The Nature of the Lorentz Transformation

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The physical sense of the special theory of relativity is shown on the basis of a model of the 4D Universe. It is following from this model that the classical ether can be considered as it really fills the World if it is treated as a boundary hypersurface of the Universe. The effects of the special theory of relativity such as length contraction and time delay are shown to be artificial and therefore undetectable.

The Lorentz transformation (LT) is the kernel of the special theory of relativity (SR). The creator of SR required that space-time be represented in a form that excluded any necessity of a medium (ether) in space, although presently
many theoretical physicists of this day are attempting to resurrect this notion. It originates from the tendency to consider again the ether in the physics as the luminiferous medium [4]. Also a big interest in the theory of Kaluza of the five-dimensional space-time [5] is arisen. The work of A.Trounev [6] where the structure of the atom of hydrogen is considered is one of the last examples of this theory. Therefore it is interesting to try to look at LT as at the usual Galilean transformation.

LT states that if there are two inertial reference frames K and K' moving with the velocity V, one with respect to the other, the distances and the times in it will be biased by the following relations

$$\begin{aligned} x &= \frac{x' + Vt'}{\sqrt{1 - V^2/c^2}} \\ y &= y' \\ z &= z' \\ t &= \frac{t' + Vx'/c^2}{\sqrt{1 - V^2/c^2}} \end{aligned} \qquad (1)$$

It is supposed that the velocity V of one reference frame, K,' is directed along the x-axis of the other frame, K, and the directions of the axes in both systems coincide. c is the light speed. Also it is supposed here that the starting points in both coordinate systems are chosen to coincide as well as the starting moments of time. In SR these relations are produced from the two postulates. One of them states that the speed of light is constant in all inertial reference frames and the other that the laws of physics are the same in all inertial frames. As it is well known, the consequences of the SR are the longitudinal length contraction and the time delay.

To demonstrate how one can interpret the sense of the LT let us write it in this form

$$\begin{aligned} x &= x' \sqrt{1 - V^2/c^2} + Vt \\ y &= y' \\ z &= z' \\ ct' &= -x'V/c + ct\sqrt{1 - V^2/c^2} \end{aligned} \qquad (2)$$

We used the so-called reversed LT in the first equation when the sign at V and the dash symbols at x and t are exchanged. It also can be obtained by substitution of t' from the fourth equation into (1).

While the LT in SR means the hyperbolic rotation in Minkovky' space-time, here one can

see that (2) is the usual rotation of the 4D space around the plain (y,z) on the angle $\alpha = asin(V/c)$ as it shown on the Fig.1. This rotation can also be determined with the help of the following matrix

$$M = \begin{pmatrix} \cos\alpha & . & . & \sin\alpha \\ . & 1 & . & . \\ . & . & 1 & . \\ -\sin\alpha & . & . & \cos\alpha \end{pmatrix} \qquad (3)$$

In contrast with the 3D rotation, the rotation in 4D space leaves invariant the vectors in the plane, so we consider it as the rotation around the plane but not rotation around the axis. Also as any other rotation (3) leaves constant the length of any vector lying in the plane of rotation that marked by the dash line on the Fig.1 with the coordinates (x, w) in one coordinate system and (x', w') in the other one where w=ct' and w'=ct. It means that its value, H, is invariant under the transformation (2)

$$H = \sqrt{x^2 + y^2 + z^2 + (ct')^2} = \sqrt{x'^2 + y'^2 + z'^2 + (ct)^2} \qquad (3)$$

In this case, however, the dashed symbol in x' and ct' are related to the different coordinate systems, but we will show below why it so happened.

One can easily get the expression for the so-called interval of SR from (3)

$$s = \sqrt{(ct)^2 - x^2 - y^2 - z^2} = \sqrt{(ct')^2 - x'^2 - y'^2 - z'^2} \qquad (4)$$

Although the interval is invariant under LT as it stems also from SR, it has no physical sense because it can take imaginary values. In contrast with it the vector H stems from the Pythagorean theorem and takes real value. The difference between time-like and space-like intervals is appropriate to those cases whether the vector H lies near to the axis ct or to the axis x.

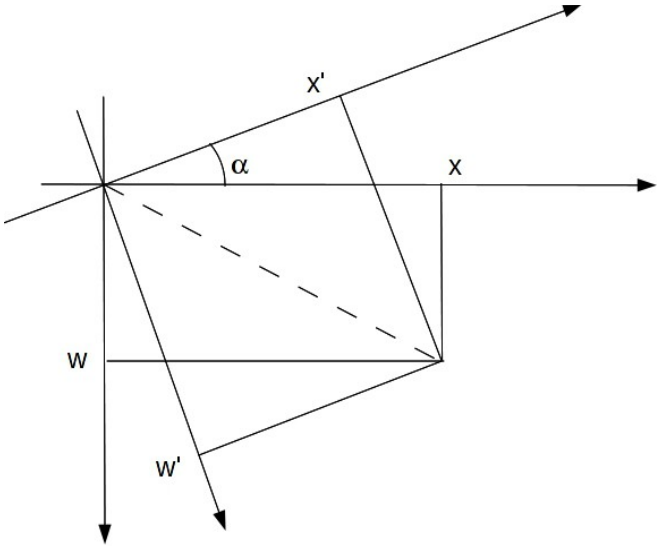

Fig.1 The cross-section of the 4D medium by the plane (y,z)

We can take another representation of LT to notice that the coordinate system K' is moved to the distance Vt for time t along the x-axis as it shown on the Fig.2. Thus the meaning of the LT becomes more clear and the coordinate systems can be considered as reference frames, one of them connected with some object situated along the w-axis and the other along the w'-axis. So the dash symbols in the frames are cast in full correspondence to the objects belonging to them.

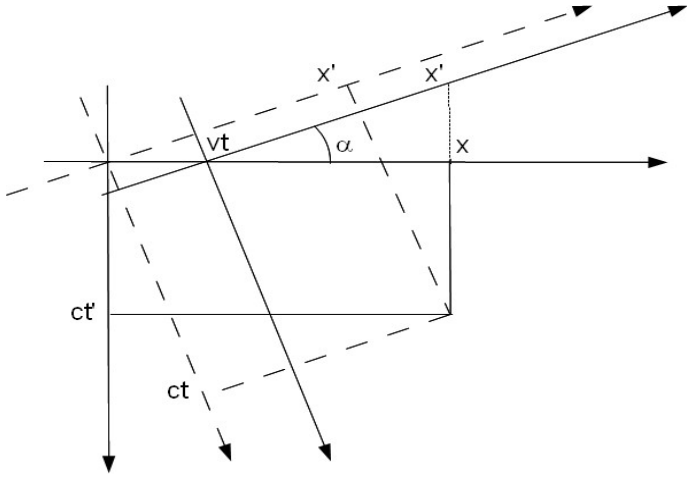

Fig.2. The translation of the reference frame K'

But when we are moving the reference frame K' to the distance Vt we make the Galilean transformation (GT)

$$x''=x-Vt$$
$$y'=y$$
$$z'=z$$
$$t'=t$$

(5)

where $x''=x'\sqrt{1-V^2/c^2}$ is the coordinate of the reference frame K' without such rotation as has been used above, it is the projecture of x' coordinate on the motion direction.

So the LT can be considered as the result of the two operations, the rotation and the translation. As it is known they are not commutative – we will get different arrangements of the coordinates if we change the order of these operations. So for any 4D vectors $\boldsymbol{x}$ and $\boldsymbol{s}$ that don't lie on the plane (y,z) $M\boldsymbol{x}+\boldsymbol{s}\neq M(\boldsymbol{x}+\boldsymbol{s})$

Thus the picture shown on Fig.2 can be obtained by the translation on the distance Vt along the axis x and the rotation of system K' on the angle α. Therefore the LT for the space coordinate looks like GT because the rotation of the coordinate axis doesn't have any special meaning and the directions of coordinates can be chosen freely without any dependence on each other.

But here the next paradox appears. The directions of the axis in both frames were already chosen to coincide in the very beginning. But then which the rotation is spoken about? And why is this turning occurring on the angle dependent on the velocity?

The first answer is that the proposed method of reducing of the LT to the GT is not correct and the second is that the whole theory of relativity is at fault because it leads to the rotation of the axes. But this turning of the axes is fully artificial, so the coordinate transformation based on it has no meaning.

We do not consider here these variants and take into account the next possibility.

As is known, there are two kinds of any transformation, active and passive. The former is related to the changing of the position of some objects in the fixed coordinate system and the latter is the change of basis, the transition from one coordinate system to another. While there is no actual changing of the orientation axis to be implicated, the rotation by the matrix (3) must fall into the first case. Then another question has arisen: what object is involved in the rotation dependent on the velocity?

In mathematics the points of the w-axis can be taken as this object. But if we are considering

the physical object moving along the x-axis we are to conclude that this object is the body with whom the reference frame K' is tagged together. But in contrast with the ordinary 3D body it extends onto the fourth dimension. In multidimensional string theory it looks like a string displacing in the empty space in the horizontal direction. Otherwise we can interpret it as the 4D whirl in some medium filling the bottom half space, below the axis x. It is this case considered in the model of the 4D medium [1].

In this model the Universe is 4D matter situated in the closed region of space. It has a spherical shape in general. So the pictures shown above are the local part of the very big Universe where one can ignore the curvature of its 3D surface. The fundamental particle is represented by the 4D vortex or roughly by the one-dimensional curve vortex line in 4D matter. It will move if it has some slope from the direction of the normal to 3D surface. For the straight vortex line the velocity of movement V is equal to $c \sin\alpha$. The light is the some type of vibrations of the boundary hypersurface in this picture.

If there is not any real rotation of the coordinate axes, the distance x' in LT must be considered as fully imaginary. It is correspondent to the distance in the rotated coordinate system K' where the moving vortex line is situated normally to the new axis x', to the new position of the hypersurface. But there is only one coordinate system where the vortexes are at rest and situated normally to the 3D surface, the absolute reference frame K. Because there can not be another real 3D surface in the Universe – of course, when we neglect the curvature of this surface and don't consider other tangent planes as the approximations of the whole surface. Therefore the time t' is not the real time lapsed in the moving frame.

What do we have in the Universe when we consider the LT? There are two vortexes at rest at the distance x from one to another and one moving vortex covering the distance Vt from the common starting point. So the event of SR that has happened at point x at the time t is nothing other than the approach of the vortex from one rest vortex to another. We consider the space-like situation here. The observer being at the starting point could see that it is left the distance x - Vt to pass by the moving body. Of course, the same distance would be covered for the same time for the observer moving together with the moving vortex. Again only if the rotation of the coordinate system of the frame K' during the moving would occur, the distances for moving observer will enlarge by the factor $1/\sqrt{1-V^2/c^2}$. But there is no rotation and therefore there is neither enlargement, nor contraction. So the times needed to pass such distance will not be greater by this factor as well, and the famous time delay will not be happened.

Thus the sense of the LT and the SR on the whole lies in the same essence of the nature. The Universe we all are living has four spatial dimensions. Three of them are composed our visible World where the axes x,y and z can be taken as the basis and it is the boundary surface of the Universe. The fourth axis w is directed into the invisible part of the Universe. The 4D matter forms all the Universe in contrast to the so-called “dark matter” that is supposed to be concentrated near the galaxies. It also can't be associated with the “dark energy” that stems from the alleged “expansion of the Universe”. There is not any significant changing in the size of Universe if the explanation of the redshift for the distant galaxies given in [3] is taken into account.

The alleged null result of the Michelson-Morley experiment is the third order with respect to the ratio V/c as it was shown in [2]. So this experiment can not be considered as the evidence of the absence of the so-called “ether wind”. The traditional 3D ether that has been sought out for so much time is the boundary surface of the Universe.

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