A New Look at Relativity

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Abstract**:**

We derived new relativity equations that not only described the related phenomena but also the origin of universe and its general evolution both at the cosmological and quantum scales. We found that there is a new relativity based on angular momentum in addition to special and general relativity. These equations also propose a cosmological model that explains the accelerating expansion of the universe and the nature of the dark energy. In this model, the creation of the universe consists of two stages of contraction and expansion, and the quantum world is present only at the stage of the universe expansion. At the stage of contraction, we encounter a shrinking universe, which ultimately generates a very great black hole. Due to its severe rotational motion, this black hole emits light and quantum black holes. The quantum black holes with the Planck mass immediately create fundamental particles. In contrast, the larger quantum black holes can be stable, acting as seeds for the formation of the galaxies. By the brightening of the universe, the light emitted from the very great black hole can travel longer distances and create the cosmic microwave background radiation. This model also shows that at the stage of the expansion of the universe, the receding velocity of the galaxies was first decelerating from the velocity approximating that of light reaching $0.7c$ and then increases at an acceleration rate.

Keywords:
Relativity, Big bang theory, Dark energy, Planck scale.

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1. Introduction

The twentieth century witnessed two scientific revolutions establishing the foundation of physics: relativity and quantum mechanics. So far, almost all predictions made by these two great theories, from the phenomena related to the universe of the fundamental particles to those related to the cosmos and its large structure have come true [1]. Therefore, it seems that all the physical laws we have discovered are maintained through the universe. But, it is surprising if we know that more than ninety percent of the universe is made of something that we do not know about its nature. Seventy percent of the universe is made up of dark energy resulting in accelerating expansion of the universe [2, 3] and twenty-five percent of it is of the dark matter, which interacts only gravitationally [4, 5]. It has been years that physicists have been uselessly searching for explanation of dark energy and dark matter, and no satisfying results have been obtained so far. Once again, many very fundamental questions concerning the nature of the universe are brought up: what is the real nature of space, time, energy, and matter? In this article, we intend to review some of the basic and fundamental concepts of physics and by combining the base quantities and the fundamental constants of physics, provide appropriate responses to these questions.

Fundamental constants have an important role in the physics. Their simplest and most important role is transforming proportional relationships into equations. The significance of Fundamental constants is not limited to this, but also these constants have physical concepts, and by combining them, significant physical quantities could be obtained. For example, what Newton's law of universal gravitation and Coulomb's law state are proportionality relationships [1].

$$F \propto \frac{m_1 m_2}{r^2} \qquad F \propto \frac{q_1 q_2}{r^2}$$

If the second sides of both equations are multiplied to a proportionality constant, this will transform the proportion into an equation:

$$F = G\frac{m_1 m_2}{r^2} \qquad F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

Apart from amazing resemblance of gravitation and Coulombs' laws, there is a delicate point between these two equations which has not been considered yet. First, we wrote the general formula of these two equations without considering fundamental constants using the following way:

$$F = \frac{m_1 m_2}{r^2} \quad (Eq.1) \qquad\qquad F = \frac{q_1 q_2}{r^2} \quad (Eq.2)$$

In the gravitation law (Eq.1), the units of mass and length are kilogram and meter, respectively. So the force unit should at least include these two dimensions and do so; since the force unit is Newton (*kg.m/s*^{2}). Coulomb's law (Eq.2) is similar to gravitation law with one difference in which mass is replaced by charge. As a result, a wise theory is to accept that the force unit should at least include a dimension of Coulomb e.g. *C.m/s*^{2}; but the unit of force is still Newton. The only reasonable explanation is that there should be a fundamental relationship between mass and charge in the proportionality constant of these two equations. If we multiply proportionality constants of these two equations, this relationship will be obtained:

$$[G].[4\pi\varepsilon_0] = \frac{m^3}{kg.s^2} \times \frac{C^2.s^2}{kg.m^3} \Rightarrow \frac{C}{kg} = \pm\sqrt{4\pi\varepsilon_0.G} \quad (Eq.3)$$

Consequently, we can obtain the relationship between mass and charge using Eq.3:

$$\frac{m}{q} = \pm\frac{1}{\sqrt{4\pi\varepsilon_0.G}} \quad (Eq.4)$$

2. The Postulate of Our Theory

Apart from physical meaning of Eq.4; since both Coulomb's and gravitation law are fundamental and universal, Eq.4 represents a universal and fundamental relation between mass and charge in which proportionality constant of this relation is a combination of fundamental constants of physics. We can extend the postulate pointed out by Eq.4 to other base quantities and provide similar relations among the base quantities including time, space (length), mass, charge, and temperature. Therefore, we establish our theory on the postulate that states: Proportionality constant of the relationships between the base quantities including space, time, mass, charge and temperature is a combination of the fundamental constants of physics. In this paper, we point to abundant evidence confirming that this postulate is correct and nature follows it. The five base quantities and their corresponding SI units are listed in the following table (Table 1).

Table 1.International System of Units base quantities.

Quantity name(symbol)	**SI unit name(symbol)**
Space or length (*l*)	Meter (m)
Time (*t*)	Second (s)
Mass (*m*)	Kilogram (kg)
Charge (*q*)	Coulomb (C)
Temperature (*T*)	Kelvin (K)

Proportionality constant of these relationships will be a combination of five fundamental constants of physics (Table 2).

Table 2.The five fundamental constants of physics.

Quantity (symbol)	**SI unit name**
gravitational constant (G)	$m^3/kg.s^2$
electric constant (ε_0)	$C^2.s^2/kg.m^3$
magnetic constant (μ_0)	$C^2/kg.m$
Boltzmann constant (k_B)	$kg.m^2/K.s^2$

Planck constant (h)	$kg.m^2/s$

In general, twenty fundamental equations can be derived from these five basic quantities so that ten equations show the proportion of the quantities and the other ten show their products. In continuation, we will prove that the proportion of these quantities, relativity universal equations, and the product of these quantities provide quantum universal equations. We will also show that it is possible to summarize these twenty equations into five final equations. In addition to these twenty equations, ten other equations can be established between these five base quantities and the energy quantity.

3. Universal Relativity Equations

The general trend of this paper is first to list the general and important results extractable from the fundamental equations so as to have a bird's-eye view of them and then explain these results in detail. We will also employ a similar trend for the quantum universal equations.

Fundamental relationship of space-time:

Proportionality constant of the space-time relationship will be obtained from the combination of electric and magnetic constants as follows:

$$[\varepsilon_0].[\mu_0] = \frac{C^2.s^2}{kg.m^3} \times \frac{kg.m}{C^2} \Rightarrow \frac{s}{m} = \pm\sqrt{\varepsilon_0.\mu_0} = \pm\frac{1}{c}$$

Consequently, space-time equation will be:

$$\frac{l}{t} = \pm c \quad (Eq.5)$$

Where $c=3\times10^8$ m/s. Special relativity says that there is in nature an ultimate speed c, and no entity that carries energy or information can exceed this limit. Formally, c is a conversion factor for changing the unit of time to the unit of space [6]. Also, if we interpret Eq.5 in a manner that space and time can be transformed into each other, we can obtain the special relativity equations then. In fact, we will show that Eq.5 is the base of the special relativity. Therefore, we can claim that Eq.5 states: 1- Space (length) and time are equivalent and could be transformed to each other. 2- The ultimate limit of the space to time ratio or velocity is c in nature and that can never be reached. 3- Corresponding phenomenon to this equation in nature is light.

Fundamental relationship of mass-time:

Proportionality constant of the mass-time relationship will be obtained as follows:

$$[G]^2.[\varepsilon_0]^3.[\mu_0]^3 = \frac{m^6}{kg^2.s^4} \times \frac{s^6}{m^6} \Rightarrow \frac{s}{kg} = \pm\frac{G}{c^3}$$

Consequently, mass-time equation will be:

$$\frac{m}{t} = \pm\frac{c^3}{G} \quad (Eq.6)$$

Where $c^3/G=4\times10^{35}$ kg/s. There are reasons that make us interpret Eq.6 like Eq.5. The firs reason is the symmetry, which is considered as a powerful tool in physics, because these two equations have been obtained by one method. The second reason is that the proportionality constant in this equation like Eq.5 is a very great number. Additionally, there are also other reasons that will be considered in section 3.2. Similar to the Eq.5, Therefore, we can claim that Eq.6 states: 1- Mass and time are equivalent and could be transformed to each other. 2- The ultimate limit of the mass to time ratio is c^3/G in nature and that can never be reached. 3- Corresponding phenomenon to this equation in nature is black hole.

Fundamental relationship of mass-space:

Proportionality constant of the mass-space relationship will be obtained as follows:

$$[G].[\varepsilon_0].[\mu_0] = \frac{m^3}{kg.s^2} \times \frac{s^2}{m^2} \quad \Rightarrow \quad \frac{m}{kg} = +\frac{G}{c^2}$$

Consequently, mass-space equation will be:

$$\frac{m}{l} = \frac{c^2}{G} \quad (Eq.7)$$

Where c^2/G=1.3×10^{27} kg/m. Similar to the Eqs.5-6, Eq.7 states that: 1- Mass and space are equivalent and could be transformed to each other. 2- The ultimate limit of the mass to space ratio is c^2/G in nature and that can never be reached. 3- Corresponding phenomenon to this equation in nature is black hole.

We can also obtain the fundamental relations of the base quantities with energy and momentum:

$$E = \pm\frac{c^5}{G}t \ , \ E = \frac{c^4}{G}l \ , \ E = mc^2$$

$$p = \frac{c^4}{G}t \ , \ p = \pm\frac{c^3}{G}l \ , \ p = \pm mc$$

If we make the energy equations (or momentum ones) equivalent altogether, similar equations to ones 5-7 will be obtained.

By the use of this method, important information can be obtained about the universal equations. For example, the time-energy equation shows that the ±sign, which has appeared in the relativity universal equations (Eqs.5-6), belongs to time quantity. The space-energy equation shows that the sign of space in these equations is positive. We call this space the relativity space to differentiate it from other type of space.

Before we embark on our main issue, we should note that although the transformation of the base quantities to each other, e.g. transformation of space to mass can disturb the mind at first glance, as we will observe later, it can describe the physical phenomena especially the cosmic phenomena beautifully. Each equation we study predicts important results about the manner of the cosmic behavior and provides us with them. At the end of this paper, we will place these results side by side like the pieces of a puzzle in a theory that explains the creation of the universe and its general evolution; we will also present evidence confirming this theory.

3.1 Space and Time

In this part, we will first show that the base of Lorentz transformation equations is Eq.5 and in continuation, we will extract the special relativity equations on the basis of this assumption that space and time can be transformed into each other. If Eq.5 is the basis of special relativity, it should apply to Lorentz transformation equations, the heart of special relativity. Suppose that inertial reference frame S' moving with speed v relative to frame S, in the common positive direction of their horizontal axes. An observer in S reports space-time coordinates l, t for an event, and an observer in S' reports l', t' for the same event. These numbers are related to each other using Lorentz equations [1]:

$$\Delta \acute{l}' = \gamma_v(\Delta l - v\Delta t) \quad , \quad \Delta \acute{t}' = \gamma_v(\Delta t - \frac{v\Delta l}{c^2}) \quad (Eq.8)$$

The above equations are related to the coordinates of a single event as seen by two observers. Since Eq.5 describes space-time relationship of an observer, we should modify the Lorentz equations in a way that it could be used by an observer. For this purpose, if we coincide the event to inertial reference frame S', the event and the observer S' will be at the same place

($\Delta l'$=0) and at the same time ($\Delta t'$=0). By placing $\Delta l'$=0 and $\Delta t'$=0 in the Lorentz equations, equations will be obtained which describe space-time coordinates of an observer moving with speed of v relative to a single event. For the first equation of Lorentz equations we have:

$$\Delta l' = \gamma_v(\Delta l - v\Delta t) \overset{\Delta l'=0}{\Longrightarrow} \frac{\Delta l}{\Delta t} = v \quad (Eq.9)$$

Eq.9 shows the space-time relationship between observer and event. For the second equation, we have:

$$\Delta t' = \gamma_v\left(\Delta t - \frac{v\Delta l}{c^2}\right) \overset{\Delta t'=0}{\Longrightarrow} \frac{\Delta l}{\Delta t} = \frac{c^2}{v} \quad (Eq.10)$$

If we place Eq.9 in Eq.10 substituting v, we will get:

$$\frac{\Delta l}{\Delta t} = \pm c$$

Above equation is exactly Eq.5 being the basis of the Lorentz equations and showing just the space-time relationship of an observer (not event). Moreover, if we place Eq.9 in Eq.10 alternating the Δl or Δt substitution, an equation will be obtained which shows the factor observer uses to measure space-time coordinates moving with speed of c ($v=\pm c$). As a result, the following equation should always be applicable to all observers moving in the inertial frame.

$$\frac{\Delta l}{\Delta t} = c$$

Any observer could pass a distance (or space) in any time interval. For being able to compare space-time coordinates of all observers, we could use the speed of observers substituting the space, by choosing one second time interval as time comparative reference. For example, if the observers 1 and 2 move with speed of v_1 and v_2 , the distance they travel in one second (as comparative time) will be $l_1=v_1$ and $l_2=v_2$,respectively. By considering this supposition, the maximum moved distance (or space) for an observer will be c. In order to prove that Eq.5 will explain the behavior of universe in addition to obtaining special relativity equations, suppose these 2 situations:

The first sate: If we insert one second time interval in the equation $l=tc$, the space will be c (the maximum one). This would mean to a stationary observer that an observer is moving with the speed of light; but it would mean to an observer (or a clock) moving with the speed of light that the whole time is transformed into space. So, while it passed a length of time as one second to a stationary observer, time is stopped to a moving observer. The more it is decreased the maximum space (or speed of light) for a moving observer the more the space is transformed into time. For example, for an observer moving with the speed of 3×10^7m/s, ($\Delta l=3\times10^8-3\times10^7=$) 2.7×10^8m of the whole space is transformed into time. As a result, if we put 2.7×10^8m instead of space in the equation $\Delta l=\Delta tc$, the obtained time will be 0.9s meaning if one second is passed for an observer or clock at rest, 0.9s is passed for an observer moving with the speed of 3×10^7m/s from constant clock's point of view (time is slowing down for moving observer). In other words, 1 second will get longer for moving clock than stationary one. Consequently, if an observer at rest reports 5 second time interval for an event, the observer moving with the speed of 3×10^7m/s will report a larger value for this time interval being (5/0.9=) 5.55s in this example (time dilation).

Another example can help to understand time dilation. Consider two observers of 1 and 2 with a candle and a chronometer in their hands. Observer 1 is static (v=0) and the time interval required for the complete burning of the candle is reported 5 seconds by him. Observer 2 is moving at a velocity of v and will report the time interval the very 5 seconds by the chronometer in his hand, which is stationary relative to him. The problem arises when we want to compare these two time intervals, because the passage of one second is different for the two observers. Each observer possesses the time related to his own world. To equalize the two time periods, we consider the one second passed for the stationary observer (or stationary chronometer) as the reference. Time passes slower for the moving observer and the passage of one second is longer for this observer. In this case, the moving observer reports a longer time interval from the view of the chronometer in the hand of observer 1.

Generally, it could be pointed out that if an observer moves with the speed of v, the scope of space, which is transformed into time, will be $\Delta l=c-v$ for 1 second. As a result, the time passing one second for a stationary observer will pass for a moving observer according to what is stated in the following equation:

$$\Delta t_1 = \frac{\Delta l_1}{c} \xrightarrow{\Delta l_1 = c-v} \Delta t_1 = 1 - \frac{v}{c} \quad (Eq.11)$$

If the observer is at rest in Eq.11, the time will get that reference time of one second meaning the stationary observer just moves in the time. If the observer moves with the speed of light, time will come to a stop in his point of view, and he will just move in space. If the stationary observer measures Δt_0 as the time of an event, the moving observer measures a larger time interval for that event from the stationary observer's point of view according to the following equation:

$$\Delta t_1 = \frac{\Delta t_0}{1 - \frac{v}{c}} \quad (Eq.12)$$

Since the equation $l=tc$ should always be applied to the observers, length should also be contracted according to the following equation by slowing down the time as the effect of moving.

$$\Delta l_1 = \Delta l_0 (1 - \frac{v}{c}) \quad (Eq.13)$$

The second state: We just saw that for the observer moving with the speed of v, the scope of the space which is transformed into time is $\Delta l=c-v$. But, Eq.12 and Eq.13 are not the very equations depicting the time dilation and length contraction in special relativity. If we suppose $\Delta l^2=c^2-v^2$ in this situation, the time passed as one second for the stationary observer will be as follows for the moving observer:

$$\Delta t_2 = \sqrt{1 - (v/c)^2}$$

Supposing this theory, time dilation and length contractions' equations could also be shown by Eq.14 and Eq.15, respectively. These equations are the very famous equations of special relativity.

$$\Delta t_2 = \frac{\Delta t_0}{\sqrt{1 - (v/c)^2}} \quad (Eq.14) \quad , \quad \Delta l_2 = \Delta l_0 \sqrt{1 - (v/c)^2} \quad (Eq.15)$$

The dimensionless ratio of c/v is often replaced by β_v in Eq.14 and Eq.15, called speed parameter, and the dimensionless inverse square root which is shown by γ_v is called the Lorentz factor. If the stationary observer reports a 5 second time interval for an event, the time interval which will be obtained from Eq.14 for the observer moving with the speed of 3×10^7m/s is 5.025s. Comparing these two situations, it can be deduced that the time dilation obtained by Eq.12 is always larger than that obtained by Eq.14 and the larger the Δt_0, the larger this difference. Now, these two questions might be asked, first, which equation gives us the true result, and second, what is the relationship between these two situations?

If Eq.14 is divided by Eq.12 and the resulted equation is rewritten by inserting $f=1/\Delta t$, we will get this equation:

$$\frac{f_1}{f_2} = \sqrt{\frac{1-\beta_v}{1+\beta_v}} \qquad (Eq.16) \qquad (where\colon\ \beta_v = \frac{l/t}{c} = \frac{v}{c})$$

The above equation is not Doppler Effect but also shows cosmological redshift or universe's expansion. Consider a star moving at a constant velocity of v relative to the earth. If light is emitted at a frequency of f_0, an observer on the earth observes a red-shift due to Doppler effect so that this light appears with the f_2 frequency [1]. But if space is also expanded, we will measure an excess red-shift resulting from space expansion following Eq.16. In this case, we detect the frequency of the light emitted from the star f_1. Therefore, Eq.16 tells us that the larger value of Δt_1 relative to Δt_2 is because of the fact that light has to travel more distance due to the space expansion to reach us. Therefore, the difference between Δt_1 and Δt_2 (or f_1 and f_2) directly shows the pure red-shift resulting from the universe expansion. We will therefore have:

$$f_2 - f_1 = f_0(\sqrt{1-\beta_v^2} - (1-\beta_v)) \quad \Rightarrow \quad \frac{f_2 - f_1}{f_0} = \frac{f}{f_0} = \sqrt{1-\beta_v^2} + \beta_v - 1 \quad (Eq.17)$$

The above equation shows the changes in the pure red-shift resulting from space expansion plotted in Figure 1-1. Consider a star stationary relative to the earth and has no motion. We therefore observe no red-shift and the frequency detected on the earth is the very frequency emitted from the star. But, if the space expands, the planet earth and the star will recede from each other and we measure a red-shift resulting from the space expansion obtained from Eq.17. If the value of f/f_0 equals zero, it means that f_1 and f_2 are equal and therefore space in not expanding. In Eq.17, β_v can be indirectly related to the passage of time, because as it was mentioned before, when its value becomes one (velocity equals the velocity of light) time stops. Also, attention should be paid to Eq.17 that does not show the relation between the receding velocity of the galaxy and space expansion, but the correct equation is the very Eq.16. Therefore, if the values extracted for f/f_0 from Eq.17 replace f_1/f_2 in Eq.16, the changes of a receding velocity of the galaxies resulting from the expansion of space with time are obtained (Figure 1-2). As it is observed in Figure 1-2, initially, the value of f/f_0 is equal to zero and according to Eq.17 there is no expansion. As soon as the value of f/f_0 gets a little higher than zero, it means that space is expanding and the galaxies are receding from each other and the velocity of receding is approximately equal to that of light. Over the passage of time, the value of f/f_0 increases and according to Eq.16, the receding velocity is decreased. This reduction continues up to a point that the receding velocity equals $0.7c$, but from this moment on the value of f/f_0 starts reducing meaning that the velocity of receding is increasing and this increase continues up to a point where the receding velocity equals the velocity of light. In this state, time is stopped and the expansion of the universe ends. In general, the expansion of the universe can be divided into two stages where at the first stage, expansion is done at a decelerating velocity and at the second stage,it is accelerating. Figure 1-2 contains another important point that the rate of the expansion of the universe takes place at two different stages. In fact, the accelerating expansion of the universe takes place faster than the other stage and requires little time to finish. Now, the question that arises is what factor can be the cause of the accelerating or decelerating expansion of the universe? We try to provide a suitable answer to this question in the next part.

We have just used the positive form of Eq.5, $l=tc$, until here. But if we suppose the negative form of this equation, the result shows universe' contraction. Therefore, in the all universal relativity equations including the t quantity, the sign $\pm$ shows the expansion and contraction of the universe. From the above discussion, it can be concluded that we can use the equations of the special relativity when we are not taking the universe's expansion into account in our calculations. So, the equations of the special relativity are only specific states of these equations. The trend used to obtain the relativistic equations derived from Eq.5 will be used for the other universal relativity equations in the following discussion.

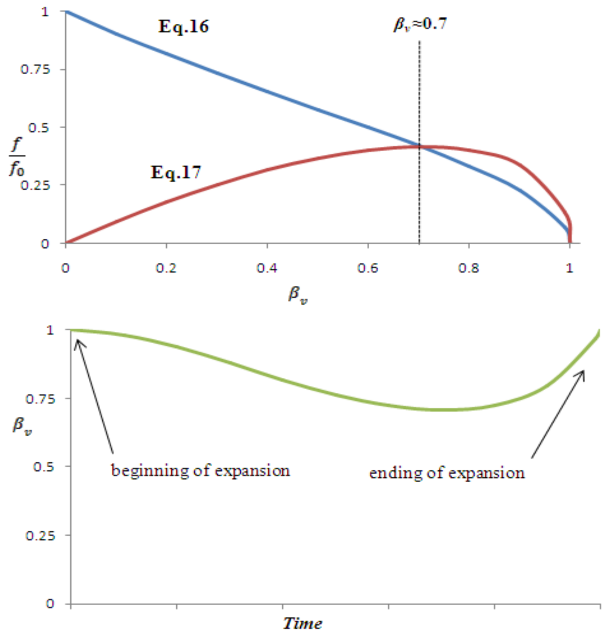

Figure 1 shows a graph of 1) f/f_0 versus βv and 2) βv versus time. This Figure shows that the universe initially expands at a decelerating velocity and in continuation; it expands at an accelerating velocity. Also, the asymmetry form of the changes of velocity shows that the accelerating stage takes a shorter time to end compared with the decelerating stage.

3.2 Mass and Space-Time

In the equations obtained in the preceding section, we inserted that very familiar quantity of the velocity (v) instead of the ratio of space-time (l/t). But, in this section, there is no corresponding quantity in physics for the ratio of mass-time (m/t) and ratio of mass-space (m/l). For this reason, we directly insert them in the equations. The equation $m/t=c^3/G$ indicates that the rate at which time passes on a clock is influenced by mass (or gravitational field). If we insert the one second time interval in this equation, mass will become c^3/G, and this means that all the time is transformed into mass. So, for the observer existing on such a mass (in fact mass to time ratio), time will stop. Symmetrically, relativity equations could be written as follows:

First state; by considering the universe expansion: Time gets slower in the presence of mass according to the following equation:

$$\Delta t_1 = 1 - \frac{m/t}{c^3/G}$$

For the observer not being in the gravitational field (m=0), time will be reference time of one second. Furthermore, if this observer reports time interval Δt_0 for an event, the other observer being in the gravitational field will report a larger time interval (gravitational time dilation):

$$\Delta t_1 = \frac{\Delta t_0}{1 - \frac{m/t}{c^3/G}} \quad (Eq.18)$$

Second state; without considering the universe expansion: Time gets slower in the presence of mass according to the following equation:

$$\Delta t_2 = \sqrt{1-(\frac{m/t}{c^3/G})^2}$$

And the amount of time dilation is obtained from the following equation:

$$\Delta t_2 = \frac{\Delta t_0}{\sqrt{1-(\frac{m/t}{c^3/G})^2}} \quad (Eq.19)$$

We can define Lorentz factor matching Eq.6 ($\gamma_{m/t}$) similar to the former state as follows:

$$\gamma_{m/t} = \frac{1}{\sqrt{1-(\frac{m/t}{c^3/G})^2}}$$

If we insert Eq.5 instead of t in Eq.6, Eq.7 will be obtained. So, t in Eq.6 is the distance from the center of the mass (l) which is stated according to the time in which light travels this distance. The sum of Eq.6 and Eq.7 shows the space-time relation with mass. Because of that, by combining of these two equations, space-time coordinates of the observers in presence of the mass could be obtained. If we insert Eq.5 in Eq.18 and Eq.19 instead of t, following two new equations are obtained which are easy to use and understand:

$$\Delta t_1 = \frac{\Delta t_0}{1-\frac{m/l}{c^2/G}} \quad (Eq.20) \ : by\ considering\ universe\ expansion$$

$$\Delta t_2 = \frac{\Delta t_0}{\sqrt{1-(\frac{m/l}{c^2/G})^2}} \quad (Eq.21) \ : without\ considering\ universe\ expansion$$

For example, Eq.21 shows that the longer the distance of the observer or the clock from the center of the mass, the more time gets slower. Since the value of the ultimate limit of the mass to length ratio is large, slowing down of the time caused by the presence of the mass for massive bodies such as planets and stars is of importance. For earth planet, the nearest distance from the center of the mass is its surface, and in this condition space (l) becomes equal with the radius of the earth. If there is a mass coordinate which applies to Eq.6 and Eq.7, time will stop in the surface of such a mass according to Eq.19 and Eq.21. On the other hand, since time stops in the surface of black holes, Eq.6 and Eq.7 should be its coordinates. The equation $l=tc$ should always be applied to the observer; so, with slowing down of the time in the presence of the mass, length should also be contacted according to the following equation:

$$\Delta l_1 = \Delta l_0 \left(1-\frac{m/l}{c^2/G}\right) \quad (Eq.22) \ : by\ considering\ universe\ expansion$$

$$\Delta l_2 = \Delta l_0 \sqrt{1-(\frac{m/l}{c^2/G})^2} \quad (Eq.23) \ : without\ considering\ universe\ expansion$$

Eq.23 tells us that the less the distance of the observer or the clock from the mass centers of a body, the more the length contracts. If man lived on the moon, he would be a little taller but time would pass a little faster instead. If an observer moves with the speed of light, time stops and length becomes zero for him but Eq.6 and Eq.7 state that no mass can possess zero time and length. As a result, nobody can reach the speed of light.

If Eq.21 be divided by Eq.20 and the obtained equation is rewritten by inserting $f=1/\Delta t$, we will get this equation:

$$\frac{f_1}{f_2}=\sqrt{\frac{1-\beta_{m/l}}{1+\beta_{m/l}}}\ ,\ (\beta_{m/l}=\frac{m/l}{c^2/G})\quad (Eq.24)$$

Similar to Eq.16, the above equation shows expansion of the universe. Here also, like the preceding section, the equation showing the changes in pure red-shift resulting from the expansion of space with time is as follows:

$$f_2-f_1=f_0(\sqrt{1-\beta_{m/l}^2}-\left(1-\beta_{m/l}\right))\quad\Rightarrow\quad\frac{f_2-f_1}{f_0}=\frac{f}{f_0}=\sqrt{1-\beta_{m/l}^2}+\beta_{m/l}-1\quad (Eq.25)$$

If the values extracted for f/f_0 from Eq.25 depicted in Figure 2-1 replaces f_1/f_2 in Eq.24, the changes of *m/l* with time is obtained at the cosmological scale (Figure 2-2). Figure 2 completely coincides with Figure 1 and shows that the *m/l* changes are completely coordinated with the changes of the receding velocity of galaxies. As it is shown in Figure 2-1, initially the value of f/f_0 is equal to zero and according to Eq.25, space is not expanding. If we interpret the *m/l* quantity as the transformation of mass and space into each other, Figure 2 can be interpreted. Mass should be transformed into space so that universe expands. The more the value of *m/l* approximates its ultimate limit, i.e.c^2/G, the more mass is transformed into space. When the value of f/f_0 is a little more than zero, the expansion of the universe begins. In this state, the value of *m/l* is approximately equal to c^2/G and as a result, in the beginning of the expansion of the universe, a great amount of mass is transformed into space at any moment. As the universe gets older, the value of f/f_0 increases and according to Eq.24, the value of *m/l* is reduced. It means that the rate of the transformation of mass to space is decreasing at any moment. In the course of time, an increase in the value of f/f_0 stops and the value of f/f_0 starts to reduce. As a result, the rate of the transformation of mass into space increases at any moment again. This increase continues up to a point that the value of f/f_0 is equal to zero. At this point, all the masses of the universe are changed into space. At this state, time stops and the expansion of the universe ends. As it is clear, the transformation of mass into space makes the universe expand and the receding velocity of the galaxies is first decelerating and then accelerating. In a simple term, transformation of mass into relativity space brings about the expansion of the universe. The rate of the transformation of mass into space depends on the gravitational effects. The question of how the gravitational effects result in a change in the value of *m/l* according to Figure 2, is explained in section 6.

Similar to Eq.16, from the above discussion we can derive several important results: 1-Eq.24 shows expansion of the universe. So, the sign ± in Eq.6 shows the expansion and contraction of the universe. 2-In order for the space to be expanded, the mass should be transformed into space. So, it can be concluded that space is transformed into mass in the contraction stage of the universe. 3-Because Eq.6 and Eq.7 apply to the black holes, so the transformation of the mass into space should happen in the black holes. This is an important and key finding in astronomy. In the preceding section, we observed that the transformation of space and time into each other is done through light.

At the end of this section, this point should be considered that the relativistic equations of mass cannot be obtained from Eq.6 and Eq.7 because these two equations show the relation between space-time and mass. In fact, when mass is influenced by the force, it has meanings and can be measured. So, to obtain the relativistic equation of mass, we should first obtain the relativistic equation of force.

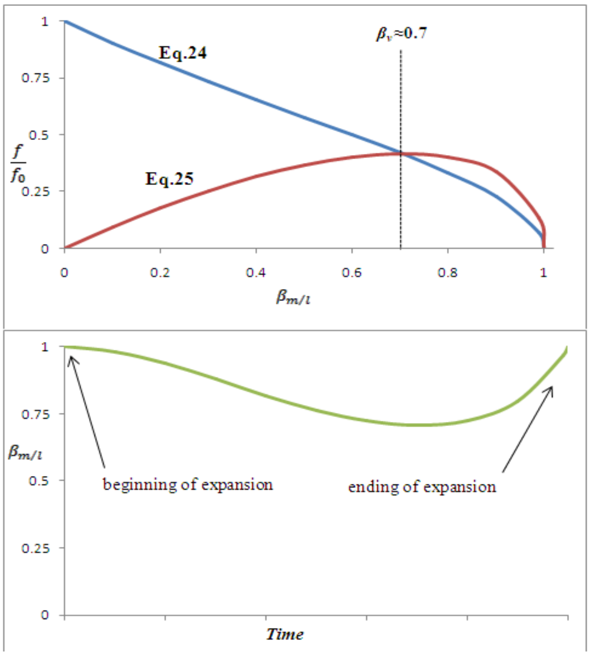

Figure 2 shows a graph of 1) f/f_0 versus $\beta_{m.l}$ and 2) $\beta_{m.l}$ versus time. Figures 1 and 2 show that the changes of the receding velocity of the galaxies and the rate of the transformation of mass into space are completely coincident.

3.3 The Relativity of Force and Dark matter

In order to obtain relativistic equation of force, we should write the general form of the force equation based on the base quantities according to the following relation:

$$F = \frac{m.l}{t.t} \quad (Eq.26)$$

Speed and force are two very important quantities in physics one of which is the basis of the special relativity and the other is the basis of the general relativity. A question is why only these two quantities can be the bases of relativity? One explanation is that Eqs.5-7 and all the equations which could be obtained from combination of m/t, m/l and l/t could be shown only with two quantities of speed and force, as follow:

$$\frac{l}{t} = v \ , \quad \frac{m}{l} = \frac{F}{v^2} \ , \quad \frac{m}{t} = \frac{F}{v} \qquad (where \ F = \frac{m.l}{t.t})$$

As a result, if speed has the ultimate limit of c, force also should have an ultimate limit. If we insert Eq.5 and Eq.6 in Eq.26, the ultimate limit of the force is obtained as follow:

$$F = \left(\frac{m}{t}\right).\left(\frac{l}{t}\right) = \left(\pm\frac{c^3}{G}\right).(\pm c) \ \Rightarrow \ F = +\frac{c^4}{G}$$

Where $c^4/G = 1.2\times10^{44}$ Newton. In fact, if the extremity of l/t and m/t is placed in Eq.26, the value of the force obtained will be the extremity of the force. Force cannot be infinite, because volume or mass of a body cannot be zero or infinite. In fact, there is no experimental sample in nature that can match an infinite mass. The corresponding phenomenon with ultimate limit of the speed is light. Symmetrically, the corresponding phenomenon with ultimate limit of the force should be in nature (surface of) black hole. To obtain the relativistic equation of force, we should first obtain the Lorentz factor of the force (γ_F) according to the following equation:

$$F = \gamma_{m/t}\left(\frac{m}{t}\right).\gamma_v\left(\frac{l}{t}\right) \ \Rightarrow \ F = \gamma_F \frac{m.l}{t.t} \quad (Eq.27) \qquad (where \ \gamma_F = \gamma_{m/t}.\gamma_{l/t})$$

If we multiply the Lorentz factor of mass-time ($\gamma_{m/t}$) and speed (γ_v), we will get this equation:

$$\gamma_F = \frac{1}{\sqrt{1-(\frac{v}{c})^2+(\frac{m.l/t.t}{c^4/G})^2-(\frac{m/t}{c^3/G})^2}} \quad (Eq. 28) \quad (where\ F = \frac{m.l}{t.t})$$

Eq.28 shows the general form of Lorentz factor of force, and depending on conditions, it can be simplified. For example, if a stationary body is being influenced by the gravitational force, γ_F will be:

$$\gamma_F = \frac{1}{\sqrt{1+(\frac{G\frac{mM}{r^2}}{c^4/G})^2}}$$

So, the relativistic form of the Newton's law of gravitation will be accordingly:

$$F = \frac{G\frac{mM}{r^2}}{\sqrt{1+(\frac{G\frac{mM}{r^2}}{c^4/G})^2}} \quad (Eq. 29)$$

In the above equation, it should be considered that although GmM/r^2 can have any quantity (more or less than c^4/G); force (F) can never become equal to c^4/G, as shown in Fig.3. This means that we cannot reach the ultimate limit of force. Eq.29 shows that only when the value of force is equal to its own extremity i.e. c^4/G that mass is infinite (in fact, the value of GmM/r^2 is infinite). When a velocity approximates the velocity of light, the time and length quantities are affected (time dilation and length contraction). Now, the question is what quantity is affected when force approximates its own ultimate limit? Response: quantity is mass. If we solve Eq.29 for m and insert $F=Gm_0M/r^2$ in it, the following relation will be obtained:

$$m = \frac{m_0}{\sqrt{1-(\frac{G\frac{m_0M}{r^2}}{c^4/G})^2}} \quad (Eq. 30)$$

The above equation is the true relation of relativistic gravitational mass stating that if the force influencing a material be equal to c^4/G, the mass of the material becomes infinite. A seemingly contradictory point that can result from the comparison of Eq.29 and Eq.30 is how GmM/r^2 can assume any value in Eq.29, but Gm_0M/r^2 in Eq.30 should be less than c^4/G. The answer to this question is hidden in this point that m is the relativity mass and m_0 is the static mass. When the value of Gm_0M/r^2 approximates the ultimate limit of force, m and as a result GmM/r^2 can assume any value according to Eq.30; yet, the relativity form of the gravitational law (Eq.29) assures us that at any state, the value of force does not exceed c^4/G. When the value of Gm_0M/r^2 is greatly less than the ultimate limit of force, then the relativity mass equals the static mass ($m=m_0$) and Eq.29 is transformed into the non-relativity gravitational law ($F=GmM/r^2= Gm_0M/r^2$). Also in this state, force does not become greater than c^4/G. In order for a stationary body to reach the speed of light, it should be accelerated using ultimate force. Based on the relativistic equations of force, we can never reach the ultimate force, meaning that no particle can reach the speed of light.

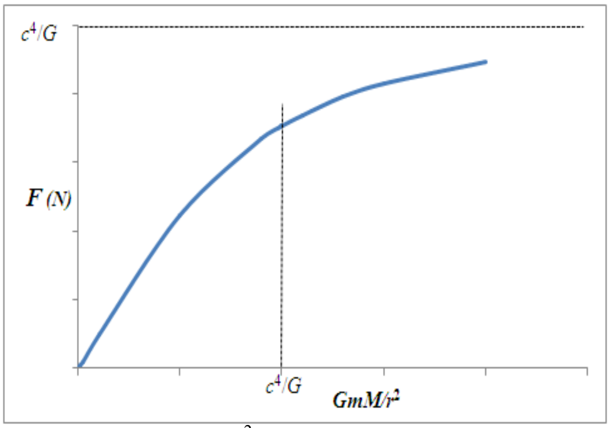

Figure 3 shows a graph of force versus GmM/r^2. This figure indicates that force never reaches its ultimate limit, unless mass (m) is infinite.

Orbital motion of the planets of the solar system obey the Newton's laws so that with an increase in the distance from the center of it, rotational speed of the planets around the sun decreases independent of their masses. But in galaxies, for clusters of stars which are scattered in the different distances from the galaxy center, the observed rotational speed remains unchanged with an increase in the far spaces. The only explanation of this issue is that the galaxy should have much more mass than what we see. Since this matter cannot be seen, it is called dark matter [2]. The relativity form of three types of force and their corresponding relativistic mass equations are presented in Table 3. If we take a look at Table 3, we can see that the rotational speed of a body of mass m rotating around the more massive central body with mass M is not independent of mass m in the high forces; so that the rotation speed of an orbiting body should obey the following equation:

$$\frac{G\frac{mM}{r^2}}{\sqrt{1+\left(\frac{G\frac{mM}{r^2}}{c^4/G}\right)^2}}=\frac{\frac{mv^2}{r}}{\sqrt{1-\left(\frac{v}{c}\right)^2+\left(\frac{mv^2/r}{c^4/G}\right)^2}}$$

In the above equation, m is the very relativity mass. Since we don't have its value, we then like to write the above equation in terms of m_0. So, we will have:

$$\frac{G\frac{m_0M}{r^2}}{\sqrt{1-\left(\frac{G\frac{m_0M}{r^2}}{c^4/G}\right)^2}}=\frac{\frac{m_0v^2}{r}\sqrt{1-\left(\frac{v}{c}\right)^2}}{\sqrt{1-\left(\frac{m_0v^2/r}{c^4/G}\right)^2}}$$

Often, the value of v and m_0v^2/r are respectively much less than c and c^4/G for the stars rotating around the center of galaxies. Therefore, the above equation is changed into a simpler form as follows:

$$\frac{G\frac{m_0M}{r^2}}{\sqrt{1-\left(\frac{G\frac{m_0M}{r^2}}{c^4/G}\right)^2}}=\frac{m_0v^2}{r}\quad\Rightarrow\quad v^2=\frac{\frac{GM}{r}}{\sqrt{1-\left(\frac{G\frac{m_0M}{r^2}}{c^4/G}\right)^2}}\qquad (Eq.31)$$

Eq.31 shows that if the gravitational force acting on a rotating body approximates the ultimate limit, its rotational velocity will be more than the velocity predicted by Newtonian mechanics. Such a thing is not surprising, because when a great gravitational force acts on that body; its mass increases according to Eq.30 and the more the mass of the body rotating around the center of galaxy, the more will be the gravitational force that attracts the body toward the center of the galaxy. In this case, the body should move at a greater velocity to remain in its own orbit. In the solar system, the forces' quantities are not that much high; so, the relativistic equations of force are not important; but in the galaxies, a high amount of force is applied to the star clusters which are in the far distance from the galaxy center because of the existence of a large quantity of mass, including massive black holes and a large number of stars and planets, and this causes their real mass to be more than our estimations. So, it seems that dark matter is a relativity of force.

Table 3 shows relativistic form of three type of force and its relativistic mass equations

Equations	Non-relativistic form	Relativistic form	Relativistic mass (m)
Gravitation law	$F = G\dfrac{mM}{r^2}$	$F = \dfrac{G\frac{mM}{r^2}}{\sqrt{1+(\frac{G\frac{mM}{r^2}}{c^4/G})^2}}$	$m = \dfrac{m_0}{\sqrt{1-(\frac{G\frac{m_0M}{r^2}}{c^4/G})^2}}$
Second law of newton	$F = ma$	$F = \dfrac{ma}{\sqrt{1+(\frac{ma}{c^4/G})^2}}$	$m = \dfrac{m_0}{\sqrt{1-(\frac{m_0a}{c^4/G})^2}}$
Centripetal force	$F = \dfrac{mv^2}{r}$	$F = \dfrac{mv^2/r}{\sqrt{1+(\frac{mv^2/r}{c^4/G})^2}}$	$m = m_0\sqrt{\dfrac{1-(\frac{v}{c})}{1-(\frac{m_0v^2/r}{c^4/G})^2}}$

In Eq.31, M is the central mass of the galaxy around which the star rotates. Unfortunately, there is no precise method to determine this mass. The approximation methods estimate the value of this mass less than the value by which the ratio of Gm_0M/r^2 to c^4/G becomes significant for the Milky Way [7]. Eq.30 can solve this problem. Eq.30 can be interpreted like Eq.14. Consider two observers of 1 and 2 each with a balance and an iron ball in hand. Observer 1 is not under any force (F=0) and reports the mass of the ball one kilogram. Observer 2 with an F force acting on him, reports the mass weighed by the balance one kilogram. But, the one kilogram of observer 1 is different from that of observer 2. If observer 2 wants to report the mass of the ball by the balance in the hand of observer 1, he reports a greater mass according to Eq.30. The curve of the rotational velocity of the stars in the Milky Way shows that the sun along with the whole of the solar system rotates around the center of the galaxy at a velocity more than that expected [7]. If we relate the dark matter to the relativistic mass, it means that we (and our balance) are under significant force compared with the ultimate limit of the force. We therefore, measure the mass of the astronomical bodies under the effect of greater force relative to us (e.g., for the stars that are farther from the galaxy relative to us) more and we report smaller mass for those bodies under smaller force compared with the sun. At the end of this section, it should be considered that although relativity of force equations may seem to challenge general relativity, but we are of the opinion that these equations help the understanding of general relativity.

3.4 Classical Equations Derived from Universal Equations of Relativity

The prevailing view in classical mechanics is that the second law of Newton and the law of gravitation cannot be obtained from the basic principles, because both are basic principles. But, now we want to show that these two equations can be extracted from the universal equations of relativity. In fact, the universal equations of relativity are the basic principles. All the Newtonian mechanics equations can be obtained by combining the three base quantities of *t, l,* and m. On the other hand, as it was mentioned before, all the equations obtained by the combination of *m/t, m/l,* and *l/t* can be represented by only two quantities of velocity (v) and force (F). We should therefore be able to derive the basic and fundamental equations of Newtonian mechanics from the universal relativity equations. The starting point is the fact that although there are phenomena such as light and black hole in nature corresponding to the ultimate speed and force limit, as it was proved before, we can never reach these limit values. Therefore, if we replace c and c^4/G with v and F in the universal relativity equations, respectively, non-relativistic equations are obtained which can be used for the description of the phenomena around us. For example: 1-By replacing c with v in $p=mc$, an equation is obtained that shows the linear momentum of a particle moving with a constant speed of v ($p=mv$). 2-If c^4/G and F are exchanged in $p=t.c^4/G$, the second law of Newton in terms of momentum is obtained ($F=dp/dt$). If the obtained momentum equation is inserted in this equation, the second law of Newton is also obtained ($F=ma$). 3-If c^4/G is replaced with F quantity in $E=l.c^4/G$, an equation for work is obtained ($W=F.l$). 4-The law of gravitation can be derived from Eqs.6-7 as follows:

$$\frac{m}{l}=\frac{c^2}{G} \quad \Rightarrow \quad \frac{m^2}{l^2}=\frac{c^4}{G^2} \quad \xrightarrow{F=\frac{c^4}{G}} \quad F=G\frac{m^2}{l^2} \;\; or \;\; F=G\frac{m_1m_2}{l^2} \quad (The\ law\ of\ gravitation\,)$$

In fact, Eq.7 is the basis of Newton's law of gravitation. The following equation is other form of the law of gravitation indicating that speed of gravity is equal to the speed of light in vacuum.

$$\frac{m}{t}=\frac{c^3}{G} \quad \Rightarrow \quad \frac{m^2}{t^2}=\frac{c^6}{G^2} \quad \xrightarrow{F=\frac{c^4}{G}} \quad F=G\frac{m^2}{c^2t^2} \;\; or \;\; F=G\frac{m_1m_2}{c^2t^2} \quad (The\ law\ of\ gravitation\,)$$

If the value of the force of the earth and the sun attracting each other along with the mass of the earth and the sun is inserted in the above equation, the value of time will be 500 seconds, i.e.If, due to any reason, the mass of the sun is changed, the earth receives its gravitational effect after 500 seconds. Since light travels the distance between the earth and the sun over the same time, therefore the speed of gravitation is exactly equal to that of light. Recent measurement shows that the speed of gravitation is equal to that of light [8]. No classical equation can prove the Newtonian laws and predict that gravity is transferred at the speed of light. Therefore, the correctness of the classical equations and experimental observations prove that the two equations of 6 and 7 are correct. Other equations of Newtonian mechanics are obtained by performing mathematical operations on these equations. Although the method we used to derive the equations of classical mechanics might seem naïve, this method greatly contributes to the understanding of the origin of these equations and their concepts. We can conclude from the above discussion that the Newtonian mechanics is an approximate result of the universal equations of relativity.

4. Quantum Universal Equations

As it was observed, the universal equations of relativity are obtained from the ratio of the base quantities and the proportionality constant of these equations is a combination of three fundamental constants of physics (i.e. ε_0, G and μ_0). Now, this question might arise that whether the product of the base quantities can also provide meaningful relations. The answer to this question is positive. In addition to the fundamental constants that have been used so far, we need another fundamental constant to obtain the proportionality constant of new equations. This fundamental constant is Planck constant (h). Since this constant is the sign of quantum mechanics and the values of the proportionality constant of these equations are a very small number, it is therefore expected that the new equations are the very quantum universal equations which are important at quantum scale. As for the universal equations of relativity, we first list the important results understood from the universal equations of quantum to have a general view of them and we then embark on the description of the details of the results.These equations can be obtained as follows:

Quantum fundamental relationship of space-time

Proportionality constant of the quantum relationship of space-time will be obtained as follows:

$$[G].[h].[\varepsilon_0]^2.[\mu_0]^2 = \frac{m^3}{kg.s^2} \times \frac{kg.m^2}{s} \times \frac{s^4}{m^4} \quad \Rightarrow \quad m.s = +\frac{hG}{c^4}$$

Consequently, quantum equation of space-time will be:

$$l.t = n\frac{hG}{c^4} \quad (Eq.32)$$

Where hG/c^4=5.5×10^{-78}$m.s$. Eq.32 states: 1- Quantum space and time are equivalent and could be transformed to each other. 2- The lowest limit of the product of space-time is hG/c^4 in nature and that can never be reached. 3- Corresponding phenomenon to this equation is light. 4- Light is an integer multiple of Planck length.

Quantum fundamental relationship of mass-time:

Proportionality constant of the quantum relationship of mass-time will be obtained as follows:

$$[h].[\varepsilon_0].[\mu_0] = \frac{kg.m^2}{s} \times \frac{s^2}{m^2} \quad \Rightarrow \quad kg.s = +\frac{h}{c^2}$$

Consequently, quantum equation of mass-time will be:

$$m.t = n\frac{h}{c^2} \quad (Eq.33)$$

Where h/c^2=7.4×10^{-51}$kg.s$. Eq.33 states that: 1- Mass and time are equivalent and could be transformed to each other. 2- The lowest limit of the product of mass-time is h/c^2 in nature and that can never be reached. 3- Corresponding phenomenon to this equation is quantum black hole. 4- Quantum black holes are an integer multiple of Planck mass.

Quantum fundamental relationship of mass-space:

Proportionality constant of the quantum relationship of mass-space will be obtained as follows:

$$[h]^2.[\varepsilon_0].[\mu_0] = \frac{kg^2.m^4}{s^2} \times \frac{s^2}{m^2} \quad \Rightarrow \quad kg.m = \pm\frac{h}{c}$$

Consequently, quantum equation of mass-space will be:

$$m.l = \pm n\frac{h}{c} \quad (Eq.34)$$

Where h/c=2.2×10^{-42}$kg.m$. Eq.34 states that: 1- Mass and space are equivalent and could be transformed to each other. 2- The lowest limit of the product of mass-space is h/c in nature and that can never be reached. 3- Corresponding phenomenon to this equation is quantum black hole. 4-Quantum black holes are an integer multiple of Planck mass.

We can also obtain the quantum fundamental relations of the base quantities with energy:

$$E = n\frac{h}{t} \ , \ E = \pm n\frac{hc}{l} \ , \ E = \pm n\frac{hc^3}{G}\frac{1}{m}$$

If the energy equations are equalized, the same universal relativity equations are obtained. But, by equalizing the above equations with the corresponding relativity equations, the quantum universal equations are obtained. This shows that at the quantum scale, the universal equations of relativity and quantum are both important. The quantum equations of energy provide us with important information about the universal quantum equations. For example, the energy-time equation shows that the sign of time quantity is positive in the quantum equations. Also, the space-energy equation shows that the ± sign appearing in the universal equations of quantum belongs to the space quantity. We call this space quantum space to differentiate it from another type of space, i.e. relativity space. We have to pay attention to this important point that the relativity space is positive only and carries a great amount of energy with it ($E=+l.c^4/G$), but the quantum space is of two states and carries little energy ($E=\pm hc/l$). So far, by space, we meant the relativity space, but regarding quantum equations, we intend the quantum space.

It is required to consider three introductions before discussing each of the universal equations of quantum.

4.1 Planck Units

The physical significance of the Planck units and correctness of physics laws at Planck scale where the length is the very Planck length, are the subject of many discussions in the world of physics [9]. It is often mentioned that the laws of physics fail beyond Planck scale. But, it will be shown that although the Planck scale exists in nature, we can never attain this scale. In this situation, the phrase "beyond the Planck scale" loses its meaning. If the universal relativity equations and quantum are presented as $x/y=a$ and $x.y=b$ respectively, where x and y are the very base quantities, these equations are then in agreement in a value of x and y. The obtained values for each quantity are the very Planck units as follows:

$$t_p = \sqrt{\frac{hG}{c^5}} = 1.35 \times 10^{-43}\ s \ , \ l_p = \sqrt{\frac{hG}{c^3}} = 4.05 \times 10^{-35}\ m \ , \ m_p = \sqrt{\frac{hc}{G}} = 5.45 \times 10^{-8}\ kg$$

Therefore, the ratio of Planck units, universal relativity equations, and their product provide the universal quantum equations. In other words, Planck units are true for the relativity and also for quantum equations. As a result, the quantum equations in the form of $x.y=b$ can be true for light and black holes, only where x and y are replaced with Planck units. An important result, which is derived from the above discussion, is that light and black holes are governed by both relativity and quantum equations. In continuation of this article, more information is provided on the meaning and consequences of Planck units.

4.2 Classical Equations Derived from Quantum Universal Equations

One way to better understand the meaning and concept of the universal equations of quantum is to understand what classical equations are extracted from them, since these equations are properly understood. We observed that all the equations obtained from the combination of m/t, m/l, and l/t can be shown by two quantities of speed and force. In contrast, to describe quantum equations obtained by the combination of *l.t*, *m.t*, and *m.l* there is a need for another quantity in addition to two quantities of *F* and *v*. This new quantity is the very angular momentum (*L*). The angular momentum formula (*L=mvl*) can be written as follows in a general form:

$$L = (m.l)(\frac{l}{t}) = \frac{m.l^2}{t}$$

Therefore, the quantum equations resulting from the combination of the three base quantities of *t*, *l*, and *m* can be presented by the three quantities of *F*, *v*, and *L* as follow:

$$l.t = \frac{L}{F} \quad , \quad m.t = \frac{L}{v^2} \quad , \quad m.l = \frac{L}{v}$$

An interesting point is that it is not possible to present energy (i.e. ml^2/t^2) quantity and linear momentum (i.e. *ml/t*) by these three quantities. Symmetrically, the angular momentum which is also similar to speed and force should have a limit which is obtained by replacing Eq.5 and Eq.34 in angular momentum formula:

$$L = \left(\pm n\frac{h}{c}\right)(+c) \quad \Rightarrow \quad L = \pm nh$$

The question concerning the concept of the above equation is discussed in section 4-5. If *c*, c^4/G, and *h* are replaced with the quantities of *v*, *F*, and *L*, respectively in universal quantum equations, equations for rotational motion are obtained which can be used for the description of our surrounding phenomena:

$$l.t = \frac{hG}{c^4} \xRightarrow{h=L\,,\ \frac{c^4}{G}=F} l.t = \frac{L}{F} \quad \Rightarrow \quad \boxed{\vec{F} \times l = \frac{\vec{L}}{t} \quad or \quad \vec{\tau} = \frac{d\vec{L}}{dt}} \quad (torque)$$

$$m.l = \frac{h}{c} \xRightarrow{h=L\,,\ c=v} m.l = \frac{L}{v} \quad \Rightarrow \quad \boxed{\vec{L} = m\vec{v} \times l \quad or \quad \vec{L} = \vec{p} \times l} \quad (angular\ momentum)$$

If Eq.34 is used instead of Eq.33 in the above relation, an equation is extracted that shows that the speed of the angular momentum is equal to that of light. We can now realize why the angular momentum and rotational motion equations in quantum are so important. Therefore, relativistic form of rotational motion equations should be employed in quantum scales. Additionally, these relations show that the quantity of *l* can be considered as the distance to a fixed point where the body rotates relative to that point in the universal equations of quantum. It can be concluded from the above discussion that the equations of the rotational motion is an approximate result of the universal equations of quantum. Another important result is that since the universal equations of quantum can be satisfactory for light and black hole, therefore the light and the black hole also enjoy rotational motion in addition to transitional motion.

4.3 New Relativity in Quantum Scales

Relativity and quantum theories have startled the world of science by challenging common sense. The world of relativity and quantum theories looks quite unfamiliar to us merely because the velocity of light is great and inaccessible, and Planck's constant (*h*) is very small value. Actually, our general perception of the world is merely correct when *h* is zero and *c* is infinite. In this case, the relativity and quantum effects are completely nullified. We know the velocity is not infinite and the ultimate limit of the velocity is *c* in nature and that can never be reached. Therefore, the speed of bodies in nature must be $l/t \leq c$ (or $v \leq c$). This very recent condition has created the special relativity (and its effects). In general, universal equations of relativity indicate that the ratio of base quantities in nature cannot be infinite, and they have the ultimate limit.

Therefore, the accessible quantity of base quantities ratio in nature must obey the following unequals:

$$\frac{l}{t} \leq c \ , \ \ \frac{m}{t} \leq \frac{c^3}{G} \ \ , \ \ \frac{m}{l} \leq \frac{c^2}{G}$$

On the other hand, we know that the Planck constant value is not zero and this has led to the presence of quantum effects. It can therefore be inferred that there is a factor in nature that does not let the Planck constant or the product of base quantities be zero. Because if the value of Planck's constant is zero, according to quantum universal equations, the product of the base quantities will also be zero. This means that the quantum universal equations present the lowest limit of the product of the base quantities in nature. Therefore, the value of the product of the base quantities in nature should obey the following unequals for all phenomena:

$$l.t \geq \frac{hG}{c^4} \ \ , \ \ m.t \geq \frac{h}{c^2} \ \ , \ \ m.l \geq \frac{h}{c}$$

The relativity and quantum equations together make the base quantities in nature not become zero or infinity. The equal sign in the unequals of relativity and quantum are only true for light and black hole. The quantum unequals clearly show that there should be a new relativity in quantum scale. At least two equations (De Broglie equation and uncertainty principle) and one experimental evidence (teleportation phenomenon) confirm the presence of a new relativity in quantum scales. When the values of the ratio of the base quantities approximate their ultimate limit, they generate the relativity effects. For example, when the velocity of a body approximates the velocity of light, the dilation of time and contraction of length take place. Now, the question is what effects might take place if the product of the quantities approximate their low limit?

4.4 Quantum Space-Time

$l=tc$ is the only equation of the universal relativity equations which is true for light. The space and time quantities in this equation can assign any value to themselves provided the recent equation is maintained. In contrast, the $l.t=nhG/c^4$ quantum equation is true for light only when the space and time quantities are replaced with Planck length and Planck time, respectively. That is because the Planck units are the only values which are applied to relativity and quantum equations. For this reason, Eq.32 denotes that light in quantum scales should be an integral multiple of Planck length. Light travels the Planck length in Planck time, but light cannot travel the distance of one and a half Planck lengths in one and a half Planck time, because although these two values are satisfied in equation $l=tc$, they are not satisfied in the quantum equation of $l.t=nhG/c^4$. Therefore, light in quantum scales can only travel an integer multiple of the Planck length. The quantum number of n inserted in Eq.32 points to this fact. In quantum scales, light behaves in a way that it seems that it is composed of pieces with Planck length. The importance of Eq.32 is lost in microscopic scales. By comparing equations $l=tc$ and $l.t=hG/c^4$, it can therefore be concluded that light at macroscopic scales, i.e. where relativity equations are governing behave in a continuous manner; and in quantum scales, i.e. where quantum equations are governing it behave in a discrete manner. Also, the latter two equations elucidate that the macroscopic world is derived from the quantum world. Since the two equations are true for light, we therefore can never have access to these values; one represents the ultimate limit and the other the lowest possible limit for space-time. It was already shown that the value of space-time in nature should obey the following two unequals:

$$\frac{l}{t} \leq c \ , \ \ l.t \geq \frac{hG}{c^4}$$

By combining the above two conditions we attain the following unequal:

$$\frac{hG}{c^4}\frac{1}{t} \leq l \leq ct$$

The right and left sides of the above unequal are related to the relativity and quantum equations of light, respectively. If proper values are assigned for time in the above unequal, we will have:

$$\begin{cases} t = 1s & \Rightarrow \ 5.5 \times 10^{-78} \leq l \leq 3 \times 10^{8} \quad (correct) \\ t = t_p & \Rightarrow \ 4.05 \times 10^{-35} \leq l_p \leq 4.05 \times 10^{-35} \ (correct) \\ t = 10^{-50}s & \Rightarrow \ 5.5 \times 10^{-28} \leq l \leq 3 \times 10^{-42} \quad (incorrect) \end{cases}$$

As it is shown by the above calculations, time cannot be less than Planck time in quantum scales. Since there is no value for the time of less than the Planck time for the length. On the other hand, since the ultimate limit of speed is the speed of light, therefore the least distance that can be covered in Plank time is the Planck length. Therefore, the least possible length in nature is the Planck length. Light can cover the distance of 3×10^{8}m, 3m and Planck length in 1s, 10^{-8}s and Planck time, but light cannot cover the distance of 3×10^{-40}m in10^{-48}s because this distance is less than Planck length. As a result, if the distance between two particles is less than the Planck length, light cannot be transferred between these two particles. Also, the above calculations show that only when the product of space-time tends to very small values, the quantum equations along with relativity equations become important, but in macroscopic scales, only the relativity equations can be important.

As shown before, the fact that the space-time product cannot be smaller than hG/c^4, it makes a new relativity in quantum scale. Similar to universal relativity equations, the following two states are taken into consideration:

First state: The importance of symmetry in physics tells us that by considering two points, an equation of time relativity related to quantum universal equations in quantum scales can be obtained similar to Eq.11. These two points are: 1- The condition of quantum for space-time is $l.t\geq hG/c^4$. In this situation $\beta_{l.t}$ would be equal to $hGc^{-4}/l.t$. 2- Space and time in Eq.32 have an inverse relation. Therefore, the time relativity equation related to Eq.32 in quantum scales should be as follows:

$$\Delta t_1 = \frac{1}{1 - \frac{hG/c^4}{l.t}}$$

The above equation shows that the $l.t$ is great in macroscopic scales and the time will be that one-second reference. The smaller the value of $l.t$ becomes and nears the hG/c^4 limit value, the more is Δt_1 value. This point to the fact that time in quantum scales relative to macroscopic scales (where we are) passes faster. We showed in section 1-3 that if we travel at the velocity of light, time will stop for us and while our velocity is reduced for us to be still, space is transformed into time. We can also apply such an interpretation here. When we transfer from macroscopic scale to quantum scale, space is transformed into time when we reach the Planck scale and in this state, time will pass faster. Since the value of the lowest limit of space-time product is very small, therefore the quick passage of time resulting from the above equation will be very negligible for the scales that physics is studying at present. If an observer in a macroscopic scale reports the Δt_0 time interval for an event, another observer in a quantum scale reports a smaller time interval:

$$\Delta t_1 = \Delta t_0 (1 - \frac{hG/c^4}{l.t}) \quad (Eq.35)$$

Since $l=tc$ should always be true for all the observers, so with the fast passage of time in quantum scales, distance should also be expanded according to the following equations:

$$\Delta l_1 = \frac{\Delta l_0}{1 - \frac{hG/c^4}{l.t}}$$

The quantity of l in the special relativity is considered as the length of the body and therefore, at a high velocity the length of the body is contracted. But, as it was mentioned about the quantum equations, the quantity of l should be considered as the distance to the rotational point. In this case, if the value of $l.t$ approximates its lowest limit, this distance is expanded.

The second state: In this state, the time for an observer in quantum scales passes for one second of the time of an observer in macroscopic scales is obtained by the following equation:

$$\Delta t_2 = \frac{1}{\sqrt{1 - (\frac{hG/c^4}{l.t})^2}}$$

Therefore, the equation denoting the fast passage of time and distance expansion will be at this state:

$$\Delta t_2 = \Delta t_0 \sqrt{1 - (\frac{hG/c^4}{l.t})^2} \quad (Eq.36) \quad , \quad \Delta l_2 = \frac{\Delta l_0}{\sqrt{1 - (\frac{hG/c^4}{l.t})^2}}$$

The Lorentz factor corresponding to Eq.32 ($\gamma_{l.t}$) can be defined as follows:

$$\gamma_{l.t} = \sqrt{1 - (\frac{hG/c^4}{l.t})^2} \quad (Eq.37)$$

The above equations and also the quantum universal equations are compatible with two important principles of quantum mechanics. One principle in quantum is that the quantum number of n is a positive integer number whose minimum value is equal to one. In Eq.31, the quantum number of n is a positive integer number which is greater than one and cannot be zero, because if n is zero, the value of $l.t$ equals zero, while the value of $l.t$ cannot be less than hG/c^4. Therefore, the minimum value of n is equal to one. The second principle named the correspondence principle expresses that in quantum numbers, which are great enough, the predictions of quantum physics gradually approximates the predictions of classical physics. Light travels the distance of one Planck and two Planck length during one Planck and two Planck time, respectively. In a general state, if light travels n Planck length in n Planck time, the value of $l.t$ is equal to $n^2 l_p t_p$. In this state, the value of $\beta_{l.t}$ will be equal to $1/n^2$. If this value is inserted in Eq.37 we will have:

$$\gamma_{l.t} = \sqrt{1 - (\frac{1}{n^2})^2} \quad (Eq.38)$$

Figure 4 demonstrates the Lorentz factor of space-time product as a function of the quantum number of n. As it is evident from this Figure, when the value of n increases, the value of Lorentz factor approximates one and this means that the quantum effect of light and in general the relativity of time resulting from quantum equations is disappearing.

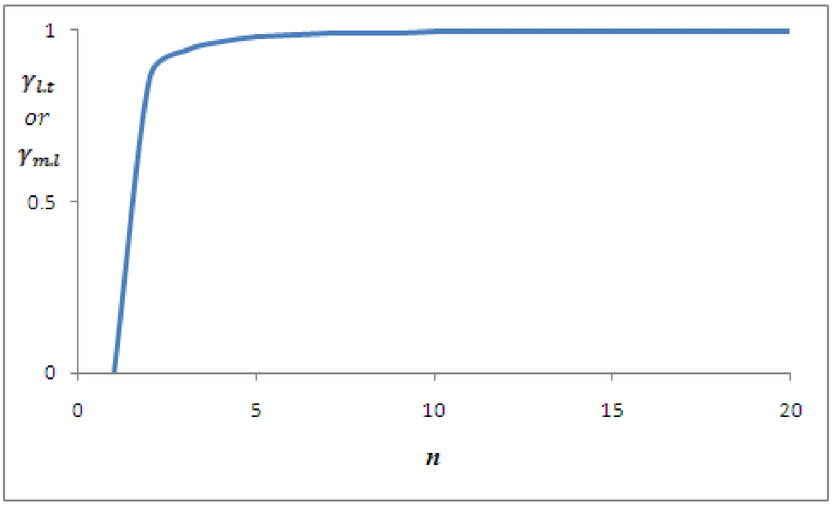

Figure 4 shows a graph of $\gamma_{l.t}$ and $\gamma_{m.l}$ versus quantum number n. When the value of n increases, the value of Lorentz factor approximates one and this means that the quantum effect is disappearing.

If Eq.36 is divided by Eq.35 and we rewrite the obtained equation by inserting $f=1/\Delta t$ in it, we will have the following equation:

$$\frac{f_1}{f_2}=\sqrt{\frac{1+\beta_{l.t}}{1-\beta_{l.t}}} \quad , \qquad \beta_{l.t}=\frac{hG/c^4}{l.t} \quad (Eq.39)$$

The above equation shows the expansion of the quantum space in quantum scales. In the beginning of the expansion of the universe the value of $l.t$ is equal to hG/c^4 (i.e. $\beta_{l.t}=1$), as it is shown later and the value of $l.t$ increases as time passes, i.e. the values of $\beta_{l.t}$ and f_1/f_2 gets smaller. This means that quantum space in quantum scales is expanding. Our theory states that the value of t and l is equal to time and length of Planck in the beginning of the universe expansion. On the other hand, the Big Bang Theory states that the Planck time is the oldest time we can talk about and so far 13.6×10^9yr has passed from the value of this time, i.e. the age of the universe. Therefore, t in the above equation can represent the age of the universe. Although we know that by the passage of time, the value of l increases (the quantum space expands), we do not know how this value increase with time. Yet, we can make some guesses about it. For this purpose, we can consider light as a scale for qualitative study of the expansion of quantum space. Figure 5 shows the changes of $\beta_{l.t}$ with time for light. The more the value of $\beta_{l.t}$ approximates the number of one; it means more transformation of time into space leading to more expansion of space. As it is shown in Figure 5, in the initial moments of the universe expansion, the value of $\beta_{l.t}$ is equal to one and the rate of the expansion of quantum space is very high, but by the passage of time, this rate is exponentially reduced. The general conclusion is that the quantum space in the initial moments of the universe expands quickly, but this expansion is reduced exponentially. Yet, the expansion of the quantum space is continuing at a very slow rate. It is possible to consider the quantity of l for the light as its wavelength (we will explain later why we can replace l with the quantity of λ in the universal equations). The cosmic microwave background radiation is the best document to show the expansion of the quantum space. Recent measurements show that the wavelength of the cosmic microwave background radiation is equal to 1/1 mm [10]. Therefore, while the value of t has reached 13.6×10^9yr from the Planck time, the value of l for light from Planck length has expanded to 1/1 mm. Our theory predicts that the rate of this expansion should have been exponentially at the initial moments of the universe. In the next section, we will explain what the stimulating force for such an expansion is? Regarding the universal equations of relativity, we showed that the ± sign showed the expansion and contraction of the universe. As a result, the plus sign in Eq.34 reveals this fact that the world of quantum and quantum universal equations play a role only in the expansion stage of the universe.

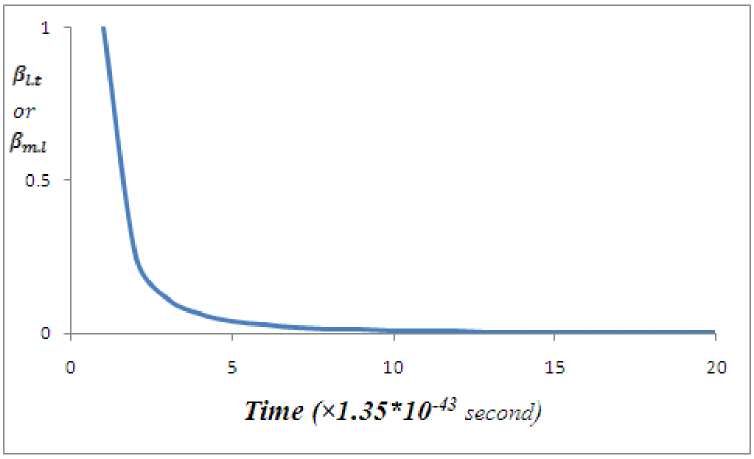

Figure 5 shows a graph of $\beta_{l.t}$ and $\beta_{m.l}$ versus time for light and quantum blackhole.

4.5 Mass and Quantum Space-Time

$m/t=c^3/G$ and $m/l=c^2/G$ are two relativity equations which are applied to the black holes. In contrast, $m.t=h/c^2$ and $m.l=h/c$ are two quantum equations that if Planck units (*Planck mass, Planck time, and Planck length*) are inserted in them, they show the features of quantum black holes. So, it can be concluded that the quantum black holes should be an integer multiple of Planck mass. The mass and radius of a quantum black hole can be equal to Planck mass and Planck length, but its mass and radius cannot be one and a half Planck mass and one and a half Planck lengths, because although this value is satisfied in $m/l=c^2/G$, it is not satisfied in quantum equation of $m.l=h/c$. Therefore, the mass of the quantum black holes can only be an integer multiple of Planck mass. The quantum number n inserted in Eq.33 and Eq.34 point to this fact. Also, by comparing the relativity and quantum equations which contain mass, it can be concluded that the massive black holes are derived from quantum black holes. Therefore, it is expected that the behavior of a massive black hole is continuous in macroscopic scales and discrete in quantum scales. $m/t=c^3/G$ and $m/l=c^2/G$ show the inaccessible and ultimate limit of the mass-time and mass-space ratios in nature which can only exist in black holes. In contrast, the two equations of $m.t=h/c^2$ and $m.l=h/c$ show the inaccessible and lowest possible limit of the mass-time and mass-space product too which can only be applied in quantum black holes. Therefore, the relation between mass and space-time in a general form should obey the following unequals.

$$\frac{m}{t} \leq \frac{c^3}{G} \;\; , \;\; m.t \geq \frac{h}{c^2} \quad and \quad \frac{m}{l} \leq \frac{c^2}{G} \;\; , \;\; m.l \geq \frac{h}{c}$$

By combining the above unequals we attain the following unequals:

$$\frac{h}{c^2}\frac{1}{t} \leq m \leq \frac{c^3}{G}t \quad , \quad \frac{h}{c}\frac{1}{l} \leq m \leq \frac{c^2}{G}l$$

The right and left sides of the above unequals are related to the relativity and quantum equations of black holes, respectively. If right values for time and space are inserted in the above two unequals, we will have:

$$\begin{cases} t = 1s & \Rightarrow\ 7.4 \times 10^{-51} \le m \le 4 \times 10^{35} & (correct) \\ t = t_p & \Rightarrow\ 5.45 \times 10^{-8} \le m_p \le 5.45 \times 10^{-8} & (correct) \\ t = 10^{-50}s & \Rightarrow\ 0.74 \le m \le 4 \times 10^{-15} & (incorrect) \end{cases}$$

$$\begin{cases} l = 1m & \Rightarrow\ 2.2 \times 10^{-42} \le m \le 1.3 \times 10^{27} & (correct) \\ l = l_p & \Rightarrow\ 5.45 \times 10^{-8} \le m_p \le 5.45 \times 10^{-8} & (correct) \\ l = 10^{-50}m & \Rightarrow\ 2.2 \times 10^{8} \le m \le 1.3 \times 10^{-23} & (incorrect) \end{cases}$$

It can be concluded from the above calculations that: 1-The least possible length and time in nature is the length and time of Planck. Because, there is no value for the mass corresponding to the length and time less than the Planck length and Planck time. This again proves that the lowest possible of space-time product is hG/c^4. 2-The ultimate limit of the mass of the fundamental particles, i.e. where the quantum equations are governing (*the left side of the unequal*), is equal to Planck mass. This particle is the very quantum black hole. 3-Only when the product of mass-time and mass-space reaches very small values, quantum equations become important.

The equations of time and space relativity related to Eqs.33-34 in quantum scale can be obtained by considering the following two states as before:

The first state; by considering the expansion of the quantum space: In this state, the time for an observer (*e.g. a fundamental particle with the mass of m*) in quantum scales passes for one second of the time of an observer's view in a macroscopic scales is obtained as follows:

$$\Delta t_1 = \frac{1}{1 - \frac{h/c^2}{m.t}}$$

If an observer in macroscopic scales reports the Δt_0 time interval for an event, another observer in quantum scales reports a smaller time interval:

$$\Delta t_1 = \Delta t_0 (1 - \frac{h/c^2}{m.t}) \quad (Eq.40)$$

The second state; without considering the expansion of the quantum space: In this state, the recent two equations are changed as follows:

$$\Delta t_2 = \frac{1}{\sqrt{1 - \left(\frac{h/c^2}{m.t}\right)^2}} \quad , \quad \Delta t_2 = \Delta t_0 \sqrt{1 - \left(\frac{h/c^2}{m.t}\right)^2} \quad (Eq.41)$$

If t in $m.t$=h/c^2 is replaced with Eq.5, $m.l$=h/c is obtained. Therefore, Eq.40 and Eq.41 can be rewritten like the section 3-2 as follows:

$$\Delta t_1 = \Delta t_0 (1 - \frac{h/c}{m.l}) \quad (Eq.42) \quad , \quad \Delta t_2 = \Delta t_0 \sqrt{1 - \left(\frac{h/c}{m.l}\right)^2} \quad (Eq.43)$$

Also, since l=tc should always be applied to all the observers, therefore by the fast passage of time in quantum scales, distance should also expand according to the following equations:

$$\Delta l_1 = \frac{\Delta l_0}{(1 - \frac{h/c}{m.l})} \quad (Eq.44) \quad , \quad \Delta l_2 = \frac{\Delta l_0}{\sqrt{1 - \left(\frac{h/c}{m.l}\right)^2}} \quad (Eq.45)$$

Lorentz factor corresponding to Eq.34 ($\gamma_{m.l}$) can be defined as follows:

$$\gamma_{m.l} = \sqrt{1 - \left(\frac{h/c}{m.l}\right)^2} \quad (Eq.46)$$

Eq.34 along with the above equations is compatible with the two principles of quantum physics referred to the preceding section. The quantum number n in Eq.34 cannot be zero, because the value of $m.l$ cannot be less than h/c. If the value of n can be zero, it means that a quantum black hole can have no mass. Also, in this equation n is a positive integer and cannot take any value, because in this case, this equation will not be satisfactory for the black hole. On the other hand, in a general state, if the mass and radius of a black hole are respectively n Planck mass and n Planck length, then the value of $m.l$ is equal to $n^2 m_p l_p$. In this state, the value of $\beta_{m.l}$ will be equal to $1/n^2$. If this value is inserted in Eq.46, we will have:

$$\gamma_{m.l} = \sqrt{1-(\frac{1}{n^2})^2} \quad (Eq.47)$$

Figure 4 shows the Lorentz factor of mass-space as a function of quantum number n. As the Figure 4 shows, by an increase in the value of n, the value of Lorentz factor approximates one and it means that if the mass of the black hole is more than ten times the Planck mass (n>10), the quantum effects will not be important for the black holes.

Eq.43 expresses that if the half-life of a fundamental particle with a mass of m in macroscopic scales is equal to Δt_0, and when this particle is in quantum scales, e.g. it is trapped in a very small space, its half-life is reduced, since time passes faster for this particle. A result is that an observer (for example a physics researcher) who is in the laboratory measures the half-life of a fundamental particle, for which $m.l$ approximates h/c, more than the real value, because time for this observer passes slower compared with that for the particle. The quick passage of time might be worrying for the fundamental particles, but there should be no worriedness, because these particles can adjust the passage of time for themselves by the use of special relativity and having a kind of an innate motion. If m is replaced with the electron mass in $m.l=h/c$, l is equal to 2.4×10^{-12}meters. That is, the least space in which an electron can move is equal to 2.4×10^{-12}meters. On the other hand, we know that the mass-space product in nature cannot reach its lowest possible limit, i.e. h/c. Therefore, the space in which an electron can exist should be larger than 2.4×10^{-12}meters.

When we say the value of l cannot be less than $2.4\times10^{-12}m$ for an electron, it means that we cannot entrap an electron in a sphere with a radius of $2.4\times10^{-12}m$. If we consider an electron entrapped in a sphere with a radius of $5.3\times10^{-11}m$, the electron cannot be at the center of the sphere, because the value of l will be less than $2.4\times10^{-12}m$. Electron can only move in the space between two spheres. Such a motion can only be a rotational motion. We also showed in section 4-2 that the equations of rotational motion were an approximate result of the universal equations of quantum. On the other hand, the mass of a proton and a neutron is larger than that of an electron, so the proton and neutron can occupy a smaller space (*i.e. atom nucleus*). The more we move down the lower scales, the more mass can occupy the scales and since the least space is the Planck length, therefore the most mass of a fundamental particle can be the Planck mass. Another example is the Neutrino. If the mass of Neutrino is considered to be 10^{-39}kg, the space in which the Neutrino can be entrapped and detected should be larger than 2.2 millimeters. This clarifies why detection of Neutrino is so difficult. Therefore, $m.l=h/c$ shows that for every fundamental particle with mass less than Planck mass whether in the free state or entrapped, space cannot be zero. As a result, the fundamental particles should have a kind of intrinsic motion. A number of scientists have shown that it is possible to create a quantum black hole by the collision of two particles with enough energy [11, 12]. An experiment was also performed for this purpose in LHC (Large Hadron Collider) which was unsuccessful. Regarding this fact, our theory states that velocity and mass of no fundamental particle can reach the velocity of light and mass of Planck, which is the very mass of the black hole. However we construct great accelerators; we cannot perform such a job. It is an innate limit in nature.

Regarding the universal equations of relativity, we showed that the ± sign in these equations were related to time, and that it showed the contraction and expansion of the universe. Now, the question is: what does the ± sign in the universal equations of quantum relating to space quantity refer to? If l is replaced with λ in $m.l=\pm h/c$, we will have an equation which explains the annihilation process of electron and positron into light ($m.\lambda=\pm h/c$). This means that the ± sign in quantum equations precisely show the particle and antiparticle. Once more, this issue shows what fundamental and profound concepts are hidden in the universal equations. The present equation also shows the transformation of mass and space into each other. Also, if c is replaced with v quantity in $m.\lambda=h/c$, de Broglie equation which is an equivalent equation is obtained.

As it was mentioned before, there are at least three documents that confirm the presence of a new relativity in addition to the special and general relativity in quantum scale: the De Broglie equation, teleportation phenomenon, and uncertainty principle. The De Broglie equation states that particles can have undulation motion. Their relativistic and non-relativistic forms are as follows:

$$\lambda=\frac{h}{mv}\ \ (nonrelativistic\ form) \qquad \lambda=\frac{h}{mv}\sqrt{1-({}^{v}/_{c})^2}\ \ (relativistic\ form)$$

The common method for obtaining the De Broglie wavelength of a particle in motion like electron is that the value of the kinetic energy of electron is first inserted in its relativistic form to obtain its velocity. Then, the velocity value, which is always less than light, is inserted in the De Broglie non-relativistic equation to obtain the value of λ [1]. Yet, if the value of an electron velocity approximates the velocity of light, then the relativistic form of De Broglie equation predicts that the value of λ tends to zero. But, experimental observations are only compatible with the De Broglie non-relativistic equation form. Now, the question is why the relativistic form does not provide correct answers? If the De Broglie equation is written in the form of $h=\lambda mv$, we can relate the relativity related to the velocity in addition to another relativity related to $m.\lambda$ (the very $m.l$ replacing l,λ) to this equation. In this case we have:

$$h=\gamma_v\gamma_{m.\lambda}.\lambda mv \quad\Rightarrow \lambda=\frac{1}{\gamma_v\gamma_{m.\lambda}}\frac{h}{mv} \quad or \quad \lambda=\frac{h}{mv}\sqrt{\frac{1-(\frac{v}{c})^2}{1-(\frac{h/c}{m.\lambda})^2}} \quad (Eq.48)$$

If Eq.48 is solved for λ, we reach the same non-relativistic form of De Broglie equation, i.e. $\lambda=h/mv$. Therefore, from the view of our theory, the De Broglie non-relativistic equation is fully relativistic. Now, we can understand why the De Broglie relativistic equation is not correct. When the velocity of a fundamental particle, e.g. electron approximates the velocity of light, the value of λ becomes smaller and smaller and as a result, the value of $m.\lambda$ reaches its lowest limit, i.e. h/c for an electron. On the other hand, nature does not let the value of $m.\lambda$ be equal to h/c. In this situation, the relativity resulting from the product of mass-space opposes to the relativity resulting from the velocity to prevent more reduction of λ. It is concluded that the non-relativistic form of De Broglie equation is always established in any condition. The value of the velocity in $\lambda=h/mv$ equation is always less than the light velocity and as a result the value of $m.\lambda$ is always less than h/c. Therefore, in addition to confirming the presence of a new relativity, the De Broglie equation shows that the product of mass-space never reaches its lowest limit.

If an observer moves at a high velocity, time for him passes slowly. On the other hand, if the observer is placed in a quantum scale, time passes faster. Now, the question is: if an observer moves at a high velocity in a quantum scale (in fact it rotates), how does time pass for this observer and what equation describes it? To answer this question, we should first find the relation between γ_v and $\gamma_{m.l}$. If we look back again at Eq.48, we understand that this relation should be in the form of a product. In this case, the general relation between Δt_0 and Δt will be as follows:

$$\Delta t = \gamma_v \gamma_{m.l} \Delta t_0 \quad or \quad \Delta t = \sqrt{\frac{1-\left(\frac{h/c}{m.l}\right)^2}{1-(v/c)^2}}\, \Delta t_0 \quad (Eq.49)$$

In order equation $l/t=c$ to be satisfactory for an observer, the relation between Δl_0 and Δl should be written as follows:

$$\Delta l = \frac{\Delta l_0}{\gamma_v \gamma_{m.l}} \quad or \quad \Delta l = \sqrt{\frac{1-\beta_v^2}{1-\beta_{m.l}^2}}\, \Delta l_0 \quad (Eq.50)$$

The value of γ_v is always larger or equal to one ($\gamma_v \geq 1$), while the value of $\gamma_{m.l}$ always varies between zero and one ($0<\gamma_{m.l} \leq 1$). In this case, the value of the product of the Lorentz factors of velocity and mass-space ($\gamma_v\gamma_{m.l}$) can obtain any value larger than zero. We can consider three general states for the value of $\gamma_v\gamma_{m.l}$. Additionally, these three states for the value of $\gamma_v\gamma_{m.l}$ can also be demonstrated by the angular momentum (L):

$$\gamma_{m.l}\,\gamma_v = 1 \quad \Rightarrow \quad mlv = \pm h \quad or \quad L = \pm h$$

In fact, angular momentum is a quantity that its value for every particle in rotational motion can directly be related to the manner of the passage of time for that particle in a quantum scale. These three states are:

1- In the first state, the product value of Lorentz factors for velocity and mass-space is larger than one ($\gamma_v\gamma_{m.l}>1$) for the observer. To make it happen, the value of the angular momentum of the observer should be larger than the Planck constant ($L>h$). Time passes slower for such an observer and its length contracts.

2- In the second state, the value of this product is exactly equal to one for the observer ($\gamma_v\gamma_{m.l=}1$). To make this state happen, the value of the angular momentum of the observer should be equal to the Planck constant ($L=h$). The relativity of time return has no effect for such an observer.

3- In the third state, the value of this product is less than one for the observer ($0<\gamma_v\gamma_{m.l}<1$). To make this happen, the value of the angular momentum for the observer should be smaller than the Planck constant ($0<L<h$). Time passes faster for such an observer and distance expands.

The results obtained from the above states can be interesting and amazing. Now, we study the above three states by several examples. In all these examples, the quantity of m and l are fixed for the observer, but their velocity (v) is changing. Yet, we could fix the quantities of m and v and change the distance from the center of rotation (l), but the results would be the same.

Example 1: consider a ball with a mass of 1kg rotating with a velocity of v in a circular path with a radius of 1 meter. To make time pass slowly for this ball and its length contract, the ball should rotate at a velocity more than $6.63\times10^{-30}\,m/s$, because in this situation L will be larger than h. It is clear that the more the value of this velocity is, the larger will be the value of time slowing down and the contraction of the length. If the ball moves at the velocity of light, the value of $\gamma_v\gamma_{m.l}$ will be infinite and time stops for this body. If the ball rotates exactly at $6.63\times10^{-30}\,m/s$, the value of L will be equal to h for it. In this situation, $\gamma_v\gamma_{m.l}=1$ and the effect of relativity disappears. If the ball rotates at a velocity less than $6.63\times10^{-30}\,m/s$, the value of L will be less than h for it. In this situation, time passes faster and the distance of the ball relative to the center of rotation will expand. Since at low velocities the value of γ_v and $\gamma_{m.l}$ is approximately equal to one in each of the three states, the value of slowing down or quick passage of time is extraordinarily negligible and cannot be measured.

Example 2: Consider an electron rotating at a velocity of v on the path of a circle with a radius of $10^{-11}m$. To make time pass slowly for it, the electron should rotate at a velocity more than $7.27\times10^{7}m/s$, since L is larger than h in this situation (i.e. $\gamma_v\gamma_{m.l}>1$). If the velocity of the electron on the circular path is equal to $7.27\times10^{7}m/s$, then the value of Δt_0 will be equal to Δt , because L becomes equal to h and the passage of time is not under the influence of the velocity and quantum scale for the electron. But, if due to any cause the velocity of the electron becomes less than $7.27\times10^{7}m/s$, then the value of the angular momentum will be less than the Planck constant. In this situation, time passes faster for the electron and the distance between the electron and the center of rotation will expand. In this example, the values of $\gamma_v$and $\gamma_{m.l}$ are significantly larger and smaller than one, respectively; therefore, the value of slowing down or quick passage of time is important and measurable.

Example 3: consider an electron rotating at a velocity of v with a radius of $2.4\times10^{-12}m$ on a circular path. Since the value of $m.l$ is equal to h/c for this electron, the value of $\gamma_{m.l}$ becomes zero for this electron and the electron should be destroyed according to Eq.49, because the value of $\gamma_v\gamma_{m.l}$ also becomes zero and time passes exceedingly fast for the electron. But, the electron has no inclination to be destroyed. In this case, the only solution is that the electron rotates at the velocity of light so that the value of γ_v becomes infinite. In such a state, the product of $\gamma_v\gamma_{m.l}$ equal one, and the values of Δt_0 and Δt become equal and the electron does not disappear. On the other hand, we know that not only the electron but also no other particle can reach the velocity of light. As a result, $m.l$ never equals h/c for both the electron and for any other particle. An interesting point in this example is that even if the electron rotates at the velocity of light, time does not stop for it.

Example 4: consider a quantum black hole with a Planck mass. Since the value of $m.l$ for it is equal to h/c, therefore the value of $\gamma_{m.l}$ equals zero. In this situation, the black hole should rotate at the velocity of light so that the value of $\gamma_v\gamma_{m.l}$ equals one and is not destroyed. In fact, the only fundamental particle for which the value of $m.l$ is h/c and rotates at the velocity of light is the quantum black hole with a Planck mass and no other particle can be likewise. For the black holes with the mass greater than the Planck mass, the value of $m.l$ is larger than h/c and there is no longer a need for the particle to rotate at the velocity of light. In fact, the more the mass of a black hole, the slower it can rotate. Yet, attention should be paid to the fact that a black hole cannot be without an angular momentum, because the value of L cannot be zero. According to Eq.21, time is stopped at the surface of all the black holes except the quantum black hole with a Planck mass.

A surprising example for the third state, i.e. for the state when time passes quickly and distance expands is the phenomenon of teleportation [13, 14]. For this phenomenon to take place for particles such as photons, electrons, etc. these particles should first be in a state of physical interactions with each other (this state is called quantum entanglement) and then separate from each other. In this case, if we change the quantum specifications of one of these particles, the change of the quantum specifications of other particles – regardless of the distance among these particles – takes place instantaneously [14]. The recent experiments show that the transfer of information among these correlated particles takes place at least at a velocity ten thousand times faster than light. If we want to explain this phenomenon by Eq.49 and Eq.50, we should say that if we bring two rotating particles close together to some extent that the value of $m.l$ for these particles approximates *h/c* and the value of $\gamma_v\gamma_{m.l}$ becomes less than one, therefore time for these two particles passes faster and the distance between them expands. The expansion of the distance means that if we separate these two particles from each other up to the distance extracted from Eq.50, it is similar to the state that these two particles were at the previous distance from each other. Therefore, the change of one feature in the particle immediately affects another particle, even if these two particles are at a great distance from our view. From the view of our theory: 1- For the teleportation to take place, first the quantum entanglement should take place, because it is only in this state that the value of $\gamma_{m.l}$ is very small. In contrast, the value of γ_v should also approximate one so that their product is sufficiently smaller than one. As a result, in order for the quantum entanglement to take place, the value of l and v should be reduced for both of the particles. In this case, the expansion of distance and the quick passage of time can take place. For example, if we entrap two electrons in the $10^{-11}m$ space and by exercising force making the electrons rotate at a velocity less than $7.27\times10^7 m/s$, the phenomenon of teleportation occurs. 2- The transfer of information among the entangled particles does not breach the light velocity, but since time passes slower for us relative to these particles, we report the velocity of this transfer more than that of light. 3- The phenomenon of teleportation can only take place for particles that can occupy a space where the value of the product of this space times their mass approximates *h/c*. As a result, this phenomenon cannot be significant for man.

As we showed, it is possible to show all the equations extracted from the combination of equations *x/y* and *x.y* by the velocity quantity (v), force (F), and angular momentum (L); where x and y are the quantities of m, l and t. If velocity and force are the base of relativity, then on the basis of symmetry, the angular momentum should also be the base of a new relativity. We somewhat explained in the above discussion that what results the relativity related to the angular momentum can bring about. In section 4-2, we showed that if Eq.5 and Eq.34 are inserted in the general form of the equation of the angular momentum, the following relation is obtained:

$$L = (m.l)\left(\frac{l}{t}\right) \;\Rightarrow\; L = \left(\pm n\frac{h}{c}\right)(+c) \;\Rightarrow\; L = \pm nh$$

In the above equation, we only consider the positive sign of Eq.5, because the quantum equations are only present at the stage of the universe expansion. The above equation embraces some important points: 1- The ± sign shows that the angular momentum can be clockwise or anticlockwise. 2- The phenomenon corresponding to this equation is the quantum black hole with a Planck mass. That is because the values of l and m inserted in the above equation are the very radius and mass of a black hole with the Planck mass. Also, the value of c shows that this black hole rotates around itself at the velocity of light. 3- The value of $m.l$ in nature cannot be zero for any particle; therefore, the angular momentum cannot be zero. If the angular momentum is not zero, the velocity cannot be zero either. Therefore, all fundamental particles enjoy a kind of innate motion on which an innate angular momentum depends. 4- The value of L can be smaller, equal, or larger than h. If the value of L for a particle becomes smaller than h, it means that the particle is on the verge of annihilation. On the other hand, no particle tends to being annihilated. As a result, the particle rotates faster to make the value of L larger than h by an increase in its velocity to run away from annihilation. Therefore, all the fundamental particles rotate at such a velocity that the value of L at least equals h for them.

The relativistic equation of the angular momentum could be written as follows:

$$L = \gamma_{m.l}\,\gamma_v(m.l)\left(\frac{l}{t}\right) \;\Rightarrow\; L = \sqrt{\frac{1-\left(\frac{h/c}{m.l}\right)^2}{1-(v/c)^2}}\;mv\times r$$

In the above equation, $\gamma_{l/t}$ and $\gamma_{m.l}$ act in contrast to each other and make L quantity not be equal to zero. The comparison of the relativity resulting from velocity and force with the relativity resulting from angular momentum can be interesting. When the value of velocity and force approximate their ultimate limit, the quantities of time, length, and mass are influenced and the phenomena such as time dilation, length contraction, and mass increase take place. In contrast, when the value of the angular momentum approximates the Planck constant, the quantity of the angular velocity is influenced making the particle rotate faster. Also, although the quantities of time, length, and mass in special and general relativity can tend to infinity or zero, the angular velocity cannot be infinite or zero, because as it is observed in the above equation, γ_v and $\gamma_{m.l}$ act in opposite directions. We know that the value of velocity and force cannot be greater than c and c^4/G; otherwise, time regresses in sequence and mass become negative. In contrast, the value of the angular momentum for a particle, in spite of the innate tendency of the particle proper, can be less than the Planck constant and in this situation time passes faster and the particle is exposed to annihilation. An experimental example is the phenomenon of teleportation for this state. Ultimately, we should also point to this important point that the relativity of force and the relativity resulting from the angular momentum are only important and significant in cosmological scale and in quantum scale, respectively, but the relativity resulting from velocity is important for all the scales.

The third document for the existence of the new relativity in quantum scales is the principle of uncertainty. If in the $m.t \geq h/c^2$ quantum unequal, $E=mc^2$ equation replaces mass, the equation showing the principle of uncertainty in quantum scale is extracted:

$$\Delta m.\Delta t \geq \frac{h}{c^2} \quad \overset{E=mc^2}{\Longleftrightarrow} \quad \Delta E.\Delta t \geq h$$

As a conclusion, we can relate a new interpretation to this equation in addition to the prevailing interpretations of the equation of the uncertainty principle as follows: The uncertainty principle indirectly reveals that quantum universal equations represent the lowest possible limit for the product of the base quantities.

If Eq.43 is divided by Eq.42 and the obtained equation is rewritten by inserting $f=1/\Delta t$ in it, we will have the following equation:

$$\frac{f_1}{f_2} = \sqrt{\frac{1+\beta_{m.l}}{1-\beta_{m.l}}} \quad , \qquad \beta_{m.l} = \frac{h/c}{m.l} \quad (Eq.51)$$

In the first instant of the universe, the value of $\beta_{m.l}$ is equal to one and by the passage of time its value is reduced, reducing the value of f_1/f_2 as well. Therefore, the above equation shows the expansion of quantum space. In fact, mass should be transformed into space so that the quantum space expands. Figure 5 shows that the expansion of the quantum space is exponentially reduced with time; therefore, the rate of mass reduction should also be exponentially reduced. We do not know exactly how the values of m and l change with time, but we can select a quantum black hole with a Planck mass as a standard and qualitatively study its behavior with time. Figure 5 shows the changes of the value of $\beta_{m.l}$ with time for this black hole. If we interpret $m.l$ as the transformation of mass and quantum space into each other, we can explain this figure. The more the value of $\beta_{m.l}$ approximates one, the more will be the transformation of mass into quantum space. Figure 5 shows that at the initial instants of the universe, the value of $\beta_{m.l}$ is close to one and the mass of the black hole is transformed into space at a very high rate, but by the passage of time, this rate is reduced exponentially. The general conclusion is that the mass of a quantum black hole is reduced exponentially at the initial instants of the universe, but this reduction in mass continues at a very slow rate. When the mass of a black hole is less than its Planck mass, it is not a black hole anymore, it is considered as a fundamental particle. Therefore, in order that the quantum space continues its expansion at a very slow rate, the mass of the fundamental particles should be reduced correspondingly. In section 6, we will discuss it in more detail and show that the mass reduction of the quantum black holes is inevitable for the creation of the fundamental particles.

Also the plus sign in Eq.33 shows that the quantum world and its equations play a role only at the stage of the universe expansion.

5. Universal Equations containing Temperature and Charge

So far, we only studied the universal equations obtained by the combination of m, l, and t quantities, but now we want to study the universal equations consisting of the quantities of temperature and charge. By the same methods, we extracted the universal equations so far, the relativity equations of temperature-space and temperature-time will be as follows:

$$\frac{T}{l}=\frac{c^4}{G.k_B} \quad (Eq.52) \qquad , \qquad \frac{T}{t}=\pm\frac{c^5}{G.k_B} \quad (Eq.53)$$

Also, the quantum equations of temperature-space and temperature-time will be as follows:

$$T.l=\pm\frac{hc}{k_B} \quad (Eq.54) \qquad , \qquad T.t=\frac{h}{k_B} \quad (Eq.55)$$

Eq.52 and Eq.53 do not denote physical meaning, but they are only equations extracted from other universal equations. In contrast, equation 54 and 55 denote physical concept and are correct. This is because temperature like charge and mass is not an additive quantity. Consider two balls with the mass of m, charge of $+q$, and temperature of T. If these two balls are combined, we will have a bigger ball with a mass of $2m$, charge of $+2q$, but its temperature will be the same T. The only correct equations for temperature are the quantum equations, i.e. Eqs.54-55. This shows that temperature is a quantity resulting from quantum scales and this temperature originating from the quantum scales will be the very macroscopic scales too. If the minimum value of length in nature i.e. the Planck length replaces l in Eq.54, the maximum temperature value in nature, which is the very Planck temperature, is obtained:

$$T_p=\sqrt{\frac{hc^5}{Gk_B}}=3.55\times10^{32}\ k$$

The corresponding phenomenon to Eq.54 and Eq.55 is the only the quantum black hole with the Planck mass; therefore, the temperature of this black hole should be the Planck temperature. On the other hand, as it was shown before, all the black holes are composed of the quantum black hole with the Planck mass; therefore, the temperature of all the black holes is equal to that of the Planck temperature and we can never reach this temperature. In the next section, we show that in the instant of the beginning of the universe expansion, there should have been black holes; therefore, the temperature of the universe in the beginning of the expansion should have been equal to that of the Planck temperature. If the quantum space expands (in Eq.54 the value of l increases), inevitably the temperature should also be reduced accordingly. Therefore, the temperature of the universe should reduce in the initial instant of the universe exponentially, reducing at a very slower rate. Measurements show that the temperature of the universe has reduced from the Planck temperature by the present value of 2.7K [15]. Also, if l is replaced with λ in $T.l=hc/k_B$, the Wien displacement law is obtained.

We can also extract the universal equations including charge quantity. In this case, the relativity equations of charge-space and charge-time are as follows:

$$\frac{q}{l} = \pm c^2 \sqrt{\frac{4\pi\varepsilon_0}{G}} \quad (Eq.56) \quad , \quad \frac{q}{t} = \pm c^3 \sqrt{\frac{4\pi\varepsilon_0}{G}} \quad (Eq.57)$$

Also, the quantum equations of charge-space and charge-time will be as follows:

$$q.l = \pm \frac{h}{c}\sqrt{G.4\pi\varepsilon_0} \quad (Eq.58) \quad , \quad q.t = \pm \frac{h}{c^2}\sqrt{G.4\pi\varepsilon_0} \quad (Eq.59)$$

In all universal equations including charge, there is the sign ±. This difference arises from the fact that, although there is only one kind of mass and temperature, there are two kinds of charge. Eq.56 and Eq.57 have physical meanings and are correct, but the quantum equations of 58 and 59 have no physical concept and are extracted from other universal equations. This is because although temperature and mass in quantum scales can assume any value, the charge quantity is not so and can only be an integer multiple of the fundamental charge *e* (e=1.6×10^{-19} C). If the Planck length replaces *l* in Eq.56, the value of *q* obtained is equal to the Planck charge:

$$q_p = \sqrt{4\pi\epsilon_0 hc} = 4.7 \times 10^{-18}\ C$$

This means that if a black hole with the Planck mass were to have charge, its value would be equal to the Planck charge. As a result, the charge of no fundamental particle can be equal to the Planck charge. On the other hand, all the black holes are composed of quantum black holes; therefore, the total charge of one heavy black hole is obtained from the sum of the single charges of the quantum black holes. A quantum black hole can have a negative or positive charge. In this case, the total charge of a heavy black hole can be positive, negative, or without charge. Yet, the sum of the total positive and negative charges in the universe should precisely be zero. A question that arises is why the fundamental charge is smaller than the Planck charge? An answer can be that according to our theory, the mass of the fundamental particles and the temperature of the universe are reducing, therefore the value of the charge might also be reducing. In fact, if all the fundamental particles are to be an integer multiple of a fundamental charge of *e*, this charge should be smaller than the Planck charge, because charge of a particle never reaches the Planck charge. We showed in section 3-4 that equation $m/l= c^2/G$ was the base of the law of gravitation. Here we can show that Eq.56 is the base of Coulomb's Law.

$$\frac{q}{l} = \pm c^2 \sqrt{\frac{4\pi\varepsilon_0}{G}} \Rightarrow \frac{q^2}{l^2} = \frac{4\pi\varepsilon_0 . c^4}{G} \xrightarrow{F=\frac{c^4}{G}} F = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{l^2} \ or \ F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

Another form of Coulomb's Law can be extracted from Eq.57 as above showing that the velocity of the electric field in vacuum is equal to that of light. Another question is that whether temperature and charge can affect the passage of time. Apparently, such a phenomenon cannot take place. One reason can be the fact that the relativity and quantum equations are not applied to temperature and charge, respectively. This very fact which seems simple has brought about basic differences. For example, if the relativity equations 52 and 53 were correct for the temperature in nature, then: 1- Temperature could have any value larger than the Planck temperature. 2- We could write an equation similar to the law of gravitation and Coulomb's Law for temperature. In this situation, two bodies with the temperatures of T_1 and T_2 could act force on each other. 3- Temperature could influence the passage of time. Also, if the quantum equations 58 and 59 were correct for the charge in nature, then: 1- Charge in quantum scales was not quantized and could have any value. 2- Charge could influence the passage of time. With regard to the above results, now we can predict that if equations $m/l=c^2/G$ and $m.l=h/c$ are not correct for an imaginary world, then how would be that world? If equation $m.l=h/c$ is not correct, then mass is quantized and as a result the mass of all bodies is an integer multiple of a fundamental mass smaller than the Planck mass. In this situation, the mass of the electron and proton will be equalized. In contrast, if equation $m/l=c^2/G$ were not correct, then a body could not have a mass higher than the Planck mass and only the fundamental particles could exist. In this situation, the relativity of force and the law of gravitation would lose their importance. It is possible to related four energy equations to the quantities of temperature and charge and only the two equations of relativity can be correct. These equations are studied at the end of the paper.

$$E = k_B T \quad , \quad E = \pm \frac{c^2}{\sqrt{4\pi\varepsilon_0 . G}} q \quad (Relativity) \qquad E = \pm n \frac{hc^5}{Gk_B} \frac{1}{T} \quad , \quad E = \pm nhc^3 \sqrt{\frac{4\pi\varepsilon_0}{G} \frac{1}{q}} \quad (Quantum)$$

So far, we have extracted and studied fourteen equations of the twenty universal equations. The six remaining equations show the fundamental relations among the three base quantities including mass, temperature, and charge; so that three equations are related to the universal equations of relativity and three other equations are related to the universal equation of quantum:

$$\frac{T}{m} = \frac{c^2}{k_B} \quad , \quad \frac{m}{q} = \pm \frac{1}{\sqrt{4\pi\varepsilon_0 . G}} \quad , \quad \frac{T}{q} = \pm \frac{c^2}{k_B} \frac{1}{\sqrt{G . 4\pi\varepsilon_0}} \qquad (Relativity\ equations)$$

$$m.T = \pm \frac{hc^3}{Gk_B} \quad , \quad m.q = \pm hc \sqrt{\frac{4\pi\varepsilon_0}{G}} \quad , \quad T.q = \pm \frac{hc^3}{k_B} \sqrt{\frac{4\pi\varepsilon_0}{G}} \qquad (Quantum\ equations)$$

The above equations are equations that are merely obtained from other universal equations. They can have either physical meaning or not.

6. Birth of the Universe

The Big Bang theory is the prevailing cosmological model that describes the early development of the Universe. The most important observational evidence that strongly confirms this theory is the abundance of primordial elements, cosmic microwave background radiation, and universe expansion. There are generally considered to be three outstanding problems with the Big Bang theory: the horizon problem, the flatness problem, and the magnetic monopole problem. The most common answer to these problems is the inflationary theory; however, this creates new problems. According to the Big Bang theory, the whole universe was smaller than a proton (*approximately equal to the Planck length*) at $t \approx 10^{-43} s$ (*Planck time*) with a temperature of $\approx 10^{32}$ Kelvin (*Planck temperature*). Due to the expansion of this extreme dense and hot state, the world we see today was formed. Now, two important questions are raised: 1- How was this hot state created? 2- According to Eq.7, the maximum mass that can be included in this state equals to the Planck mass. In this situation, how was the huge mass of the universe which is so much greater than the Planck mass created? Although the theory of the Big Bang is in the right path in principle, it cannot answer to these questions. Therefore, this theory is defective and expresses only a part of the universe creation event.

The important results which we have obtained about the universe are: 1-The creation of the universe consists of two stages of contraction and expansion. 2-The universal relativity equations are present at the two stages of contraction and expansion of the universe, but quantum universal equations play a role only in the universe expansion. Since the term “space” can have different meanings, we should first differentiate among the three types of space: 1- **relativity space**: This space is continuous and the equation related to it is $E=l.c^4/G$. This equation shows that the relativity space carries a lot of energy. The only property of this space is that when this space is shrunk it is transformed into black hole with mass of m. In addition, this space is responsible for the accelerating expansion of the universe and the dark energy [3]. 2- **Quantum space**: it is the space of our universe that we know and it can encompass matter, antimatter and light. This space is discrete and the equation related to it is $E=\pm hc/l$. We already showed that the ± sign in this equation shows particle and antiparticle; therefore, this equation shows that the quantum space can transform into particle and antiparticle. This issue is completely compatible with the idea of quantum mechanics that space at the scale of Planck is not empty and particle and antiparticle are continuously transforming into each other. The quantum space is responsible for inflation (exponential expansion of space) and some other physical phenomena like the Casimir effect [16]. 3- **Empty space**: This space is truly empty.

We showed in section 3-2 that matter (mass) should be transformed into relativity space through the black hole so that the universe expands. On the other hand, the quantum space also includes matter. Therefore, these two spaces should be related to each other through the black hole. In fact, the relativity space and quantum space can only be transformed into each other through the black hole. This is a key guide for juxtaposing the phenomena related to the universe. Now it is time to juxtapose all the findings, like the pieces of a puzzle, related to the universe obtained from the study of the universal equations to obtain a theory on the creation of the universe. Yet, it should be noted that this theory describes the general evolution of the universe and cannot present information concerning its details, especially about the fundamental particles and the weak and strong forces. We first present this theory briefly to have a bird's-eye view of it and then we explain it in more details. This theory is as follows:

The relativity space is cut off and starts shrinking. This shrinking continues until it ultimately creates a very great black hole without an edge and a boundary. Shrinkages of space in the center of the black hole starts opening and makes the black hole rotate severely. This rotational motion makes this great black hole throw light and quantum black holes into the empty space at the velocity of light. This is the instant that the quantum world is born. The universe seems foggy and looks like smoke at this instant. The quantum black holes with the Planck mass immediately reduce their mass exponentially and by creating a quantum space, are transformed into the fundamental particles. The quantum space consisting of light and fundamental particles is placed on the opened relativity space. The value of the quantum space increases in negative exponential manner and by its expansion, it reduces the temperature of the universe. In order that the quantum space continues its expansion, the mass of the fundamental particles should be reduced at a very slow rate. By the cooling of the universe, the fundamental particles form the atoms and under the influence of gravity, they start to amass and form larger bodies. By the brightening of the universe, the light emitted from the great black hole can travel longer distances and create the cosmic microwave background radiation. While the black holes with the Planck mass are immediately destroyed, the greater quantum black holes can be stable, and by absorbing light and matter become bigger acting as seeds for the formation of the galaxies. On the other hand, by swallowing light, matter, and quantum space, the black holes transform them into the relativity space and make the universe expand. In the beginning of the expansion of the universe, due to the presence of large quantities of mass, the strong gravitational force prevents the swallowing of a large quantity of matter, light, and quantum space by the black holes, causes the expansion of the universe to slow down, and makes the receding velocity of the galaxies reach $0.7c$ from the velocities close to that of light. By the passage of time and by a reduction in the value of matter and gravitational force, more quantum space is entrapped in the black holes and the expansion of the universe accelerates. This expansion continues up to the point that the receding velocity of the galaxies equals the velocity of light. In this situation, all the matter, light, and quantum space (all the mass, temperature, and charge of the universe) are transformed into the relativity space through the black hole and by the disappearing of the quantum universe, time is stopped and the life of universe ends.

The first stage in the creation of the universe should be the splitting of the relativity space and creation of an empty space. This is clear that our universe should have been made of something. The universal equations of relativity show that this "something" should be the relativity space. It cannot be the quantum space, because we already showed that the quantum universe and its equations do not exist at the stage of the contraction of the universe. There should be a relativity space before the creation of the universe. On the other hand, since the relativity space is continuous; therefore, it should first be cut off. At the moment of the cut off, this space starts to shrink and create the mass (space transforms into mass). Since at the contraction stage of the universe, only the relativity universal equations play a role, therefore the value of the mass created from the shrinking of the relativity space should obey Eq.7, i.e. $m/l=c^2/G$. On the other hand, since this equation describes the features of the black hole, therefore black hole should be formed due to the shrinking of the space. As a result, at the contraction stage of the universe there is only black hole (black hole universe). The relativity space can only be transformed into the black hole. More precisely, black holes are the ultimate limit of shrinkage or bending of the relativity space. The only quantity that can be related to this shrinking universe is the quantity of mass, because the meanings of the quantities of length, time, temperature and charge we know belong to the quantum universe where space is discrete. On the other hand, where there is mass, there is also gravitational force.

According to Eq.7, the value of the mass created resulting from the transformation of a small amount of space is very great and this makes the strong gravitational force. This force contributes to the shrinking of the space and causes the contraction of the universe to continue. The great amount of mass shrinks the space around itself causing the black hole to form a closed surface without any boundary and edge. Scientists are trying to unify the gravitational force with three other fundamental forces in nature, which are basically important in quantum scale (including electromagnetic, weak and strong forces) in a single force. However, gravitation is extremely against this unification. One interesting point that our theory shows is that gravitation exists in a universe where no quantum exists there. This can explain why gravitation cannot be unified. The initial speed of the space contraction should be very great, but by more shrinking of space, restoring torque is created preventing more contraction of space leading to the reduction of shrinking speed. At the end of the contraction stage, space is shrunk up to its ultimate limit and yet, the force torque reaches its maximum value. At this instant, the universe consists of one super black hole encircled by an empty space. Due to the too much torque force, the shrinkage and bending of space starts opening from the center of this black hole, because it is only at the center of the black hole that the resultant of the gravitational forces is zero making this black hole rotate vigorously. As the shrinks of relativity space are smoothing out, a great value of quantum black holes and light are thrown out (or irradiated) from the black hole into the empty space due to this fast and intense rotational motion.

This is the instant that the quantum universe is born. One question is how light and the quantum black holes can escape the huge gravitational force of the black hole? One answer is that some scientists believe that since the average density of a black hole is directly related to the inverse square of its mass, therefore the density of the supermassive black holes can be even compared with the density of water [17]. As a result, the tidal force of a supermassive black hole at it surface can be weak and permits light and quantum black holes escape from it. Another answer can be the quantum tunneling. Another question is that why does the great black hole only radiate light and the quantum black holes? By the radiation of the great black hole, the continuous relativity space becomes discrete and creates the quantum universe. Therefore, the quantum universe results from the pure-relativity universe. At this instant, the quantities take some values, which are both satisfied in relativity and quantum equations. As it was shown before, these values are the very Planck units. On the other hand, we showed that the phenomena corresponding to the Planck units are light, and quantum black holes; therefore, the great black hole can only radiate light and quantum black holes. At the instant of radiation, the value of time and temperature is exactly equal to the Planck time and Planck temperature. It is from this instant on that the concepts of time, length, temperature, and charge assume the present meanings to themselves and the physics laws, as we know them become applicable. Time at the contraction stage of the universe is imaginary and the concept we know of time now was only created at the expansion stage of the universe. Since the quantum world begins from Planck time, the time loses its meaning before the Planck time. We had already shown that the least possible time in nature is the Planck time. This fact can also explain a contradiction. According to the explanations presented for equation $m/l=c^2/G$, the quantity of l can also be the value of the relativity space transformed into a black hole due to shrinkage and can also be its radius, while such a thing is not possible. For example, if one meter of the relativity space is transformed into the black hole, the mass of the black hole will be equal to $1.3\times10^{27}kg$ with a radius of one meter. The response to this contradiction is that the transformation of space into a black hole takes place only at the contraction stage of the universe and in this situation; the quantity of l loses it meaning. Therefore, we cannot understand the meaning of the expression of "one meter of the relativity space." In this situation, the quantum number n in universal quantum equations shows the number of quantum black holes. Since we do not know the value of n, we therefore cannot estimate the value of the mass of the whole universe.

The quantum black holes with the Planck mass rotating at the velocity of light, immediately lose their mass and by the creation of a quantum space, they are transformed into the fundamental particles. When the mass of the black hole becomes less than the Planck mass, there is no longer a black hole, but a fundamental particle. Our theory cannot explain what mechanism the quantum black holes are exactly transformed into the fundamental particles, but it can only show how their mass should be reduced. In fact, the very early Universe is a poorly-understood epoch, from the viewpoint of fundamental physics.

The quantum space is placed on the opened relativity space and encompasses light and the fundamental particles. In the initial instants of the universe, the quantum space is exponentially expanded and by its expansion, it reduces the temperature of the universe. In addition, this expansion prevents the re-collapse of the radiated black holes into the great black hole. By the cooling of the universe, the fundamental particles form the atoms and due to the influence of gravitation, they start to accumulate and create super bodies like the stars. When the atoms are formed, the universe leaves the smoky state and becomes transparent. In this situation, the light radiated from the great black hole can travel longer distances and create the cosmic microwave background radiation. The presence of the cosmic microwave background radiation discovered in 1965 by accident is the experimental evidence confirming our theory [10]. The cosmic microwave background radiation observed today is the most perfect black body radiation ever observed in nature, with a temperature of about 2.7K. On the one hand, it is believed that the black hole radiates as a perfect blackbody [18]. On the other hand, in our theory the light forming the cosmic microwave background radiation originates from the radiation of the great black hole in the initial instants of the expansion of the universe. As a result, the discovery that the cosmic microwave background radiation is the radiation of a perfect blackbody is another corroborator for the experimental evidence confirming our theory [19].

While the quantum black holes with the Planck mass are being destroyed quickly, the larger quantum black holes can remain stable and by absorbing light, matter, and neighboring black holes get larger and act as seeds for the formation of the galaxies. The larger black holes remain for a longer duration so two states can take place for them: 1- If there is no matter around these black holes, they will also fade away gradually and create more particles. 2- These black holes can grow fast by swallowing matter and neighboring black holes. In the initial moments of the universe expansion, there is a very large amount of matter, light, and black holes, therefore it is likely that some larger black holes transform into a supermassive black holes by absorbing matter and merging with other black holes. These supermassive black holes can create galaxies by their strong gravity. At least there are three pieces of experimental evidence compatible with our theory on the formation of galaxies. 1- It is widely accepted that there is a supermassive black hole in the center of all galaxies [7]. Our theory also states that the black holes are instrumental in the formation of the galaxies, then it is evident that there is a super black hole in their center. 2- Observations reveal that quasars with their mass billions time the mass of the sun (the very supermassive black holes) are present in the time when the universe is very young. This observation is compatible with our observations, while the Big Bang theory cannot present an explanation for it. 3- In our theory, the prerequisite for the formation of the galaxies is that the quantum black holes radiated from great black hole should be an integer multiple of the Planck mass, i.e. they should be able to have masses larger than the Plank mass. If so, the difference in the density of the quantum black holes at the initial instants of the universe should have left its effect in the form of the quantum fluctuation in the cosmic microwave background radiation (CMB). Precise measurements of CMB show tiny temperature fluctuations that correspond to regions of slightly different densities, representing the seeds of all future structures [20].

After the exponential expansion of quantum space named inflation, the quantum space expansion in quantum scales continues at a very slow rate; for this purpose, proportional with this expansion, the mass of the fundamental particles and the temperature of the universe should be reduced by the passage of time. By the analysis of the cosmic microwave background radiation, it is accepted that the temperature of the universe has reached the 2.7K from the Planck temperature. Yet, no theory in physics predicts the reduction of the mass of the fundamental particles and it might appear unrealistic. Figure 5 shows that the reduction in the mass of the fundamental particles is only significant at the initial instants of the universe and now, this reduction is continuing at an extraordinary rate and it will also be slower by the passage of time. Probably, the present measuring devices are not able to measure such a mass reduction and therefore, if we want to find confirming evidence for it, we have to study the initial instants of the universe. However, there are some pieces of indirect evidence, which are: 1- Massive magnetic monopoles: the theory of GUT predicts that the massive magnetic monopoles generated due to the Big Bang should have been existed until now, but such particles have not yet been observed. From the view of our theory, the magnetic monopoles are extinct and their mass is reduced. 2- The exact and absolute value of mass of the fundamental particles has not yet been obtained. 3- None of the physics theories can predict the charge and mass of the fundamental particles. In fact, we can predict the mass and charge of a quantum black hole, but not we and no other theory can predict the charge and mass of an electron or a proton. This can be due to the fact that they are changing. By the exponential expansion of quantum space, the mass of the quantum black holes is reduced to create fundamental particles, then to continue the expansion and reduction of the universe temperature, there is no way unless the mass of the fundamental particles is also reduced.

Now, we want to study the behavior of the cosmos in cosmological scales. In the beginning of the expansion of the universe, the opening of the relativity space in the center of the super black holes affects the expansion of the whole universe, but in continuation while the galaxies are forming, the super black holes are placed on the relativity space and by swallowing light, matter, and quantum space, transform them into the relativity space expanding the universe. In simple language, black hole is a place where quantum space is transformed into relativity space.

One of the greatest secrets of physics is what inside a black hole is and what the fate of matter inside the black hole will be ultimately. Now, we have the answer to these questions. A black hole, like a sewing machine, sews the quantum discrete space including light and matter and transforms it into the relativity continuous space. If the universe is analogized to a balloon, in this case the quantum space includes matter and light along with the galaxies on the surface of the balloon. If crumpled nodes are created on the surface of the balloon, these are the black holes. The quantum space is added to these nodes and makes them larger. On the other hand, by the opening of the crumpled nodes, the surface of the balloon is increased and the galaxies recede from each other. The concept of entropy which is attributed to the black holes, in fact, shows the irreversible transformation of quantum space to relativity space in the black holes. In the initial moments of the expansion of the universe, the large amount of matter and the gravitational force among them causes the black holes to swallow less matter. This slows down the expansion of the universe and the velocity of the receding galaxies reaches $0.7c$ from the velocities close to the light velocity, as shown by Figure 1. By the passage of time and thinning of matter, the black holes can easily overcome the gravitational force and swallow more matter and so causes the expansion of the universe to accelerate. Therefore, the dark energy is in fact that value of light, matter and quantum space transformed into relativity space and is out of our reach. The accelerating expansion of the universe continues up to the point where the receding velocity of the galaxies is equal to the velocity of light. In this situation, all the matter, light, and quantum space (all the mass, temperature, and charge of the universe) are transformed into the relativity space through the black hole and by the disappearance of the quantum world, time stops and the life of the universe ends.

Two other problems resulting from the Big Bang theory are the problems of flatness and horizon. These two problems are created because the theory of Big Bang states that the size of the whole universe is approximately the size of the Planck length in the Planck time. In contrast, our theory states that the universe at the Planck time is consisting of opened relativity space, light and the large number of quantum black holes. Therefore, these two problems are completely solved by our theory. In addition, this impression might arise that the inflation in our theory is the very inflation model in the Big Bang theory. Here, attention should be paid to this important point that in the Big Bang theory, the exponential expansion of space takes place for the whole universe, but in our theory, this expansion takes place in quantum scales. Our cosmological model not only explains the observational evidence confirming the Big Bang theory, but also its problems.

We end this section with this question that whether space starts shrinking after the end of the universe expansion or not? To answer this question, we should study the splitting of the relativity space. If the quantum universe existed at the stage of the contraction of the universe, we could then relate likelihood however small, to the instantaneous splitting of space. Nevertheless, we know that the quantum universe and its effects do not exist at the contraction stage of the universe. Therefore, the only thing is to accept that something or someone has split the space on purpose; in this case, the restart of the contraction depends on it.

7. A Closer Look at Universal Equations

Apart from the two base quantities of the luminous intensity and the amount of the substance, which have little application in equations, we can write all the physics equations in terms of other five base quantities. These five quantities are space, time, mass, temperature, and charge shown in Figure 6. On the other hand, these quantities can be related to each other through five base constants of physics (Figure 6). Each of these constants can be associated with at least one fundamental physical theory: c with electromagnetism and special relativity, G with general relativity and Newtonian gravity, h with quantum mechanics, ε_0 with electrostatics, and k_B with statistical mechanics and thermodynamics.

It can be understood from the model of the universe we presented in the previous section that the value of the base quantities in the universe is changing with time and only these are the basic constants of physics that are really constant and their value does not change with time. More precisely, the fundamental constants of physics in the universal equations act as the conversion factor for the change of the base quantities. Therefore, only the value of these five constants and any other constant, which is a combination of these constants, does not change with time. A question might arise for the reader that if these universal equations are so important, then why don't all of them and quantities like $l.t$ exist in physics? One reason can be that some of these equations like Eq.52 and Eq.58 can have no physical meaning. However, the main reason is that we can obtain fifteen equations of the twenty universal equations only from five other equations; these five equations are:

$$\frac{l}{t} = \pm c \quad , \quad \frac{m}{l} = \frac{c^2}{G} \quad , \quad m.l = \pm n\frac{h}{c} \quad , \quad T.l = \pm n\frac{hc}{k_B} \quad , \quad \frac{q}{l} = \pm c^2\sqrt{\frac{4\pi\varepsilon_0}{G}}$$

Each of the above equations can at least lead to one important law in physics (Figure 6). One interesting point is that in these equations the quantity of space (l) is shared. One inference is that we relate the quantities of time, mass, temperature, and charge to space to better understand its nature and behavior and in fact, these quantities show different aspects of space, because as we showed, our universe is made up of space. In addition, these equations show that quantities are related to each other through space. One simple example can show these relations. If a body has the nonzero temperature, it can radiate light (space) according to $T.l=hc/k_B$, and light also can produce particle-antiparticle pair (mass and charge) according to $m.l=h/c$.

One secret in physics is how light behaves in a continuous and wave-like manner in macroscopic scales, but its behavior is in the form of particle and discrete in quantum scales. Universal equations show that although light is not the very relativity space or quantum space, simultaneously it has some of the specifications of the two spaces. In fact, light can be considered as the pieces of the quantum space that by being placed in tandem has generated a virtual relativity space. This issue has made light have a dual behavior, for example: 1- Special relativity generated due to the special specifications of light is important both in the macroscopic and in quantum scales. 2- Light can be swallowed by the black hole and be transformed into the relativity space or like the quantum space into particle and antiparticle. 3- It is possible to determine the rate of the expansion of the relativity space by measuring the red-shift of the light of the distant galaxies and by measuring the wavelength of cosmic microwave radiation background determine the rate of the quantum space expansion. 4- It is possible to replace the space quantity (l) with the wavelength (λ) both in the universal equation of relativity and in the universal equations of quantum, wherever it is necessary. 5- The constant c is not exclusively about light; instead it is the highest possible speed for any physical interaction in nature Based on symmetry, the quantum black holes should also show a dual behavior like light, i.e. wave and particle behavior. We showed in our model that the fundamental particles were generated from the quantum black holes; therefore, it is not surprising that the fundamental particles have both a wavy and particle behavior.

In addition to the twenty universal equations, we also established ten other equations between the five base quantities and the energy quantity. We also showed that if we equalize these energy equations, the universal equations are extracted. Yet, only six equations of these ten equations are sufficient to extract all the universal equations. These six equations are:

$$E = \frac{c^4}{G} l \ , \ E = \pm n \frac{hc}{l} \ , \ E = n \frac{h}{t} \ , \ E = mc^2 \ , \ E = k_B T \ , \ E = \pm \frac{c^2}{\sqrt{4\pi\varepsilon_0 . G}} q$$

Aside from the two equations, all of the above equations are well-known in physics (Figure 6). The above equations show that the quantities of time, mass, and temperature are always positive and cannot assume negative values. The ± sign in the charge-energy equation also show that the electric charge can be positive or negative. Additionally, the electric charge should remain conserved so that the energy is also conserved. Another interesting point is that there are two equations showing the relation of energy-space, because as it was explained before, two types of space are found in our universe. The relativity space is not within our reach, but there is a quantum space at the quantum scale around us. In fact, if even all the matter and electromagnetic waves are deleted from a small space, there is also a quantum space in it. The pervious example can be expressed in terms of energy equations as follows:

$$\textit{The hot object } (E = k_B T) \rightleftharpoons \textit{light } (E = hc/\lambda) \rightleftharpoons \textit{pair production } \left(E = mc^2 , E = \pm \frac{c^2}{\sqrt{4\pi\varepsilon_0 . G}} q \right)$$

This shows that energy transformation from one shape to other shapes results from transformation of base quantities to each other. Conservation laws of energy and momentum exactly present this idea.

8. Conclusions

We found fundamental equations between base quantities including space, time, mass, charge and temperature in which proportionality constant of equations is a combination of fundamental constants of physics. If these quantities are divided, universal equations of relativity, and if multiplied, universal equations of quantum will be obtained. The relativity equations represent the ultimate limit for the ratio of base quantities and the quantum equations represent the lowest possible limit for their products. Also, these equations proposed a new cosmological model for universe's creation explaining causes of accelerating expansion of the universe and nature of dark energy. In this model creation of the universe consists of two stages of contraction and expansion. Also, this model indicates that the quantum world and its effects play a role only in the expansion stage of the universe. As this paper shows, very valuable information is hidden in these equations, do not consider them simple.

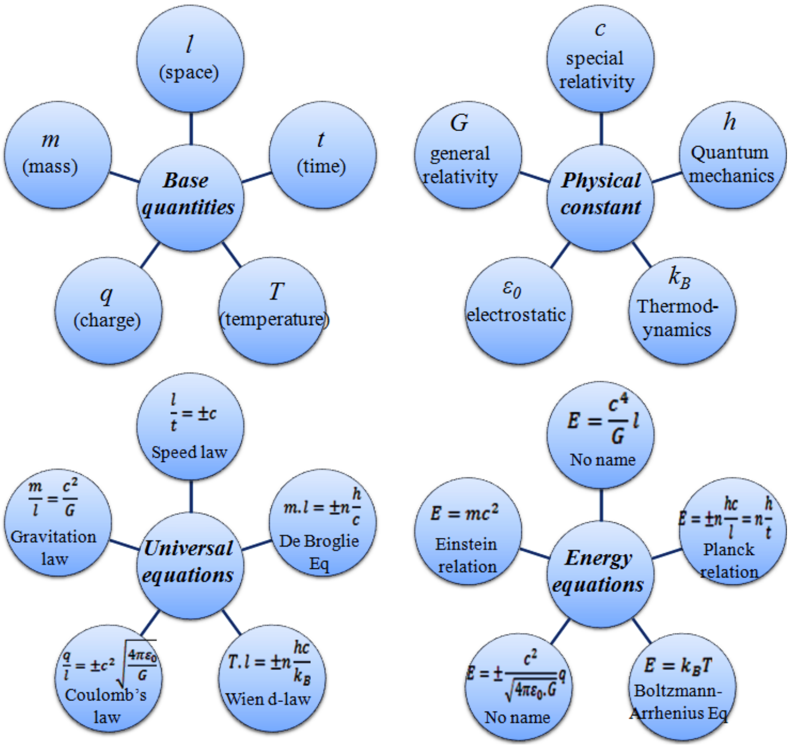

Figure 6 shows the interdependency of among base quantities, fundamental constants of physics and universal equations. Note the unique symmetry in this Figure.

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