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DOI: 10.14293/S2199-1006.1.SOR-.PPXTYIJ.v1
Preprint first posted online: 19 May 2021
Keywords: Mpemba effect, inverse Mpamba effect, nature of time , time

Mpemba Effect- the Effect of Time

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Abstract:

This paper concludes that " time is one of the properties of energy, which is the flow rate of energy from object to space or from space to object. When energy flows from object to space, the time on an object is proportional to the energy density inside the object and inversely proportional to the energy density of the space in which the object is located. When energy flows from space to object, the time on an object is inversely proportional to the energy density inside the object and is proportional to the energy density of the space in which the object is located" Using this time characteristic, the Mpemba effect and "inverse" Mpamba effect are analyzed and a reasonable explanation is given.

Key words:

Mpemba effect, inverse Mpamba effect, nature of time , time

Introduction:

" Mpemba effect ", also known as" Mupainmubar effect ", refers to the phenomenon that a slightly hotter liquid freezes first than a slightly cooler one under the same volume, mass and cooling conditions. In 1963, at a high school in Tanzania, there was a junior three student named Mpamba who enjoyed making ice cream with his classmates. They add sugar to boiling fresh milk, let it cool, pour it into a latticed container, and place it in the freezer. One day, Mpemba realized that the freezer room was running short of space. Fearing that the other students would be the first to use it, he quickly added sugar to the boiling milk and sent it to the refrigerator before it cooled down. An hour and a half later, Mpemba noticed something that puzzled him: hot milk freezes faster than cold milk. What's going on here? Confused Mpamba hurriedly ran to ask the teacher, but unfortunately, from junior high school to high school, no teacher took his problem seriously, and some people thought he was absurd and said he was lying. Until one day, Dr. Osborn, the head of the physics department of the University of Dar es Salaam, visited his school, and he seized the opportunity to consult Dr. Osborn. As a result, the doctor not only did not scoff at it, but also took him back to the laboratory to do the experiment. In 1969, Mpamba and Dr. Osborne wrote a paper on this effect and named it "Mpamba effect ".

In fact, hot water freezes faster than cold water is a mystery that has been around for thousands of years. Historically, Aristotle, Francis Bacon and Descartes have described the phenomenon in different ways, but none of them has attracted much attention [1]

More than 50 years after the "Mpamba effect " was officially named, scientists have done many experiments and written many papers want to prove the principle behind the phenomenon[2],[3],[4],[5],[6],[7] [8], but there is still no conclusion.

Recently, two physicists Avinash Kumar and John Bechhoefer from simon fraser university, Canada, have bypassed the complexity of water by replacing water molecules with tiny glass beads,

developing a method to exhibit the Mpamba effect in a controllable environment, confirming that when two systems with different initial temperatures are cooled to the same temperature, the system with higher initial temperatures can take less time than the system with lower temperatures.[9]

The result suggests that the Mpemba effect is not only present in glass beads and water, but is more likely to be present in nature in general.

About the nature of time:

The relationship between time and speed is revealed, that is, the faster the speed, the slower the time, and the relationship between time and gravitational field is revealed also, that is, the stronger the gravitational field, the slower the time. The author believes that the above two reflect the same property of time: "The higher the energy density of space, the slower the time" [10]. Because physical space is composed of ether (energy), the faster the object moves relative to ether, the more ether (energy) the object gathers, the greater the kinetic energy of the object, the higher the energy density of the local space where the object is located, so the time is slower [10]. According to formula (5.17) [10] :

$$t = t_0\sqrt{1-\frac{v^2}{c^2}} \qquad (1)$$

where, t_0 is the time when the object is at rest relative to the ether, i.e., v=0; t is the time when the object is moving with a speed v relative to the ether, and formula (5.12) [10] :

$$m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} \qquad (2)$$

and the formula:

$$mc^2 = \frac{m_0c^2}{\sqrt{1-\frac{v^2}{c^2}}} = m_0c^2 + m_0c^2\left\{\frac{1}{2}\left(\frac{v^2}{c^2}\right) + \frac{3}{8}\left(\frac{v^2}{c^2}\right)^2 + \cdots.\right\} = m_0c^2 + E_k \qquad (3)$$

where m is the moving mass of the object, m_0 is the static mass of the object, c is the speed of light in vacuum, E_k is the kinetic energy of the object, and E_0 is the static energy of the object, we can get:

$$t = \left(\frac{E_0}{E_0 + E_k}\right) t_0 \qquad (4)$$

Divide the numerator and denominator on the right side of equation (4) by the volume of the object, and we can get:

$$t = \left(\frac{\rho_0}{\rho_0 + \rho}\right)t_0 = \frac{t_0}{\left(1+\frac{\rho}{\rho_0}\right)} \qquad (5)$$

In the formula, ρ is the spatial energy density caused by the kinetic energy of the object, and ρ_0 is the energy density of the object itself. According to formula (4) and (5), the greater the kinetic energy, the greater the space energy density, the slower the time. Therefore, the acceleration of the sun's motion speed in the Galaxy would slow down the time on the sun, and thus reduce the solar radiation power and lead to the generation of the Ice Age [11].

Because the stronger the gravitational field, the higher the space energy density, the stronger the gravitational field, the slower the time, that is, the higher the space energy density, the slower the time.

Because the energy density of any field ρ and the field strength E satisfy the relation:

$$\rho = eE^{2} \tag{6}$$

In the above equation, e is the coefficient. According to equations (5) and (6), we can get:

$$t = \frac{t_0}{\left(1 + \frac{eE^2}{\rho_0}\right)} \tag{7}$$

In the above equation, t is the time on the object when the object is in the field E, and t_0 is the time on the object when the field is zero. Obviously, the stronger the field E is, the slower the time t is.

In formula (7), E can be the gravitational field，electrostatic field, magnetic field or other fields. So we can predict that the stronger the electrostatic field or magnetic field, the slower the time on the object in the electrostatic field or magnetic field.

We can prove that, from formula (7), we can get the following relation between time and gravitational field in general relativity:

$$t = t_0 \sqrt{1 - \frac{2GM}{c^2 r}} \tag{8}$$

In the above equation, t is the time interval in the gravitational field of the planet, t_0 is the time interval outside the gravitational field of the planet, M is the mass of the planet, r is the radius of the planet，G is the gravitational constant, and c is the speed of light in a vacuum.

From formula (7) we can get:

$$t = t_0 \sqrt{1 - \frac{2eE^2}{\rho_0}} \tag{9}$$

Since the specific gravity of a general object on the Earth is basically the same as that of the Earth, in Formula (9) we can approximately replace the energy density of a general object on the Earth with the energy density of the Earth:

$$\rho_0 = \frac{Mc^2}{\frac{4\pi}{3} r^3} \tag{10}$$

where M is the mass of the earth, c is the speed of light in a vacuum, and r is the radius of the earth. Substituting formula (10) and the following formula for the strength of the earth's gravitational field:

$$E = G\frac{M}{r^2} \tag{11}$$

into Formula (9), we get:

$$t = t_0 \sqrt{1 - \frac{8\pi e G^2}{3}\frac{M}{c^2 r}} \tag{12}$$

In formula (12), let

$$e = \frac{3}{4\pi G}$$

then formula (8) can be obtained.

The decrease (increase) of the energy density of space will lead to the acceleration (deceleration) of time on the object in the space, which leads the author to assume that time is a physical quantity related to the rate at which energy flows from object into space. Since energy can also flow into object from space, in this case time is a physical quantity related to the rate at which energy flows from space into object.

Because all changes in an object (including the changes in position) are essentially the energy exchange between the object and the space, time is essentially the rate of energy exchange between object and space. Therefore, time on an object (particle) is not only related to the energy density of the space in which the object (particle) is located, but also, the author hypothesizes, related to the energy density of the object (particle). In the paper [12], the author gives the definition of time: "Time is one of the properties of the ether (energy), or the flow rate of the energy from objects to space or from space to objects". When energy flows from an object to space, the time on the object is proportional to the energy density inside the object and inversely proportional to the etheric (energy) density of the space in which the object is located. When energy flows from space to an object, the time on the object is inversely proportional to the etheric (energy) density inside the object and is proportional to the etheric (energy) density of the space in which the object is located.

Since energy (ether) flows mainly from objects to space during cosmic expansion (such as luminescence of stars, cooling of planets, vibration of molecules, etc.), time on an object is proportional to the energy (ether) density inside the object and inversely proportional to the energy (ether) density of the space in which the object is located.

According to the time characteristic of "during the cosmic expansion, the time on an object is proportional to the density of energy inside the object and is inversely proportional to the density of energy of the space outside the object", the author explained the mystery of quasar's rapid optical variability or why the life of quasars is very short. [12] [13],[14],[15].

Using the temporal property that "the time on an object is proportional to the density of the

energy inside the object is inversely proportional to the density of the energy of the space outside the object", we can also explain why the luminous power of the sun changes periodically and why "the greater the mass of a star, the shorter its lifespan".

We know that stars produce light and heat by fusion reactions in which deuterium and tritium make helium, and that stars act as a black body. Since the time on an object is proportional to the energy density inside the object is inversely proportional to the energy density in the outer space of the object， when the mass of a star is determined (the energy density of the star is determined), the luminous power of the star is determined by the energy density of the space in which the star is located. Because the faster the sun moves in the Milky way, the higher the local spatial energy density of the sun, the slower the time on the sun, the smaller the luminous power. Because the solar system is not moving at a constant speed in the Milky Way, it can be seen that the periodic motion of the solar system in the Milky way causes the solar luminous power to change periodically, and thus leads to the periodic occurrence of the Earth's ice age. [11]

Because of gravity, the greater the mass of a star, the greater the mass density, the greater the mass density, that is, the greater the energy density, so when the energy density of the space in which the star is located is determined, the greater the mass of a star, the faster the time on the star, and the shorter the lifetime of the star.

The author believes that the Mpamba effect and the effect observed by Avinash Kumar and John Bechhoefer in the experiment [9] are also the embodiment of this characteristic of time， that is, when the energy flows from an object to space, the time on the object is proportional to the density of the energy inside the object and is inversely proportional to the density of the energy in the space where the object is located.

The explanation of the Mpamba effect

According to the temporal property that when energy flows from object to space time on an object is proportional to the energy density within the object and inversely proportional to the energy density of the space in which the object is located, if the energy density of the space in which the objects are located remains constant, then the time on the high temperature object will be faster than on the low temperature object. Therefore, although a high temperature object needs to emit more heat from the beginning to the end of the temperature than a same object of lower temperature, the average temperature of the high temperature object in the process of cooling from the beginning to the end of the temperature is higher than that of the low temperature object, the average time on the high temperature object is faster than that on the low temperature object, which makes it possible for the high temperature object to reach the end of the temperature first. This should be a common phenomenon in nature, not only in quasars and stars, but also in various objects on the earth. So it's not surprising that Mpemba effect happens

In the Mpamba experiment, because the refrigerator pumps away the heat of the space in time to maintain the same temperature of the space in which the two cups of water are located, the difference of time between the two cups of water are determined only by the temperature difference between the two cups of water. If the initial temperature of the cold water and the temperature difference between the two cups of water are set properly, then it should be observed that the hot water freezes first.

Since the substance (water) involved in the Mpamba experiment does not produce any nuclear reactions, the static mass of the substance (water) is independent of the system under

study, which is simply composed of the heat contained in the substance(water). Therefore, the change of time on the system studied does not require much energy (heat) flowing from the object (the water in the cup).

Why is the Mpamba efect difficult to observe?

Many people did the Mpamba experiment and most people observed that the lower temperature water froze first. Why? The author believes that the main reasons are:

1. The power of the refrigerator is too small relative to the amount of water put in, so the temperature of the space around the high temperature water is much higher than that around the low temperature water. As a result, the time difference between the high temperature water and the low temperature water is reduced, and the low temperature water freezes first. This is why we observe that a basin of warm water above room temperature turns to room-temperature cold water more quickly than a same basin of boiling water。
2. The initial temperature of low temperature water and the initial temperature difference between high temperature water and low temperature water are not set properly. Because the loss of heat and the passage of time in the Mpamba experiment are carried out simultaneously and affect each other, whether hot water or cold water freezes first is related to the initial temperature of low temperature water and the initial temperature difference between high temperature water and low temperature water.

The explanation of the "inverse" Mpamba effect.

The “inverse” Mbabar effect is the effect in which “heating a cooled, far-from-equilibrium object takes less time than *another* object that is initially closer to equilibrium under the same volume, mass and heating conditions.” [16].

According to the temporal property that "when energy flows from space to object, the time on an object is inversely proportional to the energy density inside the object and is proportional to the energy density of the space in which the object is located " If the energy density of the space in which two objects are located remains constant, the time on the cold object will be faster than the time on the hot object. Therefore, although the low temperature object needs to absorb more heat from the beginning to the end of the temperature than the high temperature object with the same volume and mass, the average temperature of the low temperature object in the process of heating from the beginning to the end of the temperature is lower than that of the high temperature object. Therefore, the average time on the low temperature object is faster than that of the high temperature object, which leads to the possibility that the low temperature object may first reach the end of the temperature or the equilibrium.

Conclusions:

1. Time is one of the properties of ether (energy), which is the flow rate of energy from object to space or from space to object. When energy flows from an object to space, the time on the object is proportional to the etheric (energy) density inside the object and inversely proportional to the etheric (energy) density of the space in which the object is located. When energy flows from space to an object, the time on the object is inversely proportional to the etheric (energy) density inside the object and is proportional to the etheric (energy) density of the space in which the object is located.

2. During the cosmic expansion, the energy (ether) flows mainly from objects to space (e.g., the luminescence of celestial bodies such as quasars, stars, planetary cooling, molecular vibration, etc.), without considering the influence of the change of the energy density of the object itself on time, the influence of the space energy density on time can be described by formula (5) or (7).
3. In the Mpamba experiment the system under study is composed of the heat contained in the object. The Mpemba effect is the time effect produced when heat flows from objects into space. The "inverse" Mpamba effect is the time effect produced when heat flows from space into objects.

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