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RELATIVE TIME DELAY AND ABSOLUTE TIME DELAY

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ABSTRACT: *This paper has explained that, the motion can be divided into two types, i.e. relative motion between two objects and circular motion unrelated to relative motion (also known as absolute motion). Time delay resulted from relative motion is referred to as relative time delay; time delay caused by circular motion is referred to as absolute time delay. Relative time delay refers to a time delay effect obtained by an observer when observing another reference system being in motion; absolute time delay refers to a real time delay of object being in motion. It is deduced that, the only way for human beings to achieve a real time delay situation is that: An observer can travel around the planet by spacecraft. The analyzed results show that, it is impossible for black hole to exist as a real matter. As a result, the time delay obtained after traveling around fixed star A_1 by spacecraft shall be considered as the maximum absolute time delay obtained by human beings.*

KEYWORDS: Special Relativity, Time Interval, Relative Velocity, Relative Time Delay, Circular Motion, Absolute Time Delay, Equivalence Principle, Black Hole, Time Travel.

INTRODUCTION

A represents a stationary object; M represents its rest mass; L represents its length; T (T_2-T_1) represents its time interval. Now, according to special relativity, when A is in motion at velocity V, the mass of A will be increased to $M' = M\big/\sqrt{1-V^2/C^2}$; the length of A will be shortened to $L' = L\sqrt{1-V^2/C^2}$; the time interval of A will be reduced to $T' = T\sqrt{1-V^2/C^2}$. T' shall be less than T ,which indicates that, the clock motion velocity is low, i.e. time delay.

In the opinion of an observer being in motion at the same velocity V as A, A is still stationary; the mass of A is still expressed as M; the length of A is still expressed as L; however, the time interval observed by the observer is not expressed as T. For the most obvious example, the particle lifetime can be determined by a synchrocyclotron. This example demonstrates that, in the synchrocyclotron, the real time interval of the particle being in motion at velocity V is expressed as $T' = T\sqrt{1-V^2/C^2}$, that is, when the observer observes that the particle being in relative motion is stationary, the real time interval of the particle observed has been changed from T to $T' = T\sqrt{1-V^2/C^2}$. Based on this fact, most of us may consider that, relative to the object being in motion at velocity V, its real clock time interval is expressed as $T' = T\sqrt{1-V^2/C^2}$. However, if this assumption is correct, the motion velocity of A observed by me will be expressed as V_1; the motion velocity of A observed by a walker will be expressed as V_2; the motion velocity of A observed by a runner will be expressed as V_3, and so forth, then the real time interval of A must be consistent with the different conclusions deduced from everyone, i.e. . $T' = T\sqrt{1-V_1^2/C^2} = T\sqrt{1-V_2^2/C^2} = T\sqrt{1-V_3^2/C^2}$ ...... Obviously, it is impossible for such an only T' accepted by everyone to exist. This means that, it is impossible for the real time interval of A being in motion at V to be expressed as $T' = T\sqrt{1-V^2/C^2}$.

Moreover, when observing that A is in motion at V, we may consider that the time interval of A shall be expressed as $T' = T\sqrt{1-V^2/C^2}$; relatively, when A observes that we are in motion at the same velocity V, A may also inevitably considers that our own time interval shall also be expressed as $T' = T\sqrt{1-V^2/C^2}$. This is the well-known twin paradox problem, namely, for twins A and B being in relative motion, when A observes B in motion, A considers that B shall become younger than A; relatively, when B observes A in motion, B also considers that A shall inevitably become younger than B. So far, there is no compelling scientific rigor explanation of this contradictory problem.

The above-mentioned untenable problems show that, we currently yet fail to come up with clear and scientific explanations for the time delay. Therefore, it is quite necessary to further analyze and explore the time delay.

Two Types of Motion

In general, the motion of an object is relative. For example, someone falls asleep before the train starts; when he wakes up, the train has already started moving; however, he did not know the train had got under way; then he saw a train moving in the opposite direction; his first response would be that the opposite train was traveling. This situation shows that, A being in motion observes that non-moving B is also in motion, i.e. the motion of an object is relative.

However, another motion - circular motion is not relative. For example, generally, the playground would be equipped with a ferris wheel. All people on the ground can observe that, one person in the ferris wheel cabin is being rotated around the center of the ferris wheel, while the person in the ferris wheel cabin can also observe that he is being rotated around the center of the ferris wheel. Obviously, this is different from the fact that both sides evolved in a relative motion will consider that the opposite side is in motion. The circular motion of the ferris wheel cabin refers to a motion acceptable to both the person in the ferris wheel cabin and the center of the ferris wheel (including the stationary ground relative to the center of the ferris wheel) as accepted by both sides. Naturally, it is also recognized that, both the center of the ferris wheel and the ground fail to be in motion accordingly.

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The above analyzed results show that, motion can be divided into two types, i.e. relative motion in which both sides consider that the opposite side is in motion; and circular motion in which both sides recognize that only one side is in motion. In the universe, circular motion can be found in such forms as the Earth moves around the Sun; and the Moon moves around the Earth, etc. Such a circular motion shall be referred to as the accepted motion, and defined as absolute motion; the circular motion velocity shall be defined as absolute velocity; naturally, the relative motion velocity shall be defined as relative velocity accordingly.

If the rotational velocity of an object being in circular motion is set as V, and the time interval of the center of rotation is set as T, then according to the special relativity, the time interval of the object being in circular motion shall be inevitably expressed as:

$$T' = T\sqrt{1-V^2/C^2} \qquad (1)$$

Obviously, here T' represents the time interval between the object being in circular motion and the center of circle. Such T' is not relative, but absolute. Relative to T, T' is reduced. A reduced T' indicates that, the time motion velocity is low, i.e. time delay. Such accepted time delay T' shall be defined as absolute time delay, e.g. time delay of the Earth relative to the Sun, time delay of the Moon relative to the Earth, etc.

Next, when it comes to the time motion condition, we will only use the term time interval; when the time interval is relatively reduced, it shall be referred to as time delay.

There are a variety of circular motions in the universe; each has its own different absolute velocity and absolute time delay. The how to compare with their sizes of motion? First of all, there must be a standard to make comparison. For us, of course, the time interval T of the rotation center of the Earth (i.e. the Earth's south and north poles, say 1 hour) shall prevail.

Relative to T, the time interval T_m of the Moon is reduced, i.e. T_m in relation to T is time delay. Assuming that the Moon moves around the Earth at a velocity of V_m, then the time interval of the Moon shall be expressed as:

$$T_m = T\sqrt{1-V_m^2/C^2} \qquad (2)$$

If the Earth moves around the Sun at V, and the time interval of the Sun is expressed as T_0,

then it can derived that $T = T_0\sqrt{1-V^2/C^2}$, namely,

$$T_0 = T\big/\sqrt{1-V^2/C^2} \qquad (3)$$

Obviously, T_0 is greater than T, so T_0 can not be referred to as time delay. If a certain planet

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of the Sun moves around it at V_x, the time interval of x planet shall be expressed as:

$$T_x = T_0\sqrt{1-V_x^2/C^2} = T\sqrt{1-V_x^2/C^2}\Big/\sqrt{1-V^2/C^2} \quad (4)$$

It can be observed that, if $V_x > V$, then $T_x < T$. Relative to T, T_x shall be defined as time delay; on the contrary, the time speeds up.

If a certain satellite moves around the Moon at V_s, then the time delay of the Moon's satellite shall be expressed as:

$$T_s = T_m\sqrt{1-V_s^2/C^2} = T\sqrt{1-V_s^2/C^2}\sqrt{1-V_m^2/C^2} \quad (5)$$

The comparison between time intervals of other objects being in circular motion can be analogized according to the above calculation methods.

Not only does each celestial body in the universe have its own different time interval, but also each generally rotates by itself. Relative to the axis of rotation, the celestial body has its different velocity of rotation at different locations; there is also a difference between time intervals. In the case of the Earth, the equatorial radius of the Earth is about 6,378km; it takes 24 hours for the Earth to rotate around its axis once; the velocity of rotation of the Earth's land surface can be calculated as 0.464km/s. Along with an increase in terrestrial latitude, the velocity of rotation of different points on the Earth's land surface will be decreased. If the terrestrial latitude somewhere on the Earth is expressed as θ, then the velocity of rotation of this point relative to the axis here shall be expressed as $V_\theta = 0.464\cos\theta km/s$; the time interval at this point shall be expressed as:

$$T_\theta = T\sqrt{1-0.2153\cos^2\theta/C^2} \quad (6)$$

It is concluded from the above analysis that, any celestial body or its different location has its own fixed time interval. The locations with the same time interval can be divided into equal time interval zones. For example, the Earth's surface with the same latitude can be divided into equal time interval zones. If a certain object is placed at T_1 time zone, the time motion velocity of such object will be operated as per T_1; if such object is placed at T_2 time zone, its time motion velocity will be operated as per T_2, and so on.

Experiment Conducted by J·C·Hafele and R·E·Keating

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In 1971, J· C· Hafele and R· E· Keating carried out an experiment for a relationship between time delay and motion velocity. They placed four caesium atomic clocks on an aircraft stopping near the equator. After the aircraft traveled along the equator from east to west so as to make a complete cycle around the Earth; it was found that, the average reading of the four caesium atomic clocks was 273×10^{-9} seconds faster than that of the caesium atomic clock placed on the ground (surface phenomenon was negative time delay). However, after the aircraft traveled along the equator from west to east so as to make a complete cycle around the Earth; it was found that, the average reading of the four caesium atomic clocks was 59×10^{-9} seconds slower than that of the caesium atomic clock placed on the ground (Reference 1). Why would such a result occur? As previously described, the absolute time delay of an object or any point on the ground relative to the Earth's axis shall depend on its motion velocity relative to the Earth's axis. When both the aircraft and equatorial ground are rotating around the Earth's axis, the velocity of rotation of equatorial ground around the Earth's axis shall be set as V_1; the flight velocity of the aircraft shall be set as V. When the aircraft is flying to the west, the motion direction of the aircraft is opposite to the direction of the Earth's rotation; the actual velocity of rotation of the aircraft around the Earth's axis shall be set as $V_2 = V_1 - V$. When the aircraft is flying to the east, the motion direction of the aircraft is consistent with the direction of the Earth's rotation; the actual velocity of rotation of the aircraft around the Earth's axis shall be set as $V_3 = V_1 + V$. It can thus be seen that, the time interval of equatorial ground relative to the Earth's axis (time interval T) shall be expressed as $T_1 = T\sqrt{1-V_1^2/C^2}$; the time interval of aircraft to the west relative to the Earth's axis shall be expressed as $T_2 = T\sqrt{1-(V_1-V)^2/C^2}$; the time interval of the aircraft to the east relative to the Earth's axis shall be expressed as $T_3 = T\sqrt{1-(V_1+V)^2/C^2}$. Obviously, if $T_2 > T_1$, namely, the time motion velocity of the aircraft to the west is faster; in relation to the Earth's axis, the absolute time delay of the aircraft to the west is less than the absolute time delay of equatorial ground (T_2 is large; time delay is small); if $T_3 < T_1$, the absolute time delay of the aircraft to the east is greater than the absolute time delay of the equatorial ground. J· C· Hafele and R· E· Keating drew the following conclusions by calculations on the basis of such difference: The caesium atomic clock on the aircraft to the west should be 275×10^{-9} faster than the caesium atomic clock on equatorial ground, which is consistent with the measured readings. In addition, they reckoned from $T_3 < T_1$ that the caesium atomic clock on the aircraft to the east should be 40×10^{-9} slower than the caesium atomic clock on the equatorial ground. Outwardly, although there is a major difference between this result and the measured readings (59×10^{-9} seconds), this is only a comparison difference, rather than a

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calculation error. For example, if the height of a wall is up to 300cm, and the height of a tree is up to 301cm; then the tree is 1cm higher than the wall. However, if the calculated height of the tree is up to 304cm; then the tree is 4cm higher than the wall according to calculations. Obviously, there is a major difference between 4 and 1; however, this difference should be considered as a comparison difference, rather than a calculation error. The calculation error shall be considered as the error between 304 and 301, i.e. the error is less than one percent (1%).

In accordance with our requirements, one hour of the equatorial caesium atomic clock, i.e. 3,600 seconds, shall be set as the standard time interval T. When the equatorial caesium atomic clock has gone forward by 50T (i.e. 1.8×10^5 seconds) after the aircraft completes one circle around the Earth, the measured motion time of the caesium atomic clock on the aircraft to the east should be $50T_3=1.8\times10^5s-59\times10^{-9}s$; while the theoretically calculated motion time of the caesium atomic clock was $50T_3'$ $=1.8\times10^5s-40\times10^{-9}s$. The ratio between the calculated value and the measured value (T_3'/T_3) can be expressed as $\left(1.8\times10^5-40\times10^{-9}\right)/\left(1.8\times10^5-59\times10^{-9}\right)$. Thus it can be seen that, there is a relatively small error between the theoretically calculated value T_3' and the measured value. Therefore, we may consider that, the analysis results are consistent with the experimental results as obtained by J· C· Hafele and R· E· Keating.

The experimental results obtained by J· C· Hafele and R· E· Keating have proved that, the velocity of rotation of the equatorial ground, the aircraft to the west or the aircraft to the east around the Earth's axis should be referred to as absolute velocity; They also demonstrated that the circular motion velocity shall be referred to as absolute velocity; the circular motion time delay as absolute time delay. Moreover, it shows the appropriateness of the method for determining the time interval as per the division of time zones.

Analysis of Time Delay

Suppose that an aircraft's flight velocity reaches up to $\sqrt{3}C/2$, i.e. 260,000 km/s, it seems to the people on the ground that the time interval T' of the aircraft would be consequentially equivalent to $1/2$ of the surface interval time T regardless of the direction in which the aircraft is traveling. This is an incontestable conclusion of special relativity. Therefore, if one of the lights outside the aircraft is on for 1‰ of a millisecond, then the people on the ground will consequentially observe that the light is on for 2‰ of a millisecond, and that the light has trailed a stream of light (260m×2=520m). The similar muon lifetime experiment has proved this conclusion. Since the conclusion on time delay will not be changed as a result of the

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magnitude of the flight velocity of the aircraft, in the experiments conducted by J· C· Hafele and R· E· Keating, people on the equatorial ground are supposed to observe that, the time delay results of the aircraft to the east shall be identical with those of the aircraft to the west. However, the experimental results show that, the time delay results of the aircraft to the east are opposite to those of the aircraft to the west, especially the time of the aircraft to the west, instead of being delayed, speeds up. It is proved beyond doubt that, the relative time delay judged by the people as per the relative velocity is fundamentally different from the real absolute time delay of a moving object. The experimental results obtained by J· C· Hafele and R· E· Keating affirmed the correctness of the method for calculating the absolute time delay as per the circular motion velocity. Moreover, the muon and π meson lifetime experiments have also confirmed that, the relative time delay should be considered as a real observation. How to understand the two seemingly different but truthful judgments?

In connection with any changes in the length of an object, we may understand the above-mentioned two different judgments. As we know, when an object is in motion at a velocity V, the length L of the object along the direction of motion will be shortened as $L' = L\big/\sqrt{1-V^2/C^2}$. We observe that, L' of the object being in motion is real, but the length L of the object is also real without any changes, i.e. both L and L' are real. Observers using different reference systems should obtain such an observation. Changes in time are similar to changes in length. That there is the distinction between relative time delay and absolute time delay with respect to time should also be observed by observers using different reference systems.

Why is there a difference between the observations of the aircraft to the east and the aircraft to the west? The reason is that, the absolute velocity of the aircraft to the west shall be expressed as $V_1 - V$; the absolute velocity of the aircraft to the east shall be expressed as $V_1 + V$.

Changes in length and time are related to the motion velocity observed by the observer. The observer on the equatorial ground being in motion at a velocity V_1 observes that, the relative velocity of the aircraft to the west or the aircraft to the east relative to him cab both be expressed as V; both the length contraction and time delay of the two aircraft are naturally identical. However, an observer not standing on the equatorial ground will not observe that, the relative velocity of the aircraft to the west is identical with the relative velocity of the aircraft to the east relative to him. For example, an observer on the Earth's north or south pole observes that, the relative velocity of the aircraft to the west relative to him is expressed as $V_1 - V$, while the relative velocity of the aircraft to the east relative to him is expressed as $V_1 + V$; both the length contraction and time delay of the two aircraft are significantly different. That is, observers using different reference systems will observe that, the same

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object will be provided with different length contractions and relative time delay, which, though different, shall be both considered as the real observation.

Under normal circumstances, the relative time delay is different from the absolute time delay. However, if an observer is located at the center of a circle of the object being in circular motion or within the stationary area relative to this center of a circle, i.e. the area where the absolute motion of the object has been accepted as mentioned before, then the observer will observe the relative velocity of the object being in circular motion relative to him, i.e. the absolute velocity of the object being in circular motion; the relative time delay of the object shall be referred to as the absolute time delay. For example, the relative time delay of the particle being in circular motion in synchrocyclotron as observed by us shall be referred to as the real absolute time delay of the particle.

The experimental results obtained by J· C· Hafele and R· E· Keating show that, when a stationary object undergoes a motion process before returning back to rest, the rest length and rest mass of the object will not be changed, while the time progress of the moving object is different from the time progress of a non-moving object. (When the aircraft returns to the ground, the time progress of the aircraft's caesium atomic clock is different from the time progress of the ground caesium atomic clock). Also, such changes in time progress shall be related to the motion history of an object, e.g. the aircraft's flight direction, velocity, flight time, etc.

Based on the foregoing analyses, we can easily calculate the corresponding time process with respect to different motion histories of an object. For example, according to the time standard of one hour (as expressed in h) relative to the Earth's axis, we can leave a clock at the terrestrial latitude (45°) on the Earth for n_1h, then on the Moon for n_2h and then on the Sun's x planet for n_3h, and then return it to the ground. According to the above motion history, we can calculate the cumulative absolute time process of this clock as per the following formula:

$$\left(n_1\sqrt{1-0.2153/2C^2}+n_2\sqrt{1-V_m^2/C^2}+n_3\sqrt{1-V_x^2/C^2}\Big/\sqrt{1-V^2/C^2}\right)h$$

We can give a very simple and clear explanation of the twin paradox problem. For example, twins A and B can be placed at two locations with an absolute time interval of T_A and T_B; if T_A is less than T_B, i.e. the time motion velocity of time zone T_A is slow, when A and B meet each other at one location after a period of time, A will inevitably become younger than B; on the contrary, if T_A is greater than T_B, B will inevitably become younger than A. Taking the experiment conducted by J· C· Hafele and R· E· Keating as an example, suppose B is located on the equatorial ground, when A travels by aircraft to the east around the Earth and then returns to the ground to meet B after a period of time, A will inevitably become younger than B; however, when A travels by aircraft to the west around the Earth and then returns to the ground to meet B after a period of time, B will inevitably become younger than A.

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Maximum Absolute Time Delay

By using the synchrocyclotron, human beings can accelerate the absolute velocity of particles so as to be close to the speed of light, so as to extend the life of particles by dozens of times. However, for an object with a certain mass, even only with one gram of mass, human beings have not yet accelerated the velocity of such object so as to be close to the speed of light; it is more difficult to accelerate the velocity of an object with one gram of mass to 0.1C than to send a one-ton-heavy-object to the moon. However, It can't be ruled out that, along with progress of technologies, it is possible for human beings to accelerate the velocity of heavy objects so as to be close to the speed of light. So, there is a traveling theory that human beings might extend their life by several times by taking a spacecraft with a velocity close to the speed of light. However, from theoretical analysis, time travel should be impossible.

As previously described, only an object being in circular motion can be provided with absolute velocity and absolute time delay; moreover, only the circular motion can be provided with the eternally unchangeable state of moving in cycles. For example, the motion of the Moon and the Sun's planets are eternal. The linear motion can only be provided with the relative velocity and relative time delay, going away forever, infinitely apart from an starting point as time goes on, that is, unrelated to the time travel of human beings. Therefore, when discussing the time delay, we will only analyze the situation of the circular motion .

By using a synchronization, the motion velocity of particles can be accelerated so as to be close to the speed of light; however, when the human travels by spacecraft, it is impossible to achieve a high-speed motion in the corresponding synchrocyclotron. The main reason is not that it is difficult to make a magnificent spacecraft synchrocyclotron, but that human beings can not bear the centrifugal force generated in such high-speed circular motion.. Calculations show that, if the human has reached a motion velocity of one ten thousandth of the speed of light (i.e. V=30km/s; the mass of the human can be taken as per 50Kg; the radius of the synchronization is assumed as 50km), the centrifugal force to be borne by the human will be up to 90,000N [equivalent to 1,800 times of a human's gravity (about 500 N)]. It is very difficult for the human to bear such a large centrifugal force.

Since the universal gravitation between planets in the universe (its mass being expressed as M) can counteract the centrifugal force generated in circular motion, a realistic approach for human beings to obtain the absolute velocity and absolute time delay is by traveling around the planet in spacecraft, Assuming the mass of a human being is m, the radius of rotation of m around M is R, and the velocity of rotation is V, then the centrifugal force mV^2/R will be inevitably equivalent to the universal gravitation GMm/R^2 (G-gravitational constant) when the rotation of m around M reaches a stable equilibrium state. It can thus be obtained:

$$V = \sqrt{GM/R} \quad (7)$$

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However, formula (7) only applies to the object being in low-speed motion. If the velocity of rotation of the object is high, formula (7) shall not apply. The main reasons are as follows:

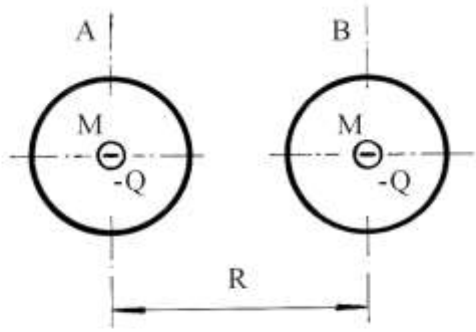

Fig. The gravitational mass of an object being a constant unrelated to motion.

As shown in the Figure above, both object A and B have the same mass M, carry the equivalent negative charge -Q; the distance between them is set as R. If the mutual gravitation between A and B happens to be equivalent to the repulsive force mutually generated by the negative charge -Q contained in them, A and B shall be in an equilibrium state. The distance between object A and B is constant without any changes.

It appears to another observer being in motion at any arbitrary velocity V that A and B shall be inevitably in an equilibrium state; he will not see A and B come into collision with or gradually separate from each other. The only possibility which meets this condition is that, the observer also observes that, the universal gravitation between A and B is equivalent to the electrostatic repulsion between A and B. Experiments have demonstrated that, when an object is in motion, its carried charge will remain unchanged. Therefore, only if the gravitational mass is also independent of the motion of an object, the universal gravitation between A and B can be identically equivalent to the electrostatic repulsion between A and B. Thus, we can inevitably draw the following conclusion: as with the carried charge, the gravitational mass can also considered as a constant unrelated to the motion of object.

Experiments have demonstrated that, the inertial mass of an object is related to its motion velocity of, i.e. $m' = m\big/\sqrt{1-V^2/C^2}$. Where, m represents the rest mass; it can be assumed that the rest mass is equivalent to the gravitational mass. Therefore, in the case of circular motion of an object, the centrifugal force formula shall be changed into $m'V^2/R = mV^2\big/R\sqrt{1-V^2/C^2}$; replace this formula with the centrifugal force formula of equation (7), and we will get:

$$\frac{V^2}{\sqrt{1-V^2/C^2}} = \frac{GM}{R} \qquad (8)$$

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Solve equation (8), and we can get the (real root):

$$V=\frac{1}{\sqrt{2}}\sqrt{-\frac{G^2M^2}{C^2R^2}+\sqrt{\frac{G^4M^4}{C^4R^4}+4\frac{G^2M^2}{R^2}}} \tag{9}$$

It can be seen from equation (8) or (9) that, in order to increase the velocity of rotation of a spacecraft around the planet, it is necessary to select the planet with large M and small R. Obviously, the black hole is the optimum selection. According to the black hole theory, for a black hole about the same size as a football field, i.e. a spherical black hole with a diameter of 120m; its mass can be up to 4 times that of the Sun. Accordingly, it can be calculated from equation (8) or (9) that, the velocity of rotation of a spacecraft around the black hole can be up to 0.999C; [if calculated as per equation (7), the velocity of rotation of the spacecraft around the black hole can be up to 10C]. This shows that, the black hole should be considered as the optimum planet where the human beings can achieve time travel by spaceship. However, it can be seen from further analysis that, the black hole is unlikely to be a kind of real substance. There are two main reasons:

As explained above, the gravitational mass of an object is unrelated to the motion of the object, while the inertial mass of an object is related to the motion of the object. This shows that, the gravitational mass and inertial mass of an object should belong to different categories of physical quantities; both are unlikely to be equivalent to each other. Suppose that the gravitational mass is equivalent to the inertial mass, i.e. the equivalence principle is the basis of general relativity, then the equivalence principle fails to be tenable, and the general relativity naturally fails to be entirely true. Only when the motion velocity of an object relative to the speed of light is very small, for instance, the Sun's planets, satellites or other stars generally have a motion velocity of less than one ten thousandth C, and there is a numerically constant proportional relationship between the gravitational mass and inertial mass, then can it be considered that the inertial mass is equivalent to the gravitational mass. In such case, the equivalence principle is tenable; the judgment on the general relativity is naturally realistic, e.g. it is practical to judge the Mercury's perihelion precessional motion, GPS positioning and other factors according to the general relativity. However, when the motion velocity of an object is very high, there will be a bias with judgment using the general relativity; It was natural for the black hole to be divorced from reality, which is inferred under high-speed conditions according to the general relativity. It can be imagined that, if the gravitational mass is equivalent to the inertial mass, when the motion velocity of an object is close to the speed of light, the gravitational mass of the object will become extremely huge, resulting in the creation of the black hole; the equivalence principle fails to be tenable; the gravitational mass becomes constant; so certainly the black hole would not exist.

Another reason is that, according to the black hole theory, for a black-hole sphere with a diameter of 120m, its mass is equivalent to the total mass of four suns, i.e. the total mass of 1.3 million earths, while the Earth's volume is 10^{15} times greater than that of the black-hole

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sphere with a diameter of 120m; in other words, the density of black-hole matter is 10^{21} times greater than that of the Earth; it means that, the mass of a black-hole matter about the same size as a grain of rice should be greater than 1000 times the total mass of all persons on the Earth (taking the average mass of a person at 50kg). It is well-known that, all the matters in the universe consist of several elements among the 118 kinds of elements known. So far, no other cosmic matters have been found to make an exception yet.

However, according calculations based on the density of black-hole matter, the atomic size of black-hole matter is only equivalent to $1/10^{21}$ of the atomic size of matter on the Earth. This is clearly impossible. The reason is that, if we assume that the black hole is also composed of atoms, after all atoms of the black hole are collapsed, all the electrons around such atoms fall on protons and change them into neutrons, and these neutrons are also gathered together to become a large-sized neutron, then the volume of such a large-sized neutron will be one million times greater than the theoretical volume of the black hole. Obviously, there is no possibility of such atoms in reality. Thus, it can be concluded that, it is impossible for the black hole to be composed of real atoms, that is, it is impossible for the black hole to exist as a real matter.

The possibility of the black hole as an existence of real matter can be ruled out. In the current astronomical observations, only fixed star A1 has a large mass but not too large radius; the mass of fixed star A1 is equivalent to 150 times that of the Sun; its diameter is equivalent to 114 times that of the Sun (Reference 4). Suppose that any other human beings (similar to earth humans) live on the planet adjacent to the fixed star A1, and also a spacecraft can fly around the stellar surface, then the calculated velocity of the spacecraft can be up to 501km/s; the obtained absolute time delay is up to 271 seconds each year. Obviously, this maximum absolute time delay is far from meeting the requirements for time travel.

CONCLUSION

From the above analysis, the time delay can be divided into two types, including relative time delay and absolute time delay. The relative time delay is real delay as is the absolute time delay. Relative time delay refers to an observation obtained when an observer observes the time variation of another reference system being in motion from a reference system; absolute time delay refers to a real time delay of an object being in circular motion. The outstanding experiments conducted by J· C· Hafele and R· E· Keating have not only provided a reliable evidence for the existence of absolute time delay, but also served as a valuable reference for the explanation of various phenomena related to time delay . The only way for human beings to obtain real time delay is by making circular movement around a celestial body in an spacecraft. Strictly speaking, since the equivalence principle fails to be tenable, it is impossible for the black hole to exist as a real matter. As a result, the time delay (271 seconds each year) obtained in traveling around fixed star A1 by spacecraft shall be considered as the maximum absolute time delay obtainable by human beings.

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