} = \aleph_{a+1}$ holds, it is called the Generalized continuum hypothesis (GCH) [26]. In 1938 Gödel proved that the CH is not contradictory to the ZFC axiom system. In 1963, Cohen proved that the CH and the ZFC axiom system are independent of each other. Therefore, the CH cannot be proved in the ZFC axiom system.

Entering the 21st century, Sergeyev questioned the principle of "1-1 correspondence". He argues that cardinality theory conflicts with another universal principle in mathematics, "the whole is greater than the parts." For example, according to cardinality theory, the cardinal number of the set of integer is equal to the cardinal number of the set of positive or negative integer numbers; the cardinal number of the set of real numbers is equal to the cardinal number of the set of positive or negative numbers. In order to overcome this problem, Sergeyev introduced the Grossone ① method, which takes the number of elements in the set of natural numbers as a total number, denoted as ①, as the basic number symbol for expressing infinity and infinitesimal, so as to accurately describe infinity and infinitesimal.

Below we use Grossone method to examine the integer set Z and real number set R.

$$Z=\left\{-①,-①+1,\cdots,2,1,0,1,2,\cdots,①-1,①\right\}$$

$$R=\left[-①,-①+1\right)\cup\cdots\cup\left[1,0\right)\cup\left\{0\right\}\cup\left(0,1\right]\cup\cdots\cup\left(①-1,①\right]$$

It is easy to see that there are no integers and real numbers exceeding ① in both the integer set and the real number set.

The number of elements in the integer set is $2①+1$; because the number of elements in (0, 1] is $10^{①}$, the number of elements in the real number set is: $C=2①\cdot 10^{①}+1$.

The Grossone ① method seriously shakes the foundation of the continuum hypothesis, making the continuum problem return to the problem of infinity and infinitesimal [27].

Traditional mathematics has an axiom: a point has no size. Taking the interval $\left(0,1\right]$ on the number line as an example, since there are infinitely many points on the interval $\left(0,1\right]$, the size s of the point in the interval $\left(0,1\right]$ is: $s=\lim\limits_{x\to\infty}\dfrac{1}{x}=0$. This proof uses the potential infinity thoughts. In mathematics, potential infinity and actual Infinity are two different views on infinity. Potential infinityists believe that infinity is not completed, but infinity in terms of its development, and infinity is only potential. Actual infinityists believe that infinity is a real, completed, existing whole. The theory of calculus adopts the concept of potential infinity, while Cantor's cardinality theory and Sergeyev's Grossone ① theory adopt the concept of actual infinity.

If the idea of actual infinity is adopted, by cardinal number method, the calculation method of the size of the point should be: because the interval $\left(0,1\right]$ is a continuum, its cardinal number is C, and the continuum is a linear ordered set of "dense and no holes", that is, the distance between two adjacent points is 0, so the size of the point in the interval $\left(0,1\right]$ is: $s=\dfrac{1}{\mathrm{C}}$. According to the cardinal number method, the cardinal number of the continuum is $C=2^{\aleph_0}>\aleph_0$, so $\dfrac{1}{\mathrm{C}}<\dfrac{1}{\aleph_0}$, which indicates that the reciprocal of the cardinal number of the infinity is infinitesimal rather than zero, otherwise $\dfrac{1}{\mathrm{C}}=\dfrac{1}{\aleph_0}$, contradicts $\dfrac{1}{\mathrm{C}}<\dfrac{1}{\aleph_0}$. Therefore $s=\dfrac{1}{\mathrm{C}}>0$. This contradicts that the point has no size.

This result can also be explained from the traditional mathematical axiom that "a point has no size", that is, the distance between two adjacent points in the continuum is not 0, but $s=\dfrac{1}{\mathrm{C}}>0$, but the continuum is not "dense and no holes". This forms a "continuum paradox": either violate "a point has no size", or violate "the continuum is dense and no holes".

The concept of relative continuity proposed by Sergeyev in Grossone ① theory solves this problem well [27].

Sergeyev established the relative continuity on the function $f\left(x\right)$. The point

that stipulates the range of the independent variable $[a,b]_S$ of $f(x)$ can be a finite number or an infinity, but the set $[a,b]_S$ is always discrete, where S represents a certain numeral system. In this way, for any point $x \in [a,b]_S$, its nearest left and right neighbors can always be determined:

$$x^+ = \min\{z : z \in [a,b]_s, z > x\}$$

$$x^- = \max\{z : z \in [a,b]_s, z < x\}$$

Suppose a set $X = [a,b]_s = \{x_0, x_1, \cdots, x_{n-1}, x_n\}_s$, where $a = x_0$, $b = x_n$, and the numeral system S allow a certain unit of measure μ to be used to calculate the coordinates of the elements in the set. If for any $x \in (a,b)_S$, $x^+ - x$ and $x - x^-$ are infinitesimal, then the set X is said to be continuous in the unit of measure μ. Otherwise, set X is said to be discrete in the unit of measure μ.

For example, if the unit of measure μ is used to calculate that the position difference between adjacent elements of set X is equal to $①^{-1}$, then set X is continuous in the unit of measure μ; but if the unit of measure $\upsilon = \mu \cdot ①^{-3}$ is used instead, calculate that the position difference between adjacent elements of the set X is equal to $①^2$, then the set X is discrete in the unit of measure υ. Therefore, whether the set X is continuous or discrete depends on the size of the unit of measure μ.

Function $f(x)$ is continuous in the unit of measure at some point $x \in (a,b)_S$ in $[a,b]_S$, if $f(x^+) - f(x)$ and $f(x) - f(x^-)$ are both infinitesimal. If only one is infinitesimal, it can be called left continuous or right continuous. If function $f(x)$ is continuous in the unit of measure μ at each point of $[a,b]_S$, then $f(x)$ is said to be continuous in the unit of measure μ on set $X = [a,b]_s$.

In layman's terms, relative continuity is the continuity associated with a unit of measure. Assuming that the distance between any adjacent elements in a set is infinitesimal under a certain unit of measurement, then the set is continuous for that unit of measurement, and discrete otherwise. By this definition, the same set that is continuous for one unit of measure may be discrete for another. The theory of relative continuity realizes the unity of continuity and discreteness. In the theory of relative continuity, the traditional mathematical axiom "a point has no size" still holds, but the distance between two adjacent points is not 0. In order to distinguish it from the existing continuum theories, I refer to the traditional continuum as the absolute continuum, and the relative continuity set as the relative continuum. It can be seen from the above discussion that the absolute continuum is only a special case of the relative continuum.

The cosmic continuum is the basic theory of physics established on the basis of the mathematical continuum. According to the understanding of the physical existence and its dimension in Cosmic Continuum Theory, after the concept of existence quantity is established, if the mass body, energy body and dark mass body in the universe are regarded as three infinite sets that can be listed, then their power set is exactly one absolute continuum. This continuum composed of mass body, energy body, and dark mass body is the so-called existence conti-

nuum. And space, time, and dark space are the existence dimensions of mass body, energy body, and dark mass body, respectively, and they change with the change of mass, energy, and dark mass, respectively, then they will also form a absolute continuum. This continuum composed of space, time and dark space is the so-called existential dimension continuum.

Cosmic continuum hypothesis: the universe is a continuum consisting of an existence continuum and an existing dimension continuum. The existence continuum is composed of mass bodies, energy bodies and dark mass bodies. The existing dimension continuum is composed of space, time and dark space [17].

In the cosmic continuum, particle, quantum and dark particle are the three basic quantized existence forms, of which dark particle refers to the existence form when the frequency of particles and quantum reaches the limit value; mass body is the existence body composed of particles, The energy body is the existence body composed of quantum, and the dark mass body is the existence body composed of dark particles; mass is the measure of the inertia of the mass body, energy is the measure of the inertia of the energy body, and dark mass is the measure of the inertia of the dark mass body, in which inertia refers to the inherent existence property of existing body; space is the existence dimension of mass body, time is the existence dimension of energy body, and dark space is the existence dimension of dark mass body.

The cosmic continuum theory believes that there are three basic entities in the universe: mass body, energy body and dark mass body. Their smallest units are elementary particle $m_{\min}$, elementary quantum $q_{\min}$, and elementary dark particle $d_{\min}$.

In this way, we get three countably-infinite sets in the universe: elementary particle set M, elementary quantum set Q, and elementary dark particle set D. Suppose m_i is a elementary particle, q_i is a elementary quantum, d_i is a elementary dark particle, i is a natural number, then:

$$M=\{m_1,m_2,\cdots,m_i,\cdots\},\quad Q=\{q_1,q_2,\cdots,q_i,\cdots\},\quad D=\{d_1,d_2,\cdots,d_i,\cdots\}$$

Thus, the basic existence set E is obtained:

$$\begin{aligned}E&=M\cup Q\cup D\\&=\{m_1,m_2,\cdots,m_i,\cdots\}\cup\{q_1,q_2,\cdots,q_i,\cdots\}\cup\{d_1,d_2,\cdots,d_i,\cdots\}\\&=2^E=\{e|e\subseteq E\}\end{aligned}$$

According to the cosmic continuum theory, the coupling energy quantum connects all existence bodies into the universe as a whole, and the change of any existence body in the universe affects the whole. Due to the action of coupling energy quantum, the power set of the basic existence set E will form the existence continuum $P(E)$:

$$P(E)=2^E=\{e|e\subseteq E\}$$

Since space is the existence dimension of mass bodies, time is the existence dimension of energy bodies, and dark space is the existence dimension of dark

mass bodies, correspondingly, we get the smallest units A, B, and C of space, time, and dark space, respectively. So three other countable infinite sets in the universe can be obtained: basic space set *S*, basic time set *T* and the basic dark space set *G*. Suppose s_i is the elementary space, t_i is the elementary time, g_i is the elementary dark space, *i* is a natural number, then:

$$S=\{s_1,s_2,\cdots,s_i,\cdots\},\ T=\{t_1,t_2,\cdots,t_i,\cdots\},\ G=\{g_1,g_2,\cdots,g_i,\cdots\}$$

Thus, we obtain the following basic dimension set *W*:

$$W=S\cup T\cup G=\{s_1,s_2,\cdots,s_i,\cdots\}\cup\{t_1,t_2,\cdots,t_i,\cdots\}\cup\{g_1,g_2,\cdots,g_i,\cdots\}$$

The basic dimension set *W* will correspondingly form the following power set, namely the dimension continuum $P(W)$:

$$P(W)=2^W=\{w|w\subseteq W\}$$

In Cosmic Continuum Theory, the dimensional continuum $P(W)$ is the mirror image of the existence continuum $P(E)$. For example, Euclidean space, Riemann space, probability space, etc. in Newtonian mechanics, relativity theory and quantum mechanics, respectively, correspond to the space-time mirror images of physical events in the corresponding physical theories.

According to the cosmic continuum hypothesis, let the cosmic continuum be *U*, then:

$$U=P(E)\cup P(W)=2^E\cup 2^W=\{e|e\subseteq E\}\cup\{w|w\subseteq W\}$$

The cosmic continuum is a multi-dimensional continuum composed of the power set of the basic existence set and the power set of the basic dimension set, in other words, the continuum composed of all physical events in the universe. Every element of the cosmic continuum is a physical event. According to the theory of relative continuity, every physical event is a relative continuum, a unity of continuity and discreteness.

4. Axiomatization of Physics: Formal Unity of Basic Theory

Axiomatization is an important tradition in the development of Western science. It can be traced back to Aristotle's complete syllogism and Euclidean geometry in the ancient Greek period. The first fundamental theory of unified physics was Newtonian mechanics, which was established with reference to Euclidean geometry. In 1899, the Hilbert geometry system once again pushed the axiomatic thought to a new height. In 1900, Hilbert listed the "Axiomatization of Physics" as the sixth problem in his famous "Mathematical Problems" lecture at the International Congress of Mathematicians in Paris. Maybe he thinks that the consistency, independence and completeness of axiomatic theory is too important for physics!

Theoretically speaking, a strict and complete axiom system must have the following three basic requirements for the selection and setting of axioms: First, consistency. It means that in an axiom system, it is not allowed to prove a theorem and its negation at the same time. The second is independence. It means

that each axiom in an axiom system exists independently, and it is not allowed to have an axiom that can be derived from other axioms, while reducing the number of axioms to a minimum. The third is completeness, referring to ensuring that all the propositions studied can be derived in an axiomatic system.

The axiomatic system of probability theory established by Kolmogorov that has so far been recognized as meeting the solution criteria, fulfills a minor goal of Hilbert's sixth problem. The axiomatization of probability theory was specifically mentioned by Hilbert when he raised the sixth question. In 1933, Kolmogorov's monograph "Fundamentals of Probability Theory" was published, in which the strict axiom system of probability theory was established for the first time on the basis of measure theory. This may serve as a specimen of the axiomization of physics.

But unexpectedly, within 30 years after Hilbert's sixth problem was raised, physics has undergone tremendous changes, and classical physics has been gradually replaced by modern physics [28]-[38]. Later, axiomatization achieved certain success in quantum mechanics and quantum field theory. Modern physics has two main theories, relativity and quantum mechanics. So, should the axiomatic goal of physics be to establish the physics axiom system of each branch separately, or to realize the unity of physics by establishing the physics axiom system?

Cosmic Continuum Theory chose the latter. Because the original intention of Hilbert's sixth problem should be to strictly construct the axiom system of physics from a set of initial assumptions. In the axiom system of physics, no contradiction will be allowed in the physics foundation, but all the laws of physics can be derived from the same axiom system. In this way, physics will no longer be an unrelated description of different cosmic phenomena, but a set of rigorous mathematical, logically consistent, and unified theoretical systems that reflect physical reality.

The axiom system of cosmic continuum is based on the cosmic continuum hypothesis, and has 5 axioms [17]. These 5 axioms are refined after absorbing the essence of classical mechanics, relativity and quantum mechanics.

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

Boundary axiom is the inheritance and development of the "quantum hypothesis" in quantum mechanics. "Boundary axiom" shows that Cosmic Continuum Theory has a clear research boundary. According to Gödel's incompleteness theorem, a theoretical system without setting research boundaries is incomplete. For example, the "two dark clouds" that appeared in classical physics at the end of the 19th century were actually caused by the problems involved that went beyond the research boundaries of classical physics. Similarly, the emergence of new "dark clouds" in the sky of modern physics is also because they are beyond the boundaries of modern physics research.

Axiom 2 (Inertia axiom): In a cosmic system A, the elementary particles, elementary quantum and elementary dark particles all have inertia and are equivalent in size: $m_{\min} \equiv q_{\min} \equiv d_{\min}$. "$\equiv$" is the "equivalent" symbol.

In modern physics, physical equivalent is a universal cosmic phenomenon. The "principle of equivalence" revealed by general relativity is just a special case of physical equivalence. Inertia axiom shows that the essence of physical equivalence is inertial equivalence. Cosmic Continuum Theory further deduces that the physical dimension of the existing quantity and the physical dimension of the dimensional quantity can be unified on the abstract physical dimension, respectively. All changes in the universe can be equivalent in abstract physical dimensions [18].

Axiom 3 (Conservation axiom): 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, E_{t_1}, d_{t_1} and m_{t_2}, E_2, d_2 the size of system mass, energy, dark mass , respectively in time t_1, t_2.

Conservation axiom shows that any existence will not disappear out of thin air. This is actually what we often call "matter conservation". Cosmic Continuum Theory found that the nature of physical conservation is the conservation of existence. Although there are many conservation laws in physics, such as conservation of mass, conservation of energy, conservation of momentum, conservation of angular momentum, conservation of charge, etc., they all ultimately come down to conservation of existence.

Axiom 4 (Couple axiom): 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. If there is a structure at the structural level of the quantum of q connection, e the corresponding amount of existence, the corresponding structure of the particle m, dark particle d is also the amount of e: $m \equiv d \equiv q \equiv e$.

Couple axiom states that all existence is connected by energy quanta. It reveals the secret of the cosmic continuum, which is that any existence body is connected to all other existence body through energy quanta. Couple axiom is the "power set mechanism" of the set of existence body, which enables any existence body at any level in the universe to combine with other existence body to form new existence body.

The scientific of the Couple axiom has been questioned by some opponents. They believe that the coupling energy quantum of the same structural level is equivalent to the amount of existence of the connected particles and dark particles, there is no scientific basis. We can easily explain this principle with a thought experiment. The "Couple axiom" is actually the "law of buoyancy" in the micro world. "Law of buoyancy" says that an object immersed in a stationary fluid is subjected to a buoyancy force whose size is equal to the weight of the fluid expelled by the object. In other words, buoyancy is a change in the energy produced by the fluid to support floating objects due to the existence of floating objects. This energy change value is equal to the amount of existence of floating

objects.

In the cosmic continuum model, the universe is an energy ocean with floating masses and dark masses, and this energy ocean is composed of energy quanta one by one, and the floating mass and dark mass are also composed of particles and dark particles one by one. One by one particles and dark particles are supported by one by one energy quantum, and follow the "law of buoyancy" where the amount of existence is equivalent.

If an amount of existence is Z, its supporting energy is E; also suppose that the size of the holographic particle that composes the existence body is z, and the size of the energy quantum that composes the supporting energy is e. Then the quantity of existence is equivalent to its support energy, and the number of holographic particle that make up the existence body is equal to the number of energy quanta that make up the support energy, that is, $Z \equiv E$ and $\frac{Z}{z} = \frac{E}{e}$.

On the contrary, in the microcosm, if the amount of existence of microscopic particle and the energy quantum supporting it at the same structural level are not equivalent, there will be a situation where the "buoyancy" is greater or less than the amount of existence of microscopic particles, and the result must be the collapse of the structure. Just like a boat in the sea, if its buoyancy is not equal to its weight, then it will either sink to the bottom of the sea or be overturned.

Axiom 5 (Variation axiom): 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 system of the universe be Δx, then $\Delta E \equiv \Delta x$.

Variation axiom shows that the essence of physical motion, including quantum phenomena and interactions, is the change of energy. The change equation $\Delta E \equiv \Delta x$ was inspired by the Classic of Changes. The most exquisite aspect of thought of Classic of Change is that as its name reveals, it is "change". If you write $E = mc^2$ as $\Delta E = \Delta mc^2$, you will find that the mass-energy equation is a special case of the change equation, Because $\Delta E = \Delta mc^2$ can also be written as $\Delta E \equiv \Delta m$.

In the change equation $\Delta E \equiv \Delta x$, ΔE refers to the energy change of the universe system, and all energy changes will eventually fall on the energy quantum changes in the universe system. Because of $E = h\upsilon$ (h is the Planck constant, υ is the frequency of the quantum), there are: $\Delta E = \sum_{i=1}^{n} h\Delta\upsilon_i$, where i is a natural number. This formula can be called the energy change equation, which reveals the nature of energy change.

In the change equation $\Delta E \equiv \Delta x$, Δx refers to the corresponding change in the state of the universe system when the energy changes, and the change of the state of the universe system is generally not a single change, but a collection of multiple changes. Therefore, $\Delta x = \sum_{i=1}^{n} \Delta x_i$, where i is a natural number. In the change equation, the change of energy is the independent variable, and the cor-

responding change of the state of the universe system is the dependent variable.

5 axioms of Cosmic continuum are concise and clear. First, there is no contradiction in the system, which meets the requirement of consistency; second, there is no mutual proof between axioms, which meets the requirement of independence; third, the research boundaries are clear, which meets the requirement of completeness. This shows that the Cosmic Continuum Theory is a strict and perfect axiomatic system, which achieves the goal put forward by Hilbert's sixth problem "axiomatization of physics": the formal unification of the foundation of physics.

In summary, we can obtain the following brief table of the development of physical theory (Table 1):

Table 1. Overview of the development of physics theory.

	Classical Physics	Modern Physics		Unified Physics
Physical Existence	Mass m	Mass m Energy E		Mass m Energy E Dark mass D
physical theory	Classical mechanics	Quantum mechanics	Relativity	Cosmic Continuum Theory
Existence Dimension	3-dimensional space	3-dimensional space	4-dimensional space-time	4-dimensional space-time x-dimensional dark space
Physical constant	Gravitational constant G	Planck constant h	Speed of light c	frequency extreme value $\upsilon_{\max}$
Mathematical equation	$F = ma$ $F = G\frac{m_1 m_2}{r^2}$	$E = h\upsilon$	$E = mc^2$	$\Delta E \equiv \Delta x$

5. Conclusions

Cosmic Continuum Theory is not the so-called ultimate theory of physics. It is just an axiomatic unified theory that inherits and develops the achievements of the existing theories of physics.

Cosmic Continuum Theory absorbs the essence of classical mechanics, relativity and quantum mechanics, and at the same time breaks the logical barriers between classical mechanics, relativity and quantum theory.

Cosmic Continuum Theory integrates the holistic, unified and inclusive oriental scientific thinking, overcomes the limitations of traditional scientific thinking, and provides a new philosophical path for the unification of the foundations of physics.

Cosmic Continuum Theory is based on the latest research results of the mathematical continuum, and uses axiomatic methods to establish a theoretical

system, inheriting and developing the scientific tradition of establishing the basic theory of physics since Newton.

Cosmic Continuum Theory can be expressed by the following formula: Cosmic Continuum Theory = (Classical Mechanics + Relativity + Quantum Mechanics) × (Holistic + Unified + Nclusive) × Continuum × Axiomatization.

Conflicts of Interest

I declare that there is no conflict Interest.

References

[1] Newton (2006) Mathematical Principles of Natural Philosophy. Peking University Press, Beijing.

[2] Jones, A.Z. (2017) Kelvin's "Clouds" Speech. ThoughtCo, New York, NY.

[3] Pauli, W. (1979) Theory of Relativity. Shanghai Science and Technology Press, Shanghai.

[4] Dirac, P.A.M. (2008) Principles of Quantum Mechanics. Science Press, Beijing.

[5] Gribin, J. (2009) Looking for the Cat of Schrödinger. Translated by Zhang Guangcai, Hainan Publishing House, Haikou.

[6] Penrose, R (2007) Emperor's New Brain. Translated by Xu Mingxian and Wu Zhongchao, Hunan Science and Technology Press, Changsha.

[7] Van Fraassen, B.C. (1974) The Einstein-Podolsky-Rosen Paradox. *Synthese*, **29**, 291-309. https://doi.org/10.1007/BF00484962

[8] Aspect, A. (1999) Bell's Inequality Test: More Ideal than Ever. *Nature*, **398**, 189-190. https://doi.org/10.1038/18296

[9] Kline, M. (1972) Hematical Thought from Ancient to Modern Times. Oxford University Press, Oxford.

[10] Wang, X.J. (1997) Modern Interpretation of the I Ching System. *Social Sciences*, No. 9, 57-59.

[11] Wang, X.J. (1990) The Poverty and Way Out of Science. *Science and Management*, No. 4, 28-30.

[12] Wang, X.J. and Wu J.X. (1992) Theory of Unification. Haitian Publishing House, Shenzhen.

[13] Wang, X.J. and Wu J.X. (1993) Theory of Unification: Deciphering the Mysteries of the Universe. *Science and Technology Tide*, **11**, 24-26.

[14] Wang, X.J. (1997) The Sublimation of Thought Test. *Invention and Innovation*, No. 6, 8-9.

[15] Wang, X.J. and Wu, J.X. (2001) Solving the Mystery of Scientific Unification. Hunan Science and Technology Press, Changsha.

[16] Wang, X.J. (2003) Unity Theory: Challenging Traditional Scientific Norms. *Invention and Innovation*, No. 4, 32-33.

[17] Wang, X.J. (2018) Cosmic Continuum Theory: A New Idea on Hilbert's Sixth Problem. *Journal of Modern Physics*, **9**, 1250-1270. https://doi.org/10.4236/jmp.2018.96074

[18] Wang, X.J. (2018) New Discovery on Planck Units and Physical Dimension in Cosmic Continuum Theory. *Journal of Modern Physics*, **9**, 2391-2401.

https://doi.org/10.4236/jmp.2018.914153

[19] Wang, X.J. (2020) Axiomatization of the Symbols System of Classic of Changes: The Marriage of Oriental Mysticism and Western Scientific Tradition. *Foundations of Science*, **25**, 315-325. https://doi.org/10.1007/s10699-019-09624-5

[20] Wang, X.J. (2020) New Explanation on Essence of Quantum Phenomena and Interactions and the Gravitational Action in Cosmic Continuum Theory. *SSRG International Journal of Applied Physics*, **7**, 88-96. https://doi.org/10.14445/23500301/IJAP-V7I3P114

[21] Wang, X.J. (2022) Hilbert's First Problem and the New Progress of Infinity Theory. Research Square. Preprint. https://doi.org/10.21203/rs.3.rs-306991/v1

[22] Wang, X.J. (2022) The Mirror Reversal Mechanism on Black Hole Collapse and Singularity Eruption in Cosmic Continuum. Research Square. Preprint. https://doi.org/10.21203/rs.3.rs-958444/v6

[23] Thomas, S.K. (1996) The Structure of Scientific Revolutions, University Of Chicago Press, Chicago.

[24] Song, Z.Y. (2000) Zhou Yi. Yuelu Book Club, Changsha.

[25] Surhone, L.M., Tennoe, M.T. and Henssonow, S.F. (2010) Probability Amplitude. Betascript Publishing, Beau Bassin.

[26] Cantor, G. (1952) Contributions to the Founding of the Theory of Transfifinite Numbers. Dover Publications, New York, NY.

[27] Sergeyev, Y.D. (2017) Numerical Infifinities and Infifinitesimals: Methodology, Applications, and Repercussions on Two Hilbert Problems. *EMS Surveys in Mathematical Sciences*, **4**, 219-320. https://doi.org/10.4171/EMSS/4-2-3

[28] Tulsi, D. (2009) A Stepwise Planned Approach to the Solution of Hilbert's Sixth Problem. I: Noncommutative Symplectic Geometry and Hamiltonian Mechanics.

[29] Klein, M. and Shadmi, D. (2008) Organic Mathematics—Proposing a Way to Solve Hilbert's 6th Problem. *International Journal of Pure and Applied Mathematics*, **49**, 329-340

[30] Sudarshan, E.C.G. and Mukunda, N. (1974) Classical Dynamics: A Modern Perspective. Wiley, New York.

[31] Gorban, A.N. (2018) Hilbert's Sixth Problem: The Endless Road to Rigour. Royal Society Publishing, London. https://doi.org/10.1098/rsta.2017.0238

[32] Aldaya, V. and De Azcarraga, J.A. (1980) Geometric Formulation of Classical Mechanics and Field Theory. *La Rivista del Nuovo Cimento*, **3**, 1-66. https://doi.org/10.1007/BF02906204

[33] Corry, L. (2004) David Hilbert and the Axiomatization of Physics (1898-1918): From Grundlagen der Geometrie to Grundlagen der Physik. Archimedes: New Studies in the History and Philosophy of Science and Technology 10, Kluwer Academic Publishers, Dordrecht.

[34] Ferreirós, J. (1999) Labyrinths of Thought. A History of Set Theory and Its Role in Modern Mathematics. Birkhäuser. https://doi.org/10.1007/978-3-0348-5049-0

[35] Wightman, A.S. (1976) Mathematical Developments Arising from Hilbert Problems. In: Browder, F.E., Ed., *Proceedings of Symposia in Pure Mathematics*, *Symposia in Pure Mathematics*, American Mathematical Society, Providence, RI, 147-240. https://doi.org/10.1090/pspum/028.1/0436800

[36] Corry, L. (2006) On the Origins of Hilbert's Sixth Problem: Physics and the Empiricist Approach to Axiomatization. *Proceedings of the International Congress of*

Mathematicians, 22-30 August 2006, Madrid, 1697-1718.
https://doi.org/10.4171/022-3/82

[37] Accardi, L. (2018) Quantum Probability and Hilbert's Sixth Problem. *Philosophical Transactions of the Royal Society A*, **376**, e20180030.
https://doi.org/10.1098/rsta.2018.0030

[38] Gruninger, M. (2009) The Heirs of Hilbert's Sixth Problem. American Geophysical Union, Washington DC.