Exploration of Fundamental Principles and Free will: Towards Theory of Everything

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Abstract

Everything starts from nothing. The fundamental principle is to create a point out of nothing, and a point creates time and space. Time and space create the stars and galaxies, the solar system, and the earth. On Earth, life is created, and humankind emerges. And the existence called 'me' is born. This paper assumes fundamental principles from several facts and tries to explain various phenomena such as the birth process of the universe, the movement of particles, and the double slit experiment. Also, from the similarity between the wave function and the neural network, it was confirmed that the square of the absolute value of the wave function is different from a probability but corresponds to each other like an input and output signal. In addition, it was found that there is a threshold value in the wave function, and through this, the fundamental principle could be assumed much more clearly. In addition, by integrating the mental world, the mathematical world, and the physical world, various phenomena were explained within a single theoretical system called the fundamental principle. This dissertation includes Euclidean geometry, relativity theory, quantum mechanics, the concept of string theory, consciousness, and free will, which are the basic contents for making a theory of everything. There is a lot of content in the thesis, but the conclusion is simple. The conclusion of this paper is as follows. Free will always exists.

1. Introduction – Towards Theory of everything

What is Theory of Everything? Theories that explain everything in nature have changed over time. It was Aristotle's worldview that explained everything in nature in ancient Greece, and this was widely accepted as common sense for a long time before classical mechanics appeared. Aristotle's natural philosophy was that everything is made up of water, fire, wind, and earth, and has a certain quality or tendency of itself. Aristotle's worldview was a teleological worldview, and everything was thought to be directed towards this end. Classical mechanics integrated the movement of celestial bodies in the sky and the movement of objects on the ground into one world view. Also, under the philosophical concept of absolute space and absolute time, the motion of all objects was explained by physical laws. Since then, the laws of physics have been accepted as the most fundamental principle that explains everything, and it has become a firm belief among scientists.

After that, the theory of relativity and quantum mechanics took their place. The theory of relativity destroyed Newton's philosophical concept of absolute space and absolute time, and quantum mechanics destroyed the belief in the determinism of classical mechanics. The two theories are evaluated as the most accurate theories in the macroscopic world and the microscopic world, respectively. However, there is a collision problem at the singularity between the theory of relativity and quantum mechanics, and in particular, the mystery of the collapse of the wave function remains in quantum mechanics. To solve this problem, a new theory had to emerge again. In modern physics, the theory of everything is considered a hypothetical theory that integrates the four fundamental forces of nature into one. String theory is the most representative theory that can unify all forces. However, string theory has not yet been able to explain the collapse of the wave function. String theory rather deny the collapse of the wave function and tried to solve it by introducing a multi-world interpretation. String theory is the result of an effort to maintain the symmetry and deterministic worldview of the laws of physics. These efforts returned the philosophy of physics to determinism.

A few questions arise here. Why must the symmetry of the laws of physics always be maintained? When was the ultimate physical law with symmetry discovered? Why should this world be deterministic? Is the mathematics of quantum mechanics deterministic? Why should the mathematics of quantum mechanics have symmetry? Why doesn't modern physics include free will and consciousness? Can a theory that does not explain human consciousness be a theory of everything? If human free will is an illusion, how does physics create such an illusion? Are the laws of physics really the most fundamental principles?

If human consciousness and free will belong to natural phenomena, the theory of everything should be able to explain consciousness and free will as well. Can string theory explain human consciousness? Some may say that physics only needs to explain natural phenomena, but consciousness and free will are also natural phenomena. String theory cannot explain human consciousness and free will. Therefore, string theory is not a theory of everything. String theory is said to be a theory that explains everything that can be observed, but ironically, multiverse and strings are not observed. So, does unobserved mean non-existence? Ironically, for string theory to be correct, the unobserved must also exist. In comparison, free will and consciousness are things we experience directly, and we can conduct experiments on free will and consciousness sufficiently if we have the will to do so. Unobserved just means unobserved, it doesn't mean non-existent.

Nevertheless, string theory is evaluated as the closest theory to the theory of everything. According to the string theory, everything in the microscopic world is made up of tiny strings, and the fate of the universe is determined by the patterns in which they vibrate. The smallest unit that makes up the universe is not a point-like particle, but a very thin string that vibrates constantly. [1,2] String theory solves the problem at the singularity, where quantum mechanics and the theory of relativity collide. String theory deserves high praise for integrating general relativity and quantum mechanics and unifying all forces into one. Looking at this, the concept of string seems very essential and important to explain natural phenomena. But is string really the smallest unit of nature? The size of a string is so small that it is impossible to observe realistically, and there is no guarantee that a string is the smallest unit of nature. Even if strings exist, smaller ones may also exist. The size of the smallest may be 0, regardless of whether it is observed or not. Then why does the most fundamental thing have to be strings? Strings have not yet been observed, and it is unlikely that they will be observed in the future. In this case, there is no problem even if you think that the internal structure of a string is composed of points of size 0. Then the smallest unit would be a point of size 0, not a string.

Another problem with string theory is that you must study too much to understand it. If string theory were truly the theory of everything, it should be able to explain simple things easily. However, string theory does not do a good job of describing the properties of elementary particles such as photons and electrons. String theory also comes out of nowhere from a complex equation called the Euler beta function. In fact, this is a problem that other theories have the same problem, but the explanation of why it starts from such equations is obscure. String theory has the disadvantage of being too mathematically complex to understand. There is no guarantee that the most fundamental thing in the world must be simple, but if it is complicated, we must explain why it must be so complicated. However, string theory does not provide a simple explanation of natural phenomena. If string theory does not explain the motion of objects or the double slit experiment well, it will not be a theory that explains everything, but a theory that explains special areas such as singularities. The theory of everything deserves a simple explanation worthy of its name. For this to be possible, we need a fundamental principle that applies equally to everything.

The purpose of this paper is to find the fundamental principle and explain various phenomena from the birth of the universe to the creation of matter, the movement of particles, and the double slit experiment. In the course, contents on Euclidean geometry, relativity theory, quantum mechanics, and string theory are included. Through the application of fundamental principles, various physical quantities and physical constants are considered, and through this, the necessity of high-dimensional space is confirmed. Furthermore, free will and consciousness are considered, and the relationship between fundamental principles and the mental world is examined. This paper also tries to guess fundamental principles from various facts, construct a mathematical system from these principles, and explain various physical phenomena. Fundamental principles would have to do one of two things: One is to find the single ultimate equation that will explain everything, and the other is to find the fundamental principle that makes everything governed by the laws of physics. In the case of the former, many physicists have already tried it and have not succeeded yet. However, the latter case does not seem to have been tried yet. Therefore, this paper attempts to find a solution by approaching the latter method.

2. An attempt to find the fundamental principle

What is the fundamental principle of this world? Where should we start to find the fundamental principle? In this complex world, it seems very difficult to suddenly find the fundamental principle. In the first place, what form does the fundamental principle take? Is it God? Or is it the laws of physics? Or is it a philosophical proposition? Or is it math? Oh, for now, let's leave out God as much as this paper pursues something scientific. Philosophy, mathematics, and physical laws are fine, but it is not appropriate to refer to God in scientific papers. Then only three things remain: philosophy, mathematics, and the laws of physics. Many modern people study mathematics and the laws of physics to find something fundamental in this world. However, in modern society, ambiguous philosophies are excluded. Almost all cling to mathematics and the laws of physics, despite the failures of many. Mathematics and the laws of physics are important, but that doesn't mean philosophy isn't important. Dr. Roger Penrose's 'The Road to Reality' briefly mentions three worlds and three mysteries.[3] Figure 1 shows three worlds and three mysteries. As shown in Figure 1, the three worlds mean Plato's ideal mathematical world, physical world, and mental world. These three worlds are connected through three unknown and mysterious elements.

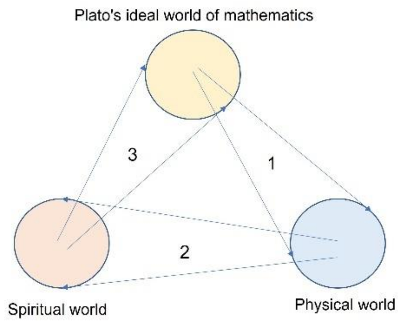


Fig1. three worlds and three mysteries. Mathematical beings are different from physical or conscious beings, but these three beings are connected in some way. In the vast mathematical world, only some mathematics is applied to the physical world, the physical world embodies the conscious being, and the conscious being creates the ideal mathematical world.

The first step to understanding nature in history is to understand mathematics. Mathematics and science have a close connection, and mathematics helps to objectively understand the laws of nature. Mathematics, once proven, remains unchanged forever and belongs to Plato's ideal world of mathematics. However, this ideal mathematical world was created by human imagination. One of the models belonging to Plato's ideal mathematical world is applied to the physical world and exists as physical laws. However, Plato's ideal mathematical world was created by human imagination. Why is the ideal mathematical world created by human imagination related to the laws of nature? Is it because Plato's ideal world of mathematics is a fiction? An interesting fact here is that the physical world constructed from Plato's ideal mathematical world builds the mental world again. The physical world creates beings with intelligence like humans, and humans with intelligence build the mental world, and this mental world can build Plato's ideal world of mathematics. Without Plato's ideal mathematical world, the laws of the physical world are not guaranteed to be objectivity and validity. Then, in some way, an ideal mathematical world must exist, but how is that possible? Does an ideal mathematical world already exist independently, and humans interpret it? Or are the three worlds closely interconnected? How could an ideal mathematical world just exist?

To find answers to these questions, let's explore how the physical world builds the mental world. How is the human mental world built? In other words, how do humans have intelligence and consciousness? There are still many unclear parts about consciousness in modern science, but a lot of research has been done about intelligence. Modern people already know that human intelligence comes from the brain's neural network. How these neural networks create consciousness is a mystery, but they can achieve intelligence. Artificial intelligence such as AlphaGo is created by imitating the structure of human neural networks. It is not clear whether these artificial intelligences have consciousness, but they do have intelligence. Perceptron, an early form of artificial neural network, is an algorithm that outputs one result from multiple inputs. Figure 2 shows the structure of the perceptron. The perceptron is mathematically represented as:

$$\psi(x) = \sum_{i}^{n} w_i x_i = w_1 x_1 + w_2 x_2 + w_3 x_3 + \cdots + w_n x_n$$

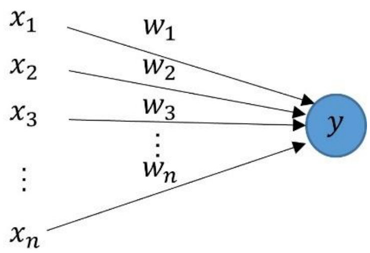


Figure2. Perceptron

Here, each input has a weight, and the sum of the products of the input and the weight is expressed as a psi function $\psi(x)$. If the psi function $\psi(x)$ is greater than the threshold V_{th}, the output value y is 1, and if it is less than the threshold V_{th}, the output value y is 0. This means that the psi function has a critical value.

An artificial neural network consists of a network of multiple perceptrons. Human neural networks are similarly composed of artificial neural networks. These neural networks have a mathematical form very similar to a wave function. Like neural networks, the wavefunction has a linear equation:

$$\psi(x) = \sum_{i}^{n} c_i \phi_i = c_1\phi_1 + c_2\phi_2 + c_3\phi_3 + \cdots + c_n\phi_n$$

However, unlike neural network equations, wavefunctions are not physically clear. Instead, the square of the absolute value of the wavefunction has a known physical meaning. The square of the absolute value of the wavefunction represents the probability density of locations where the particle can be found.

$$\rho(x) = |\psi(x)|^2 = \left|\sum_{i}^{n} c_i \phi_i\right|^2$$

$$P = \int_a^b \rho(x)dx$$

Here, the maximum probability is 1. Common sense knows that the probability cannot exceed 1. However, one doubt can be raised here. The probability obviously cannot exceed 1. But can't the square of the absolute value of the wave function exceed 1? We take for granted that the probability and the square of the absolute value of the wavefunction are equal. But is it really so? Let's make one assumption. What if the square of the absolute value of the wavefunction has some critical value? What if the probability represented the output rather than the square of the absolute value of the wavefunction? Then the square of the absolute value of the wavefunction can exceed 1. Then, the following inference can be made. The probability cannot exceed 1, but the square of the absolute value of the wavefunction can exceed 1. So, what should happen if the square of the absolute value of the wavefunction exceeds 1? If the square of the absolute value of the wavefunction crosses a threshold, the output should be 1. That is, the probability must be 1. In other words, the wave function must collapse. In other words, the particle is observed.

We have taken for granted that the square of the absolute value of the wave function and the probability are equal, but it may not be the case. The square of the absolute value of the wavefunction represents the density of some physical object, with a probability of 1 if this density exceeds a critical value and a probability of 0 if the density does not exceed a critical value. In other words, the wave function represents the relationship between the input and the weight, and the probability represents the output. Surprisingly, there may be similarities between wavefunctions and neural networks with respect to thresholds.

$$P = \begin{cases} 1, & for\ |\psi(x)|^2 \geq V_{th} \\ 0, & for\ |\psi(x)|^2 \leq V_{th} \end{cases}$$

So, is this the only similarity between a wave function and a neural network? Perhaps there are more. In fact, I discovered a peculiar phenomenon in my graduate school days in this regard. This is my experience, so subjective opinions are bound to enter. During my graduate school days, I researched resistive change memory devices, also called memristors. [4,5] Memristors are devices suitable for mimicking synapses in neural networks. [6] Conventionally, a memristor is composed of an electrode/resistance change layer/electrode structure. Here, the resistance change layer imitates a synapse. When electrical stimulation is applied to the resistance change layer through the electrodes, the resistance is changed. In terms of classical mechanics, when electrical stimulation is applied, resistance change will occur only in selected devices as shown in Figure 3.

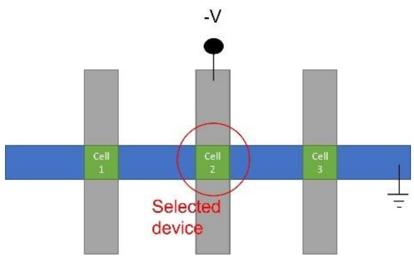


Fig3. Memristor switching. In terms of classical mechanics, resistance change should occur only in the selected device 2.

Surprisingly, resistance changes also occurred in devices 1 and 3, which were not selected. For example, when selected element 2 decreases in resistance, the unselected device 1 and device 3 randomly increase in resistance. Of course, this phenomenon has not been reported in memristors. This phenomenon was discovered by me, but at the time I couldn't find a way to explain it in principle, so it was considered an experimental error and I couldn't report it. But it's too early to be disappointed. A similar phenomenon exists in biological neural networks. A similar phenomenon is called hetero-synaptic plasticity.[7] The phenomenon in which the connection strength of the selected synapse changes is called homosynaptic plasticity. In synaptic plasticity, long-term strengthening of neuronal strength is called LTP (long term potentiation), and long-term weakening of neuronal strength is called LTD (Long term depression). In a neural network, a change in weight appears due to a combination of homosynaptic plasticity and hetero-synaptic plasticity. As a result, LTP appears at the synapse to which electrical stimulation is applied, and LTD appears at the synapse to which electrical stimulation is not applied. That is, I discovered the hetero-synaptic phenomenon in memristors. And the hetero-synaptic phenomenon that appeared in the memristor was a random resistance increase phenomenon.

Even if subjective opinions are ignored, homosynaptic plasticity and hetero-synaptic plasticity occur together in neural networks. Given only homosynaptic plasticity in neural networks, changes in neural networks appear deterministic. However, the combination of homosynaptic plasticity and hetero-synaptic plasticity cannot be guaranteed to be deterministic. There is room for chance to intervene in the combination of homosynaptic plasticity and hetero-synaptic plasticity. Simply put, the human brain may not be deterministic. The problem of determinism in neural networks is closely related to the problem of free will. According to the Libet's experiment, it is already well known that a ready potential occurs before a volitional action occurs.[8] The results of Libet's experiments sparked a lot of controversy, leading to the conclusion that humans do not have free will. Also, the view that electrical activity in neural networks is deterministic precludes the claim that free will might be due to chance. However, if hetero-synaptic plasticity in neural networks is random, the view that electrical activity in neural networks is deterministic is defeated. If the view that neural networks are deterministic is defeated, Libet's results can lead to one of two conclusions. One is that the random changes caused by hetero-synaptic plasticity in the neural network create free will, and the other is that the human brain interprets the random electrical activity in the neural network. Therefore, we need to bring back the hasty conclusion that humans do not have free will and think about free will again.

These are questions that need to be asked again. What is free will? What is Coincidence? According to a philosophical definition, free will is the ability to voluntarily determine thoughts and actions without being influenced by external factors. Coincidence refers to a phenomenon that appears to happen spontaneously without a cause. Just looking at the philosophical definition, chance and free will seem different, and even the definition of free will seems unclear. But are chance and free will really different? Recall here that neural networks and wave functions have similarities. In the case of a neural network, neurons are activated, and in the case of a wave function, the collapse of the wave function occurs. When the wave function collapses, the probability of finding a particle at any point is 1. At all other points, the probability is zero. Expressed as an ordered pair,

$$P = (0,0,0,1,0,0,0,\ldots)$$

In the case of a neural network, similarly, LTP occurs only at selected synapses and LTD occurs at the rest. Expressing this as an ordered pair,

$$w = (0,0,0,1,0,0,0,\ldots)$$

The two phenomena are not exactly the same, but they have interesting enough similarities. It is also similar in that it has random properties. At this point, it can be said that they are similar, if not completely identical. These are not the only similarities between free will and chance. There are many similarities between quantum chance and free will.

In the quantum double slit experiment, chance appears as probability. The choice of one of the two paths is represented by probability. A person's choice by free will and a particle's choice in quantum mechanics are equally represented by probabilistic rules. This property means that free will and chance are mathematically indistinguishable. However, there is a slight difference between classical coincidence and quantum mechanical coincidence. For example, in a dice throw, all sides of the die have the same probability. Conceptually, in a random walk motion, each state is considered to have the same probability. However, in quantum mechanics, the probability of finding a particle at any point is different for each location. For example, a high probability of discovery may be found in a nearby location, but a low probability of discovery in an infinitely far away location. Quantum-mechanical coincidences can have different probabilities for each state, which seems to have a preference based on any specific physical quantity. Here, any specific physical quantity means an action. In quantum mechanics, particles are more likely to be found on paths that minimize actions. In quantum mechanics, what happens when a particle is unaffected by an action and has equal probability in all states? If the particle has the same probability in each position state, the problem of infinity can occur, or the probability can be zero in all states. Therefore, to avoid contradiction, each state must have a preference, or the probability must be different depending on the action.

So, what is the difference between free will and quantum chance? It is easier to find similarities than to find differences. The only difference would be that the philosophical definition is different. But there are many similarities. Quantum mechanical chance and free will have preferences. The difference is that chance is based on action, and free will has no clear relationship to physical quantities. However, this problem is solved because the movement of particles and molecules in hetero-synaptic plasticity is based on action. Coincidence in the brain's neural networks and quantum mechanics are fundamentally the same. Free will is the brain's interpretation of that chance. Free will is an interpretation based on this chance and prefers certain choices. Since both free will and chance are expressed as probabilities, it is impossible to distinguish them scientifically. Thus, it is safe to say that coincidence and free will are the same.

From now on chance and free will are considered the same thing. Then, what is the connection between chance and the physical world? According to the view of modern physics, everything is governed by the laws of physics. Numerous particles that obey the laws of physics create celestial bodies, create the solar system, create the earth, and create life and neural networks. In the end, it creates a being with intelligence. A being with intelligence builds a mental world with free will and consciousness. In other words, beings with intelligence can have consciousness because they have free will. In summary, the physical world creates beings with intelligence, and intelligence builds the mental world.

In the mental world, chance and free will can build an ideal mathematical world. In an ideal mathematical world, mathematical models are constructed based on a few self-evident axioms and have objectivity and validity. Some of these mathematical models can be applied to the physical world and create physical laws. Then, the physical world creates beings with intelligence again and builds the mental world. Figure 4 shows the three worlds and the three elements connecting them.

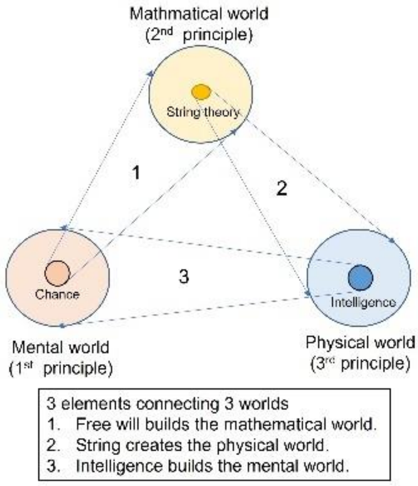


Fig4. Three worlds and three elements connecting them.

Physical laws, intelligence, and chance have an interconnected relationship. The laws of physics, intelligence, and coincidence are important elements that connect the three worlds. String theory, or the laws of physics, constitutes the physical world, the intelligence of the physical world constitutes the mental world, and the coincidences of the mental world constitute the mathematical world. In other words, intelligence is governed by the laws of physics, but the laws of physics are determined by chance. Could the laws of physics exist without chance? Let us consider the case of many worlds. If all the ideal mathematical worlds exist as universes, all universes have different physical laws. Some of these universes create intelligent beings and create the illusion of free will and consciousness. An intelligent being then observes the laws of physics. However, since all free will and consciousness are illusions, we cannot rule out the possibility that the observed physical laws are also illusions. Therefore, beings with intelligence cannot completely trust the laws of physics. An intelligent being must doubt everything and consider the possibility that everything is an illusion. The ideal mathematical world, which exists independently of chance, nullifies belief in the laws of physics. If consciousness and free will are illusions, we cannot believe in the laws of physics.

The existence of chance is essential for the existence of an ideal mathematical world and physical laws. Coincidence is essential for the birth of our universe and humanity. Without coincidence, we could not exist either. Coincidence always exists and is the most fundamental thing in all worlds. The laws of physics are passive, but chance is active and spontaneous. The laws of physics are passive, but chance is active and spontaneous. Chance also has preferences, and these preferences are action-based. Also, free will and chance are indistinguishable from each other. Based on these facts, we can postulate the first principle. The first principle is as follows.

First Principle: Coincidence always exists.

Chance spontaneously constructs an ideal mathematical world and determines the laws of physics. Then, how does chance build an ideal mathematical world? How are the laws of physics determined?

The laws of physics are determined by chance. The most fundamental physical law is symmetry for all transformations. The most fundamental laws of physics are always the same in any case. But we often find exceptions to the laws of physics. Except for the law of conservation of energy, exceptions have been found to most laws of physics. When an exception is found in the laws of physics, it means that the symmetry is broken. So, how does the collapse of symmetry occur? In the example of the wave function mentioned above, the wave function collapses when it exceeds a threshold. If this property exists in all physical laws, we can infer the following. All laws of physics collapse when thresholds are exceeded. In other words, symmetry breaking occurs when a threshold value is exceeded. Based on this fact, we can infer how the ideal mathematical world is constructed. In the world of mathematics, symmetry is broken when the threshold is exceeded, and symmetry is formed when the threshold is not exceeded. Here, let us simply call the ideal mathematical world a system. This system is formed by chance. And this system can form or break symmetry depending on the threshold value. So, the second principle is:

Systems are created by chance, and depending on the threshold, they can form or break symmetry.

This sentence can be divided into three parts:

(1) Chance can create a system by action.

(2) The system can form symmetry below the threshold.

(3) The system can break symmetry above a threshold.

This second principle constitutes the ideal mathematical world of the system. The second principle can be used to create systems as simple as Euclidean geometry or as complex as non-Euclidean geometry and string theory. And out of countless possible systems, only one system makes up our universe and determines the laws of physics. Since it is the laws of physics that govern the physical world here, the third principle is the laws of physics. Here, only one system has only one physical law, so our universe is governed by the physical laws. Therefore, the third principle is a physical law. Unfortunately, the third principle has not yet been discovered.

In summary, all worlds are composed of the mental world, the mathematical world, and the physical world. Here, the spiritual world can be called the philosophical world. The first principle applies to the philosophical world, and the second principle applies to the mathematical world. And in the physical world, the third principle applies. Then the mathematical world could be constructed using the second principle. Now let's look at the simplest example that can be made using the second principle.

3. Simplest example of application of the second principle: Formation of Euclidian geometry

Euclidean geometry is the simplest example of an application of the second principle. Coincidence can make a system out of nothing, as shown in Figure 5. In the initial system where symmetry formation and symmetry breaking are not applied, no information is known. Figuratively, the initially created system can be regarded as a point. Let's call this point a chaotic system because its location is unknown, its size is unknown, and its dimensions and direction are unknown. Also, physical quantities are not known in the chaotic system. Here, the process by which chance creates a system is called action. The action from nothing is zero, and the creation of a system by chance increases the action. Also, the threshold for action in the absence of anything is zero. Therefore, in a state where there is nothing, the symmetry is naturally broken, and a chaotic system is created.

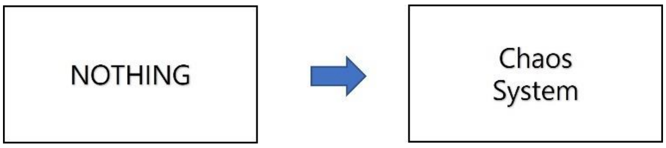


Fig5. Creation of chaotic systems by chance.

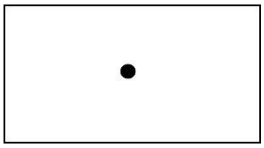


Fig6. A point with no size.

Since the threshold value is completely unknown in a chaotic system, both symmetry formation and symmetry breaking can occur. When a chaotic system forms symmetry, a state of total unknown information is maintained. On the other hand, when a chaotic system breaks symmetry, there is only one way to know the information. In addition, since coincidence has the property of minimizing the action as much as possible, the change of the system changes to the lower action. The way to minimize the behavior of a chaotic system is to zero all information. For example, size and dimension become zero, and action also becomes zero. If the initial action of the chaotic system is S, the chaos system can repeat the symmetry breaking infinitely to make the magnitude of the action zero.

$$S_f = \frac{S_i}{\infty} \cong 0$$

Then, as shown in Figure 6, a point with no size is created. It is a transformation from a chaotic system to a system with information. At this case, the threshold value is determined by chance. If the action is not lower than the threshold value, symmetry breaking continues. So, this process is repeated until the action is lower than the threshold value. Symmetry breaking stops when the threshold value is determined to be higher than the action, with the point size being zero.

$$S < V_{th}$$

Points can form symmetries if the action of the system is below the threshold. Forming symmetry can increase the size, dimension, and action of a point. Forming a point's symmetry ensures that the point's size and dimension remain zero. Also, chance can create points with the same symmetry as a point. The creation of points with the same symmetry can increase the size, dimension, and action of the entire system. No information about location is given in this case. Figure 7 shows the creation of points with the same symmetry.

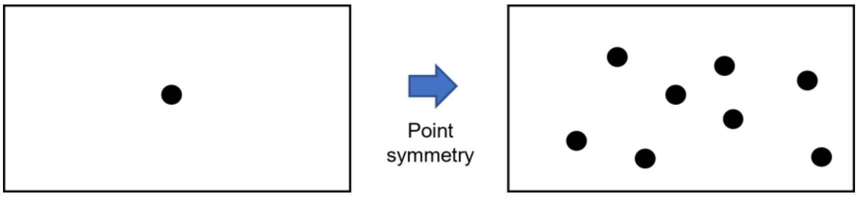


Fig7. Point symmetry. Below the threshold, points with the same symmetry can be created.

When points are created by point symmetry, the action of the entire system increases and exceeds a threshold value at some point and the symmetry can be broken. If the symmetry is broken, all but one randomly selected point collapses. However, breaking the symmetry minimizes the action, which creates a new symmetry. The new symmetry is determined by chance. In this case, let's say that the point forms a symmetry in one dimension. Then, if coincidence creates a series of points with the same one-dimensional symmetry, a straight line is created. When a straight line is made, the generation of points is made sequentially to minimize the action. The creation of a straight line is shown in Figure 8.

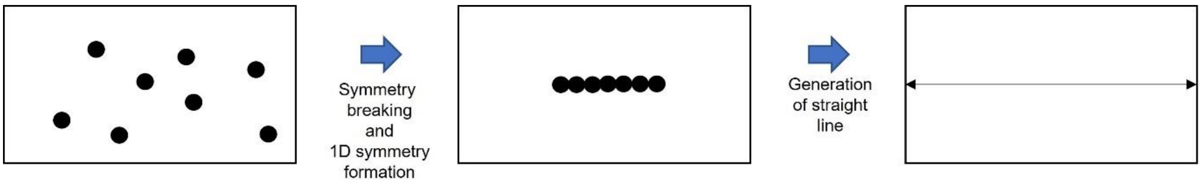


Fig8. generation of straight line by symmetry breaking and formation

A straight line has zero width and an unknown total length. However, if there is a straight line in the system, the position of the points on the straight line can be measured, and the length of the line segment can be measured through the position of each point. In other words, in a system, a line segment has a length, and the ends of a line segment are points. This is a one-dimensional line segment.

So, how is a 2D space made? The system has a threshold for the length of a line segment. When the action due to the length of a line exceeds a threshold value, the line collapses back into a point. When symmetry breaking occurs, the dimension of a point can be determined as two-dimensional. The system can then generate points with the same two-dimensional symmetry. The generation of 2D points is done continuously to minimize the action, which leads to the creation of 2D space. Three-dimensional space is also created through the same process. The characteristics of points, lines, and planes created through these processes are as follows.

(1) A 0D point has size 0. (The point is that there are no parts.)

(2) A 1D line has a length and a width of zero. (A line is a length without width.)

(3) A 2D plane has an area. (A plane has length and width.)

And the following propositions can be derived from the properties of straight lines and planes.

(1) There is only one straight line connecting any point to any other point.

(2) Any line segment can be further extended.

(3) A circle with any point as its center and any length as its radius can exist.

(4) In 2D or 3D space, each dimension is perpendicular to each other.
(All right angles are equal.)

(5) When two straight lines intersect a straight line, if the sum of the ipsilateral interior angles is less than 180 degrees, the two straight lines meet at a point.

When nothing and chaos systems do not obey the above propositions. However, after the formation and breaking of symmetry, after the Euclidean geometry is formed, the above proposition follows. Depending on how symmetry formation and symmetry breaking are applied, the above proposition may or may not hold. In other words, the second principle can create various geometric spaces other than Euclidean geometry. In addition, even if the existing space follows Euclidean geometry, it can be converted to another geometric space as soon as the action exceeds the threshold. For example, the most representative is the time dimension.

Also, the space created through the second principle increases the action. If the size of action and space is proportional, action and space have the following relationship.

$$S = px$$

where p is the constant of proportionality and is called momentum. Perhaps due to symmetry, a proportional relationship between action and momentum is established. Expressing this relationship in differential form, it is as follows.

$$p = \frac{dS}{dx}$$

However, this momentum has no meaning when time does not exist. So, how is the time dimension created?

4. Formation of the time dimension through the application of the second principles

Time has a somewhat different quality than space. In the case of space, dimensions are added whenever dimensions are increased. If this is expressed as a formula, it is as follows.

$$s = (x, y, z)$$
$$s^2 = (\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2$$

Without the time dimension, the above formula just represents a line segment at rest. However, if the time dimension exists, the above formula represents the distance the point has moved.

$$s = (x, y, z, t)$$
$$(c\Delta t)^2 = (\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2$$
$$(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2 - (c\Delta t)^2 = 0$$

Therefore, in the case of the time dimension, it is necessary to change the method of breaking symmetry and forming symmetry. The three-dimensional space was created assuming an infinite length or a sufficiently large length, but the length of time needs to be rather short. In order to create a time dimension, it is first necessary to consider the three-dimensional space as a single point. To be precise, when the action of the 3D space crosses a threshold and the symmetry is broken, the 3D space collapses into a point with 3D symmetry. In addition, 1D time must have symmetry. Therefore, after the symmetry collapse of the 3D space, the point has a 4-dimensional space-time. The 4D space-time becomes a kind of string. As shown in Figure 9, the 4D space-time string becomes a straight line. And then, when the symmetry is broken again as the action increases, a 4D space-time string with a finite length is created. At this case, the minimum length of the 4-dimensional space-time string is determined. And then the system creates strings with the same symmetry as this string below the threshold.

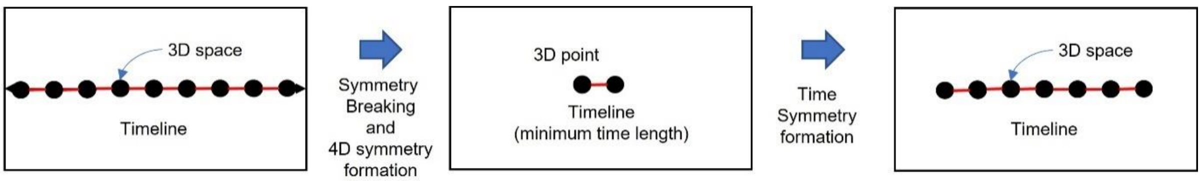


Figure9. The process of creating 4D space-time string.

This 4D space-time string always has a starting point and an ending point. Strings also have a minimum length of time, which is the Planck time. Since the string has a minimum time length, it also creates a minimum value for the action. At this time, the minimum value of the action of the string is called Planck's constant. In other words, Planck's constant exists because of the time dimension, and its magnitude is determined by chance. If action and length of time are proportional in a string, then the ratio of action to length of time is given by.

$$S = Et$$

Here, E is a constant of proportionality and means energy. The differential form of this formula is:

$$E = \frac{dS}{dt}$$

When the time dimension is created, energy is created. Also, the relationship between momentum and energy is as follows.

$$Et = px$$

$$E = p\frac{x}{t} = pc$$

In a 4D space-time string, energy and momentum exist, and the relationship between momentum of energy represents speed c. However, mass does not yet exist in the 4D space-time string. How is mass made? Also, how are charge and spin created?

5. String bending and vibration through application of the 2nd principle

A 4D space-time string has a minimum value of action called Planck's constant. As the length of time on the string increases, the action increases. Symmetry breaking occurs when the action exceeds a threshold, but the action does not fall below Planck's constant. At this time, the string forms a new symmetry, creating bending and vibration. This bending and vibration of the string creates mass, charge, and spin. Consider the case of a simple two-dimensional space-time string, as shown in Figure 10.

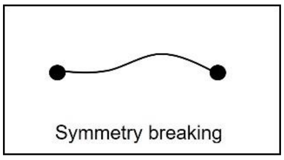


Fig10. 2D space-time string

Let's imagine this two-dimensional string vibrating in 4D space-time. Symmetry is established if the vibrating string clearly contains information about its frequency. Here, the minimum energy of a vibrating string is:

$$E = hf$$

Vibration of the string creates electric charge and spin. For example, photons are electromagnetic waves and have no mass. A mass of zero means that there is no bending of the string except for vibration. A change in the electric field means a change in charge, and a change in the magnetic field means the presence of spin. Since the spin of a string is a rotation in space-time, even if the size of space decreases, the spin tilts more towards time and angular momentum is conserved. Electric charge can be seen as the bending of a string that occurs when it vibrates. When there is a change in charge and spin on a string, the shape of the string becomes a coil wound around a cylinder as shown in Figure 11 below. If there is charge and spin in the string, the shape of the string becomes a coil wound around a cylinder as shown in Figure 11 below.

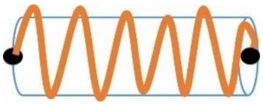


Fig11. A string wrapped around a cylinder.
The string is wound into a cylindrical shape while vibrating. These strings have a charge and a spin.

The action of a string wound into a cylindrical shape is as follows because it corresponds to the cylindrical side.

$$S = 2\pi \int 2E dt \approx 4\pi E t \geq h$$

$$Et \geq \frac{\hbar}{2}$$

Here, the action is doubled because time exists overlapping forward and backward directions. So, the product of energy and length of time is greater than $h/4\pi$.

Then how is mass formed? Below the threshold, the system establishes symmetry with the vibrations of the string, so within the string's time span, the string's oscillations overlap. Since the action increases as the vibrations of the string overlap, a threshold value is reached at some point and the symmetry is broken again. Some of the string's vibrations collapse and transform into bending, resulting in a complicated twist of the string. It is not simply bent in the 3-dimensional space, but the symmetry with respect to the dimension is newly formed and transformed into a high-dimensional space. The creation of a high-dimensional space increases the time it takes for the vibration of the string to be transmitted from the start point to the end point, and contracts the space, and creates mass. This high-dimensional space has mass and velocity, and if the vibration of a string exists in this high-dimensional space, it becomes matter. In this case, the velocity in high-dimensional space is:

$$v = \frac{dx}{dt}$$

Momentum in high-dimensional space is the product of mass and velocity. Since high-dimensional space has two velocity components, it has two momentum components.

$$p_1 = mv$$

$$p_2 = m_0 c$$

Energy is the product of the two momentum components times the speed of the string.

$$E_1 = p_1 c = mvc$$

$$E_2 = p_2 c = m_0 c^2$$

Here, each energy component is perpendicular to each other. The square of the total energy of a high-dimensional space is the sum of the squares of each energy component.

$$E^2 = {E_1}^2 + {E_2}^2$$

$$E^2 = (p_1 c)^2 + (p_2 c)^2$$

$$E^2 = (mvc)^2 + (m_0 c^2)^2$$

Thus, the energy in the high-dimensional space is:

$$|E| = \sqrt{(mvc)^2 + (m_0 c^2)^2}$$

However, mass is not a constant here. Higher-dimensional space is the same as matter, and mass changes with the velocity of matter. When velocity changes, space contracts and time expands, so mass also changes. In high-dimensional space, the time it takes for the vibration of the string to travel increases. Since the high-dimensional space has two velocity components, the distance traveled by the vibration of the string is expressed as follows.

$$l^2 = (vt_1)^2 + (ct_2)^2 = (ct_1)^2$$

Then, the relationship between the two-time components is:

$$t_1 = \frac{t_2}{\sqrt{1 - v^2/c^2}} = \gamma t_2$$

Each time component represents a time moving through a high-dimensional (HD) space and a time moving through a 3D space. t_1 is the time for the vibration of the string to be transmitted from the starting point to the ending point through a HD space, and t_2 is the time for the vibration of the string to be transmitted from the starting point to the ending point through the 3D space. For example, if a matter is moving as seen by an observer, the vibration of a string transmitted through the HD space appears to have traveled a greater distance. Therefore, to the observer, time in HD space appears to be delayed. Figure 12 shows the time delay effect by high-dimensional space.

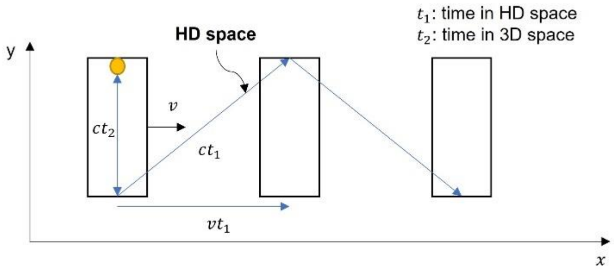


Fig12. Time dilation by HD (high dimensional) space.

When a high-dimensional space is moved, the length of the space is shortened in the direction of motion. A high-dimensional space with vibration is the same as matter. With time delay, the length of the object shortens as follows:

$$L = L_0\sqrt{1 - v^2/c^2} = \gamma L_0$$

As higher-dimensional space moves, mass also increases.

$$\frac{dE_1}{dt} = \frac{dE}{dt}$$

From this equation, the following equations are derived.

$$\frac{dp_1}{dt} \cdot v = \frac{dp}{dt}c$$

$$\frac{vd(mv)}{dt} = \frac{dm}{dt}c^2$$

$$\frac{mvd(mv)}{dt} = m\frac{dm}{dt}c^2$$

$$(mv)^2 + C = m^2c^2$$

When $v = 0,\ m = m_0$

$$C = {m_0}^2c^2$$

$$m^2v^2 + {m_0}^2c^2 = m^2c^2$$

$$m = m_0\sqrt{1 - v^2/c^2} = \gamma m_0$$

$$mc^2 = \gamma m_0c^2$$

If the mass of a high-dimensional space at rest is m_0, then the momentum of a moving object is as follows.

$$p_1 = mv = \gamma m_0 v$$

The hidden momentum of a stationary high-dimensional space is:

$$p_2 = m_0 c$$

The total momentum in high-dimensional space is:

$$p = mc = \gamma m_0 c$$

Also, the energy is:

$$(pc)^2 = (p_1c)^2 + (p_2c)^2$$

$$\gamma m_0c^2 = \sqrt{(p_1c)^2 + (m_0c^2)^2}$$

$$mc^2 = \sqrt{(p_1c)^2 + (m_0c^2)^2}$$

$$E = mc^2$$

The stationary high-dimensional space hides momentum and energy. The hidden momentum and energy are released in other forms, such as light or expansion of space, when higher-dimensional space collapses.

6. Creation of matter and the birth of the universe by the second principle

Everything starts with nothing. In the absence of anything, a chaotic system is created by the first principle, and the system forms space-time through the second principle. 4D space-time is made in the form of a string, and this string vibrates according to the second principle. The vibrating string forms particles such as photons, and the symmetry breaking and formation of the vibrating string makes the string have a high-dimensional space. And this HD space allows particles with mass to exist. The type of particle is determined by the vibration pattern of the string and the shape of the high-dimensional space. The charge and spin of the particle are determined according to the vibration pattern of the string, and the HD space gives it mass. In addition, HD space changes the vibration pattern of the string, so it can change the mass, charge, and spin. Here, the HD space has a property of trying to exist as a material or collapsing into a 4D space-time due to the property that the system tries to form symmetry below the threshold. Therefore, it is easy to maintain a HD space stably in a relatively high energy density, and it is easy to collapse a HD space into a 4D space-time in a low energy density.

The creation of different types of particles and higher dimensions occurs in stages. In a 4D space-time string of Planck time length, photons are the first to be created. Since the system develops symmetry below the threshold, photons continue to be generated in the 4-dimensional space-time string within the Planck time. When the energy of the photons rises and reaches a threshold, the symmetry of the 4D space-time string is broken, and a new symmetry is formed into HD space. In Planck time, a HD space string produces only one type of particle. And this type of particle is a boson. These bosons have very high energy to keep HD space stable. Among the many known boson particles, only one can be a candidate for the first boson, and that is graviton. In other words, HD space strings with Planck time create gravitons. Also, since Graviton is derived from 11-dimensional mathematics, it can be assumed that the initial HD space was 11-dimensional. Within Planck time, the shape of the 11D space string can vary widely, but the only particles present are gravitons. Also, due to the formation of time symmetry, some 11-dimensional strings and gravitons may exist even before the Big Bang. When the system's action crosses a threshold, the system again breaks symmetry, and the Big Bang occurs. The 11D space and Graviton collapse, and the higher dimension and Inflaton are created. However, this state is so unstable that it immediately collapses, and the system forms a new symmetry. Inflaton collapses HD space and rapidly creates 3D space. 3D space expands rapidly until the Inflaton is exhausted, and when the Inflaton becomes sparse, the rate of expansion slows down considerably. The energy of the collapsed gravitons and HD space is used to create other particles. However, not all gravitons and HD space collapse, and some gravitons and HD spaces survive. Some of the remaining HD space creates gravity, and gravitons allow the HD spaces to remain stable. The energy of the collapsed gravitons and HD spaces creates elementary particles such as photons, W-bosons, Z-bosons, gluons, quarks, and electrons.

However, this process does not happen once, but occurs countless times due to time flow symmetry. This iterative process continues until the action of the system reaches a threshold value. In the symmetry of the time flow, all possible events below the threshold are superimposed. Among countless possible events, a single event with the right gravity, the right ratio of boson particles, and the right ratio of fermion particles is chosen by chance, and time starts to flow in one direction as the threshold value is exceeded. The selected event is likely to be the one whose action can be minimized in the symmetry of the time flow. In other words, the Big Bang and inflation would be the most probable event. Several physical constants, such as Planck's constant and the speed of light, are also finally determined during this period. Or it could be that there were more events that were more likely, but they were unstable and collapsed and the Big Bang happened again. Or, if multiple Big Bangs occurred, one of them could be our world. Perhaps these three reasons are mixed in moderation.

When the time-flow symmetry is broken by reaching a threshold, the Big Bang and inflation become events of the past. This determines the energy of the entire system, and this total energy is conserved if it does not exceed a certain threshold later. Here, a certain threshold at which the law of conservation of energy can be broken means the end of the universe.

$$V_{th} \approx \int_{start}^{end} E_{total} dt$$

$$V_{th} \geq Et \geq \frac{\hbar}{2}$$

The action immediately after the Big Bang is roughly equivalent to Planck's constant. And as time goes by, the action increases, and the moment the threshold is reached, symmetry is broken, and the universe meets its end. If the total energy of the universe is always conserved, the time it takes for the universe to end is about the same. In other words, the end time of the universe is almost determined. If so, wouldn't the final size of the universe be almost determined?

$$V_{th} \geq px \geq \frac{\hbar}{2}$$

If the momentum of the universe is almost constant, the maximum size of space is almost determined. That is, the maximum size and final time of our universe are determined almost equally.

Inflation nearly equalizes the density of energy over the entire universe. However, locally, energy density may vary slightly due to gravitons. If Inflaton collapses HD space, Graviton creates or stabilizes HD space. The collapse of HD space due to rapid expansion causes the collapse of many gravitons. At this time, the energy from the collapse of gravitons creates quarks, electron, gluons and the electromagnetic weak force. After the inflation, much of the Inflaton disappears, and the temperature of the universe begins to drop. After the temperature drops to a certain extent, the electroweak force is separated into photons and weak forces, and quarks and gluons combine to create protons and neutrons. When quarks and gluons combine, time-flow symmetry is broken and a HD space is created, which increases the mass of protons and neutrons. Here, protons become hydrogen nuclei, and as time passes and the temperature drops further, helium nuclei are created by combining protons and neutrons. As time passes and the temperature drops further, atomic nuclei and electrons combine to form neutral atoms such as hydrogen and helium.

The gravitons that survived the inflation combine with HD space, creating a mini-black hole. After that, the mini black holes collide with each other to create additional HD space and create a more massive black hole. Some of the HD space collapses again and is emitted as photons, or it exits the black hole in the state of HD space and spreads out. At this time, the HD space that came out of the black hole has mass and becomes dark matter, acts as a Higgs field, or spreads farther and collapses to expand the 3D space. Figure 13 shows the events that occur during the formation of mini-black holes and the collision of mini-black holes.

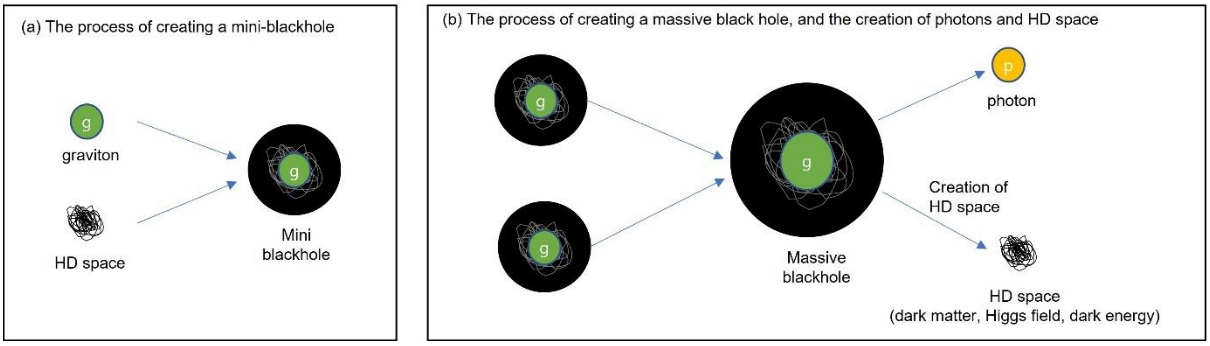


Fig13. (a) The process of creating a mini-blackhole, (b) The process of creating a massive blackhole.

HD space exists in very diverse forms, some having mass, some having energy without mass, and some vibrating uniformly to form a field. In other words, depending on the shape of the HD space, some become dark matter, some become massless dark energy, and some become the Higgs field. Dark matter with mass exists in a region with high energy density because there are many particles, and dark energy exists uniformly throughout the universe. The Higgs field also exists uniformly throughout the universe, but unlike dark matter and dark energy, the Higgs field vibrates. Figure 14 shows the dark matter due to the mass of HD space, the formation and interaction of the Higgs field due to HD space, and the generation of dark energy due to the collapse of HD space. The density of dark matter increases as the energy density increases. The distribution of dark energy is generally uniform, but the HD space collapses or expands at lower energy densities. In addition, the vibrating HD space spreads evenly to form the Higgs field, and when particles appear in the Higgs field, the HD space combines with the particles to give them mass, and the place where the HD space was located creates a bubble by vibration. The bubbles are called Higgs bosons.

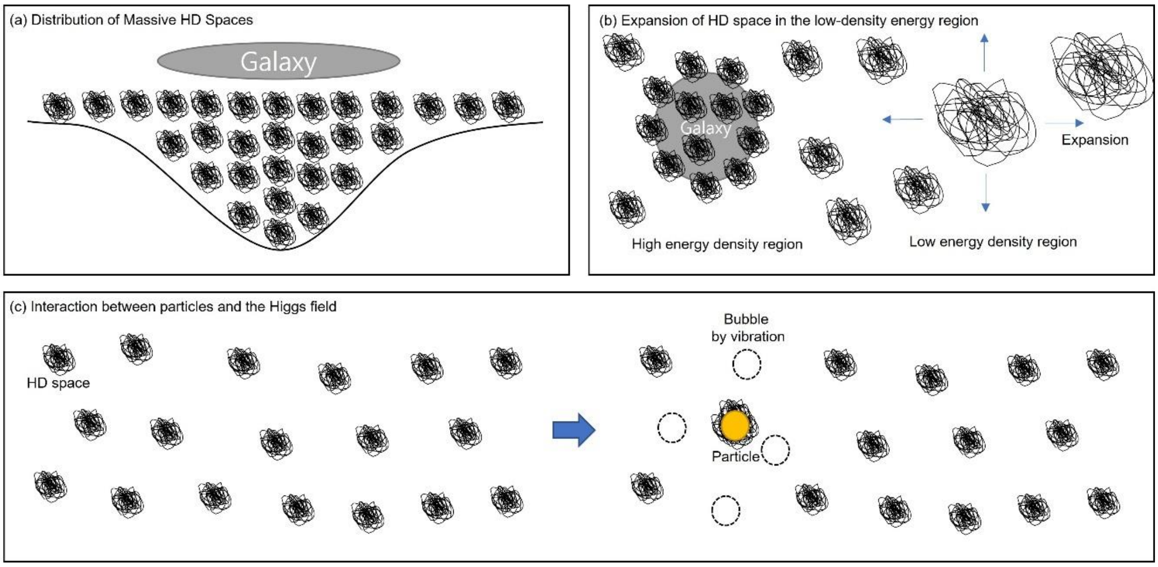


Fig14. Dark matter, dark energy, and Higgs field by HD spaces

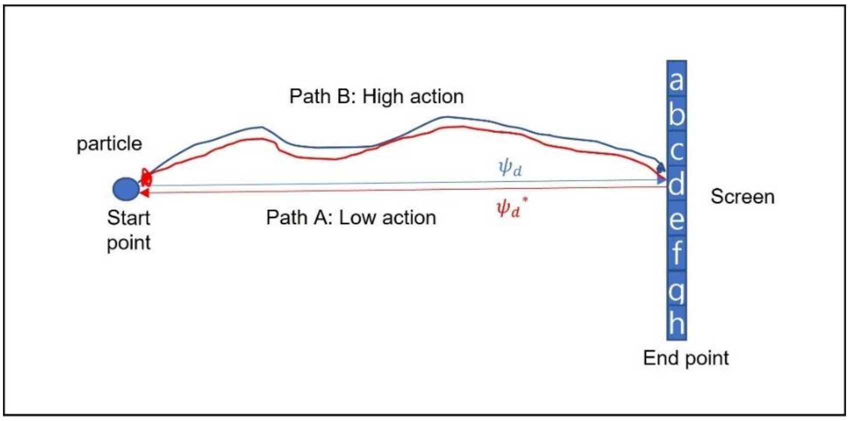
HD space gives mass to 3-dimensional space, causing length contraction and time delay. HD space is generally uniform but exists more locally where energy density is high. Dark matter in galaxies has a higher density than the surroundings, causing the galaxy's edges to rotate faster. And where matter is sparse, HD space collapses and expands 3D space. The expansion caused by the collapse of HD space lowers the temperature of the universe. Immediately after the Big Bang, HD space collapses and rapidly expands due to Inflaton, but after the rapid expansion, HD space spontaneously collapses in the region of low energy density and expands the space. This is like shooting a gun, when a bullet accelerates rapidly at the moment it is fired, but then flies constantly. But why is the universe still expanding at an accelerating rate? The reason is that black holes continue to create HD space. HD space created by black holes collapses where matter is sparse, expanding space. This causes the universe to accelerate its expansion. This is like how a rocket accelerates through a propellant. Also, dark matter forms the large structure of the universe and affects the distribution of matter. Dark matter influences the formation of galaxies by attracting matter with its gravitational pull. Dark matter is created most and remains most stable around black holes with high energy density, so galaxies are usually built around black holes. In addition, the Higgs field gives gluons mass, the accelerated expansion of the universe lowers the temperature of the universe, and quarks combine through gluons to create protons and neutrons. Here, when the temperature drops further due to the accelerated expansion of the universe, atomic nuclei combine with electrons through electromagnetic force to create neutral atoms. HD space attracts hydrogen and helium atoms to form atomic clouds. When the energy of the atomic cloud increases and the action exceeds a threshold value, the atomic cloud undergoes a nuclear fusion reaction and stars are formed. And these stars begin to rotate around the black hole, attracted by the gravitational pull of the HD space. Nuclear fusion reactions break down hydrogen and helium atoms and create elements with higher atomic weights. And then through various processes such as supernova explosions, more complex and heavier elements are created. Here, the collapse and generation of particles correspond to symmetry breaking and symmetry formation, respectively.

7. The motion of particles and the law of physics

The vibration of the string creates particles, and HD space gives the particles mass. In other words, a particle is a vibrating string. The string's vibration pattern and mass indicate the type of each particle. These particles remain symmetric as long as the action does not exceed a threshold. In other words, particles can safely conserve information below a threshold. According to quantum mechanics, information cannot be newly created or deleted, but according to the second principle, information can change when it crosses a threshold. Threshold and symmetry breaking play a very important role in particle motion. If a particle cannot break its symmetry, no particle can be observed. Also, if a particle cannot form symmetry, everything collapses and disappears. Particles form symmetry below the threshold value and form a new symmetry after breaking the symmetry above the threshold value. Particles form symmetry below the threshold value, and above the threshold value, the symmetry is broken, and a new symmetry is formed. This changes the particle's information or collapses the particle and creates new ones. Above a threshold, symmetry breaking can change a particle's energy or momentum, or it can collapse existing particles and create new ones. For example, interactions between particles can change their momentum and energy, and photons can be created or lost in the process.

However, symmetry is always formed before this symmetry breaking occurs. For example, in the microscopic world, wavefunctions are created by forming symmetries below a threshold. The wave function contains as much information as possible. However, the vibration pattern and mass of the string is one for each particle. How can a particle store so much information and form a wave function? The secret lies in the formation of time flow symmetry. Figure 15 shows the vibrations of strings propagating from the start point to the end point in time-flow symmetry.

The vibration of the string corresponding to the particle moves in a random path from the starting point. The vibration of the string may travel along path A or path B. There are infinitely many paths that reach an arbitrary end point d, but not all paths can be traveled due to the limitation of the threshold value. The vibration of the string can move within the permissible action value. Vibration of the string can travel in all possible paths within the permissible range. The vibration of the string does not select all paths with equal probability, but preferentially selects paths with low action. The string's vibrations travel a randomly chosen path, then reverse direction in time at the end point and return to the start point. This causes a vibration in forward time and a vibration in backward time to overlap. Since there are high-dimensional spaces along the path along which the vibration of the string travels, the vibration of the string is not completely canceled, and the information is safely conserved. After the vibration of the string returns to the starting point, it selects a random path again and moves, and at the end point, the time direction changes and returns to the starting point again. Then, information about the route traveled is added. Vibrations in a string can travel in multiple paths, and the path with the lowest action is likely to be preferentially selected. The vibration of the string repeats this process repeatedly, storing information about all possible routes within its range. Currently, each vibration is superimposed to form a wave function.



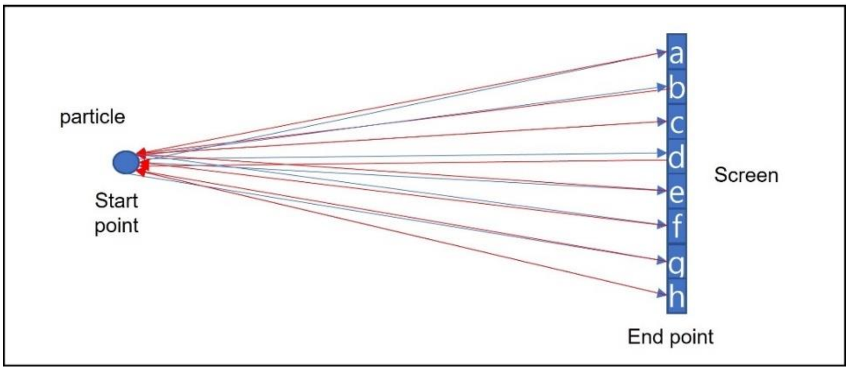


Fig15. The vibrations of strings propagating from the start point to the end point in time flow symmetry.

The number of endpoints and paths can be very large, but the vibrations of the strings all share the same starting point. This means that the vibrations of the strings exist in an entangled state. The wave function forms time-flow symmetry, and the vibrations of the strings are entangled and superimposed. Currently, the action of the wave function has a value between Planck's constant and the threshold value. The wavefunction accumulates information about all possible paths and endpoints, and at some point, it collapses when a threshold is reached.

$$V_{th} \geq Et \geq \frac{\hbar}{2}$$

What if there is no threshold for the wavefunction? Then, the wave function reaches the black hole, so the square of the absolute value of the wave function in the black hole becomes infinity. To avoid this contradiction, the existence of a threshold is essential. If there is a threshold value, the wavefunction can have a maximum spatial length and a maximum temporal length. Also, the reason why the wave function is a complex function is because of the HD space. The overlapping of HD space and 4D space-time makes it possible to interpret it as a complex plane. The solution of the wave function is determined by the Schrödinger equation assuming the simplest case. In general, the square of the absolute value of the wavefunction has a high distribution where the action is low and a low distribution where the action is high.

When the action of the wave function exceeds the threshold value, the symmetry of the time flow is broken, and the vibration of time in the reverse direction is converted to a high-dimensional space, and the vibrations of the remaining strings, except for one selected by chance, collapse and disappear. This is because the time flow symmetry is broken, the entanglement state is also broken, and the vibrations of strings that do not have the same starting point are canceled due to decoherence. And the one information that survives becomes the past, and time begins to flow. Figure 16 shows the collapse of the wave function due to the time flow symmetry breaking. After the collapse of the wave function, one selected end point becomes a new starting point, where the vibration of the string again forms the time flow symmetry and creates a new wave function.

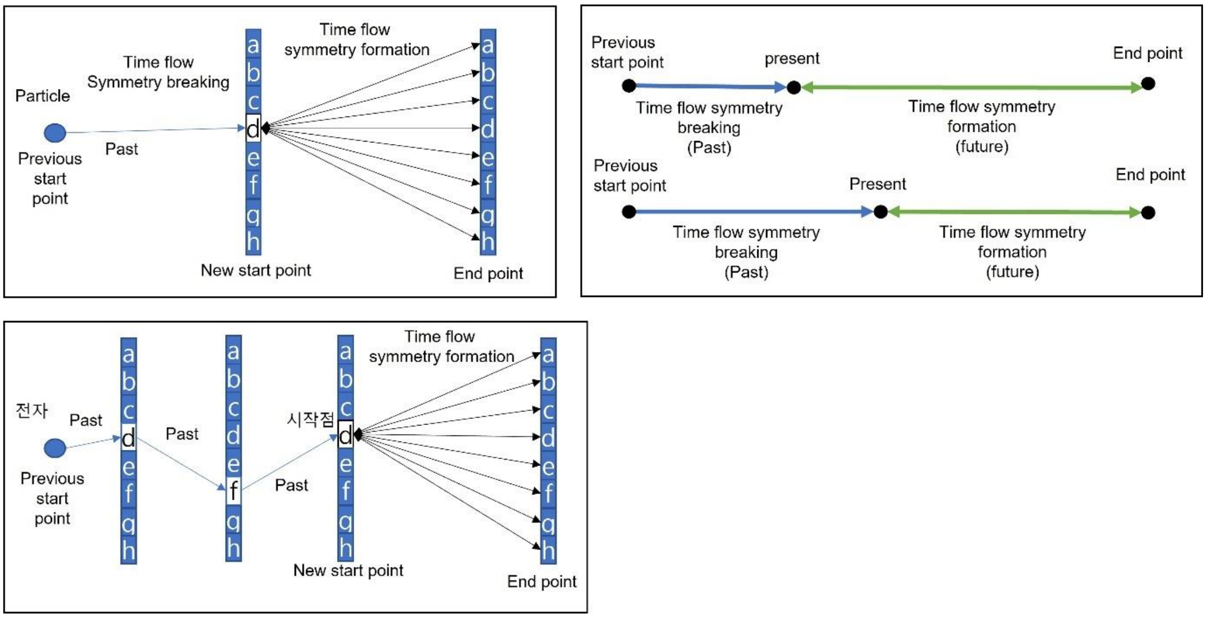


Fig16. the collapse of the wave function due to the time flow symmetry breaking, and formation of new symmetry

This process is equally applied to the double-slit experiment. You might think that the interference fringe pattern is impossible because the past becomes one when the time flow symmetry is broken, but it is not. Because it is a wave function that passes through the double slit in an overlapping state, the interference effect is applied as it is. And after the time flow symmetry is broken, according to the law of conservation of energy, particles pass through only one hole and create an interference pattern. There is no problem in creating an interference pattern because the wave function is affected as it is. For easy understanding, think of the water droplet walker experiment. In the water drop walker experiment, water waves pass through the double slit at the same time, but water droplets pass through only one hole.[9] Figure 17 shows the time-flow symmetry formation and time-flow symmetry breaking in the double-slit experiment.

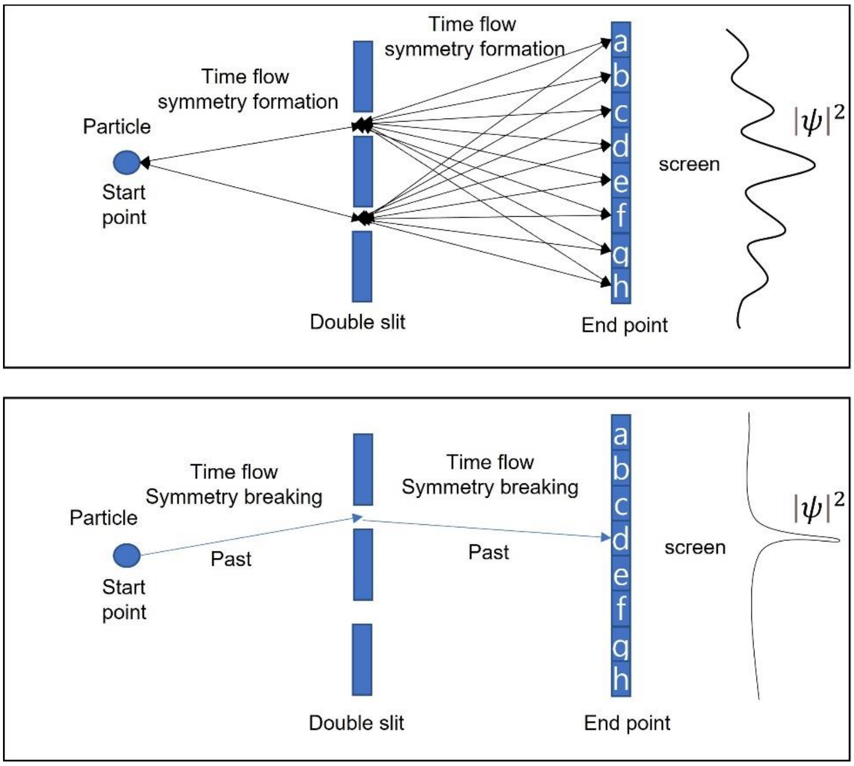


Fig17. the time-flow symmetry formation and time-flow symmetry breaking in the double-slit experiment.

Objects in the macroscopic world are made up of combinations of many small particles. Due to the high energy of the object, the time flow symmetry of the particles is continuously broken, and the superposition and entanglement state is broken. So, in the macroscopic world, time flows forward even when objects are not observed from the outside. In other words, an object with a large mass breaks the symmetry of the physical laws of the microscopic world and forms a new symmetry of the physical laws. If a massive object does not interact with other particles or objects, its mass and momentum are conserved. That is, an object has the property of always maintaining a constant state of motion unless it interacts with something else. This is called Newton's first law of inertia. From the past information of an object, the momentum of an object is the product of mass and speed. The change in momentum with time is defined as force. So, force is the product of mass and acceleration. This is called Newton's second law of motion.

8. Interpretation of actions in the complex plane

Above the threshold, the action gives an output of 1. Below the threshold, the action gives zero as an output. The creation of a symmetric high-dimensional space makes it possible to interpret string vibrations in a complex plane. Actions in the complex plane correspond to complex numbers. An action can cross a threshold, but it gives out 1 as an output, so the maximum value of the real part of an action is limited to 1.

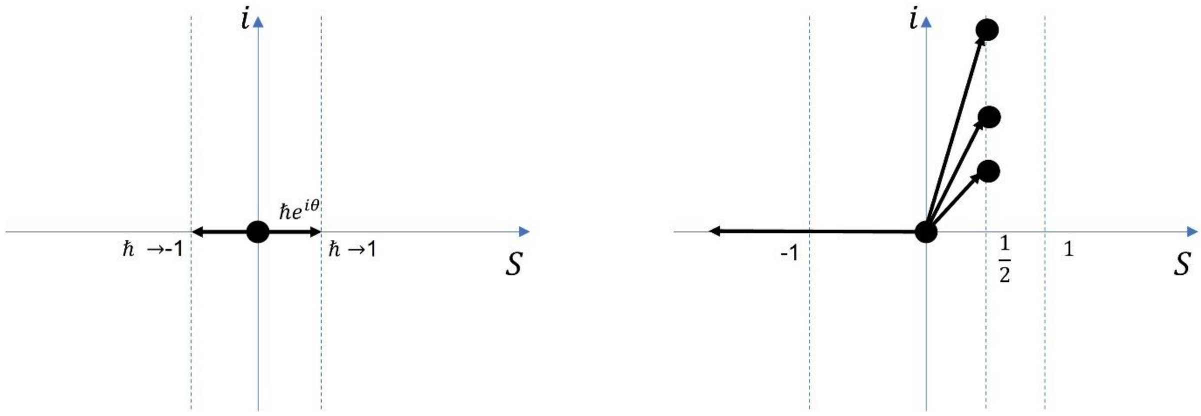


Fig18. Interpretation of actions in complex plane.

Initially, the actions of the string are divided into those of 1 and those of -1. The action of gravitons is 1, and the action of HD space is -1. Here, the symmetry is broken when the action exceeds a threshold. The action in high-dimensional space goes below -1, and the gravitons are converted into other particles and the real part of the action is changed to 1/2. The real part of the action changes to 1/2 because the vibration of the reverse time flow is converted to a high-dimensional space above the threshold value. Particles whose real part of action is 1/2 are only possible for the Riemann zeta function to be 0.

$$\zeta(s) = 0$$

Therefore, the action of the particles exists discontinuously. The action in high-dimensional space becomes negative, and the initial state is -1, and the value of the Riemann zeta function is as follows.

$$\zeta(-1) = -\frac{1}{12}$$

In summary, symmetry is maintained in the region where the real part of the action is less than 1, and symmetry is broken in the region where the real part of the action is greater than 1. For particles, the real part of the action is always 1/2, and the action of HD space is negative. This property appears because of the nature of the system to minimize the action.

9. Relationship between gravity and particles

The real part of an action in a particle is 1/2, whereas in high-dimensional space the action is negative. When a particle's action exceeds a threshold value, the excess action is converted to a HD space by symmetry breaking, turning it into a negative action. In this way, the entire system inhibits the increase in action. And this makes it look as if the particle is trying to minimize the action. The minimization of the action value happened by chance. Below the threshold value, the particles have time flow symmetry, but above the threshold value, the particles in the reverse direction of time are converted into a HD space. In low energy density, HD space is very unstable and has the property of changing into particles or 3D space. For example, HD space can be converted into photons at moderate energy densities. These photons mediate interactions between particles. This allows the particles to accelerate and move in a path that minimizes the action. In other words, high-dimensional space mediates interactions between particles and photons and exchanges momentum. The interaction by HD space is represented by the following equation.

$$F = \frac{dm}{dt} c$$

The speed at which interactions by HD space are propagated is the speed of light, and these interactions also change the mass of the particle. All interactions take place through this HD space. Particle-to-particle interactions occur through HD space. Virtual photons between particles are created by HD space. Virtual photons are created through the energy of a high-dimensional space, exist for a very short time, and then disappear while creating a HD space again.

Then, can't we create a HD space using particles? In order for the high-dimensional space to be created well, the energy density must be high. Then, a boson particle whose particles can overlap each other would be more advantageous than a fermion whose particles cannot overlap each other. If you superimpose a lot of boson particles in a small space, the energy density will be very high, and more HD space will be created. Using this mechanism, it may be possible to make a rocket capable of accelerating without propellant in a vacuum. This will work better the higher the energy density.

Another example that can be found in real nature is the black hole. Another example that can be found in real nature is the black hole. A black hole creates a high-dimensional space through gravitons, creating gravity and attracting matter around it. Black holes are created by the combination of gravitons and HD space. Graviton and high-dimensional space are symmetrical and form a high threshold, so surrounding materials cannot be sucked into the center. This creates an event horizon around the black hole. As the material on the event horizon increases and the action reaches a threshold, the symmetry is broken and the material is destroyed, creating more gravitons and HD space. This causes the black hole to grow.

Hawking radiation is caused by quantum fluctuations around a black hole. Quantum fluctuations around the black hole are caused by the collapse of HD space. When particles with positive energy are emitted toward the outside of the black hole, the HD space with negative energy remains as it is. HD space with negative energy is easy to maintain stably around the black hole, and it floats in space and then collapses in a place with low energy density to expand the 3D space. Therefore, black holes do not evaporate, and on rare occasions, black holes can grow rapidly by consuming enormous energy from matter on the event horizon. In this process, existing information is destroyed, and new information is created by Graviton. Also, Hawking radiation creates new information by photons. That is, information can be destroyed, created, or conserved.

10. On Free Will and Consciousness of human

What is Consciousness? We experience consciousness and make choices with free will. Consciousness is difficult to define, but we certainly feel it. Free will is almost like chance. Consciousness seems to be related to intelligence, but it's not quite the same thing. There is a report that consciousness is related to the quantum superposition pattern of the brain's neural network. [12] The fact that consciousness appears as a quantum superposition pattern means that consciousness is related to wave functions. How can quantum superposition create consciousness? Although the activity of brain neural networks creates quantum superposition patterns, the relationship between quantum superposition patterns and consciousness is still ambiguous. What is the relationship between the consciousness we experience and quantum superposition? Is the wave function conscious and discriminating information? This is still ambiguous. Moreover, consciousness is related to intelligence, and it is difficult to see that a single wave function has the intelligence to discriminate information. Humans can discriminate between minute differences in numbers, but wave functions are incapable of discriminating minute differences in numbers. Again, this means that the wave function has no ability to discriminate even if there is a side with a lower action. So, how does the wave function find the side with the lower action? The answer to this lies in thresholds and HD space.

The wavefunction breaks time-flow symmetry when the total action crosses a threshold. Then, a high-dimensional space is formed at any point in the wave function. This high-dimensional space amplifies the square of the absolute value of the wavefunction at that point, and the square of the absolute value of the wavefunction goes to infinity. Because of this, the wave function is divided into a region with infinite amplitude and a region with finite amplitude. At points where the absolute value of the wave function is infinite, the probability goes to 1, and at points where the square of the absolute value of the wave function is finite, the probability goes to 0. Because of this, the wave function can distinguish two states, 1 and 0. This is the most minimal unit related to consciousness, let's call it primitive consciousness.

Primitive consciousness is the simple ability of the wave function to distinguish between 0 and 1, but when neural networks form networks, form intelligence, and create quantum superposition patterns, they have very high levels of consciousness. Patterning is important to form higher levels of consciousness. The important point here is that it is the wave function, not the brain's neural network, that distinguishes 0 from 1. The neural network of the brain enables quantum superposition as the wave function forms a network, but the subject of consciousness is not the neural network of the brain but the wave function. Simply put, it means that the origin of consciousness is a wave function. Without the quantum patterning and the collapse of the wave function, there would be no consciousness. Artificial intelligence has free will, but it moves only according to set rules, so there is no freedom, and there is no collapse of the wave function and no quantum superposition pattern, so there is no consciousness. Rocks and computers do not have quantum superposition patterns, so they are unconscious. Rocks and computers are unconscious. Humans can have consciousness because the wave function collapses continuously, forming a quantum superposition pattern.

11. Summary and Conclusion

In this study, the relationship between mathematics, physics, and philosophy was considered, and the fundamental principle was found by examining the similarity between the brain's neural network and the wave function. The first principle is a philosophical principle, which means coincidence, and the second principle is a mathematical principle, which is the most basic principle to build an ideal mathematical world. The third principle derives from the second principle, which means the laws of physics. The laws of physics build the physical world, creating space and matter. The physical world creates intelligent beings and builds the mental world to embody free will and consciousness. In addition, the wave function and the neural network of the brain have a very high similarity, and based on this point, it was found that Born's probability interpretation in quantum mechanics needs to be modified. Through comparison of the similarity between the wave function and the neural network, it was found that the square of the absolute value of the wave function represents the input and output, respectively. In addition, it was found that there is a threshold value between input and output that determines 1 and 0. This is so simple and clear that it seems hard to doubt. This allowed us to infer the second principle much more clearly.

The second principle enables us to deal with various objects such as Euclidean geometry, four-dimensional space-time, high-dimensional space, and the concept of strings, and can describe the physical world by constructing an ideal mathematical world. According to the second principle, the smallest unit that nature can have is a point of size zero. Therefore, it is meaningless to discuss the smallest unit conceptually anymore, and it is meaningful only to discuss the minimum size that can be observed. Also, according to the second principle, string exists, which enables the creation of a high-dimensional space. High-dimensional space has mass and speed, can impart mass to particles, can contribute to contraction or expansion of space, and mediates all forces. Particles are created by combining string vibration and high-dimensional space. Particles create a wave function by forming time flow symmetry below a threshold value and collapse the wave function by breaking time flow symmetry above a threshold value. This allows time to pass and particles to move according to the laws of physics. In addition, it was found that the mechanism by which consciousness arises is related to the collapse of the wave function according to the quantum superposition pattern and the threshold value, and that high-dimensional space is involved in it.

This study is very meaningful in that it explained various phenomena within the same system through fundamental principles. It showed that various natural phenomena can be easily explained through the fundamental principles that exist in each world by integrating the philosophical world, the mathematical world, and the physical world into one. In addition, the reinterpretation of Born's probability analysis seems to be an important key to solving the problem of infinite probability that has baffled physicists so far. However, since this study approached the problem mainly based on philosophical interpretation and imagination, it seems necessary to supplement mathematical analysis or quantitative research. These problems need to be corrected and improved through cooperation and additional research in various fields. The evidence for the hypothesis of this paper can be secured through the discovery of materials that existed before the Big Bang, the development of engines without propellants, and the development of strong artificial intelligence. In addition, the discovery of event horizon collapse in black holes can be another strong evidence. In addition, the proof of the Riemann hypothesis may also lead to results supporting the claim of this study. Evidence such as this will enhance the completeness of the theory of everything.

Everything starts from nothing. Everything is created by chance, and points are created by the second principle, time and space are created, particles and higher-dimensional space are created, physical laws are created, stars and galaxies, solar systems, the earth, life forms, and 'I' existence was created. And I now think and exist. Everything was created by chance. If chance and free will are the same thing, everything is created by free will. So, how is free will created? Free will is not created. Free will always exists, even in the absence of anything.

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