Physical Review & Research International
1(3): 57-60, 2011

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Research on Lorentz "Local Time"

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Research Article

Received 25th May 2011
Accepted 27th June 2011
Online Ready 3rd July 2011

ABSTRACT

The meaning of Lorentz "local time" is reconsidered in the classical physics. Set up two inertial reference frames *S* and *S′*, the frame *S′* is moving at a velocity *v* relative to frame *S* in the *x* direction. When the origin of frame *S′* passes the origin of frame *S*, the clocks at the two frames all read zero. In the zero instant in the frame *S*, a motionless light source emits light signals. One light signal reaches the origin of frame *S* at time *t*, and another light signal reaches the origin of frame *S′* at time *t′*, then *t′* is Lorentz "local time". The research indicates that the constant of *c* derived by using Lorentz "local time", in fact, is the velocity of light propagating in the ether medium.

Keywords: Lorentz "local time"; meaning; velocity of light; ether medium; Special Relativity;

1. INTRODUCTION

In the end of 19 century, the hypotheses of Lorentz-Fitzgerald contraction (Lorentz, 1892) and Larmor-Lorentz time dilation (Larmor, 1900) were established in order to explain Michelson-Morley experiment. Lorentz, H. A. had insisted on the ether theory by his life, in order to make Maxwell's equations maintain the form invariant under Galilean transformation, he raised the concept of the "local time" (Lorentz, 1892), but he didn't give the meaning of the "local time". He did not think the "local time" was clock time, and thought it was merely a requirement in mathematics. Well then, what is the meaning of Lorentz "local time"? and what is the difference between Lorentz "local time" and the relativistic time

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defined in the Special Relativity (Einstan, 1905)? Up to the present, these problems are not yet resolved; therefore, Lorentz “local time” is discussed in this thesis.

2. THE ORIGINAL MEANING OF LORENTZ “LOCAL TIME”

Now we explore the implication of Lorentz “local time” in the classical ether theory. Establish inertial reference frame S and S'. In the two frames, the x-axis and the x'-axis are coincident, the y and y'-axes, the z and z'-axes are parallel respectively. The frame S' is moving at a velocity v with respect to the frame S along the x-axis towards the x direction. When the clocks in the two frames all read zero, the origins of the two frames pass each other. Suppose the space-time coordinates of one event in the frame S are related to the corresponding space-time coordinates in the frame S' by Galilean transformation. According to the classical ether theory, the light propagates in the ether medium with the constant velocity of c. Suppose that the frame S is at rest relative to the ether, then the space is isotropic for the propagation of light. In the frame S, we have a motionless light source that is located at point $P(x_0, y_0, z_0)$. In the frame S', the light source is moving with the velocity v in the negative x' direction. At the time $t = t' = 0$, the light source is at point $Q(x'_0, y'_0, z'_0)$ in the frame S', and at this instant in time the light source emits light signals. At instant t'_1 , a light signal arrives at the origin O' in the frame S', and during this time interval t'_1, the light source is moving from point Q to point $R(x'_1, y_0, z_0)$. Obviously, the length of line segment $O'R$ is equal to the distance of the light propagation in the ether medium during the time interval t'_1 in the frame S'. Because the velocity of light is the constant c in the ether medium,

$$O'R^2 = x_1'^2 + y_0'^2 + z_0'^2 = c^2 t_1'^2 \qquad 1$$

The light source moves with the velocity v relative to the frame S' towards the left, therefore

$$x_1' = x_0' - v t_1' \qquad 2$$

Now we suppose that,

$$x_0' = x_0 / \gamma \qquad 3$$

Where $\gamma = 1/(1 - v^2/c^2)^{1/2}$, which is purely an assumption in mathematics, and here, we refer to $x'_0 = x_0/\gamma$ as the “length contraction”. x'_0 is the value of the x'-coordinate of point Q in the frame S' and x_0 is the value of the x-coordinate of point P in the frame S. Put equation 3 into equation 2. We get

$$x_1' = x_0 / \gamma - v t_1' \qquad 4$$

The Galilean transformation gives

$$y_0' = y_0 \qquad 5$$

$$z_0' = z_0 \qquad 6$$

Put equation 4, 5, and 6 into equation 1. We obtain

$$(x_0 / \gamma - v t_1')^2 + y_0^2 + z_0^2 = c^2 t_1'^2 \qquad 7$$

Solving for equation 7, we get

$$c^2 t_1'^2 / \gamma^2 + 2 v x_0 t_1' / \gamma + v^2 x_0^2 / c^2 - (x_0^2 + y_0^2 + z_0^2) = 0 \qquad 8$$

The light source emits light signals at the time t = 0 in the frame S. Assume a light signal arrives at the origin O at instant t_2 in the frame S. Since the velocity of light is the constant of c in the frame S,

$$OP^2 = x_0^2 + y_0^2 + z_0^2 = c^2 t_2^2 \tag{9}$$

Where OP is the distance from point O to point P. Substituting equation 9 into equation 8, we get

$$c^2 t_1'^2 / \gamma^2 + 2v x_0 t_1' / \gamma + v^2 x_0^2 / c^2 - c^2 t_2^2 = 0 \tag{10}$$

Solving for equation 10, we obtain

$$t_1' = \gamma(t_2 - v x_0 / c^2) \tag{11}$$

Equation 11 is the same as expression for Lorentz "local time", so we call the time t'_1 Lorentz "local time". The t'_1 represents the time interval that the light signal takes to travel from the light source to the origin O' in the frame S', while the t_2 represents the time interval that the light signal takes to travel from the point P to the origin O in the frame S. Therefore, the time t'_1 and t_2 are not at the same instant. This is the difference between Lorentz "local time" t'_1 and the time t_2. Substituting equation 11 into equation 4 yields

$$x_1' = \gamma(x_0 - v t_2) \tag{12}$$

Collect equation 5, 6, 11, and 12 together, and strip off the subscripts marking the symbols.

We get

$$x' = \gamma(x - vt)$$

$$y' = y$$

$$z' = z$$

$$t' = \gamma(t - vx / c^2)$$

These equations are the same as the equations for Lorentz transformation in the Special Relativity. In these equations, x, y, and z are the space coordinates of the light source at rest in the frame S, and x', y', and z' are the space coordinates of the light source at the instant t' in the frame S'. Preceding arguments have shown, Lorentz "local time" $t' = \gamma(t - xv/c^2)$ is clock time, but the time t' and the time t are not at the same instant in the two reference frames.

3. DISCUSSION

The Special Relativity claimed the Lorentz "local time" was a clock time, and thought t and t' in Lorentz transformation equation of $t' = \gamma(t - xv/c^2)$ were at the same instant. But the research in the thesis shows that the time t and the time t' are not at the same instant. From preceding statements we know, Lorentz "local time" is different essentially from the relativistic time in the Special Relativity. In summary, we can't absolutely regard Lorentz transformation equations as the mathematical bases for the constancy of the velocity of light. The research on Lorentz "local time" indicates that the constant c in the fame S' moving relative to the ether derived by using equation of $t' = \gamma(t - xv/c^2)$ is the velocity with which the light propagates through the ether medium.

4. CONCLUDING REMARKS

The Special Relativity has changed the space-time concepts formed since Newton's time, and has been accepted universally. Nevertheless, the Special Relativity has been challenged continuously since its establishment from both theories and experiments. In 2000, *Nature* journal declared an experiment result to find super-light velocity (Wang, et al., 2000). Thenceforth, different laboratories in the world have successively accomplished a series of parallel test results about super-light velocity. In 2007, there is the crossed Doppler effect in classical physics was proved (Guo, 2007). In 2010, research showed that some physics laws did not satisfy requirement of the principle of relativity in the relativistic mechanics (Guo, 2010). Today, while we affirm and praise the great triumphs achieved by the Relativity Theory, we should work hard to establish a more scientific theory so far as the Relativity Theory is concerned.

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