

MiTiTempo

My Time

Natures of the time and the universe

Part-1

What the time is

Chapter 1. Nature and definition of the time

Chapter 2. A model of the universe and a
common measuring time

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*In Nov. 2018, I reported the “**Energy Circulation Theory**”. The “**Fundamental force**” works between energy pieces based on momentum. The momentum in the hidden dimension of energy circulation in hidden-space dimensions is the electric charge.*

The force ruling the cosmic expansion is the fundamental force but not the gravity. Accordingly, I revised this book for the space expansion. The expansion speed is given by a new formula, but it is of a similar form to the former one based on the gravity. The new theory gives the identical equation of the light speed to the formerly reported one. Except for the space expansion equation, other parts remain unchanged.

For details, please see “Energy Circulation Theory” and “Space Expansion” in the home page of MiTiempo.

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Chapter 2. A model of the universe and a common measuring time

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Ch. 1. Nature and definition of the time

1. Start of a tour around the time

A couple are talking of a town they visited before. In days gone by, they could clearly retrace their memories of scenes and events from their travels back for many years, but it is now getting harder and harder to recall them. Occasionally their memories conflict each other and the both insist that its own memory should be the fact. “There would be no difference either we travel or not because we forget memories from it” the wife whispered. Upon heard of it, the husband questioned to himself, “what is a fact happened in the past?” The difference between the real and the virtual is getting more uncertain as the computerization of the society advances. We can regard one’s memory and senses like sight as a virtual representation by its brain. As days went by with the couple, they got aged and lost lots of memories. Turning her eyes on a small ruby in her ring, the wife muttered, “This ruby has been shining red without changing for long. Would it have an eternal time? It’s enviable, isn’t it?”

On a night around 2000, I could not fall asleep. My longtime question “what the time is” came up and did not disappear easily. I gave up sleeping and turned over in my mind. However, I only repeated over the phrase that the “event” is a temporal change of a spatial distribution of an energy. I did not find any clue to answering to “what the time is” or “how the time dimension differs from the space dimension”. After a time, I jumped up upon perceived an important feature for the time. Whereas the time is essential for the movement, the movement is also a prerequisite for the time. The time does not exist without any movement. Here the first step of my long-cherished dream to step into the subject “what the time is” started to go forward. I testified in excitement this point with various examples. As it matched to the all cases I checked, I became confident that this should be one of important features of the time.

2. Time and movement

In response to the argument that the movement is essential for the presence of time, there would firstly arise the objection that there exist stationary objects and the time is passing even if they are stationary. However, the passage of time is not a time of the stationary object but is a time of the observer. Suppose a case that there is a ruby stationary on a table. The following processes achieve the phenomenon that a person regards the ruby stationary; lights transmitted through or reflected on the ruby go into the eye, electric signals transmit to the brain and after data processing, he or she recognizes there is a ruby. If there is no change of location of the ruby by continuous visual measuring, the observer feels it remaining stationary. The time, which the observer feels, is the time that it spends for measuring the light and processing the information. Then what is a time of the ruby? The ruby consisting of atoms embraces various movements such as inter-atom actions and movement of electrons in atoms. However, the ruby does not have a time corresponding to the observer's time if it does not recognize change of the outside world. In a case that there exists variation in the ruby's internal structure, the change has a possibility to work as the ruby's time. However, in a time scale, for which we can regard such an internal change in steady state, the change cannot be a time. If there is no change in a ruby, the ruby does not possess the attribute as time, far from having an eternal time.

There is another important respect. The time and the movement exist in pairs each other, that is, a time measuring a movement and a movement measured by a time. In the case of the ruby, no time of the observer only for movement of the ruby exists because there is no movement of the ruby. Someone may contradict that the observer is detecting the ruby as stationary. The time, however, is not for the ruby's movement but is for movement of its brain activity. During the time, the ruby looks stationary for the observer. Additional side is that there can exist plural times for measuring (or expressing) a single movement. There are various types of time; such as

time suitable to express intra-atom movements, time useful for describing molecular movements, time for sense organs to catch outer stimuli and for successive recognition by the brain, and time for memories recorded in the brain. Nowadays human beings have clocks by which we share common time intervals as well as records of event, which we can share. Therefore, we tend to regard what we think to be the common time shared with others is fundamental. We unintentionally perceive it due to feeling by our brain but not due to variation of speed of time passing that we feel the time passing slow some time and fast another time. However, from the viewpoint of life of a human being, we may say the brain time, which an individual feels, should be more fundamental for him or her.

Though nothing yet been revealed about nature of the time, I noticed an important aspect of the time. That night I promised to myself that I would surely elucidate the nature of the time some day and write a book on it with the title of “MiTiempo”.

3. Decrease of dimension

In the summer of 2007, my wife and I aborted a customary travel. I alternatively searched an open summer class of university, but failed to find an attractive one to me. Instead, I found that an international congress on astrophysics to be held in Nara, an old capital of Japan. In my high school days, I liked physics very much. However, as realized I was too lazy to continue studying for life, I entered the pharmaceutical department for a university. I majored organic chemistry and later became engaged more in biological aspects at a pharmaceutical company. I had no relation at all to professional physics. On the other hand, my interest in physics was getting greater as I had a look at books for the public in physics such as quantum particles, superstring theory, and accelerating expansion of the universe. In the same time, I surely realized that the professional physics is a society of heaven for me, where I can never step in. Being nervous with anxiety and expectation, I attended the 8th Asia – Pacific International Conference on

Gravitation and Astrophysics (ICGA8) held in the campus of the Nara Women's University.

In the conference there were some presentations on cosmological models based on the superstring theory, which treats quantum particles as vibration in multiple dimensions (models of 26-D, 10-D etc.). Two ends of a string are bound to a so-called brane like a plane, which induces its mass. The graviton, said to be the transmitter particle for the gravitational force, is a closed string with the two ends connected like a loop without binding to a brane. While branes of various numbers of dimensions are theoretically possible, our current universe has the brane in which three dimensions spread. The remaining dimensions are compactified and unrecognizable. The models presented in the conference proposed that two branes approach and collide each other, and then separate to another pair of two branes. Each brane represents a single universe and the collision corresponds to the Big Crunch and the Big Bang. I did not understand the relation between the intra-brane gravity and the inter-brane gravitational interaction then.

During the conference, I was thinking of wave and number of dimension over taking longish lunch at a restaurant near the university. I thought that energy would be vibration in multiple dimensions and if the energy further vibrates in an additional dimension, it attains the corresponding energy additionally. What would happen if the number of dimensions of the energy alters, especially what does it mean the decrease of dimension number? The sea wave came to my mind then. A wave of low wave-height in the open sea becomes higher when it approaches a seashore and the sea depth gets shallow. A wave gets higher also when the width turns narrow like at a bay. I considered it relating to decrease of dimension number. As a model of it, I took the case that a slit narrow in width with long length and same height is attached to a part of a dam. We can regard water in the slit loses one dimension for movement due to the loss of freedom in the width direction. When a low wave of water inside the dam transmits to water in the slit, the vibration in three dimensions transforms to vibration

in nearly two dimensions, which would exhibit high wave height because the wave energy is preserved. I felt a foreboding that this would become a breach for understanding the universe.

A banquet was held as an event of the conference. All attendees except for two including me were from academia. Alcohol made me encouraged to talk to other participants. One of the most serious subjects in astrophysics is why the expansion of universe is accelerating. A Japanese professor kindly talked to me on astrophysics including this subject. I asked him “Isn’t there a possibility that the speed of time passing would have altered instead of accelerating space expansion?” He taught me that the speed of time passing does not make sense because the time is an imaginary dimension. He stated that there should be no way other than to expect that the space itself should have energy. “I am approaching it by quantum mechanics, but we should derive it mathematically”, he added. His statements at that time have become later an important advice for my consideration about time. However, I did not memorize his name or affiliation and I could not contact him afterward.

When I was pondering the model of dam with slit the following day over lunch, I thought what would happen if the slit moves along the dam wall. I noticed another aspect not on how the inside of the slit would behave but that the slit is tracing waves inside the dam to the direction of the breadth of dam. I felt by intuition that this should be a clue to elucidate what the time is. Returned from the conference in Nara, I started to investigate a potential nature of the time and a scenario of the universe initiating from vibrations in multiple dimensions. After repeated trials and failures, I accomplished first documentation about the time and the universe in about two weeks. During the time, I could hardly sleep since I could not calm excitation of brain activities.

4. Tracing dimension and imaginary order of freedom

Think of a movement in a one-dimensional world. The value in the dimension D1 changes from A to B. We may think that we can express it in a one-dimensional world because it is only a value change. However, we unintentionally add another dimension “time” there. At a certain time, it takes the value A and at another time point, it takes the value B. Additional dimension is essential to express value change in D1. The upper schemes of Fig. 1 show a generalized image for it. Corresponding to value change of D2, the value of D1 varies. Calling a value alteration as a movement, in order to express a movement in one dimension another dimension is required. It is a two-dimensional world. As shown in the lower part of Fig. 1, in order to express a movement in two dimensions we need a third dimension D3. Here, let us define the “tracing dimension” as follows:

- “*Tracing dimension*” is defined as a dimension, by variance of which a value-change (movement) of the resting other dimensions is expressed.

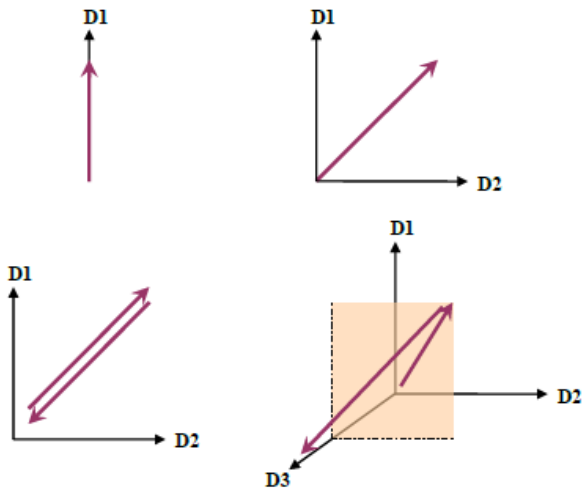


Figure 1

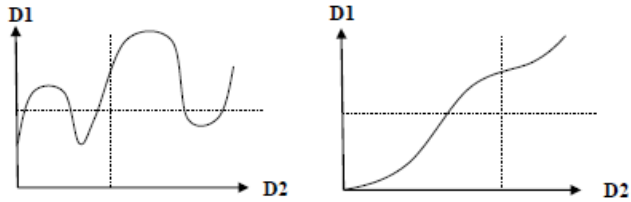


Figure 2

In order for a dimension to work as a tracing dimension, its single value should correspond to a single value in a traced dimension. In the left case of Fig. 2, any single value of D2 corresponds to a single value in D1. Therefore, D2 can be a tracing dimension for D1. However, D1 cannot work as a tracing dimension for D2 because a single value of D1 corresponds to plural values in D2. In the right case of Fig. 2, tracing by either D1 or D2 gives a single value. Therefore, D1 and D2 can be a tracing dimension for D2 and D1, respectively. A common tracing dimension for plural movements should represent by its tracing a single value in any dimensions respectively for all the movements, which gives a high limitation for common tracing.

Subsequently let us think of the imaginary order of freedom. While we easily tend to grasp the imaginary number as not existing in reality, it appears by a system of mathematical notation. For instance, we can describe the values of D1 and D2 in Fig. 2 as a combination of real numbers like (D_1, D_2) . We can also express it by a complex number as $D_1 + iD_2$ taking D2 value as imaginary number for D1 as D2 is orthogonal to D1. The expression method is different between the two presentations but the both signify the same one.

We sometimes express spatial movement by showing time as imaginary number such as the Minkowski space-time. The movement $Y = XT$ is expressed as $Y + iXT = 0$. The metric, which corresponds to distance, for the later expression including imaginary number gives $Y^2 - X^2T^2 = 0$,

which is equal to the square of the former expression. From this aspect, we occasionally call the time as an imaginary dimension. The time is imaginary only when we express the space as real number. If we describe the time as real number, the space turns to be imaginary number. Stephen Hawking insisted that the time before the Big Bang was imaginary time and behaved space-likely. Reversely traced the expansion of the universe to shrink, the time we observe would become no longer capable to work as a tracing dimension for the space, I assume. We will discuss this point later, but it would be a good example to understand the relationship in real and imaginary numbers between the space and the time.

Although the word “imaginary dimension” is often used, it seemed insufficiently defined. I noticed that we could define a nature of imaginary order of freedom when I was considering properties of the tracing dimension. As far as I searched by internet, I could not find “imaginary freedom” or “imaginary order of freedom” while “imaginary dimension” appeared often. The concept of the “imaginary order of freedom” I propose is shown in Fig. 3.

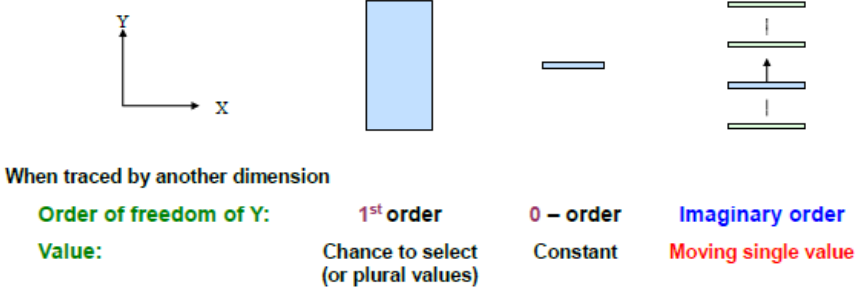


Figure 3

In a single dimension the first order of freedom means that there is a freedom to select a value or take plural values. Zero-order of freedom has no chance to select a value and takes a constant. In addition, here define the

“imaginary order of freedom” as follows.

- “*Imaginary order of freedom*” is defined as that
 - there is no freedom of selecting a value, and furthermore
 - the value is not a constant but moving in a single direction (increase or decrease).

5. Properties of a dimension having the imaginary order of freedom and definition of the time

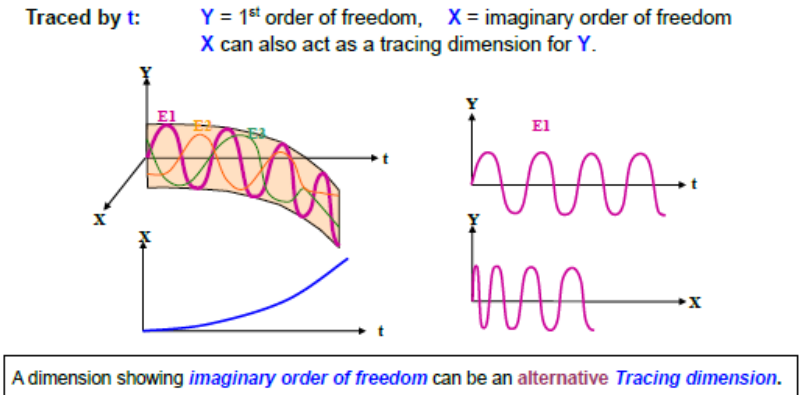


Figure 4

Fig. 4 shows vibrations in three dimensions of Y , X , t . Traced by t , Y takes fluctuating plural values of $E1$, $E2$, $E3$ etc. However, X takes only a single value common to all of them and further the value is moving in a single direction, when traced by t . Therefore, Y has the first order and X has the imaginary order, respectively, of freedom. A dimension showing the imaginary order of freedom can act as an alternative tracing dimension. For instance, $E1$ in Fig. 4, which is shown as the upper right graph when traced by t , is alternatively expressed as the lower right graph when traced by X .

The action “tracing” itself of a tracing dimension results in exhibiting the

imaginary order of freedom. We can express a tracing dimension as an imaginary number component for a movement. In case X_1 shows the imaginary order of freedom when a k -dimensional space of X_1 to X_k is traced by X_0 , X_1 can be a tracing dimension for the $(k-1)$ -dimensional space of X_2 to X_k . By formula we can express this as follows, where e_i is the basis vector of X_i .

A movement in k -dimensional space (e_1 to e_k) traced by e_0 :

$$dA^k = idx^0 + dx^k e_k$$

$$(\text{=} idx^0 + dx^1 e_1 + dx^2 e_2 + dx^3 e_3 + \dots + dx^k e_k)$$

If e_1 shows the imaginary order of freedom, the movement in $(k-1)$ -dimensional space of e_2 to e_k traced by e_1 :

$$dA^{k-1} = idx^1 + dx^m e_m \quad (m = 2, 3, \dots, k)$$

As you may already realize, the time, which expresses a spatial movement by its value change, is duly a tracing dimension. Here we can define the space (of universe) and the time as follows.

- “*Space*” is the **area** where **energy** is distributed.
- “*Time*” is a dimension to **trace** values in space dimensions.

Many movements exhibit the imaginary order of freedom when traced by such a time that we unintentionally believe to be common for us. An example of such a movement is brain activity of an individual person. As the transition of brain activity is localized within one’s brain, we can treat it as a dimension orthogonal to the space. Therefore, the brain activity can work as another time to trace movements in its surrounding area.

6. Another important property of the time

By discussions so far, we have revealed substantive properties of the time and given its definition successfully, I guess. Furthermore, there is another important property of the time that “**the time exists only at the present point**”. My classmates in high school hold a party annually on New Year holidays. Mr. T, a classmate of mine, kindly gave an ear to my proposed ideas on the time and the universe. We exchanged opinions at the party and by follow-up email correspondences. He taught me that in the area of philosophy the time is interpreted to exist only at the present. “The past is a record of past existing at the present, and the future is an expectation on what to happen from now existing at the present”, he added. We two also discussed the time for an individual person. He introduced to me the book written by Akiko Ikeda “Philosophy starting from 14 years old”. In the book the time is discussed and natures of respective time for each individual (“for you” in the book) are thoughtfully explained. Whereas I also partly touched on time for an individual already in this book, the piece of Ms. Ikeda made me think deeply again about by what a human being traces its surrounding world.

I will describe details in a later chapter but I expect the space and the time are of similar dimensions in the sense of gravitational interaction. Both the time and the space are the area where energy exists. There exists no space nor time where energy does not reside. The difference is that energy distribution in the time dimension is only at a single point in contrast that it spreads to a huge area in the space. By alteration of the residual point of energy in the time dimension, it can trace energy movements in space dimensions. The “existence” is the “energy distribution”, which resides only at a single point in the time dimension. The point of time is the “present”. The philosophical interpretation of the time “existing only at the present” seems to accord with the natures of the time I propose, which encouraged me for subsequent investigations on the universe.

Ch. 2. A model of the universe and a common measuring time

7. 4-D spherical model of the universe

How would it be possible that energy is located only at a single point of time whereas it spreads out in a so tremendously huge area of space? For considering the initiation of the universe, I based upon the premises that energy is a vibration in multiple dimensions and any energy interacts each other receiving gravitational force. From the assumptions, I examined possibilities of the development of the universe.

In order to describe the energy of the initial universe as vibrations, a tracing dimension is essential. Without it, relative relations of distribution in the multiple dimensions exist but we cannot describe the energy as vibrations. Among the dimensions where energy exists, that showing the longest cycle for value change can work as a tracing dimension. Let us call the dimension, which can trace both fluctuations of the initial universe before the Big Bang and the subsequent expansion of universe, as the “*Original time*” and express it by small letter t as “*time*” or “*t*”.

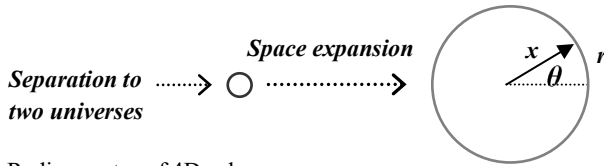
It is often said that a phase transition of the vacuum happened at the beginning of the universe. Take a water droplet as an example of a phase transition. Water forms a sphere exhibiting the smallest volume by attraction of hydrogen binding between water molecules if its gravitational influence is small. When it is heated, the kinetic energy of molecules increases and molecules become to move individually turning into a gas. The energy released from inter-molecular binding transforms to kinetic energy of individual molecules and has them move rapidly. This is the phase transition from liquid to gas. There is another status of liquid, in which water is located only on the spherical surface with empty inside like a soap bubble, other than the droplet. Resolving the Newtonian gravity equation, there exists also such a solution showing an energy distribution on a spherical surface.

In case any vibrations in all dimensions are in the steady state for a measuring time duration scale greater than a certain value when traced by the Original time, we can regard the whole universe as a single quantum particle by observation longer than the duration. Should the energy become to be localized on the spherical surface from the globular distribution for instance, huge energy liberated from the decrease of dimension transforms to kinetic energy, which results in rapid expansion of the surface. A scenario of space expansion of the universe triggered by such a phase transition of energy distribution can be considerable. Since our current space is of three dimensions, the expanded sphere should be of four dimensions, on the 3-D surface of which energy spreads.

I have proposed the following model of the universe:

- Energy is vibration in multiple dimensions.
- The space of the universe is the area where energy spreads.
- ~~Gravitational attraction works between any energy in accordance with the Newtonian gravity equation.~~ **Fundamental force works between energy pieces based on momentum.**
- ~~At the Big Bang, the energy distribution transformed to be located with expansion in 3-D surface of a 4-D sphere by the Original time.~~ **The initial energy separated to two universes, which have opposite circulations in two planes in 4D space (*Giant Separation*). The energy distribution in 3D surface of a 4D sphere turned to expand at the Big Bang by the Original time.**
- Vibrations in the hidden dimensions render energy to the space. Let us refer the intrinsic space energy to as “*Spacia*”.
- A vibration of the intrinsic space energy (*Spacia*) in the 3-D space vests additional energy (***Apparent energy***), which is our observable energy in the 3-D space as light or a quantum particle.
- The time we observe passing constantly and commonly is the radius dimension of the 4-D sphere for the distribution of the space energy. Let us call it as the “***Observed Time***” and express it by large letter T as “***Time***” or “***T***”.

This kind of “3-D surface of 4-D sphere” models of universe were proposed in a rather early period from the viewpoint of the isotropy of the universe. According to such old models, however, the expansion speed of the universe should have decreased rapidly due to the gravity. Because the universe is expanding roughly at a constant speed even now, astrophysicists contradicted such models. Furthermore, the accelerating expansion of universe, reported in 1997 and onward from measurement of supernovae, has entirely denied those models. The model I am proposing has the special distinctive that our observed time is the radius of the 4-D sphere, in accordance with which the expansion speed of the universe turns to be constant.



x : Radius vector of 4D sphere

$$\mathbf{x} = (x, \boldsymbol{\theta}) = (x, \theta_1, \theta_2, \theta_3) \text{ (4D spherical coordinate)}$$

r : 3D space vector corresponding to $\boldsymbol{\theta}$, $r = x\boldsymbol{\theta}$

$$\mathbf{r} = (r, \varphi_1, \varphi_2) = (x\boldsymbol{\theta}, \varphi_1, \varphi_2)$$

\mathbf{x} by 4D cylindrical coordinate:

$$\mathbf{x} = (x, r, \varphi_1, \varphi_2) = (x, x\boldsymbol{\theta}, \varphi_1, \varphi_2)$$

Figure 5

Fig. 5 shows a reference image of the model. The circle there indicates a 3-dimensional space. We can express a position of energy distribution by 4-D spherical coordinates of the radius x and three angular components. We can show its corresponding position in the 3-D space by 3-D spherical coordinates consisting of the distance from a reference point and two angular components. We can describe the position in the 4-D space also by 4-D cylindrical coordinates consisting of the radius of 4-D sphere, the distance in 3-D space and the two angular components in 3-D space. Upon traced by the Original time, the radius x shows the imaginary order of freedom and can be an alternative tracing dimension for the 3-D space. A distance r in 3-D

space is equal to the product of a corresponding angle θ and radius x from the center shown by $r = x\theta$, which implies that the 3-D space of universe expands at a constant speed toward x .

According to this model, the expansion of the universe by the Original time will decrease due to the intra-circulation interaction by the fundamental force and then turn to shrink. Taking the unit for x , the maximum of which is one (1) when the space expansion stops, the change speed (v_x) of x by the Original time t is given by the following formula.

$$v_x = \pm \sqrt{\frac{K_f E_U}{\pi} \left(\frac{1}{x} - 1 \right)} \quad (\mu_0 \leq x < 1)$$

K_f denotes the fundamental force constant. E_U represents the total energy of the whole universe. μ_0 is the initial radius at the Big Bang. By the Observed Time $T (= x)$, the expansion speed of x is one. The expansion speed v_r of a distance r corresponding to any central angle θ by the Original time t is shown as $v_r = \theta * v_x$. That by the Observed Time T is constant given as $V_r = \theta$.

8. Measuring time

A dimension showing the imaginary order of freedom can be an alternative tracing dimension. Then what kind of tracing dimension is the time that humankind feels sharing in common? Suppose two movements showing the imaginary order of freedom. Within the range of common domain, it does not have a substantive meaning which movement traces an object. Because the two movements correspond one-to-one in the common domain, either one can trace objects with difference only in expression outcome. For instance a movement of x shown by t_1 as $v_1 = dx/dt_1$ can be also expressed by t_2 as $v_2 = dx/dt_2$, where exists the relation

$v_2 = (dt_1/dt_2) * v_1$. In order to work as a “**measuring time**”, the following conditions are required.

- 1) It should have a domain in which it can trace all movements of objects.
- 2) It should fulfill the requirement as a tracing dimension that its single value should correspond to a respective single value in all target dimensions.

The maximum domain of the brain time of a human is the duration of its life. The period during it is sleeping is excluded from the domain for observing its ambient world. Therefore, the brain time cannot be a universal common measuring time. Furthermore, the brain time could not trace external rapid movements such as electric signals and light propagation fully continuously because it comprises chemical and electric transmissions. It would trace such a rapid movement only intermittently.

The Original time should be the only tracing dimension capable to describe all movements of the initial universe, the Big Bang and the sequent expansion / shrink. On the other hand, the 4-D sphere radius x , which exhibits the imaginary order of freedom when traced by the Original time, can be a tracing dimension in the range except the time before the Big Bang and the point when the cosmic expansion stops due to gravity. That is for the range $x_0 \leq x < 1$ (by the unit of x with maximum one when the expansion stops). Therefore the radius x can be a common measuring time to describe any movements in the 3-D space. A time interval to measure any movement in the 3-D space in general is extremely short compared with the time scale of the cosmic expansion. Therefore, the expansion speed of the radius x by the Original time t can be treated constant during the measuring interval. Because the Original time t and the Observed Time T ($= x$) become proportional each other, it does not have a fundamental difference by which of them a measurement in the 3-D space is made but the outcome differs only in unit between the two cases. For macroscopic measurement like the cosmic expansion, on the contrary, the expansion speed

of the universe is constant by the Observed Time but decelerates by the Original time. The tracing dimension should be given from by what a mean we measure the space expansion. We unintentionally perceive the time is passing constantly. In order to provide a speed of time passing, it is necessary to specify a target movement. We can also regard inversely that the movement traces the time and gives the passing speed of the time. Then what can be such a target movement for our common time passing? The space expansion is a possible one. “The space expands at a constant speed” should be identical to “the time passes at a constant speed toward the space expansion”. I guess that we unintentionally take the Observed Time as our common time.

Possible mathematical expressions of movements, respectively by the Original time and the Observed Time, in accordance with the 4-D spherical model of the universe are given in Fig. 6.

◇ 4-D space traced by t (Original time) :

$$dA(4)_t = i v_x dt + dx e_x + dr e_r$$

(The imaginary component is multiplied by v_x so that its metric for space expansion in x remains zero.)

◇ 3-D surface space traced by t :

$$dA(3)_t = i v_x dt + dr e_r \approx i v_{xc} dt + dr e_r$$

$$v_r = v_x V_r \approx v_{xc} V_r \quad (\text{expressed by } T)$$

◇ 3-D surface space traced by T (Observed Time) :

$$dA(3)_T = idT + dr e_r$$

$x e_x$:	Radius vector of 4-D sphere
$r e_r$:	Position vector in 3-D space
$v_x \equiv \frac{dx}{dt}$:	Speed of x by the original time t
v_{xc} :	Current v_x (can be treated a constant for present measuring in 3-D space)
$v_r \equiv \frac{dr}{dt}$:	Speed of 3-D space distance by t
$V_r \equiv \frac{dr}{dT} = \frac{dr}{dx}$:	Speed of r by the Observed Time T
$V_x \equiv \frac{dx}{dT} = 1$:	Speed of x by T

Figure 6

The 4-D space can be divided to the radius x and the 3-D space r , which are orthogonal each other. Variations of x and r are expressed with the component of the tracing dimension given by an imaginary number. e_x and

e_r in the formulas are respective basis vectors for x and r . Take V_r as the velocity of r traced by T . The voracity of r traced by t , v_r , is equal to the product of v_x , which is the velocity of x by t , and V_r as shown by $v_r = v_x V_r$. We can regard the current value of v_x constant for measuring r .

Next, let us examine the aspect of “**common**” measuring time. Both the time and the space are area where energy is distributed. Therefore, at the place where a tracing target movement of energy resides, the time corresponding to the place exists. According to the 4-D spherical model of the universe the radius x equal to the Observed Time T is primarily a 4-D vector and has a position vector direction in the 3-D space in addition to the direction of the Time passing. At a place apart from us by the spherical center angle θ , the radius direction differs from ours, and its component to our radius direction is equal to $x \cos \theta$. It may be afraid that there would be a difficulty to trace a movement, location of which varies, if a measuring time differs by different locations. However, the absolute value of x is common at any locations. Therefore, even for any shift in location of an object along with its movement, the magnitude of respective radiuses associated with the movement can work as a measuring time and furthermore it is common regardless of location or movement. Thus the radius magnitude x of the 4-D sphere can be a common measuring time for any movements in the 3-D space, and is specially referred to as the Observed Time. There would be only the Original time and the Observed Time, which can act as a common measuring time covering any movements in the 3-D space.

Gravitational force works between every energy in inverse proportion to the square of distance. All dimensions including the time act space-likely for gravity since both the space and the time are area where energy is distributed. Between the diametrically opposite area of the universe from us and our location, the gravitational interaction exists corresponding to the distance of $2x$ while extremely weak. I do not know if there exists a mediator (graviton) for gravitational force like light for electromagnetic

force. Even if it exists, it does not need to propagate in the space energy, and its mass and energy should be zero. Therefore, there is no need of the upper limit of transduction speed like the light speed, and further it can pass through the vacant inside part of the 4-D sphere. This seems somewhat resemble to the aspect that graviton is a closed string not bound to a brane in the superstring theory.

9. Measurement of movement and the clock

While I have mentioned that the Observed Time can be a common measuring time for all movements in the 3-D space, how would we perform the measurement of such a movement in concrete? Take a case that a person looks at a car in motion. In actuality, the person does not directly trace the movement of the car. Lights reflected on the car pass through its eyes, convert to electric signals and then project a picture image on a virtual space constructed by the brain, which results in feeling that the car is moving. It is a kind of hologram. What directly traces an electric signal of visual information is a mechanism in the brain playing a role of a clock. Details of such a brain clock are yet unknown but should be like an electric circuit with underlying micro electric currency or electromagnetic field derived from intermolecular interactions. When an electric signal from outer stimulus reaches the electric circuit, it would recognize the signal, send a secondary signal in the brain, and then perceive the existence, I expect. Here let us remind the respect that the time exists only at the present. Tracing a single movement targets only **a single point where the time and the space cross each other**. In case of the brain time, it detects individual electrons of currency induced by visual sensation. Not only for a single movement but also for plural movements in parallel the brain time works as a common tracing dimension. Many detection units queue up there and provide a spatial perception likewise an image sensor of a digital camera comprises many picture elements. By processing data of chronological transitions of individual unit cells collectively for all units, the brain

perceives the movement. The electric signal disappears at the cell corresponding to the location of the car just before, and it appears at a neighboring cell instead, by which the brain recognizes the car being moving.

Not only sight but all senses such as auditory and tactile sensations are under the same situation, where what the brain directly traces is an electric signal (electron or electromagnetic wave). Thus, the aspect that we indirectly trace the target object applies to almost all measurements. We usually perform measurement of an object by using a measuring device with the mediator of electromagnetic wave. Therefore, the measurement does not directly trace an object at the place of it. However, by setting up a common time for all places, we can deal result of a measurement as the time at the place of the target. In this case, we compensate the time lag of the electromagnetic wave reaching the device as needed. What can acts as such a common time is the Observed Time. In order to express a passage of the Observed Time, we can use another movement, which is in a uniform motion to the Observed Time. This is indeed essence of the “**clock**”. The clock does not fulfill the requirement of time being at the location where the target energy exists, but has a clear relation to the Observed Time that meets the requirement, and further shows the imaginary order of freedom when traced by the Observed Time. Thus such a clock can indirectly work as a tracing dimension, namely it can be a time for measurement.

Before I propose the Observed Time, people have recognized the existence of such a common measuring time but what it is in concrete would have been unknown. In the circumstances where myriad of clocks can be used, we assign a specific movement and set a duration of it as a base period, which can act as a standard clock. The latest standard time interval is “one second”, which is defined as the duration of a certain number periods of the radiation corresponding to the transition between the two energy levels of the cesium 133 atom. Cesium 133 atoms exhibit the same period of the radiation at any location under common conditions like temperature. Thus, the cesium 133 atom is now the standard clock, which can exist in plenty

without depending on location. Historically one hour was defined ahead as one 24th of one day, from which one second was provided secondarily.

10. Interim conclusion and invitation to the Part-2

I have completed descriptions in this book about the investigation on the time. We have seen various aspects of the time such as tracing dimension, imaginary order of freedom, definition of the time, and measuring time and clock in a real measurement. It would be my greatest pleasure if they would, even a little, clear fuzzy feelings you had on the time.

We have discussed the time in the real universe by proposing a model of the universe not only examined the philosophical aspects of the time. It now turns out the biggest question whether the model is true or not. The 4-D spherical model of the universe I propose insists that vibrations of the intrinsic space energy in the 3-D space are light and other energies. It signifies that a medium exists for light propagation. This apparently confronts the light speed invariance independent of frame selection and the special relativity derived from it.

I have been publishing the following contents so far: From the point that light is vibration of a medium, light propagation speed is not necessarily constant to any observers while constant to the medium based on fundamental properties of wave in general. Moreover, the propagation speed alters along with decrease in density of the medium. The Michelson-Morley experiment, widely considered to have proved the light speed invariance, is not capable to detect a light speed variation by the set index. Accordingly, I proposed to abandon the special relativity and newly introduce the acceleration factor of stationary wave as a property of wave. The current understanding of accelerating expansion of the universe is subject to the light speed invariance. If light speed has been decreasing, it would become possible to interpret the observed data of supernovae as that the universe has been expanding at a constant speed.

The accelerating expansion of universe is one of the biggest mysteries in

modern astrophysics. Many professional scientists are engaged in elucidating it. They introduce an unknown repulsive force, which generates the energy called “dark energy”. According to my proposed model, the dark energy in that sense does not exist because the cosmic expansion is not accelerating. The biggest objection of professional physicists against my proposed model is on the point that I deny the special relativity. They place absolute trust in the special relativity and require the invariance by the Lorentz transformation, which the special relativity requests, for any physical models.

I have been making efforts toward submission to scientific journals and presentation in conferences, but most of physicists except for a very few ones disregard my arguments entirely: this is the reality unfortunately. Nevertheless, thanks to kind appreciation and support of a certain professor I participated in an international conference in astrophysics and presented by poster every two years since 2008, four times in total. My papers were published in a scientific journal as proceedings from the conference. Though written by a nonprofessional like me, the articles include minimum mathematical formulas as they are on physics. My colleagues in the pharmaceutical industry complain that my theory and claims are too difficult to understand. Physicists argue that I should use their common language of mathematics. I guess I used such mathematical expressions that are theoretically completed at a minimal level while a nonprofessional style in latest papers including that under submission. The biggest contradiction of professionals is after all on the light speed invariance and the special relativity.

I raised my articles in the reference list at the end of the Part-2 of this series especially for your persons who have kindly read this volume up to here. In the subsequent Part-2 “Verification of the 4-D spherical model of the universe”, I briefly introduce important subjects such as light speed, acceleration factor instead of the special relativity, redshift and propagated distance of light, and comparison with observed data of supernovae. I will

highly appreciate if you look over it comfortably up to any page you can continue.

URL for MiTiempo:

<https://mitiempo-ect.main.jp/index.html>

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