Chapter

From Relativity to Creation of Temporal (t > 0) Universe

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Abstract

One of the important aspects of science must be the substantiated physical realities, which were built by the fundamental laws of physics that cannot be simply substituted by unsubstantiated virtual reality. In writing this chapter we have mostly based on the constraints of the current laws of physics to illustrate the enigmatic time as the origin for creating our physical space (i.e., temporal universe). The differences between physical reality and virtual reality are that physical reality is existing within the rule of time and supported by the laws of science, while virtual reality is created without the constraints of time and mostly not substantiated by the laws of physics. One of the important aspects of temporal (i.e., $t > 0$) space is that any emerging science has to be proven to exist within our temporal universe; otherwise it is fictitious and virtual as mathematics is.

Keywords: relativity theory, Einstein energy equation, temporal space, creation of universe, time and space

1. Introduction

One of the most intriguing variables in science must be time. Without time, there would be no physical substances, no space, and no life. In other words, time and substance have to coexist. In the chapter, I will start with Einstein's relativity theory to show his famous energy equation, derived from in which we will show that energy and mass can be traded. Since mass is equivalent to energy and energy is equivalent to mass, we see that mass can be treated as an energy reservoir. We will show any physical space cannot be embedded in an absolute empty space and it cannot have any absolute empty subspace in it and empty space is a timeless (i.e., $t = 0$) space. We will show that every physical space has to be fully packed with substances (i.e., energy and mass), and we will show that our universe is a subspace within a more complex space. We see that our universe could have been one of the many universes outside our universal boundary. We will also show that it takes time to create a subspace, and it cannot bring back the time that has been used for the creation. Since all physical substances exist with time, all subspaces are created by time and substances (i.e., energy and mass). This means that our cosmos was created by time with a gigantic energy explosion, for which every subspace coexists with time. This means that without time the creation of substances would not have happened. We see that our universe is in a temporal (i.e., $t > 0$) space, and it is still expanding based on current observation. This shows that our universe has not reached its half-life yet, as we have accepted the big bang creation. We are not alone with almost absolute certainty. Someday, we may find a planet that once upon a time had harbored a civilization for a period of light-years. In short, the burden of a scientific postulation is to prove a solution exists within our temporal universe; otherwise it is not real or virtual as mathematics is.

Professor Hawking was a world renowned astrophysicist, a respected cosmic scientist, and a genius who passed away last year on March 14, 2018. As you will see, our creation of universe was started with the same root of the big bang explosion, but it is not a sub-universe of Hawking's. You may see from this chapter that the creation of temporal universe is somewhat different from Hawking's creation.

2. Relativity to Einstein energy equation

The essence of Einstein's special theory of relativity [1] is that time is a relative quantity with respect to velocity as given by

$$\Delta t' = \frac{\Delta t}{\sqrt{1 - \mathrm{v}^2/c^2}} \tag{1}$$

where $\Delta t'$ is the relativistic time window as compared with a standstill subspace, Δt is the time window of the standstill subspace, v is the velocity of a moving subspace, and c is the velocity of light.

We see that the time window $\Delta t'$ of a moving subspace, with respect to the time window Δt of a standstill subspace, appears to be wider as velocity of the moving subspace increases. In other words, velocity of a moving subspace changes the relative time speed as with respect to a standstill subspace. For instance, the time speed goes slower for a moving subspace as with respect to a standstill subspace. We see that time speed within the subspaces is invariant or constant. In other words, the speed of time goes as it is within the subspaces but is relatively different between the subspaces at different velocities. As a matter of fact, the speed of time within a subspace is governed by the speed of light (such as 1 s, 2 s, etc.) as will be seen in how our temporal universe was created.

Equivalently, Einstein's relativity equation can be shown in terms of relative mass as given by

$$m = \frac{m_0}{\sqrt{(1 - \mathrm{v}^2/c^2)}} = m_0\left(1 - \mathrm{v}^2/c^2\right)^{-1/2} \tag{2}$$

where m is the effective mass (or mass in motion) of a particle, m_o is the rest mass of the particle, v is the velocity of the moving particle, and c is the speed of light. In other words, the effective mass (or mass in motion) of a particle increases at the same amount with respect to when the relative time window increases.

With reference to the binomial expansion, Eq. (2) can be written as

$$m = m_0\left(1 + \frac{1}{2} \bullet \frac{\mathrm{v}^2}{c^2} \quad + \mathit{terms\ of\ order}\ \frac{\mathrm{v}^4}{c^4}\right) \tag{3}$$

By multiplying the preceding equation with the velocity of light c^2 and noting that the terms with the orders of v^4/c^2 are negligibly small, the above equation can be approximated by

$$m \approx m_0 + \frac{1}{2} m_0 \mathrm{v}^2 \frac{1}{c^2} \tag{4}$$

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which can be written as

$$(m - m_0)c^2 \approx \frac{1}{2} m_0 v^2 \quad (5)$$

The significance of the preceding equation is that $m - m_o$ represents an increase in mass due to motion, which is the kinetic energy of the rest mass m_o. And $(m - m_o)c^2$ is the extra energy gain due to motion.

What Einstein postulated, as I remembered, is that there must be energy associated with the mass even at rest. And this was exactly what he had proposed:

$$\varepsilon \approx mc^2 \quad (6)$$

where ε represents the total energy of the mass and

$$\varepsilon_o \approx m_o c^2 \quad (7)$$

the energy of the mass at rest, where v = 0 and $m \approx m_o$.

We see that Eq. (6) or equivalently Eq. (7) is the well-known Einstein energy equation.

3. Time and energy

One of the most enigmatic variables in the laws of science must be "time." So what is time? Time is a variable and not a substance. It has no mass, no weight, no coordinate, and no origin, and it cannot be detected or even be seen. Yet time is an everlasting existing variable within our known universe. Without time there would be no physical matter, no physical space, and no life. The fact is that every physical matter is associated with time which includes our universe. Therefore, when one is dealing with science, time is one of the most enigmatic variables that are ever present and cannot be simply ignored. Strictly speaking, all the laws of science as well every physical substance cannot exist without the existence of time.

On the other hand, energy is a physical quantity that governs every existence of substance which includes the entire universe. In other words without the existence of energy, there would be no substance and no universe! Nonetheless based on our current laws of science, all the substances were created by energy, and every substance can also be converted back to energy. Thus energy and substance are exchangeable, but it requires some physical conditions (e.g., nuclei and chemical interactions and others) to make the conversion start. Since energy can be derived from mass, mass is equivalent to energy. Hence every mass can be treated as an energy reservoir. The fact is that our universe is compactly filled with mass and energy. Without the existence of time, the trading (or conversion) between mass and energy could not have happened.

4. Time-dependent energy equation

Let us now start with Einstein's energy equation which was derived by his special theory of relativity [1] as given by

$$\varepsilon \approx mc^2 \quad (8)$$

where m is the rest mass and c is the velocity of light.

Since all the laws in science are approximations, for which we have intentionally used an approximated sign. Strictly speaking the energy equation should be more appropriately presented with an inequality sign as described by

$$\varepsilon < mc^2 \tag{9}$$

This means that in practice, the total energy should be smaller or at most approaching to the rest mass m times square of light speed (i.e., c^2).

In view of Einstein's energy equation of Eq. (8), we see that it is a singularity-point approximation and timeless equation (i.e., t = 0). In other words, the equation needs to convert into a temporal (i.e., t > 0) representation or time-dependent equation for the conversion to take place from mass into energy. We see that, without the inclusion of time variable, the conversion would not have taken place. Nonetheless, Einstein's energy equation represents the total amount of energy that can be converted from a rest mass m. Every mass can be viewed as an energy reservoir. Thus by incorporating with the time variable, the Einstein's energy equation can be represented by a partial differential equation as given by [2]

$$\frac{\partial \varepsilon(t)}{\partial t} = c^2 \frac{\partial m(t)}{\partial t}, \mathrm{t} > 0 \tag{10}$$

where $\partial\varepsilon(t)/\partial t$ is the rate of increasing energy conversion, $\partial m(t)/\partial t$ is the corresponding rate of mass reduction, c is the speed of light, and t > 0 represents a forward time variable. We see that a time-dependent equation exists at time t > 0, representing a forward time variable that only occurs after time excitation at t = 0. Incidentally, this is a well-known causality constraint (i.e., t > 0) [3] as imposed by our universe.

5. Trading mass and energy

One of the important aspects in Eq. (10) must be that energy and mass can be traded, for which the rate of energy conversion from a mass can be written in terms of electromagnetic (EM) radiation or Radian Energy as given by [4]

$$\frac{\partial \varepsilon}{\partial t} = c^2 \frac{\partial m}{\partial t} = [\nabla \cdot S(\mathrm{v})] = -\frac{\partial}{\partial t}\left[\frac{1}{2} \in E^2(\mathrm{v}) + \frac{1}{2}\mu H^2(\mathrm{v})\right], \mathrm{t} > 0 \tag{11}$$

where ϵ and μ are the permittivity and the permeability of the physical space, respectively, v is the radian frequency variable, $E^2(v)$ and $\mathrm{H}^2(v)$ are the respective electric and magnetic field intensities, the negative sign represents the outflow energy per unit time from a unit volume, (∇) is the divergent operator, and S is known as the Poynting vector or energy vector of an electromagnetic radiator [4] as can be shown by $S(v) = E(v) \times H(v)$. Again we note that it is a time-dependent equation with t > 0 added to present the causality constraint. In view of the preceding equation, we see that radian energy (i.e., radiation) diverges from the mass, as mass reduces with time. In other words we see that Eq. (11) is not just a piece of mathematical formula; it is a symbolic representation, a description, a language, a picture, or even a video as can be seen that it has transformed from a point-singularity approximation to a three-dimensional representation and it is continually expanding as time moves on.

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Similarly the conversion from energy to mass can also be presented as

$$\frac{\partial m}{\partial t} = \frac{1}{c^2}\frac{\partial \varepsilon}{\partial t} = -\frac{1}{c^2}[\nabla \bullet S(\mathrm{v})] = \frac{1}{c^2}\frac{\partial}{\partial t}\left[\frac{1}{2}\epsilon E^2(\mathrm{v}) + \frac{1}{2}\mu H^2(\mathrm{v})\right], \mathrm{t} > 0 \tag{12}$$

The major difference of this equation, as compared with Eq. (11), must be the energy convergent operator $-\nabla \cdot \mathrm{S}(v)$, where we see that the rate of energy as in the form of EM radiation converges into a small volume for the mass creation, instead of diverging from the mass. Since mass creation is inversely proportional to c^2, it requires a huge amount of energy to produce a small quantity of mass. Nevertheless in view of the cosmological environment, availability of huge amount of energy has never been a problem.

Incidentally, black hole [5, 6] can be considered as one of the energy convergent operators. Instead the convergent force is relied more on the black hole's intense gravitational field. The black hole still remains an intriguing physical substance to be known. Its gravitational field is so intense even light cannot be escaped.

By the constraints of the current laws of science, the observation is limited by the speed of light. If light is totally absorbed by the black hole, it is by no means that the black hole is an infinite energy sink [6]. Nonetheless, every black hole can actually be treated as an energy convergent operator, which is responsible for the eventuality in part of energy to mass conversion, where an answer remained to be found.

6. Physical substances and subspaces

In our physical world, every matter is a substance which includes all the elemental particles; electric, magnetic, and gravitation fields; and energy. The reason is that they were all created by means of energy or mass. Our physical space (e.g., our universe) is fully compacted with substances (i.e., mass and energy) and left no absolute empty subspace within it. As a matter of fact, all physical substances exist with time, and no physical substance can exist forever or without time, which includes our universe. Thus, without time there would be no substance and no universe. Since every physical substance described itself as a physical space and it is constantly changing with respect to time. The fact is that every physical substance is itself a temporal space (or a physical subspace), as will be discussed in the subsequent sections.

In view of physical reality, every physical substance cannot exist without time; thus if there is no time, all the substances which include all the building blocks in our universe and the universe itself cannot exist. On the other hand, time cannot exist without the existence of substance or substances. Therefore, time and substance must mutually coexist or inclusively exist. In other words, substance and time have to be simultaneously existing (i.e., one cannot exist without the other). Nonetheless, if our universe has to exist with time, then our universe will eventually get old and die. So the aspects of time would not be as simple as we have known. For example, for the species living in a far distant galaxy moving closer to the speed of light, their time goes somewhat slower relatively to ours [1]. Thus, we see that the relativistic aspects of time may not be the same at different subspaces in our universe (e.g., at the edge of our universe).

Since substances (i.e., mass) were created by energy, energy and time have to simultaneously exist. As we know every conversion, either from mass to energy or from energy to mass, cannot get started without the inclusion of time. Therefore, time and substance (i.e., energy and mass) have to simultaneously exist. Thus we see that all the physical substances, including our universe and us, are coexisting with time (or function of time).

7. Absolute empty and physical subspaces

Let us define various subspaces in the following, as they will be used in the subsequence sections:

An absolute empty space has no time, no substance, and no coordinate and is not event bounded or unbounded. It is a virtual space and timeless space (i.e., $t = 0$), and it does not exist in practice.

A physical space is a space described by dimensional coordinates, which existed in practice, compactly filled with substances, supported by the current laws of science and the rule of time (i.e., time can only move forward and cannot move backward; $t > 0$). Physical space and absolute empty space are mutually exclusive. In other words, a physical space cannot be embedded in an absolute empty space, and it cannot have absolute empty subspace in it. In other words, physical space is a temporal space in which time is a forward variable (i.e., $t > 0$), while absolute empty space is a timeless space (i.e., $t = 0$) in which nothing is in it.

A temporal space is a time-variable physical space supported by the laws of science and rule of time (i.e., $t > 0$). In fact, all physical spaces are temporal spaces (i.e., $t > 0$).

A spatial space is a space described by dimensional coordinates and may not be supported by the laws of science and the rule of time (e.g., a mathematical virtual space).

A virtual space is an imaginary space, and it is generally not supported by the laws of science and the rule of time. Only mathematicians can make it happen.

As we have noted, absolutely empty space cannot exist in physical reality. Since every physical space needs to be completely filled with substances and left no absolutely empty subspace within it, every physical space is created by substances. For example, our universe is a gigantic physical space created by mass and energy (i.e., substances) and has no empty subspaces in it. Yet, in physical reality all the masses (and energy) existed with time. Without the existence of time, then there would be no mass, no energy, and no universe. Thus, we see that every physical substance coexists with time. As a matter of fact, every physical subspace is a temporal subspace (i.e., $t > 0$), which includes us and our universe.

Since a physical space cannot be embedded within an absolute empty space and it cannot have any absolute empty subspace in it [7], our universe must be embedded in a more complex physical space. If we accepted our universe is embedded in a more complex space, then our universe must be a bounded subspace.

How about time? Since our universe is embedded in a more complex space, the complex space may share the same rule of time (i.e., $t > 0$). However, the complex space that embeds our universe may not have the same laws of science as ours but may have the same rule of time (i.e., $t > 0$); otherwise our universe would not be bounded. Nevertheless, whether our universe is bounded or not bounded is not the major issue of our current interest, since it takes a deeper understanding of our current universe before we can move on to the next level of complex space revelation. It is however our aim, abiding within our current laws of science, to investigate the essence of time as the enigma origin of our universe.

8. Time and physical space

One of the most intriguing questions in our life must be the existence of time. So far, we know that time comes from nowhere, and it can only move forward, not backward, not even stand still (i.e., $t = 0$). Although time may somewhat relatively slow down, based on Einstein's special theory of relativity [1], so far time cannot move backward and cannot even stand still. As a matter of fact, time is moving at a constant rate within our subspace, and it cannot move faster or slower. We stress that time moves at the same rate within any subspace within the universe even closer the boundary of our universe, but the difference is the relativistic time. Since time is ever existing, then how do we know there is a physical space? One answer is that there is a profound connection between time and physical space. In other words, if there is no time, then there would be no physical space. A physical space is in fact a temporal (i.e., $t > 0$) space, in contrast to a virtual space. Temporal space can be described by time, while virtual space is an imaginary space without the constraint of time. Temporal space is supported by the laws of science, while virtual space is not.

A television video image is a typical example of trading time for space. For instance, each TV displayed an image of (dx, dy) which takes an amount of time to be displayed. Since time is a forward-moving variable, it cannot be traded back at the expense of a displayed image (dx, dy). In other words, it is time that determines the physical space, and it is not the physical space that can bring back the time that has been expended. And it is the size (or dimension) of space that determines the amount of time required to create the space (dx, dy). Time is distance and distance is time within a temporal space. Based on our current constraints of science, the speed of light is the limit. Since every physical space is created by substances, a physical space must be described by the speed of light. In other words, the dimension of a physical space is determined by the velocity of light, where the space is filled with substances (i.e., mass and energy). And this is also the reason that speed of time (e.g., 1 s, 2 s, etc.) is determined by the speed of light.

Another issue is why the speed of light is limited. It is limited because our universe is a gigantic physical space that is filled with substances that cause a time delay on an EM wave's propagation. Nevertheless, if there were physical substances that travel beyond the speed of light (which remains to be found), their velocities would also be limited, since our physical space is fully compacted with physical substances and it is a temporal (i.e., $t > 0$) space. Let me further note that a substance can travel in space without a time delay if and only if the space is absolutely empty (i.e., timeless; $t = 0$), since distance is time (i.e., $d = ct$, $t = 0$). However, absolute empty space cannot exist in practice, since every physical space (including our universe) has to be fully filled with substances (i.e., energy and mass), with no empty subspace left within it. Since every physical subspace is temporal (i.e., $t > 0$), in which we see that timeless and temporal spaces are mutually exclusive.

9. Electromagnetic and laws of physics

Strictly speaking, all our laws of physics are evolved within the regime of EM science. Besides, all physical substances are part of EM-based science, and all the living species on Earth are primarily dependent on the source of energy provided by the sun. About 78% of the sunlight that reaches the surface of our planet is well concentrated within a narrow band of visible spectrum. In response to our species' existence, which includes all living species on Earth, a pair of visible eyes (i.e., antennas) evolved in us humans, which help us for our survival. And this narrow band of visible light led us to the discovery of an even wider band of EM spectral distribution in nature. It is also the major impetus allowing us to discover all the physical substances that are part of EM-based physics. In principle, all physical substances can be observed or detected with EM interaction, and the speed of light is the current limit.

Then there is question to be asked, why is the speed of light limited? A simple answer is that our universe is filled with substances that limit the speed of light. The energy velocity of an electromagnetic wave is given by [3]

$$\mathrm{v} = \frac{1}{\sqrt{\mu\varepsilon}} \tag{13}$$

where (μ, ε) are the permeability and the permittivity of the medium. We see that the velocity of light is shown by

$$c = \frac{1}{\sqrt{\mu_0\varepsilon_0}} \tag{14}$$

where ($\mu_{0,}$ ε_0) are the permeability and the permittivity of the space.

In view of Eq. (13), it is apparent that the velocity of electromagnetic wave (i.e., speed of light) within an empty subspace (i.e., timeless space) is instant (or infinitely large) since distance is time (i.e., d = ct, t = 0).

A picture that is worth more than a thousand words [8] is a trivial example to show that EM observation is one of the most efficient aspects in information transmission. Yet, the ultimate physical limitation is also imposed by limitation of the EM regime, unless new laws of science emerge. The essence of Einstein's energy equation shows that mass and energy are exchangeable. It shows that energy and mass are equivalent and energy is a form of EM radiation in view of Einstein's equation. We further note that all physical substances within our universe were created from energy and mass, which include the dark energies [9] and dark matter [10]. Although the dark substances may not be observed directly using EM interaction, we may indirectly detect their existence, since they are basically energy-based substances (i.e., EM-based science). It may be interesting to note that our current universe is composed of 72% dark energy, 23% dark matter, and 5% other physical substances. Although dark matter contributes about 23% of our universe, it represents a total of 23% of gravitational fields. With reference to Einstein's energy equation (Eq. (8)), dark energy and dark matter dominate the entire universal energy reservation, well over 95%. Furthermore, if we accept the big bang theory for our universe creation [11], then creation could have been started with Einstein's time-dependent energy formula of Eq. (11) as given by

$$\frac{\partial\varepsilon}{\partial t} = c^2\frac{\partial M}{\partial t} = [\nabla\cdot S(\mathrm{v})] = -\frac{\partial}{\partial t}\left[\frac{1}{2}\in E^2(\mathrm{v}) + \frac{1}{2}\mu H^2(\mathrm{v})\right], \mathrm{t} > 0 \tag{15}$$

where [∇·S(v)] represents a divergent energy operation. In this equation, we see that a broad spectral band intense radian energy diverges (i.e., explodes) at the speed of light from a compacted matter M, where M represents a gigantic mass of energy reservoir. It is apparent that the creation is ignited by time and the exploded debris (i.e., matter and energy) starts to spread out in all directions, similar to an expanding air balloon. The boundary (i.e., radius of the sphere) of the universe expands at the speed of light, as the created debris is disbursed. It took about 15 billion chaotic light-years [12–14] to come up with the present state of constellation, in which the boundary is still expanding at the speed of light beyond the current observation. With reference to a recent report using the Hubble Space Telescope, we can see galaxies about 15 billion light-years away from us. This means that the creation process is not stopping yet and at the same time the universe might have started to de-create itself, since the big bang started, due to intense convergent gravitational forces from all the newly created debris of matter (e.g., galaxies and dark matter). To wrap up this section, we would stress that one of the viable aspects of Eq. (15) is the transformation from a spatially dimensionless equation to a space-time function (i.e., ∇·S); it describes how our universe was created with a huge explosion. Furthermore, the essence of Eq. (15) is not just a piece of mathematical formula; it is a symbolic representation, a description, a language, a picture, or even a video as may be seen from its presentation. We can visualize how our universe was created, from the theory of relativity to Einstein's energy equation and then to temporal space creation.

10. Trading time and subspace

Let us now take one of the simplest connections between physical subspace and time [15]:

$$d = \mathrm{v}t \tag{16}$$

where d is the distance, v is the velocity, and t is the time variable. Notice that this equation may be one of the most profound connections between time and physical space (or temporal space). Therefore, a three-dimensional (Euclidean) physical (or temporal) subspace can be described by

$$(dx, dy, dz) = (\mathrm{v}x, \mathrm{v}y, \mathrm{v}z)t \tag{17}$$

where ($\mathrm{v}x$, $\mathrm{v}y$, $\mathrm{v}z$) are the velocities' vectors and t is the time variable. Under the current laws of science, the speed of light is the limit. Then, by replacing the velocity vectors equal to the speed of light c, a temporal space can be written as

$$(dx, dy, dz) = (ct, ct, ct) \tag{18}$$

Thus, we see that time can be traded for space and space cannot be traded for time, since time is a forward variable (i.e., $t > 0$). In other words, once a section of time Δt is expended, we cannot get it back. Needless to say, a spherical temporal space can be described by

$$\mathrm{r} = ct \tag{19}$$

where radius r increases at the speed of light. Thus, we see that the boundary (i.e., edge) of our universe is determined by radius r, which is limited by the light speed, as illustrated in a composite temporal space diagram of **Figure 1**. In view of this figure, we see that our universe is expanding at the speed of light well beyond the current observable galaxies. **Figure 2** shows a discrete temporal space diagram, in which we see that the size of our universe is continuously expanding as time moves forward (i.e., $t > 0$). Assuming that we have already accepted the big bang creation, sometime in the future (i.e., billions of light-years later), our universe will eventually stop expanding and then start to shrink back, preparing for the next cycle of the big bang explosion. The forces for the collapsing universe are mainly due to the intense gravitational field, mostly from giant black holes and matter that were derived from merging (or swallowing) with smaller black holes and other debris (i.e., physical substances). Since a black hole's gravitational field is so intense, even light cannot escape; however, a black hole is by no means an infinite energy reservoir. Eventually, the storage capacity of a black hole will reach a limit for explosion, as started for the mass to energy and debris creation.

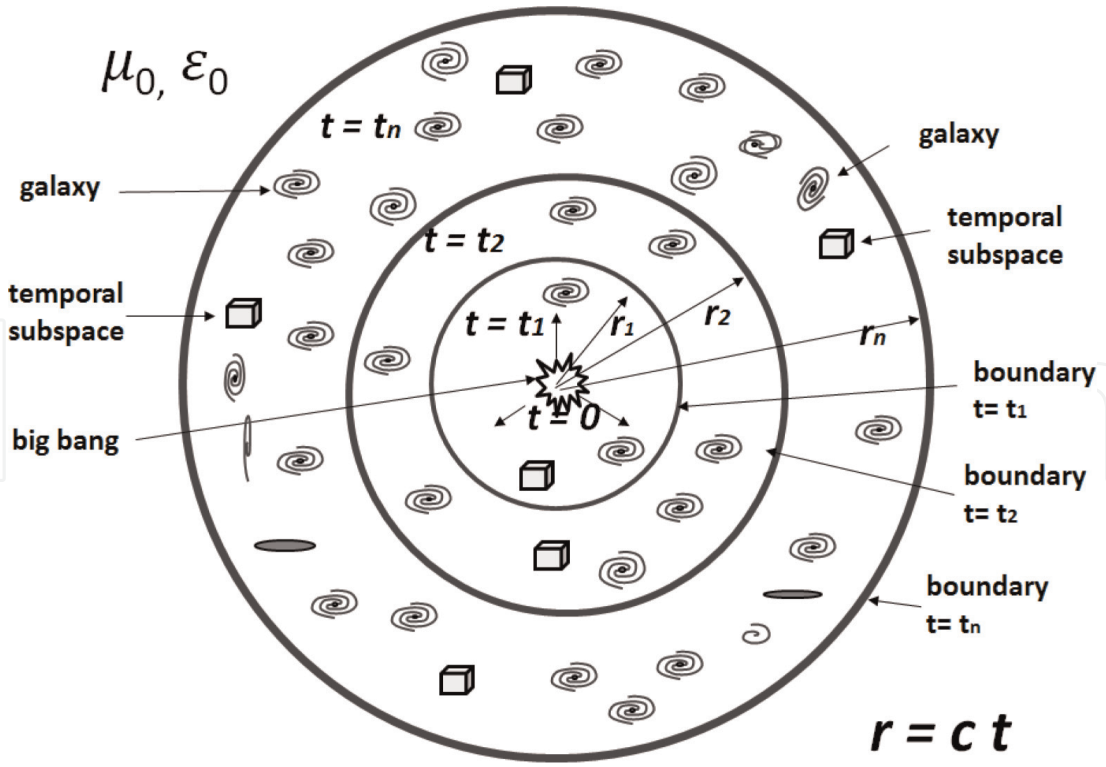

Figure 1.
Composite temporal space universe diagram. r = ct, r is the radius of our universe, t is time, c is the velocity of light, and ε_0 and μ_0 are the permittivity and permeability of the space.

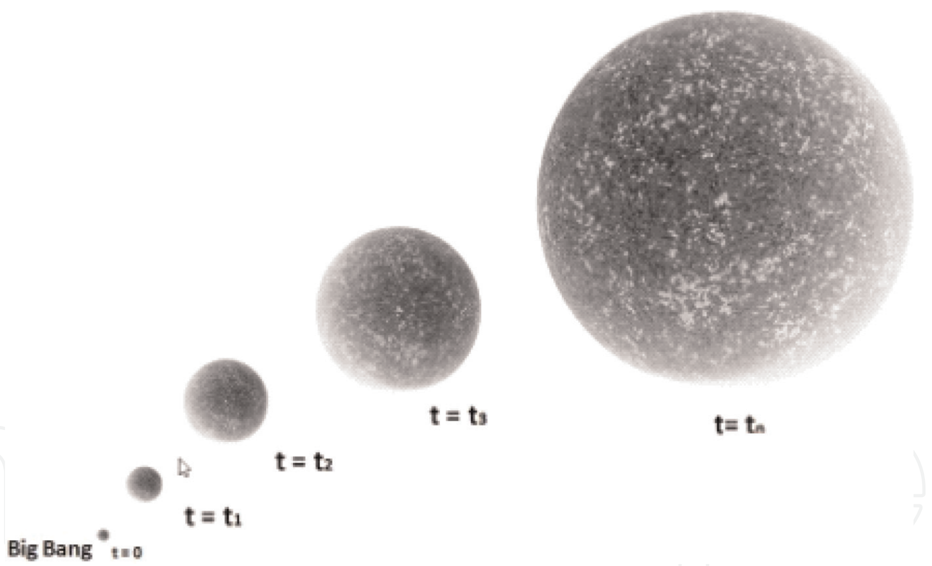

Figure 2.
Discrete temporal universe diagrams; t is time.

In other words, there will be one dominant giant black hole within the shrinking universe, to initiate the next cycle of universe creation. Therefore, every black hole can be treated as a convergent energy sink, which relies on its intense gravitation field to collect all the debris of matter and energies. Referring to the big bang creation, a gigantic energy explosion was the major reason for the universe's creation. In fact, it can be easily discerned that the creating process has never slowed down since the birth of our universe, as we see that our universe is still continuingly expanding even today. This is by no means an indication that all the debris created came from the big bang's energy (e.g., mc^2); there might have been some leftover debris from a preceding universe. Therefore, the overall energy within our universe

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cannot be restricted to just the amount that came from the big bang creation. In fact, the conversion processes between mass and energy have never been totally absent since the birth of our universe, but they are on a much smaller scale. In fact, right after birth, our universe started to slow down the divergent process due to the gravitational forces produced by the created matter. In other words, the universe will eventually reach a point when overall divergent forces will be weaker than the convergent forces, which are mostly due to gravitational fields coming from the newly created matter, including black holes. As we had mentioned earlier, our universe currently has about 23% dark matter, which represents about 23% of the gravitational fields within the current universe. The intense localized gravitational field could have been produced from a group or a giant black hole, derived from merging with (or swallowing up) some smaller black holes, nearby dark matter, and debris. Since a giant black hole is not an infinite energy sink, eventually it will explode for the next cycle of universal creation. And it is almost certain that the next big bang creation will not occur at the same center of our present universe. One can easily discern that our universe will never shrink to a few inches in size, as commonly speculated. It will, however, shrink to a smaller size until one of the giant black holes (e.g., swallowed-up sufficient physical debris) reaches the big bang explosive condition to release its gigantic energy for the next cycle of universal creation. The speculation of a possible collapsing universe remains to be observed. Nonetheless, we have found that our universe is still expanding, as observed by the Doppler shifts of the distant galaxies at the edge of our universe, about 15 billion light-years away [12–14]. This tells us that our universe has not reached its half-life yet. In fact, the expansion has never stopped since the birth of our universe, and our universe has also been started to de-create since the big bang started, which is primarily due to convergent gravitational forces from the newly created debris (e.g., galaxies, black holes, and dark matter).

11. Relativistic time and temporal (t > 0) space

Relativistic time at a different subspace within a vast universal space may not be the same as that based on Einstein's special theory of relativity [1]. Let us start with the relativistic time dilation as given by

$$\Delta t' = \frac{\Delta t}{\sqrt{1 - \mathrm{v}^2/c^2}} \tag{20}$$

where $\Delta t'$ is the relativistic time window, compared with a standstill subspace, Δt is the time window of a standstill subspace, v is the velocity of a moving subspace, and c is the velocity of light. We see that time dilation $\Delta t'$ of the moving subspace, relative to the time window of the standstill subspace Δt, appears to be wider as velocity increases. For example, a 1-s time window Δt is equivalent to the 10-s relative time window Δt'. This means that a 1-s time expenditure within the moving subspace is relative to about a 10-s time expenditure within the standstill subspace. Therefore, for the species living in an environment that travels closer to the speed of light (e.g., at the edge of the universe), their time appears to be slower than ours, as illustrated in **Figure 3**. In this figure, we see an old man traveling at a speed closer to the velocity of light; his relative observation time window appears to be wider as he is looking at us, and the laws of science within his subspace may not be the same as ours.

Two of the most important pillars in modern physics must be Einstein's relativity theory and Schrödinger's quantum mechanics [15]. One is dealing with very large objects (e.g., universe), and the other is dealing with very small particles

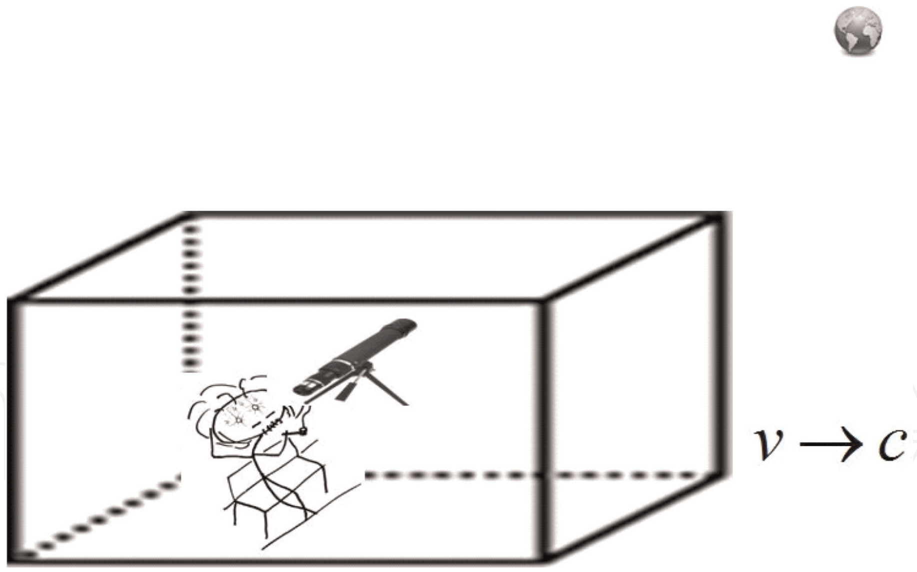

Figure 3.
Effects on relativistic time.

(e. g., atoms). Yet, there exists a profound connection between them, by means of the Heisenberg's uncertainty principle [16]. In view of the uncertainty relation, we see that every temporal subspace takes a section of time Δt and an amount of energy ΔE to create. Since we cannot create something from nothing, everything needs an amount of energy ΔE and a section of time Δt to make it happen. By referring to the Heisenberg uncertainty relation as given by

$$\Delta E \cdot \Delta t \geq h \tag{21}$$

where h is the Planck's constant. We see that every subspace is limited by ΔE and Δt. In other words, it is the h region, but not the shape, that determines the boundary condition. For example, the shape can be either elongated or compressed, as long as it is larger than the h region.

Incidentally, the uncertainty relationship of Eq. (21) is also the limit of reliable bit information transmission as pointed out by Gabor in [17]. Nonetheless, the connection with the special theory of relativity is that the creation of a subspace near the edge of our universe will take a short relative time with respect to our planet earth, since Δt' > Δt. The "relativistic" uncertainty relationship within the moving subspace, as with respect to a standstill subspace, can be shown as

$$\Delta E \cdot \Delta t'[1-(v/c)^2]^{1/2} \geq h \tag{22}$$

where we see ΔE energy is conserved. Thus a narrower time-width can be achieved as with respect to standstill subspace. It is precisely possible that one can exploit for time-domain digital communication, as from ground station to satellite information transmission.

On the other hand, as from satellite to ground station information transmission, we might want to use digital bandwidth (i.e., Δv) instead. This is a frequency-domain information transmission strategy, as in contrast with time domain, which has not been exploited yet. The "relativistic" uncertainty relationship within the standstill subspace as with respect to the moving subspace can be written as

$$\frac{\Delta E \Delta t}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \geq h \tag{23}$$

Or equivalently we have

$$\frac{\Delta \text{v} \bullet \Delta t}{\sqrt{1-\left(\frac{\text{v}}{c}\right)^2}} \geq 1 \tag{24}$$

in which we see that a narrower bandwidth Δv can be in principle use for frequency-domain communication.

12. Time and physical space

Every physical (or temporal) subspace is created by substances (i.e., energy and mass), and substances coexist with time. In this context, we see that our universe was essentially created by time and energy and the universe is continuously evolving (i.e., changing) with time. Although relativistic time may not be the same at the different subspaces within our universe, the rule of time may remain the same. As for the species living closer to the speed of light, relativistic time may not be noticeable to them, but their laws of science within their subspace may be different from ours. Nonetheless, our universe was simultaneously created by time with a gigantic energy explosion. Since our universe cannot be embedded in an empty space, it must be embedded in a more complex space that remains to be found. From an inclusive point of view, mass is energy or energy is mass, which was discovered by Einstein almost a century ago [1]. And it is this basic fundamental law of physics that we have used for investigating the origin of time. Together with a huge energy explosion (i.e., big bang theory [11]), time is the igniter for the creation of our universe. As we know, without the existence of time, the creation of our universe would not have happened. As we have shown, time can be traded for space, but space cannot be traded for time. Our universe is in fact a temporal physical subspace, and it is continuously evolving or changing with time (i.e., $t > 0$). Although every temporal subspace is created by time (and substances), it is not possible for us to trade any temporal subspace for time. Since every physical substance has a life, our universe (a gigantic substance) cannot be excluded. With reference to the report from a recent Hubble Space Telescope observation [12–14], we are capable of viewing galaxies about 15 billion light-years away and have also learned that our universe is still by no means slowing down in expansion. In other words, our universe has still not reached its half-life, based on our estimation. As we have shown, time ignited the creation of our universe, yet the created physical substances presented to us the existence of time.

13. Essence of our temporal (i.e., t > 0) universe

In view of the preceding discussion, we see that our universe is a time-invariant system (i.e., from system theory stand point); as in contrast with an empty space, it is a not a time-invariant system and it is a timeless or no-time space. We see that timeless solution cannot be directly implemented within our universe. Since science is a law of approximation and mathematics is an axiom of absolute certainty, using exact math to evaluate inexact science cannot guarantee its solution to exist within our temporal (i.e., $t > 0$) universe. One important aspect of temporal universe is that one cannot get something from nothing: There is always a price to pay; every piece of temporal subspace (or every bit of information [7]) takes an amount of energy (i.e., ΔE) and a section of time (i.e., Δt) to create. And the subspace [i.e., f(x, y, z; t), t > 0] is a forward time-variable function. In other words, time and subspace coexist or are mutually inclusive. This is the boundary condition and constrain of our temporal universe [i.e., f(x, y, z; t), t > 0], in which every existence within our universe has to comply with this condition. Otherwise it is not existing within our universe, unless new law emerges since laws are made to be broken. Thus we see that any emerging science has to be proven to exist within our temporal universe [i.e., f(x, y, z; t), t > 0]. Otherwise it is a fictitious science, unless it can be validated by repeated experiments.

In mathematics, we see that the burden of a postulation is first to prove if there exists a solution and then search for a solution. Although we hardly have had, there is an existent burden in science. Yet, we need to prove that a scientific postulation is existing within our temporal universe [i.e., f(x, y, z; t), t > 0]; otherwise it is not real or virtual as mathematics is. For example such as the superposition principle in quantum mechanics, in which we have proven [18] it is not existed within our temporal universe (i.e., t > 0), since Schrödinger's quantum mechanics is timeless as mathematics is.

There is however an additional constrain as imposed by our temporal universe which is the affordability. As we have shown that everything (e.g., any physical subspace) existed within our universe has a price tag, in terms of an amount of energy ΔE and a section of time Δt (i.e., ΔE, Δt). To be precise, the price tag also includes an amount of "intelligent" information ΔI or an equivalent amount of entropy ΔS (i.e., ΔE, Δt, ΔI) [7]. For example, creation of a piece of simple facial tissue will take a huge amount of energy ΔE, a section of time Δt, and an amount of information ΔI (i.e., equivalent amount of entropy ΔS). We note that on this planet Earth, only humans can make it happen. Thus we see that every physical subspace (or equivalently substance) within our universe has a price tag (i.e., ΔE, Δt, ΔS), and the question is that can we afford it?

14. Are we not alone?

Within our universe, we can easily estimate there were billions and billions of civilizations that had emerged and faded away in the past 15 billion light-years. Our civilization is one of the billions and billions of current consequences within our universe, and it will eventually disappear. We are here, and will be here, for just a very short moment. Hopefully, we will be able to discover substances that travel well beyond the limit of light before the end of our existence, so that a better observational instrument can be built. If we point the new instrument at the right place, we may see the edge of our universe beyond the limit of light. We are not alone with almost absolute certainty. By using the new observational equipment, we may find a planet that once upon a time had harbored a civilization for a period of twinkle thousands of (Earth) years.

15. Remarks

We have shown that time is one of the most intriguing variables in the universe. Without time, there would be no physical substances, no space, and no life. With reference to Einstein's energy equation, we have shown that energy and mass can be traded. In other words, mass is equivalent to energy, and energy is equivalent to mass, for which all mass can be treated as an energy reservoir. We have also shown that a physical space cannot be embedded in an absolute empty space or a timeless (i.e., t = 0) space, and it cannot even have any absolute empty subspace in it. In reality, every physical space has to be fully packed with physical substances (i.e., energy and mass). Since no physical space can be embedded in an absolute empty space, it is reasonable to assume that our universe is a subspace within a more complex space, which remains to be found. In other words, our universe could have been one of the many universes outside our universal boundary, which comes and goes like bubbles. We have also shown that it takes time to create a physical space and the time that has been used for the creation cannot be brought back. Since all physical substances exist with time, all physical spaces are created by time and substances (i.e., energy and mass). This means that our cosmos was created by time and a gigantic energy explosion, in which we see that every substance coexists with time. That is, without time, the creation of physical substances would not have happened. We have further noted that our universe is in a temporal space and it is still expanding based on current observation. This shows that our universe has not reached its half-life yet, as we have accepted the big bang creation. And it is noted that we are not alone with almost absolute certainty. Someday, we may find a planet that once upon a time had harbored a civilization for a period of light-years. We have further shown that the burden of a scientific postulation is to prove it exists within our temporal universe [i.e., $f(x, y, z; t)$, $t > 0$]; otherwise it is not real or virtual as mathematics is.

Finally, I would like to take this opportunity to say a few words on behalf of Professor Stephen Hawking, who passed away last year on March 14, 2018. Professor Hawking was a world-renowned astrophysicist, a respected cosmic scientist, and a genius. Although the creation of temporal universe started with the same root of the big bang explosion, it is not a subspace of Professor Hawking's universe. You may see from the preceding presentation that the creation of temporal universe is somewhat different from Hawking's creation. One of the major differences may be at the origin of big bang creation. My temporal universe was started with a big bang creation within a "non-empty" space, instead within of an empty space which was normally assumed.

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References

[1] Einstein A. Relativity, the Special and General Theory. New York: Crown Publishers; 1961

[2] Yu FTS. Gravitation and radiation. Asian Journal of Physics. 2016;**25**(6): 789-795

[3] Einstein A. Zur elektrodynamik bewegter koerper. Annals of Physics. 1905;**17**:891-921

[4] Kraus JD. Electro-Magnetics. New York: McGraw-Hill Book Company; 1953. p. 370

[5] Bartrusiok M. Black Hole. New Haven, CT: Yale University Press; 2015

[6] Abell GO, Morrison D, Wolff SC. Exploration of the Universe. 5th ed. New York: Saunders College Publishing; 1987. pp. 47-88

[7] Yu FTS. Science and the myth of information. Asian Journal of Physics. 2015;**24**(24):1823-1836

[8] Yu FTS. Optics and Information Theory. New York: Wiley-Interscience; 1976

[9] Amendola L, Tsujikawa S. Dark Energy: Theory and Observation. Cambridge: Cambridge University Press; 2010

[10] Bertone G, editor. Particle Dark Matter: Observation, Model and Search. Cambridge: Cambridge University Press; 2010

[11] Bartrusiok M, Rubakov VA. Introduction to the Theory of the Early Universe: Hot Big Bang Theory. Princeton, NJ: World Scientific Publishing; 2011

[12] Bennett JO, Donahue MO, Voit M, Schneider N. The Cosmic Perspective Fundamentals. Cambridge, MA: Addison Wesley Publishing; 2015

[13] Zimmerman R. The Universe in a Mirror: The Saga of the Hubble Space Telescope. Princeton, NJ: Princeton Press; 2016

[14] Yu FTS. Time, space, information and life. Asian Journal of Physics. 2015; **24**(2):217-223

[15] Schrödinger E. An undulatory theory of the mechanics of atoms and molecules. Physical Review. 1926;**28**(6): 1049

[16] Heisenberg W. Über den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik. Zeitschrift für Physik. 1927; **43**:172

[17] Gabor D. Communication theory and physics. Philosophical Magazine. 1950;**41**(7):1161

[18] Yu FTS. The fate of Schrodinger's Cat. Asian Journal of Physics. 2019; **28**(1):63-70