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Article

A Possible Explanation for the Twin Paradox and Action at a Distance — The Relative Independence of Space and the Absoluteness of Simultaneity

Sheng Qin

Southwestern University of Finance and Economics,China,610000; qinsheng@smail.swufe.edu.cn

Abstract: This paper is mainly based on a stricter premise of the twin paradox and the assumption of inertial frame, discusses the properties of time and space under the premise of complete symmetry, and draws an interesting conclusion: the simultaneity of different reference frames is possible realized, and the space is relatively independent. And based on this, the twin paradox, cosmic inflation, ultra-distance action of quantum entanglement, microscopic space motion of particles, measurement problems and other phenomena are tentatively explained from a new angle. This interpretation is exploratory and new. At the same time, the author also proposes an experimental way to test the relative independence of space.
At the same time, this paper attempts to strictly prove that Einstein's definition of simultaneity and spatial absoluteness in special relativity may be problematic.

Keywords: the absoluteness of simultaneity; the relative independence of space; special relativity; the problem of measuring; the action at a distance ;cosmic inflation

1. Introduction

Einstein once said that solving the twin paradox is beyond the scope of special relativity [1]. Although particle decay in cosmic rays can prove the clock slowing effect to a certain extent [2] [3], the twin paradox still puzzles many physicists. For example, "Meng Guangda" and others believe that it is impossible to solve the twin paradox within the scope of special relativity [4]. And "Qian Shangwu" once mentioned a method when analyzing this problem, that is to use the time transformation of different reference frames to explain [5], the premise of which is still the asymmetry of the movement process. For example, Muller first solved this problem in 1972, and its premise is still based on an asymmetric reference frame [6].

However, this paper hopes to set the premise of the twin paradox more strictly, and discuss it on the basis of complete symmetry. Based on this, we will infer a different conclusion from the past, that is, simultaneity in different reference frames can be established. In addition, we also deduce another interesting conclusion, which is that the spaces seem to be relatively independent.

Although we have many experiments in the past to confirm the unity of the inertial frame space [7] [8], the method proposed by the author in this paper is unique and is based on a detection method between different inertial frames.

The author found that these two conclusions can be used to explain many phenomena, such as: twin paradox, quantum entanglement at a distance, cosmic inflation and other phenomena. The authors believe that this tentative explanation is possible.

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2. Another tentative explanation of simultaneity and space in special relativity

2.1. A new tentative interpretation of "simultaneity" in Einstein's special theory of relativity

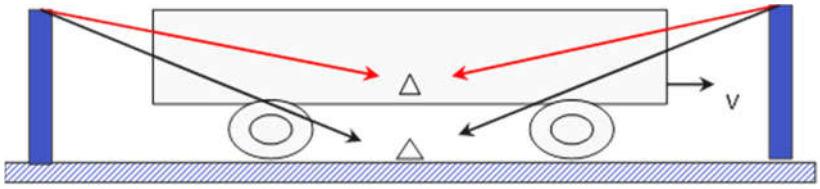

Figure 1. Einstein train experiment.

As shown in Figure 1 above, this is the description of the concept of simultaneity in the classic Einstein thought experiment[9]. The train moves in the direction of the X-axis at a speed V, and a beam of light is emitted from both ends of the platform at the same time. To an observer at the midpoint on the platform, the two beams appear to arrive at the same time; however, to a person on the train, the light in front of the movement will arrive before the light behind. Therefore, Einstein considered simultaneity to be relative[9].

However, what this article should point out is: if the speed V of the train relative to the ground is known, then the people on the train can actually calculate and correct the "phenomenon" that the lights on the platform arrive successively. A person can correct the so-called "simultaneity" confusion by eliminating the time difference between the arrival of the two beams of light before and after. After the correction, the people on the train will also realize that the two beams of light shine at the same time.

If the person on the train sees that the time of arrival at the speed of light in front is t_0, the distance from the light-emitting point of the front platform is L_0 when it arrives; the time of arrival at the speed of light behind is t_1, and the distance from the light-emitting point of the rear platform when it arrives is L_1, the train and the ground the relative motion speed is v.

Then, after calculating the moment when the platform ahead is illuminated is: $t_0 - \Delta t$, where $\Delta t = \frac{L_0}{c}$;

The moment when the rear platform glows is: $t_1 - \Delta t'$, where $\Delta t' = \frac{L_1}{c}$;

After the correction, the people on the train actually looked like the lights on both ends of the platform happened at the same time, that is: $t_0 - \Delta t = t_1 - \Delta t'$.

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2.2. A new tentative explanation for the cognition of space in the special theory of relativity

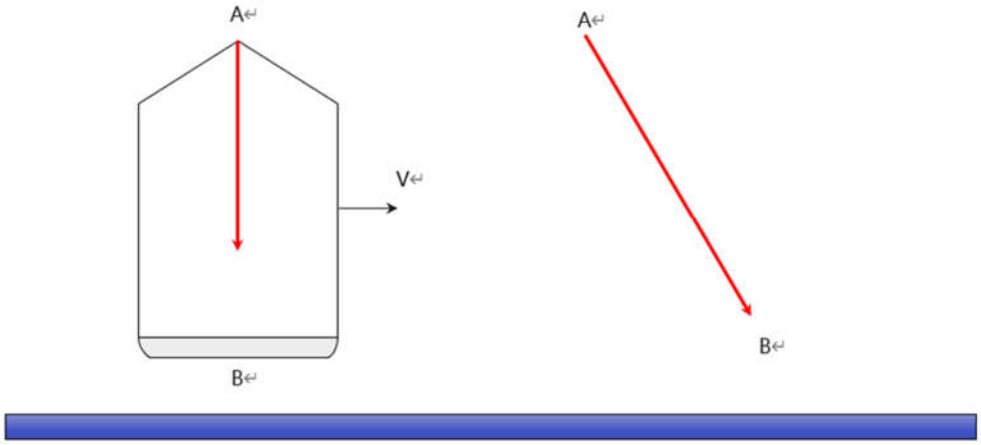

Figure 2. Light speed trajectories seen in different reference frames.

As shown in Figure 2 above, an object moves at a constant speed relative to the ground along the X-axis direction at a speed V, and a beam of light is emitted from point A to point B inside the moving object. It is assumed that the observation system of the moving object is the S' system, and the ground coordinate observation system is the S system.

In the eyes of the observer of the S' system, the beam of light is moving in a straight line from A to B, and the moving distance is the straight-line distance between AB and the speed is the speed of light C; but in the view of the S system, the beam of light is actually moving obliquely (right side of Figure 2).

According to the principle of the constant speed of light, the observer of the S system requires the time of the S' system to slow down, otherwise there will be a dilemma of superluminal speed.

What this article wants to amend is: In fact, the S system and S' system spaces are relatively independent.

For the observer of the S system, unless it enters the "space" of the moving object S' system, this beam of light is "invisible" to the system S.

For the S system observer, this beam of light is "invisible" to the S system unless it enters the inertial frame of the moving object S' system. An observer of the S system wants to see the propagation process of a beam of light on the S' system, the premise is that the observer of the S system must first observe the beam of light, and the premise of the observation is: either this beam of light is observed in the S system, so the beam of light and the matter of the inertial frame of the observer has acted; or the observer of the S system enters the S' system to observe.

Therefore, the so-called "speed of light is constant", the premise is that the speed of light is measured in an inertial frame. Any measurement of the speed of light requires at least two points in the inertial frame as references. Therefore, it is not permissible to say: "In the same time, the beam of light travels longer than the S' system in the view of the S system" without making a measurement.

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2.3. The twin paradox explained by the special theory of relativity

We know that the current theoretical explanation for the twin paradox mainly focuses on the asymmetry between the two reference frames. Many articles will explain that the process of "rocket acceleration" causes this time difference[10].

However, we can redesign the twin paradox experiment to better illustrate that the "accelerating process" is not the cause of the slowdown:

Suppose that A and B are exactly the same rigid body, and two clocks with the same structure are placed on them and the initial positions of the clock hands are the same. After the two sides are accelerated with the same force (which can be accelerated by the spring connecting A and B), the relative motion speed of A and B becomes V. The two parties agree that at a certain "time t" of the clock, A and B will decelerate and return in a certain set of the same program, and finally decelerate in the same way to reach a relatively stationary state.

In such an experiment, all the motion processes of objects A and B are completely symmetrical.

According to special relativity, when A and B return to their final state of relative rest, A will see the clock on B slow down; B will also see the clock on A slow down.

If a ground observer is the third observer relative to A and B, it will be found that the whole motion process of A and B is completely symmetrical, including the position of the clock hands. In the whole process, we can not find that A or B have any unique advantages in the process of motion relative to each other, so it is difficult for us to explain the dilemma of "clock slowing down" in special relativity.

Therefore, the dilemma of twin paradox is real and can not be eliminated by the difference of acceleration process.

3. Defining Time, Space and Simultaneity in Inertial Frame

3.1. Inertial system

We assume that the physical laws of any inertial system are the same, which is actually equivalent to assuming that the physical laws of the interaction between identical substances in any inertial system are the same.

For example, we assume that electrons, protons and neutrons are identical particles, and the physical relationship between the nucleus, the interaction between the nucleus and the extranuclear electrons, mass and energy is the same in any inertial system.

In any inertial system, we can use a certain fixed-energy photon as a basis to define a unified standard of physical units such as energy, mass, length, and time. For example, we can use a certain known hydrogen atom energy level corresponding to a photon of frequency ω to uniformly define 1 second in any inertial frame as the time corresponding to the photon of this energy level oscillating ω times; at the same time, we can use the wavelength of the photon defines the unit of length; the energy of the photon defines the unit of mass, and so on. We first think that, in all inertial systems, the physical units such as time, space, length, energy, etc., which are uniformly defined in this way, are consistent, and the physical laws derived from such uniformly defined units are consistent.

First of all, we believe that in all inertial systems, the physical units of time, space, length and energy defined in this way are consistent, and the physical laws derived from the units defined in this way are consistent.

For the non-inertial system, if we can calculate the influence of non-inertial factors (such as gravitational field, electromagnetic field, acceleration, etc.) on the mass, energy and length of these basic identical particles, then we can also consistently define the basic physical quantities such as time, length and mass in the non-inertial system.

Hidden behind the assumption that the laws of physics are the same in all inertial frames, we will find that there is a more profound prerequisite: **the relative independence of space**.

That is to say, the space of the inertial system must be relatively independent. If the space of the inertial system is not independent and is affected by the relative motion state

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with other inertial systems (such as relative motion speed, relative distance, etc.), then these variables will undoubtedly directly affect the relationship between all substances in the inertial system. Unless this action is completely proportional and linear to the physical relationship between all substances in the inertial frame, it will be difficult for us to obtain the property of "the physical laws of all inertial frames are consistent".

3.2. Defining time and length

According to the previous definition, we can define the time and length in different inertial frames uniformly:

(1) The unified definition of time and length in different inertial frames is based on the frequency and wavelength of some identical photons.

(2) Then, we can infer that the corresponding lengths of two rigid rulers with the same structure in two different inertial systems should be the same (the results measured in different inertial systems with the lengths defined above should be the same), otherwise, different physical laws are needed to explain the differences, which will violate our assumption of inertial systems.

(3) In any non-inertial system (acceleration field or gravitational field), after fully considering the influence of acceleration or gravitation, we define the time and length on this basis, and the same physical quantities such as mass, length and time should be the same.

Definition: Simultaneity. The simultaneous occurrence of two events means that in two reference frames S and S', respectively, at some instant t and t', a beam of light is emitted towards their midpoint, they arrive at the midpoint at the same time after taking into account the influence of the symmetry or asymmetry of space. Then we say that the t time in the S system and the t' time in the S' system occur at the same time.

4. The proof of the absoluteness of simultaneity and the relative independence of spaces

4.1. for two reference frames kept relatively stationary

We assume that there are two relatively stationary reference frames S and S' (eg, two relatively stationary inertial frames, two relatively stationary objects in a gravitational field), As shown in Figure 3 below:

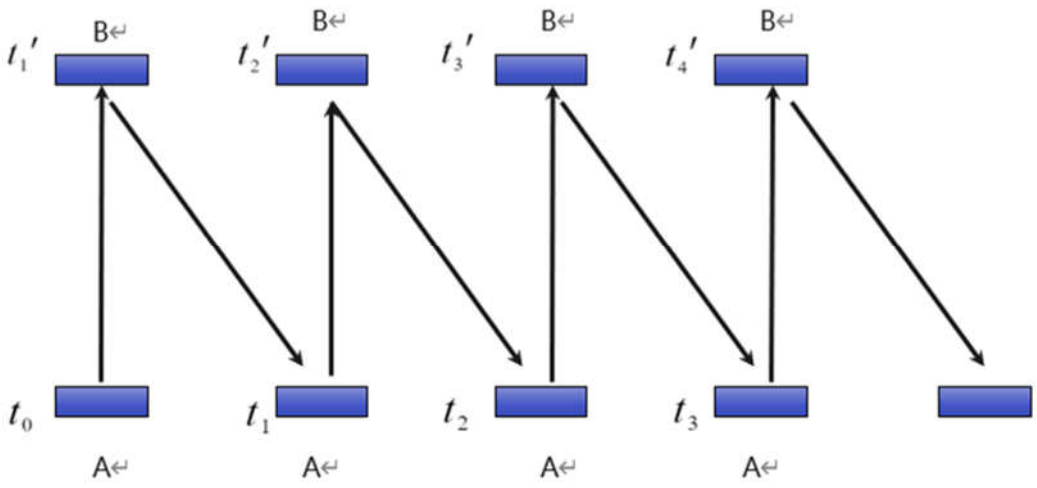

Figure 3. Light beams reflected back and forth in a still system.

Send a beam of light from point A in the S frame to point B in the S' frame, and let the beam bounce back and forth.(Note that we do not need to assume that the speed of light c is the same back and forth, nor do we need to assume that the speed of light in

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the S system and the S' system is the same, just need to ensure that the back and forth reflected photons return to the initial state with the same frequency, because the path is repeated)

Assume that the "local" time of the S or S' system corresponding to the "moment" of each photon being reflected is: t_0、t_1'、t_1、t_2'、t_2、t_3'、t_3、.....、t_n'、t_n, as shown in Figure 3.

We assume: $t' = f(t)$ is the time transformation function between S and S' series.

Conclusion 1: We first prove that $t' = f(t)$ it's linear.

Proof: Suppose that in the view of the S system, it takes time Δt_1 to travel from A to B at the speed of light, and it takes time Δt_2 to return from B to A. The corresponding in S' it appears that the time required to go from A to B and from B to A is respectively $\Delta t_1'$ and $\Delta t_2'$, then there is the following relationship:

$$t_1' = f(t_0 + \Delta t_1)$$
$$t_2' = f(t_1 + \Delta t_1) = f[t_0 + (\Delta t_1 + \Delta t_2) + \Delta t_1]$$
$$t_3' = f(t_2 + \Delta t_1) = f[t_0 + 2(\Delta t_1 + \Delta t_2) + \Delta t_1]$$

.....

$$t_n' = f(t_{n-1} + \Delta t_1) = f[t_0 + (n-1)(\Delta t_1 + \Delta t_2) + \Delta t_1]$$

Due to the S' it seems that $t_2' - t_1' = t_3' - t_2' = ... = t_n' - t_{n-1}' = \Delta t_1' + \Delta t_2'$.Therefore, the left side of the equation is linear, and the variable relationship on the right side of the equation is also linear, and the time interval of the two coordinate systems $\Delta t_1' + \Delta t_2'$ and $\Delta t_1 + \Delta t_2$ is a linear relation, so that $t' = f(t)$ it's linear.

Prove it.

Therefore, we can further assume that the linear relationship of the time function between the S system and the S' system is: $t' = kt + b$, in fact, if it is a real physical experiment, we can immediately obtain the coefficients b and k through the experimental data.

Conclusion 2: Prove K = 1.

Prove:

First, according to the assumption of inertial frame, the mass-energy equation in any reference frame $E = mc^2$ and Planck formula: $E = h\omega$ （ω is the photon frequency), and it can be verified that identical substances have the same mass (such as electrons, protons, neutrons, etc.).

We assume that the times of the S and S' system have been uniformly defined in the manner described above, due to $t' = kt + b$, so according to our previous definition of time, if K < 1, according to the definition of simultaneity, means that 1 second has passed in the S system, and S' no more than 1 second has elapsed. It also means that photons of the same energy vibrate in the "1 second" time in the S system ω times, but at the same time S' it only vibrated in the system $k\omega$ times.

However, in the above thought experiment, the time corresponding to the propagation process of the photon in the view of the S system and the S' system is respectively Δt_1 and $\Delta t_1'$、$\Delta t_2'$ and $\Delta t_2'$, the corresponding photon propagation path $A \to B$ and $B \to A$ it's exactly the same. Then it means that no matter the photon is in

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the S system or the S' system, the number of vibrations n of the photon in the propagation process of $A \rightarrow B$ and $B \rightarrow A$ is the same.

Then it means that no matter from the point of view of the S system or the S' system, Δt_1 and $\Delta t_1'$, $\Delta t_2'$ and $\Delta t_2'$ are corresponding to the photons of the same energy vibrating the same number of times n, so according to our previous definition of time, we will get the following conclusion: $\Delta t_1 = \Delta t_1'$, $\Delta t_2' = \Delta t_2'$。

Thus, K = 1.

Prove it.

(Note: The above conclusion is not affected by whether the photon is in the gravitational field or the acceleration field, and whether it produces gravitational redshift. Because the number of times a photon oscillates during its propagation does not change whether it has a gravitational redshift or not)

Conclusion 3: In any relatively stationary frame of reference, we only need to properly adjust the positions of the hands of two identically constructed clocks to obtain a series of simultaneous clocks with exactly the same hands everywhere.

This is not only suitable for the inertial frame, but also for the two relatively static reference frames in the gravitational space, and for the acceleration frame in the relatively static state.

4.2. Proof for two reference frames in relative motion

4.2.1. Complete symmetry

After two rigid bodies A and B with the same structure obtain the same acceleration process (for example, a spring is used to connect the two ends of A and B to obtain acceleration), the relative motion speed of A and B becomes V, and the motion direction is the X-axis direction (the X-axis direction of A is the same as that of B).

According to symmetry, we should not think that either A or B has a relative advantage, for example, that A's time is faster than B's time, or that A's length shrinks in the direction of motion relative to B.

From our conclusions in the static system, we can obviously place a series of equidistant clocks on both A and B along the direction of their motion with the same positions of the clock hands. From the perspective of the A system, the positions of the clock hands on the A system are completely synchronized and strictly simultaneous; from the B system, the positions of the clock hands placed on the B system are also completely synchronized and strictly simultaneous.As shown in Figure 4 below (assuming that A moves to the left and B moves to the right after acceleration):

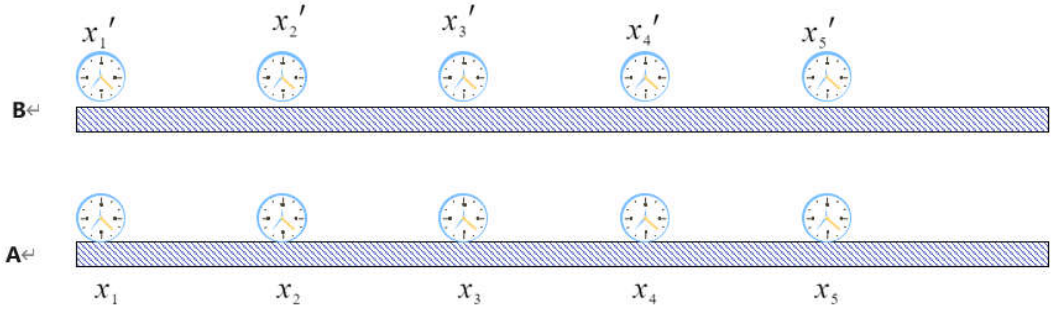

Figure 4. Symmetrically accelerated rigid body and clock.

It is assumed that the coordinate positions of these clocks in their respective coordinate systems are:

$A: x_1\ x_2\ x_3 \ldots\ldots\ x_n$

$B: x_1'\ x_2'\ x_3' \ldots\ldots x_n'$

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Their intervals are equal in their respective reference systems, and the intervals of these clocks are equal when comparing system A and system B in the static state, that is:

$$x_2 - x_1 = x_3 - x_2 = \ldots\ldots = x_n - x_{n-1}$$

$$x_2' - x_1' = x_3' - x_2' = \ldots\ldots = x_n' - x_{n-1}'$$

And: $X_2 - X_1 = X_2' - X_1'$

We assume that after A and B are accelerated, the coordinate origins of A and B systems coincide at time t_0, and X_1 and X_1' are exactly at the positions of A and B systems where x=0. At this time, the positions of all clock hands on A and B are time t_0.

Assuming that the coordinates of X_2' and X_1 coincide exactly after Δt (at this times X_3' and X_2 coincidence,……, X_k' and X_{k-1} coincidence) in the view of the A system, the distance A runs relative to B within the time Δt is $\Delta t \cdot v$. Since the "coincidence" is a fact, the event will only happen once at a certain time, either from the A system or to the B system point of view. Then we can obviously conclude that at some time in the A-system $t_0 + n\Delta t$, (n=0,1,2,3,……), $x_1\ x_2\ x_3 \ldots\ldots\ x_n$ will coincide with $x_1'\ x_2'\ x_3' \ldots\ldots\ x_n'$ they are overlapped with each other in turn (it is necessary to move the corresponding position sequence).

We assume that the time and length functions between the A and B systems are:

$$t' = f(t),\ L' = g(L)$$

Then by symmetry one has:

$$t = f(t'),\ L = g(L')$$

Therefore, every time the clocks of A system and B system coincide, we can see that the positions of the clock hands on the two coordinate systems are the same by comparing the clocks on A system and B system.

At the same time, if the coordinate points corresponding to two clocks are at a certain time $t_0 + n\Delta t$ they do not coincide, the relative velocity of motion will not be equal to V.

For example, if t_0 moment X_1 and X_1' coincidence, and t_0 moment X_2 and X_2' do not coincide, then when passing through Δt time, according to the assumption of uniform motion in the $t_0 + \Delta t$ the moment we will see X_1 and X_2' coincidence. But because t_0 moment X_2 and X_2' do not coincide, then calculate at this time X_2' at Δt the velocity of motion in time will get not V.

Therefore, we have the following important conclusions:

Conclusion 4: The relative length of A and B in the direction of motion is practically unchanged.

Conclusion 5: Since the lengths of inertial frames A and B correspond to the number of photon vibrations and the propagation distance of a certain frequency, it can be inferred that the clock trends of the two reference frames A and B are completely synchronous and strictly simultaneous.

4.2.2. For two non-symmetrical bodies C and D with relative velocity V

We can construct two identical rigid bodies, A and B, that are initially at rest relative to each other and have the same velocity and opposite directions relative to C and D, respectively (for example, V/2 relative to C and -V/2 relative to D). As shown in Figure 5 below:

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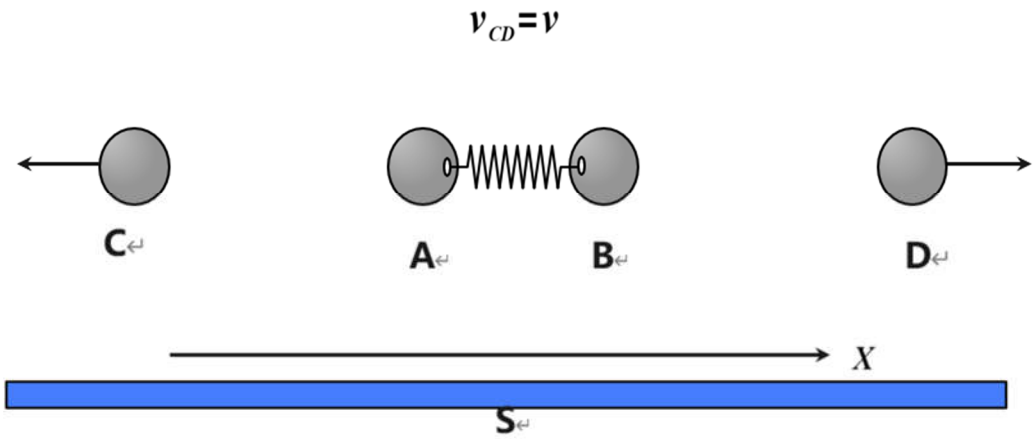

Figure 5. Objects in asymmetric relative motion.

Then make A and B perform symmetrical acceleration motions in two directions, respectively. After acceleration, A remains stationary relative to C, and B remains stationary relative to D.

At this time, because A and C are relatively static, according to our previous conclusion in the static system, the clock hands between them will be completely synchronized and strictly simultaneous after adjustment. The same is true for B and D.

According to the conclusion of the above thought experiment in the moving frame, both length and time between A and B are symmetrical and equal.

Then it means that the clocks between C and D are also perfectly synchronized. If C and D are rigid bodies in an inertial frame, their lengths in the direction of motion will also be exactly the same.

Conclusion 6: Whether it is a static system or a dynamic system, the simultaneity in the inertial system is strictly established, and there is no effect of relativistic time slowing down; the lengths are also absolutely equal, and there is no effect of length contraction in the direction of motion.

Even in the non-inertial system, these conclusions are still valid when we fully consider the influence of non-inertial factors.

5. Interpretation of relative independence of space and design of experimental test

Let's take the thought experiment of two identical rigid bodies, A and B, moving at a relative velocity of V. We have previously proved the equality of length and time. Then we assume t_0 moment X_1 and X_1' at exactly the same position (X axis coordinates coincide), in the t_0 moments from A and B, respectively X_1 and X_1' the coordinate positions emit a beam of light to the front at the same time, Δt after that (the time of the two coordinate systems is consistent), the beam of the A system arrives X_p, the beam arrival of the B system X_p', as shown in Figure 6 below:

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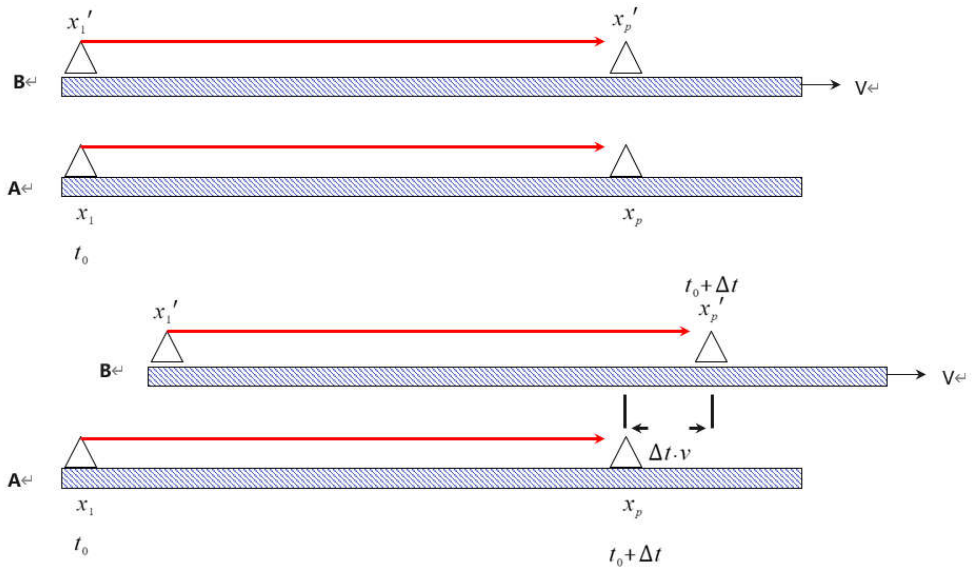

Figure 6. Experimental test of spatial relative independence.

$t_0 + \Delta t$ moment, X_p' and X_p at a distance of $\Delta t \cdot V$,that is to say, there is actually what we call "superluminal" phenomenon. Suppose we place a mirror at X_p' to reflect the beam from the B reference frame to a point in the A reference frame immediately adjacent to X_p' (ignoring the distance between the two reference frames), then we can find that when the light of the A system reaches X_p, the light of the B system will reach $X_p + \Delta t \cdot V$ at the same time after being reflected by the mirror, and the two beams of light will arrive at the time $t_0 + \Delta t$ at the same time.

The reason is not because of the "superluminal" phenomenon, but because of the relative spatial independence of A and B.

The above thought laboratory can be tested by experiments. We can indeed emit the same beam of light to the B reference system through the relative independence of space, then reflect it forward through the mirror of the B reference system, and finally reflect it back to the A reference system through the mirror after reaching a certain point.

As long as the relative velocity of A and B is large enough, we can get a very significant "superluminal" effect.

(Note: Up to now, the author has not found any scientists who have done similar experiments.). Our previous experiments to measure the speed of light were based on the same inertial frame.

6. Applications of the Absoluteness of Simultaneity and the Relative Independence of Space: Explanation of Quantum Entanglement, Supergiant Interaction, Cosmic Inflation, Newton's Bucket Experiment and Mach's Principle, Measurement Problem

6.1. Quantum Entangled State Problem and Action at a Distance

It is precisely because of the relative independence of space that two quanta are allowed to be in an independent entangled state.

Measurement means the destruction of the independent space of the entangled state, and also means the unification of the space where the entangled particles are located and the observation space where the measurement is located. Before the measurement, we can think that the entangled particles are in a relatively independent space.

If the space does not have relative independence, it is impossible for us to separate two entangled particles without affecting the measured entangled particles.

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As for the action at a distance of entangled particles, in fact, it will be explained naturally after we strictly prove the "absoluteness of simultaneity". The "absoluteness of simultaneity" guarantees the instantaneous conservation of energy, momentum and angular momentum between two particles.

Conversely, if there is no "absolute simultaneity" as a guarantee, the relative independence of space will not be guaranteed. Because the conservation of energy and momentum between substances caused by the relative independence of space can only be guaranteed by absolute simultaneity.

6.2. The problem of particle orbits in atoms

At present, we use the uncertainty principle to answer the question of particles at the microscopic level. The premise of the assumption is that we have always believed that the space-time of microscopic particles is unified with the space-time of our observers. Only in a unified space-time can we uniformly specify the position, velocity and other information of particles.

However, if particles are relatively independent in space in the microscopic field, we will not be able to predict their state in independent space before observation, including speed, position and other information. Before observation, we can not define the position, velocity and other information of a particle in another independent space unless we measure it.

6.3. A Thought Experiment on the Expansion of the Universe

We assume that there are objects A_0、A_1、A_2、A_3、……、A_n,objects are moving along the X axis, and there is a lens on each object. Among A_1 relative A_0 has a velocity V, A_2 relative A_1 has a velocity V, A_k relative A_{k-1} the velocity of is V, and so on, the velocity of the latter object relative to the former object is V, as shown in Figure 7 below:

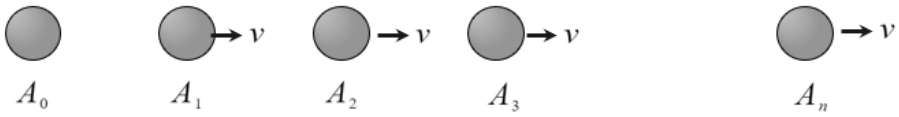

Figure 7. Cosmic inflation thought experiment.

(Note: The velocity V marked in the figure refers to the relative velocity of the previous object, not to the observer.)

We assume that $nv > c$, with c the speed of light. Then we will get the following conclusion: A_0 and A_n the space between them will expand faster than the speed of light.

If a beam of light starts from A_0 and passes through the lenses on A_1、A_2…… until there is a mirror on A_n, and then reflects the beam back in the same way.

For the sake of simplicity, let's assume that there are only A_0、A_1、A_2、A_3 these four bodies, they are moving at C/2 relative to the previous body, that is A_1 as opposed to A_0 moving at C/2, A_2 as opposed to A_1 moving at C/2, A_3 as opposed to A_2 moving at C/2, where C is the speed of light.

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We assume that a beam of light is emitted from A_0 to A_1 at time t_0, and the distances between A_0 and A_1, A_2 and A_1、A_3 and A_2 are all L_1 at time t_0.This beam of light from A_0 to A_1 the time required for propagation is $\frac{L_1}{c-v}=\frac{2L_1}{c}$; the time at which the speed of light reaches A_1 is $t_1=t_0+\frac{2L_1}{c}$. t_1 moment A_1、A_2 the distance is $L_2=L_1+\frac{2L_1}{c}\cdot\frac{c}{2}=2L_1$. The time required for the beam to go from A_1 to A_2 at time t_1 is $\frac{L_2}{c-\mathrm{v}}=\frac{4L_1}{c}$;Therefore, the time when the beam reaches A_2 is $t_2=t_1+\frac{4L_1}{c}$, and the distance between A_2 and A_3 is $L_3=L_1+\frac{2L_1}{c}\cdot\frac{c}{2}+\frac{4L_1}{c}\cdot\frac{c}{2}=4L_1$; the time required for the beam to start from A_2 to A_3 at time t_2 is $\frac{L_3}{c-v}=\frac{8L_1}{\mathrm{c}}$, and the time when the beam reaches A_3 is $t_3=t_2+\frac{8L_1}{c}$. When the beam reaches A_3, we assume that the distance between A_3 and A_2 at t_3 is $L_{23}^{t_3}$, the distance between A_2 and A_1 is $L_{12}^{t_3}$, and the distance between A_1 and A_0 is $L_{01}^{t_3}$, then we have:

$$L_{23}^{t_3}=L_{12}^{t_3}=L_{01}^{t_3}=8L_1$$

At this time A_0 to A_3 the actual distance of is: $L_{03}^{t_3}=24L_1$, compared to t_0 moment A_0 to A_3 the distance has increased $21L_1$; And the speed of light from A_0 to A_3 the time has only passed: $t_3-t_0=\frac{2L_1}{c}+\frac{4L_1}{c}+\frac{8L_1}{c}=\frac{14L_1}{c}$, therefore A_0 and A_3 the rate of space expansion between is:

$$\frac{21L_1}{\frac{14L_1}{c}}=\frac{21}{14}c>c$$

Obviously A_0 and A_3 the space between them expands faster than the speed of light C.

At the same time, the light beam can still return the same way, passing through $A_3\rightarrow A_2\rightarrow A_1\rightarrow A_0$ respectively, and finally back to A_0, the light beam will not be unable to reach A_0 due to the superluminal expansion of the space between A_0 and A_3, because the space is relatively independent.

Corollary: The superluminal expansion of the universe does not mean that photons at both ends will never reach each other, but will reach each other through relatively independent spaces.

However, according to the velocity transformation formula of special relativity, we know that A_0 and A_3 their relative speed does not exceed the speed of light, so the distance between them does not increase faster than the speed of light. The reason for this

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is that there is no distinction between the relative independence of space in special relativity, which confuses two relatively independent spaces into a common space.

6.4. Explanation of Newton's Bucket Experiment and Mach's Principle

We know that Newton understood absolute space with the bucket experiment; Mach explained the principle of relativity by saying that the water in the bucket moves relative to the whole universe[11].

Then, we consider the following thought experiment:

Objects A, B and C, D have a rest mass of 2m respectively, and initially A, B, C, D and S remain at rest. Then, by consuming its own mass, it is converted into relative velocity, and the relative velocity of S is V (moving along the X axis of the S system). A, B, C and D respectively consume the energy corresponding to their own mass of m.

As shown in Figure 7 below:

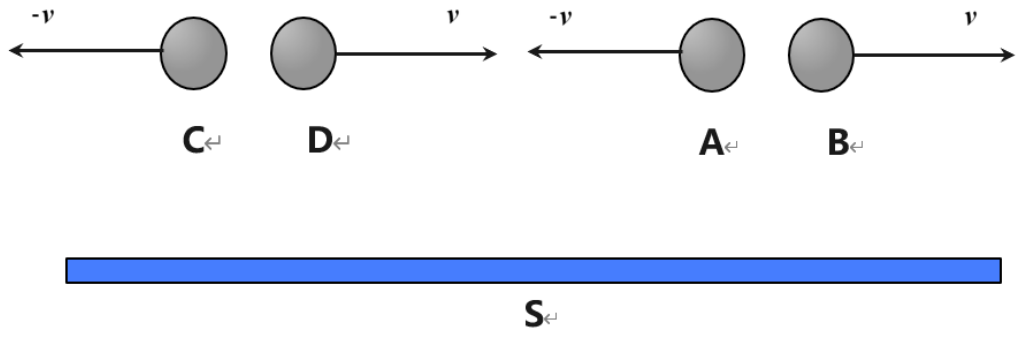

Figure 8. Explanation of Mach's principle.

At this time, according to the conservation of momentum and energy, the kinetic masses of A, B, C and D are equal and equal in the S system:

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

Where $\sqrt{\frac{c^2}{c^2 - v^2}} = 2$,therefore, in the S system, the energy and momentum of A, B, C and D are conserved before and after acceleration.

According to the special relativistic velocity transformation formula[9], In the observation system of A, the velocities V_B and V_D of B and D are:

$$V_D = V_B = \frac{v - (-v)}{1 - \frac{(-v)v}{c^2}} = \frac{2v}{1 + \frac{v^2}{c^2}} = \frac{2vc^2}{c^2 + v^2}$$

At this time, from the point of view of the A system, the dynamic masses $m(V_B)$ and $m(V_D)$ of B and D are:

$$m(V_B) = m(V_D) = m\sqrt{\frac{c^2}{c^2 - V_B^2}} = m\sqrt{\frac{c^2}{c^2 - (\frac{2vc^2}{c^2 + v^2})^2}} = m\frac{c^2 + v^2}{c^2 - v^2}$$

Then the total mass (corresponding to the total energy) of A and B seen from the perspective of the A system is:

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$$m + m\frac{c^2 + v^2}{c^2 - v^2} = m + m\frac{c^2}{c^2 - v^2} + m\frac{v^2}{c^2 - v^2} = 5m + m\frac{v^2}{c^2 - v^2} > 4m$$

That is to say, if calculated according to the relativistic transformation formula, the total mass and energy of A and B increase after acceleration. However, according to the law of conservation of energy, this is impossible.

And if A and D collide, the static mass after the collision will be 4m, not $5m + m\frac{v^2}{c^2 - v^2}$.

Explanation for this:

In fact, the acceleration process of objects A and B is meaningful. When we talk about the relative velocity of A and B, it is not entirely related to the relative motion of objects A and B, but to the process of acceleration and the relative space S system of acceleration.

The so-called relative acceleration space is actually a "relatively independent" space composed of accelerated objects A, B and S, which is the inertial system space before acceleration.

Therefore, as Mach's principle points out, the relative "space" of water movement in the bucket is determined by the total space composed of our cosmic matter, and the conservation of energy and momentum is guaranteed by "absolute simultaneity".

Conclusion 7: Space is determined and defined by matter, and the conservation of energy and momentum in our universe is guaranteed by the "absoluteness of simultaneity".

6.5. Interpretation of measurements

We know that if we measure the spin direction of a particle, once we measure it and assume that the spin direction of the particle is upward, then if we repeat the measurement again, the spin direction will remain unchanged.

In fact, the measurement is a unified process of the independent space of the particle and the space of our measuring instrument. Before the measurement, the particle is in a relatively independent space, and its spin direction relative to the measuring instrument is not yet determined.

After the measurement, the particles are no longer in a relatively independent state, but in a unified space with the measuring instrument. At this time, because of the conservation of the unified space, its spin direction will not change randomly.

Of course, with the passage of time, microscopic particles always tend to be in a relatively independent spatial state (or entangled state), as long as the whole of microscopic particles maintains a global conserved state.

7. Conclusion

Based on the assumption that "all inertial frame physical laws are consistent", this paper rigorously deduces the clock effect in both static and dynamic states, and demonstrates the absolute simultaneity of various reference frames and the relative independence of space. Two interesting conclusions, proving the possibility conclusion that "space is defined by matter". It also explains the impossibility of the twin paradox under the premise of complete symmetry.

Based on this, this paper proposes an experimental test method for the independence of space; and based on the conclusion of this paper on simultaneity and relative independence of space: tentatively explain the ultra-distance effect of quantum entanglement, the orbit of particles, the universe Inflation phenomenon, Mach principle, interpretation of measurement problems and other important physics problems.

This paper proposes that the absoluteness of simultaneity is a necessary guarantee and a prerequisite for the conservation of energy and momentum in the relative independence of space, and is indispensable.

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At the same time, this paper attempts to strictly prove that Einstein's definition of simultaneity and spatial absoluteness in special relativity may be problematic.

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