A Study on the Physical Mechanism of Universal Gravitation and Space-time Curvature

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Abstract: It has been proven in studies that the speed of light remains absolutely constant within a local area, but relative changes in the speed of light can occur between different local areas. The speed of light that changes with space is the physical factor responsible for the generation of gravitational acceleration g ($g = -(dc^2)/ds$). Within a range of 10 m, it is possible to generate a gravitational acceleration $g = 10 \ m/s^2$ with only a relative change in the speed of light at △ C=-0.000000166782 (m/s), which is a remarkable feat. The change in the speed of light can be attributed to the influence of the mass of an object on the physical properties of vacuum $\mu_0\varepsilon_0$, which changes it with space. Although it is a minor change to the object in space, it results in the establishment of high and low energy states, and consequently, the object will spontaneously move towards the low energy state. In such a space, an object is equivalent to being subjected to the action of gravity F_m, and $F_m = -m_0\frac{dc^2}{ds}$. In this article, the physical mechanism of the conduction of gravity in space and the physical mechanism of space-time curvature are explained.

Keywords: Gravitational field; Space-time curvature; $\mu_0\varepsilon_0$; Energy; Mass; Space; Time
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Introduction: The physical mechanism of the gravitational field and the physical mechanism of space-time curvature have long been a subject of intrigue among people. Einstein and many other scientists have made great efforts to establish a unified field theory that encompasses both electromagnetic interaction and gravitational interaction, but the realization of such a theory remains elusive to date. It is found in studies that the failure in solving the aforementioned issue can be attributed to the premise that the physical properties of vacuum $\mu_0\varepsilon_0$ are constants. These properties are constants in the inertial reference frame, but they are variables in the non-inertial reference frame. $\mu_0\varepsilon_0$, which changes with space, leads to the phenomena of gravity and space-time curvature. There is often a profound physical significance to the physical constants. The recognition of mass, time, and space as variables in the past has significantly enhanced the depth and breadth of our understanding of the material world. Now, extensive research on $\mu_0\varepsilon_0$ have yielded the same outcome.

1. Insights from an Important Experiment

It is understood that both classical mechanics and special relativity are founded on the inertial reference frame. Within the space of the inertial reference frame, both objects and light move at a uniform speed along a straight line. The linear propagation of light shows that the values in the space $\mu_0\varepsilon_0$ at this time are uniformly distributed constants, but this observation is limited only to the inertial reference frame, as the conditions change in the presence of gravity in the non-inertial reference frame.

It is also widely recognized that the presence of solar mass causes a deflection in the propagation direction of light [1] [2] [3] [4] [5] [6] [7]. As shown in Figure 1, the speed of light at this time decreases rather than increases under the action of the Sun's "gravity". Based on the results of the solar radar echo test, it has been found that the echo delays [8][9][10][11][12], providing strong evidence supporting the idea that the closer it is to the Sun, the slower the speed of light. This indicates that the direction of light deviates towards the Sun, which is a result of the refraction of light caused by the change of light speed [13], showing wave-like characteristics.

Fig.1

$$c = \frac{1}{\sqrt{\mu_0\varepsilon_0}} \qquad (1-1)$$

ε_0-Vacuum dielectric constant μ_0−Vacuum permeability

From Formula $(1-1)$, it can be seen that the propagation speed of electromagnetic waves is only influenced by the physical properties of space $\mu_0\varepsilon_0$; no other physical factors can directly change the propagation speed of light. In other words, although the mass of the Sun causes this refraction phenomenon, it does not directly impact the speed of light. Instead, it increases $\mu_0\varepsilon_0$ in space from far to near, as shown in Figure 2, to cause light to refract towards the Sun, which is the only way mass affects the speed of light and cause light refraction. The analysis above proves that $\mu_0\varepsilon_0$ can also be a variable. Since the phenomenon of the refraction of light at the solar side is influenced by $\mu_0\varepsilon_0$, there exists the question of whether there is a correlation between the spatial

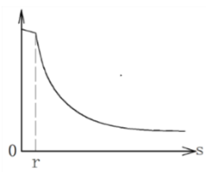


Fig.2

variation $\mu_0\varepsilon_0$ and the gravitational phenomenon. In this article, the relationship between the spatial variation $\mu_0\varepsilon_0$ and the gravitational phenomenon is discussed on the basis that these two factors are correlated.

2. Physical Mechanism Behind Gravitational Interaction Generation

2.1 Relationship between universal gravitation and $\mu_0\varepsilon_0$

It is supposed that an object with mass m [14] is in a space of continuous monotonic change $\mu_0\varepsilon_0$ caused by the mass of the Sun, as shown in Figure 3, the mass energy formula [15] is expressed as:

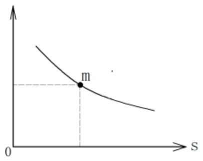


Fig. 3

$$E_0 = m_0 c^2 \qquad (2-1)$$

Substitute Formula $(1-1)$ into the formula above, it can be obtained that:

$$E_0 = \frac{m_0}{\mu_0\varepsilon_0} \qquad (2-2)$$

As shown in Formula $(2-2)$, the internal energy E_0 of an object varies with its spatial position in a changing space $\mu_0\varepsilon_0$; the larger the value of $\mu_0\varepsilon_0$, the lower its internal energy. Based on the principle of minimum energy [16] [17] [18], an object will spontaneously move in the direction of increasing $\mu_0\varepsilon_0$, where it will have a lower internal energy. The change in the spontaneous motion state of the object is comparable to being subjected to a force.

The principle of minimum energy is fundamental in the field of physics. It holds that in an equilibrium state, the energy of an object or system tends towards its minimum value. This principle has been widely used in fields such as classical mechanics, quantum mechanics [19] [20] [21] [22], thermodynamics, and electromagnetism. This principle also provides an important theoretical basis for understanding the phenomenon of universal gravitation.

It is assumed that the total energy E of the object is equal to the sum of its internal energy $\mathrm{E_i}$ and kinetic energy E_v, the correlation between this equivalent force and $\mu_0\varepsilon_0$ can derived as:

$$\mathrm{E} = \mathrm{E_i} + \mathrm{E_v} \qquad (2-3)$$

After an object spontaneously moves for a given distance, the change in total energy of the object $\Delta\mathrm{E}$ is zero because there is no external force.

Change in the total energy of an object: $$\Delta E = \Delta E_i + \Delta E_v \quad (2-4)$$

Because: $$\Delta E = 0 \quad (2-5)$$

Therefore: $$\Delta E_v + \Delta E_i = 0 \quad (2-6)$$

$$\Delta E_v = -\Delta E_i \quad (2-7)$$

Formula (2 − 7) is obtained based on the law of conservation of energy, stating that the increased kinetic energy ΔE_v of an object is equal to its reduced internal energy $-\Delta E_i$. If the increment of the kinetic energy ΔE_v of the object is equal to the work done by a force F_m over a given distance Δs:

$$A = F_m \cdot \Delta s = \Delta E_v \quad (2-8)$$

Its F_m is: $$F_m = \frac{A}{\Delta s} = \frac{\Delta E_v}{\Delta s} \quad (2-9)$$

Because the increase in kinetic energy is equal to the decrease in internal energy, Formula (2 − 7) is substituted into the formula above to obtain:

$$F_m = -\frac{\Delta E_i}{\Delta s} \quad (2-10)$$

$$F_m = -\frac{dE_i}{ds} \quad (2-11)$$

It can be seen from Formula (2-11) that when the mass of the Sun affects $\mu_0\varepsilon_0$ in the space, the object generates a force F_m that moves towards the Sun, which is equivalent to the rate at which the object's internal energy changes with the space. However, the force F_m does not represent the direct force exerted by the Sun on the object, nor does it represent the force exerted by the gravitational field of the Sun on the object. The Sun only changes the spatial distribution of $\mu_0\varepsilon_0$ around it, and the gravity F_m is a self-generating force exerted by the object itself as it moves towards the low energy state. Therefore, the phenomenon of universal gravitation can be explained as the phenomenon where any object changes its spatial distribution

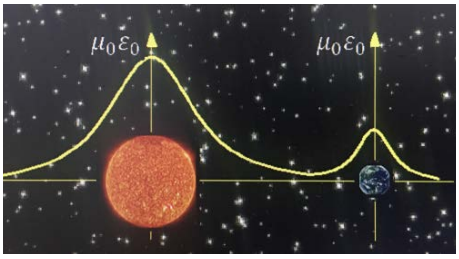


Fig.4

state $\mu_0\varepsilon_0$ in accordance with its mass. As illustrated in Figure 4, the object will spontaneously move towards the lower energy state due to the change in $\mu_0\varepsilon_0$ in its own space. The belief that there exists a physical property of mutual attraction between objects is incorrect; it is a misconception to believe that there is a "gravitational" or "repulsive" force between objects. The phenomenon of mutual aggregation between objects is due to the fact that the direction in which objects gather is also the direction in which their energy state is lowest. If objects interact, it is a scalar field of $\mu_0\varepsilon_0$ formed by the mass of the object that varies with space. If the spatial distribution of $\mu_0\varepsilon_0$ is a constant and the energy state of an object remains unchanged at any position in space, the object will either remain relatively stationary or move uniformly in a straight line.

2.2 Relationship between gravitational acceleration and $\boldsymbol{\mu_0\varepsilon_0}$

It is widely acknowledged that an object with any mass will experience the same acceleration in a gravitational field. However, is this physical characteristic exhibited in the scalar field formed by $\mu_0\varepsilon_0$ of spatial changes?

Consider an object m is in a stationary state in this changing scalar field:

$$\mathrm{E_i} = E_0$$

Substitute it into Formula (2-11):

$$F_m = -\frac{\mathrm{d}E_0}{\mathrm{ds}} \qquad (2-12)$$

According to the mass energy formula: $E_0 = m_0\mathrm{c}^2$

Substitute it into Formula (2-12):

$$F_m = -\frac{d(\mathrm{m}_0c^2)}{ds} \qquad (2-13)$$

As the object is stationary, its mass is a constant:

$$F_m = -m_0\frac{dc^2}{ds} \qquad (2-14)$$

Set the acceleration experienced by an object under the action of force F_m as g

Because: $$\mathrm{g} = \frac{F_m}{m_0} \qquad (2-15)$$

Substitute Formula $(2-13)$ into Formula $(2-15)$:

$$g=-\frac{dc^2}{ds} \qquad (2-16)$$

Substitute Formula (1-1) into the formula above:

$$g=-\frac{d}{ds}\left(\frac{1}{\mu_0\varepsilon_0}\right) \qquad (2-17)$$

It can be seen from Formula (2-16) that the gravitational acceleration is determined by the rate of change of the square of the light speed with respect to space. To calculate the speed of light c_2, the gravitational acceleration is set as $g = 10\ \mathrm{m/s^2}$; when Δs is 10 meters, $c_1 = 299792458(\mathrm{m/s})$.

$$g = -\frac{dc^2}{ds} = -\frac{\Delta c^2}{\Delta s} = -\frac{c_2{}^2 - c_1{}^2}{\Delta s} = \frac{c_1{}^2 - c_2{}^2}{\Delta s}$$

$$c_2 = \sqrt{c_1{}^2 - g\cdot\Delta s} = 299{,}792{,}457.999999833218 \quad (\mathrm{m/s})$$

Relative change in the speed of light $\triangle C$:

$$\triangle \mathbf{C} = \mathbf{C}_2 - \mathbf{C}_1 = -0.000000166782 \quad (\mathrm{m/s})$$

Relative rate of change of the speed of light:

$$\frac{\Delta c}{c_1}\times 100\% = -0.0000000000000556325\ \%$$

From the calculation results, it can be seen that the speed of light changes only by -0.000000166782 (m/s) within a 10-meter range under the action of a gravitational acceleration of $g = 10\ \mathrm{m/s^2}$, which is of minimal significance. Although the quantification of this change remains elusive, it produces observable gravitational acceleration and “gravity” on the macro level.

From Formula (2-17), it can be seen that the acceleration experienced by an object is solely determined by the rate of change of the reciprocal of $\mu_0\varepsilon_0$ with respect to space, and is independent of the mass of the object. In other words, regardless of the mass of the object, it will experience the same acceleration, which is consistent with the characteristics of the gravitational field.

Set $1/\mu_0\varepsilon_0$ as the function of a three-dimensional space $f(x,y,z)$, the distribution of gravitational field strength in space E_g is the negative gradient of $f(x,y,z)$, as shown in Formula (2-18):

$$E_g = -\nabla f(x, y, z) \qquad (2-18)$$

F_m is considered as the “gravity” acting on an object. Consequently, Formula (2-19) is a unified expression of “gravity” and electromagnetic properties.

$$F_m = -m_0 \frac{d}{ds}\left(\frac{1}{\mu_0 \varepsilon_0}\right) \qquad (2-19)$$

3. Relationship Between Space and Time

3.1 $\mu_0\varepsilon_0$ controls space and time

Since the gravitational field is replaced by $\mu_0\varepsilon_0$ that change with space, it becomes imperative to understand how $\mu_0\varepsilon_0$ that change with space relates to time and space.

To facilitate analysis, it is assumed that there are two vacuum spaces, that is, space A and space B, with the only difference being that the values of $\mu_0\varepsilon_0$ of space B is higher than that of space A. The values of $\mu_0\varepsilon_0$ in spaces A and B are uniformly distributed, demonstrating that both spaces are inertial spaces. The speed of light in spaces A and B measured by the observers is the same, which is 300,000 kilometers per second, and is consistent with the principle of constant speed of light [23] [24] [25] [26] [27] [28] [29]. However, the speed of light in space B measured by the observer of space A is relatively slower compared to that in space A, which is in line with the setting that $\mu_0\varepsilon_0$ in space B is greater than that in space A. If so, why is the speed of light in space B slower than that in space A, despite both spaces measuring the speed of light to be 300,000 kilometers per second. Both experimental results are correct; however, it is essential to understand the explanation for this seemingly contradictory experimental phenomenon.

Velocity v is dependent on two basic physical quantities: space and time.

$$c = \frac{\Delta s}{\Delta t} \qquad (3-1)$$

If the numerator and denominator of the formula above are simultaneously multiplied by a proportional coefficient k,

$$c = \frac{k \cdot \Delta s}{k \cdot \Delta t} \qquad (3-2)$$

Regardless of the value of k, its velocity c remains constant. For example, the light in space B only travels 150,000 kilometers relative to space A within 1 second of space A. This indicates that space B contracts relative to space A, and at this point, the expansion coefficient of space can be expressed as:

$$\Delta s_b = k \cdot \Delta s_a$$

$$k = \frac{\Delta s_b}{\Delta s_a} = \frac{15}{30} = 0.5$$

K = 0.5. It can be seen from Formula (3-2) that to maintain the constant speed of light, the expansion coefficient of space must be equal to the expansion coefficient of time, and at this point in time, the expansion coefficient of time k is also 0.5.

$$\Delta t_b = k \cdot \Delta t_a = 0.5 \times 1 = 0.5$$

In other words, 1 second in space A is equivalent to only 0.5 seconds in space B. In this scenario, although the speed of light in space B is only 150,000 kilometers per second relative to space A, the absolute speed of light in space B remains at 300,000 kilometers per second (c=15 (10,000 kilometers)/0.5 (seconds)). The expansion and contraction of space and time in equal proportions is the underlying physical explanation for the relative variations in the speed of light between different local areas, while remaining constant within each local area. Therefore, it is more accurate to state that the space and time on the Sun's side contract relative to Earth, resulting in a perceived slowdown of the clock on the Sun's side, rather than attributing a decrease in the speed of light on the Sun's side. The expansion and contraction of space and time involve the movement of all matters within a given local area. Therefore, the relative speed of light is merely a superficial phenomenon, while the true essence of physics lies in the expansion and contraction of space and time.

Accordingly, the relationship between the expansion and contraction of space and time and $\mu_0\varepsilon_0$ can be explained through the physical properties of space and time. To study the relationship between $\mu_0\varepsilon_0$ and space and time, let us delve into the relationship between the proportional coefficient k and $\mu_0\varepsilon_0$.

Let c_a represent the speed of light in space A and c_b be the speed of light in space B measured in space A. The difference between the two values reflects the relative expansion and contraction of the two spaces. Therefore, the proportion coefficient k of space is expressed as:

$$\mathrm{k} = \frac{c_b}{c_a} \qquad (3-3)$$

$$\mathrm{c} = \frac{1}{\sqrt{\mu_0\varepsilon_0}} \qquad (3-4)$$

Set $\mu_{0a}\varepsilon_{0a}$ as $\mu_0\varepsilon_0$ in space A and $\mu_{0b}\varepsilon_{0b}$ as $\mu_0\varepsilon_0$ in space B relative to space A.

$$k = \frac{c_b}{c_a} = \frac{\frac{1}{\sqrt{\mu_{0b}\varepsilon_{0b}}}}{\frac{1}{\sqrt{\mu_{0a}\varepsilon_{0a}}}} = \frac{\sqrt{\mu_{0a}\varepsilon_{0a}}}{\sqrt{\mu_{0b}\varepsilon_{0b}}} = \sqrt{\frac{\mu_{0a}\varepsilon_{0a}}{\mu_{0b}\varepsilon_{0b}}} \qquad (3-5)$$

$$k = \sqrt{\frac{\mu_{0a}\varepsilon_{0a}}{\mu_{0b}\varepsilon_{0b}}} \qquad (3-6)$$

Through the formulas above, the relationship between $\mu_0\varepsilon_0$ and the coefficient of proportionality k is determined, from which we can obtain the formula that describes the relationship between relative space, time dilation, and contraction of spaces A and B as follows:

$$\Delta s_b = k \cdot \Delta s_a \qquad (3-7)$$

$$\Delta t_b = k \cdot \Delta t_a \qquad (3-8)$$

$$\Delta s_b = \Delta s_a \sqrt{\frac{\mu_{0a}\varepsilon_{0a}}{\mu_{0b}\varepsilon_{0b}}} \qquad (3-9)$$

$$\Delta t_b = \Delta t_a \sqrt{\frac{\mu_{0a}\varepsilon_{0a}}{\mu_{0b}\varepsilon_{0b}}} \qquad (3-10)$$

Formulas (3-9) and (3-10) indicate that changes in the physical state of vacuum inevitably impact space and time with vacuum as the physical background. In the case of changes in the physical state of vacuum, the spatial interval and the rate of time loss are no longer constants. From the formulas presented above, it can be seen that the size of the spatial interval and the rate of time loss are both determined by $\mu_0\varepsilon_0$. Only when there is a difference between $\mu_0\varepsilon_0$ in two local areas can the impact of $\mu_0\varepsilon_0$ on time and space be observed. $\mu_0\varepsilon_0$ in the cosmos always changes with space; therefore, there is no unified space and time, let alone absolute space and time. Curved space-time is a manifestation of $\mu_0\varepsilon_0$ with continuous changes in space. Due to its physical properties, vacuum is considered a matter, and although it lacks the properties of substance, it can be seen from the aforementioned analysis that the interaction between the physical properties of a vacuum and objects is what makes up the vibrant material world.

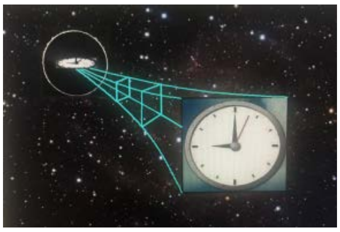


Fig.5

Formula (3-10) reveals that $\mu_0\varepsilon_0$ is the physical quantity that controls the rate of time loss. Since $\mu_0\varepsilon_0$ is always positive, time can only progress in one direction and vary in speed, but is irreversible. The impact of time on the movement of matter is omnipresent due to the omnipresence of $\mu_0\varepsilon_0$. The concept of time, essentially, is people's interpretation of the rate at which matters move. In reality, $\mu_0\varepsilon_0$ does not control time, but rather controls the rate of all matter movement within a given local area. Time is merely a quantitative measure of the rate of matter movement.

At this stage, people may have questions about the specific function of $\mu_0\varepsilon_0$. However, relativity formulas, such as Maxwell's equations, the principle of invariance of light speed, Lorentz transformation, special relativity, and general relativity [30] [31], are intrinsically linked to the physical quantity of light speed c. It is also widely recognized that $\mu_0\varepsilon_0$ play a crucial role in determining the speed of light, and the theory of relativity has provided strong evidence confirming the inseparable and important role of the physical properties of vacuum $\mu_0\varepsilon_0$ in the existence and movement of matter. The theory of relativity pertains to situations where e is a constant. In this article, that $\mu_0\varepsilon_0$ is both an absolute invariant and a relative variable, and the investigation on relative change based on $\mu_0\varepsilon_0$ presented above builds upon and extends previous research conducted on the theory of relativity.

4. Insights from the Relative Change in $\boldsymbol{\mu_0\varepsilon_0}$

4.1. Theoretical basis of antigravity

The antigravity propulsion device has garnered increasing attention from scholars due to its great significance. However, scholars have yet to make a breakthrough in understanding the physical mechanism for the generation of gravity, which is also the key reason for the failure in the development of antigravity propulsion devices. The field equation of general relativity only states that "matter tells space-time how to bend, and curved space-time tells matter how to move", which does not adequately explain the physical mechanism behind the bending of space-time, giving rise to the field of study of spatial geometric dynamics. Theoretically, the antigravity technology is grounded in the unified theory of electromagnetic field and gravitational field (space-time curvature). Only when we understand the physical characteristics of the gravitational field and its correlation with electromagnetic properties can we establish a theoretical basis for antigravity technology.

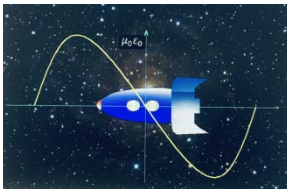


Fig.6

Antigravity technology utilizes specific motion laws of electromagnetic fields to generate the necessary curved space-time, which enables the generation of a driving force similar to "gravity". Discussions in this article up to this point have provided us with a clear understanding of the physical mechanism behind the bending of space-time and the generation of gravity, based on which Formula (2-19), which outlines the relationship between gravity and the electromagnetic properties of space, is established. This theoretical support is important for research in antigravity technology. Since $\mu_0\varepsilon_0$ are variables, the spatial distribution can be changed through electromagnetic technology, and the antigravity device can harness a driving force expressed as follows:

$$F_m = -m_0 \frac{d}{ds}\left(\frac{1}{\mu_0\varepsilon_0}\right) \qquad (2-19)$$

The engine technology described operates only on electrical energy, eliminating the need for any other propellant and supporting flight in a vacuum environment. It is believed that research on antigravity propulsion devices holds promising prospects for success in the near future.

4.2. Space expansion and superluminal motion

It can be seen from Formula (3-9) that space B can contract or expand to infinity relative to space A. The expansion and contraction of space can either reduce or increase the physical distance between two objects.

$$\Delta s_b = \Delta s_a \sqrt{\frac{\mu_{0a}\varepsilon_{0a}}{\mu_{0b}\varepsilon_{0b}}} \qquad (3-9)$$

For example, it is measured that the distance between a specific planet and Earth is 10 million kilometers. If the space between Earth and the planet expands 1,000 times relative to Earth, the actual distance from Earth to the planet is 10,000 kilometers, while the duration of travel from Earth to the planet is 0.1% of the estimated duration on Earth.

Is this phenomenon observed in space? The expansion of spaces relative to Earth is determined by the presence of spaces below $\mu_0\varepsilon_0$ on Earth. Traversing these spaces will not take as much time as is predicted on Earth. For example, objects in a galaxy tend to converge towards the center of the galaxy, indicating a monotonic increase of $\mu_0\varepsilon_0$ from the edge of the galaxy to the center of the galaxy. This means that

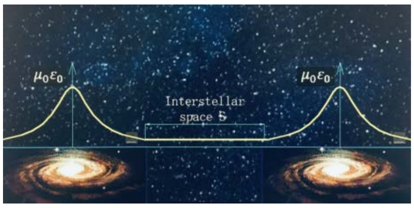


Fig.7

$\mu_0\varepsilon_0$ is the highest at the center of the galaxy and lowest at the edge. In the vast expanse of space s between two galaxies, the $\mu_0\varepsilon_0$ will further reduced. As shown in Figure 8, the space s will experience a significant expansion relative to Earth. As a result, the time required to traverse interstellar space will be much shorter than what is expected on Earth.

It does not exceed the speed of light, but simultaneously, it travels at a speed surpassing that of light. Given that space B expands 1,000 times compared with space A, the distance of light propagation in 1 second in space B is 300 million kilometers relative to space A. The light in space B appears to be moving faster than the speed of light when observed in space A, but it remains at 300,000 kilometers per second when observed in space B. This seemingly faster-than-light speed is attributed to the use of the slower clock in space A, as the clock in space B operates at a rate that is 1,000 times faster than the clock in space A. Even when the time expansion of 1,000 times is taken into account, the speed of light in space B is still 300,000 kilometers per second. Therefore, whether the speed is normal can only be determined when the local time is used for calculation.

4.3. Time redshift and nuclear fusion

From Formula (3-10), it can be seen that the relative changes in spaces A and B have an impact on the differences in time progresses between the two local areas. The control of $\mu_0\varepsilon_0$ within a given local area holds significant prospects for application.

$$\Delta t_b = \Delta t_a \sqrt{\frac{\mu_{0a}\varepsilon_{0a}}{\mu_{0b}\varepsilon_{0b}}} \qquad (3-10)$$

As is known to all, the mass of an object will cause a relative increase of $\mu_0\varepsilon_0$ in its surrounding environment, and according to Formula (3-10), the progress of time will be relatively slow. The phenomenon of delayed solar echoes and refraction of sunlight on the Sun's side can be understood as the result of a relatively slow time progress on the Sun's side. Assuming a photon is emitted from the Sun's side towards Earth, a decrease in the frequency of the photon will be observed on Earth, which is commonly referred to as a "gravitational" redshift phenomenon [32] [33] [34] [35]. However, the concept of gravity itself does not exist in this phenomenon. Therefore, the decrease in photon

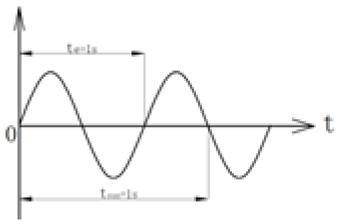
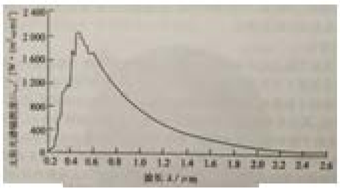
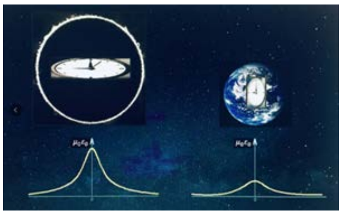


Fig.8

frequency can be attributed to the faster clock on Earth t_e compared to the clock on the Sun t_{sun}. This phenomenon of frequency reduction is referred to as time redshift, as shown in Figure 5.

The phenomenon of time redshift becomes more significant as the mass of the Sun increases. When ultraviolet light with a wavelength of 200 nm, which is the shortest wavelength radiated by the Sun, reaches the Earth and red-shifted to an infrared light of 750 nm, the Sun transforms into a black hole invisible to the naked eye when observed from Earth.





Solar radiation smoothing (NASA, 1971)

Fig.9

At this point, k is:

$$k = \frac{\lambda_{sun}}{\lambda_e} = \frac{200(\text{nm})}{750(\text{nm})} = \frac{1}{3.75} \qquad (4-1)$$

Therefore, the black hole resulting from time redshift only needs to satisfy one of the following formulas:

$$\Delta t_{sun} = \frac{1}{3.75} \cdot \Delta t_e \qquad (4-2)$$

$$\lambda_{sun} = \frac{1}{3.75} \cdot \lambda_e \qquad (4-3)$$

A black hole can form when k = 1/3.75, which is a physically imaginable condition. At This stage, 1 year on Earth is equivalent to 3.2 months on the Sun. In this article, only time redshift is discussed, and it is established that a total reflection visual interface capable of reflecting more than 83% of solar radiation is formed when k = 1/3.75.

A continuous and stable nuclear fusion reaction can significantly alleviate the current energy crisis and benefit mankind, but it is challenging to control the conditions of nuclear fusion reaction and the speed of energy release. If $\mu_0\varepsilon_0$ in a local nuclear fusion reaction can be increased, thereby slowing its internal clock, it is possible to significantly reduce the temperature required for the nuclear fusion reaction and delay the energy release of the nuclear fusion reaction. This conversion of an explosion process into a gradual energy release process can greatly alleviate the challenges associated with controlling nuclear fusion reactions.

5. $\mu_0\varepsilon_0$ in Relation to Dark Matter and Dark Energy

As previously stated, objects in the galaxy tend to converge towards the center of the galaxy,

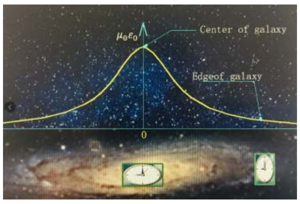


Fig.10

indicating a monotonic increase of $\mu_0\varepsilon_0$ from the edge of the galaxy to the center of the galaxy. This means that the value of $\mu_0\varepsilon_0$ is the highest in the center of the galaxy, as shown in Figure 9, where the time progress is the slowest. The value of $\mu_0\varepsilon_0$is relatively lower at the edge of the galaxy, where the time progress is relatively faster. If we only observe the ex pansion of space at the edge of the galaxy, without considering the acceleration of time at the area, and measure the relative speed of movement among objects in the galaxy using the same clock, while ignoring the difference in the speed of time progress, it is inevitable that we will come to an erroneous conclusion that the speed of movement of the galaxy arm is excessively high [36]. This is because the Sun and Earth have different time progress due to the difference in size between the two, and the difference in time progress is more pronounced in the galaxy that is hundreds of billions of times larger than the solar system. If the velocity data between stars in the galaxy are calculated with the same clock, it does not provide a theoretical basis to support the existence of dark matter [37] [38].

As previously mentioned, there is no "gravity" or "repulsive force" between objects, as both "gravity" and "repulsive force" arise from different spatial distributions of $\mu_0\varepsilon_0$. The object moves as $\mu_0\varepsilon_0$ changes in space. The purpose of object movement is to reduce its own energy state, and the movement of the object is powered by its internal energy, which is substantial. Therefore, the concept of the presence of dark energy is unnecessary, and it is advisable to research the spatial change law of $\mu_0\varepsilon_0$.

6. Conclusion

In this article, the physical properties of vacuum $\mu_0\varepsilon_0$ as both variable and invariant physical quantities are analyzed, which are significantly interconnected to objects in multiple aspects. $\mu_0\varepsilon_0$ control the energy of objects, and they change with space, resulting in the generation of a "gravity" that causes objects to move towards a low energy state and leading to the relative expansion and contraction of space and time. This demonstrates the fundamental physical property of space-time curvature. It is also revealed that $\mu_0\varepsilon_0$ controls the progress of time, thereby clarifying its nature.

This article only provides a novel physical approach to this topic, and it is hoped that future scholars will further explore this topic on this basis.

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