The Complete Relativity of Motion and Time

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Abstract: It is well known that motion is relative. It is well known that motion is relative. Considering that all the realities exist mutually in the universe, the motion of an object is relative not only to the reference system in a model, but also to all the other systems in the universe. This nature of relativity can be understood as complete relativity. Meanwhile，time in a specific system is relative not only to another system, but also relative to all the systems in the history. This is the complete relativity of time. Lorentz transformations are derived by observing a specific motion in a specific model, but neglected the complete relativity of motion. With this recognition we can see that Lorentz transformations are incorrect, and the postulation of the constant speed of light is also incorrect.

Key words: completeness; space and time; reference frame; Lorentz transformation; complete relativity

1. Introduction

Time dilation and length contraction predicted by the theory of relativity have aroused widespread interest and also brought a lot of confusions. The debate of time between Bergeson and Einstein occurred in 1922 might be the most influential event concerning these confusions. Bergson believes that time does not dilate. He even wrote a book, 'Durée et simultanéité' to illustrate his views, in which he claimed that Einstein's theory is demi-relativity or unilateral relativity [1]. However, Einstein simply replied that "the time of philosophers does not exist" [2] and did not give much explanation. Although it is generally believed that Bergson is the loser in the debate, physicists generally acknowledge that time is still a big secret [3][4][5].

The effect of time dilation and length contraction are predicted by Lorentz transformations. These effects happen in the direction of motion and do not happen in the direction rectangular to the direction of motion. In fact, the twin paradox experiment proposed by Langevin more than 100 years ago has already shown that time dilation is questionable. And as Deng pointed out, length contraction is also questionable for it implies that the ratio of the scale of a 3D coordinate frame is not constant in a moving system [6]. However, many physicists believe that twin paradox is not really a paradox or this paradox is solvable [7][8][9].

For clarifying the above mentioned controversies and/or confusions, another debate initiated by Einstein may provide us an important clue. In 1935, Einstein, Podolsky and Rosen published a paper questioning the completeness of quantum mechanics [10], also known as the EPR paradox. However, quantum physicist Bohr rejected EPR's criticism, and claimed that quantum mechanics "fulfill all the rational demand of completeness" [11]. Although the successful application of quantum mechanics in practice has proved that Bohr is correct, the discussion about the completeness of scientific theories continues today [12]. Because it is really an important thing for scientists and philosophers to make their theories complete enough.

In this paper I will check the completeness of Lorentz transformations and the postulation of constant speed of light. It is found that Lorentz transformations and special relativity have not considered the complete relativity of motion and time.

2. The complete relativity of motion

The derivation of Lorentz transformations are introduced in many text books [13][14]. The relation of time and space in the moving system and stationary system can be usually expressed as follows:

$$\varDelta x' = \gamma \varDelta x \quad (1)$$

$$\varDelta t' = \gamma \varDelta t \quad (2)$$

$$\gamma = 1/\sqrt{1 - v^2 / c^2} \quad (3)$$

where v is the velocity of the moving system in x-direction; c is the speed of light; x and x' are the coordinates of the stationary and moving systems .

As illustrated in Figure 1, S is the stationary system, S' is the moving system, which is represent by a train. Since motion is relative, the train can also be considered as stationary while the tracks as moving in the opposite direction. Such consideration is not a problem if we talk only about the relation between the train and the tracks. However, science is the study of general realities, not only the realty between two objects. The motion and the length of the train are not only relative to the tracks, but also relative to all other things in the universe, including the stations, buildings, the sun, the moon, Mars, etc. This does not mean that all these references should be described in a model. It means that they be considered so that a model can be designed relatively complete.

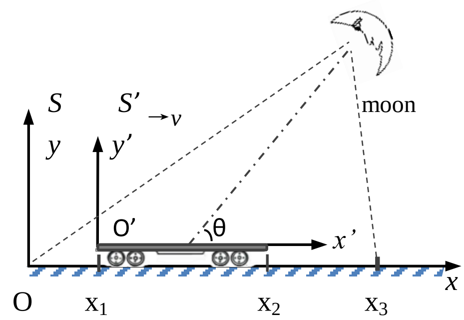

Figure 1 Incompleteness of the relative motion

For example, suppose there is an observer observing the motion of the train from the moon. The angle between the gaze of the observer and the direction of the train is θ. When $\theta=0$, the train moves toward the moon, the change of the length of the train is given by equation (1). And when $\theta=90^o$, the direction of the train is perpendicular to the gaze of the moon observer, the length of the train does not contract. And when $0^o < \theta < 90^o$, the length of the train varies in different degrees. This means the length of the train is not only determined by its relation to the tracks, but also by its relation to the moon, the sun or other objects in the universe. This implies that the length of the train is undeterminable. This is certainly impossible.

With this example we can understand better the meaning of “complete”. The length and motion of an object are relative to all the other objects in the universe. In other words, the space of a reference system is relative to all the other things. The length of a train is not only relation to the tracks, but also to the height of a building, to the distance between the moon and the earth, to the length of a light wave, etc. Such relations may not be described explicitly in a scientific model, but it should not be neglected.

3. The complete relativity of time

Not only space, time is also relative to everything, not only relative to another reference system. Let’s see an example:

(E1) *World War II began at Sep 1, 1939 and ended at Sep 2, 1945 (CE)*

(E1) describes a historical event or reality, in which time is an important reference. As we know, CE (Christian Era or Common Era) also refers to a historical event. 1939 and 1945 refer to the revolution cycles of the Earth around the sun; the dates refer to the rotation cycles of the Earth during a year. To make the description of time more accurate, “second" and “time zone” may also be used. We can see that the definition of time needs a lot of realities to refer. As Deng pointed out, time is a tool designed for describing the relation of all realities[9].

In practice, the most commonly used reference frame of time is UTC (Coordinated Universal Time). Meanwhile, we have many other reference systems of time, such as last week, this summer, after a while, just a moment, in a certain dynasty, and so on. In the ancient time, people may use sundial, the era of the monarch's rule or even the quipu (strings with knots and colors) as the reference of time. Obviously, Lorentz transformations cannot tell us how these references can be observed in a moving system. Time can be calculated by the distance divided by velocity in a specific model under specific conditions. But this does not mean that time is defined by distance divided by velocity in a philosophical sense.

With this knowledge we can understand that time in a train like that in figure 1 is not only relative to the tracks or the Earth, but also relative to all the other things in the universe. Most of these things exist in the history. In fact, time is a tool or model designed for describing the historical relation of all realities. Time in a system is not only relative to another system, but also relative to all the systems throughout the history of the universe. This is the complete relativity of time.

To describe the relation between realities, we should have at least two realities to refer. Again let us observe the relative motion of S’ relative to S mentioned in figure 1. As shown in figure 2, a difference is that a mirror is placed in a distance ahead of the moving frame. When the origins of the two frames coincide, the light source F at O (or O’) emits a flash of light or a photon. Assuming that the time of the two reference frames at this moment is January 1, 2024 at 0:00:00 (UTC). This is an event or reality that can be observed by observers in the both systems. So, we have:

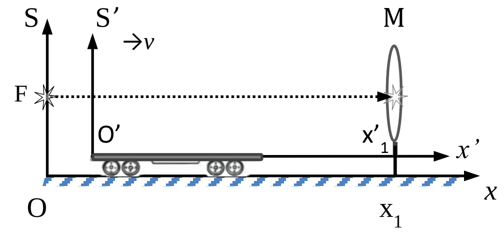

Figure 2 The photon travels from O’ to the Mirror

$t(\varepsilon = O) = t'(\varepsilon ' = O') =$ January 1, 2024 at 0:00:00 (4)

Where ε and ε’ are the position of the photon in S and in S’ respectively. Since there is only one photon, we have

$\varepsilon \equiv \varepsilon'$ (5)

For simplicity of calculation, suppose the speed of light is c=300000km/s, the velocity of S’ is v=100000km/s, and the position of the mirror is at x_1=300000km. When the photon hits the mirror (at x_1 and x'_1), it can be seen by both observers in S and in S’. In S, time is :

$t(\varepsilon = x_1) =$ January 1, 2025 at 0:00:01 (6)

What’s the time in S’ now? Lorentz transformation didn’t tell us. However, “hitting the mirror” is a reality that can be observed by observers in both systems at the same moment. Then we have:

$t'(\varepsilon ' = x'_1) = t(\varepsilon = x_1) =$ January 1, 2025 at 0:00:01 (7)

(7) means that time in the moving system does not dilate. Why? Because realities in the history do not dilate. Or histories do not dilate.

Even we don’t believe (7), according to Lorentz transformation (1) and (2), we have:

$x'_1 = x_1 = 200000\gamma$ (km) (8)

$\Delta t'_{\rightarrow} = \gamma \Delta t = 1\gamma$ (sec) (9)

The speed of light right forward in S' can be found:

$c'_{\rightarrow} = x'_1 / \Delta t'_{\rightarrow} = 200000$ (km/s) (10)

This means that the speed of light in the moving frame does change, and the postulation of constant speed of light is incorrect. Moreover, it seems that (7) and (10) follow the Galilean transformations. But why?

Just like Lorentz transformation, Galilean transformations did not considered UTC or the historical references of time also. But fortunately, UTC is designed for providing a consistent frame of time so that it is designed as fixed as possible. Then, when we are observing realities in a short period or short history, the scale of time can be considered as unchangeable approximately. This is why time can be considered as absolute in classical mechanics. Another reason might be that the existence of other references has been considered by default in Galilean transformations. But as we can see in many text books, Lorentz transformations take only one reality (a flash at O) as the reference of time. One reality cannot make up a history or a frame of time.

4. Conclusions

Science is the study of reality. All the realities in the universe exist mutually. To describe something, all the other things can be taken as reference so that scientific models can be made complete. In practice, for making our communication efficient or making scientific models simple, we usually take only a few realities as references. The existence of other references can be omitted, but cannot be really neglected.

The motion of an object is relative not only to another object, but also relative to all the other objects in the universe. This is the complete relativity of motion. The space of a system is not only relative to another system, but also relative to all the other systems in the universe. Similarly, the time of a system is not only relative to another system, but also relative to all the other systems in the universe. Observers on the train can not only observe the moving of the tracks， but also observe many other things and most of these things exist in the history. This is that Lorentz transformations and the theory of special relativity have not considered.

With the help of the moon and the mirror described above, we get more realities to refer and we find that Lorentz transformations are incorrect, and the postulation of the constant speed of light is also incorrect. A spatial frame is a tool for describing the positional relation of realities. It does not contract because realities all over the universe do not contract. Time is a tool for describing the historical relation of realities. It does not dilate because realities throughout the history do not dilate.

By the way, as we can see in (E1), time is not one dimensional because the historical relations of realities are not one dimensional. However, realities described by scientific models usually have a limited period or limited history. For this reason, time can be considered as one dimensional approximately.

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