The Meaning of the Postulates of the Special Relativity

Valery P. Skorobogatov

http://vps137.narod.ru/phys/ mailto: vps137@yandex.ru

It is shown the cause of the invariant value of the light speed on the ground of 4D model.

The theory of special relativity (SR) was disturbing minds of many people for the whole century and is still causing many questions. In our opinion the main question is why it was stated in it that the speed of light is not depend from the velocity of the source of light. By our opinion, it is easy to show why it can happen so if accept the model of 4D medium.

This model supposes that the our *Universe* is the vast region of space occupied by so called 4D medium or fluid with its 3D border as our visual *World*. The special waves on the border is perceived by us as the light and other electromagnetic waves in the World. The sources of the light are so called *4D whirls* which perceived by us as the fundamental particles.

Although in the endless space there can exist a great many of universes, our Universe can be taken conditionally as the absolute reference frame (ARF), at the least for us belonging to the Universe. The representation of ARF can help us to understand why SR seems us as the true theory. For this purpose we can made the simple experiment with two mirrors as it is pictured on Fig.1. As a result the light speed c_0 in ARF with name K_0 can be calculated by the dividing of the double length L between the mirrors to the time T needing for light to make a two-way trip from one mirror to another and backward to the first mirror:

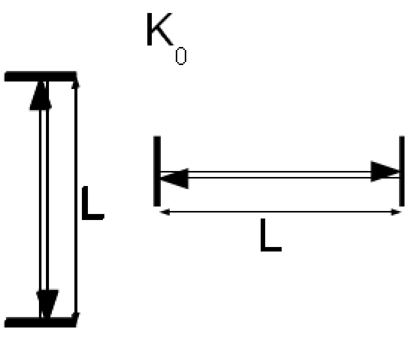


Fig.1. In the ARF K_0 the light goes from one mirror to another and returns. The result does not depend from the orientaion of the device.

$$c_0=\frac{2L}{T} \tag{1}$$

Then we will consider the same apparatus moving with constant velocity v. We can call the reference frame connected with this device as initial reference frame (IRF) K. Into it the device looks as it was pictured in Fig.2 and SR postulate states that the light speed in it is equal to $c=c_0$. From the ARF the path that the light goes between mirrors looks so that it depends on the orientations of device in our experiment. At first we adopt that the device moves along the direction perpendicular to the light path as it shown ob Fig.2, (The same picture was given in Wikipedia.) One can see that the light path becomes longer in comparison with the light path in ARF. So the time of the two-way trip is also becomes longer because it proportional to the path as one can see from the point of view of ARF. Therefore the light speed in the moving reference frame is equal to

$$c=\frac{2L/\cos\alpha}{T/\cos\alpha}=c_0 \tag{2}$$

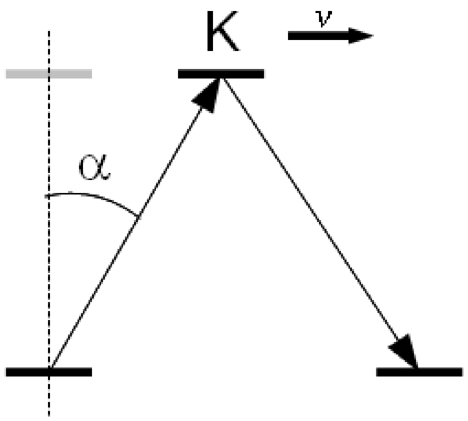


Fig.2. The device moves with constant velocity v in the transverse direction as it is shown by arrow, The angle α denotes on how the path of light is deflected from the initial path.

We see that the light speed is not change compared to the ARF. Moreover it does not change at any velocity v with which the device moves, It is no hard to show that it is the same result with respect to IRF K instead of ARF, The picture of the arrangement of the mirrors in this case is represented on Fig.3. From the point of view of ARF there is appeared additional angle β that does not change the result of division

$$c'=\frac{2L/\cos(\alpha+\beta)}{T/\cos(\alpha+\beta)}=c_0 \tag{3}$$

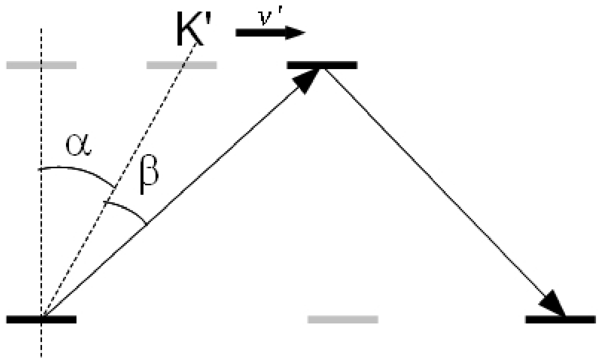
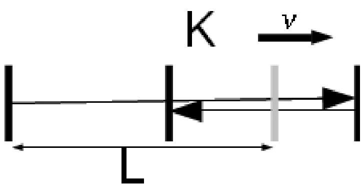


Fig.3. The new reference frame K' is moving with velocity v' with respect to the IRF K,



Fir.4. The reference frame K is moving with constant velocity v in the longetudinal direction with respect to the light path.

The case when the movement of the IRF K goes along the light path is more complicated (Fig.4). We denote the time of the light path into the device in one direction by T_1 and in the opposite direction by T_2. Then the paths in both direction will be wrote by these equations

$$\begin{aligned} cT_1&=L+vT_1,\\ cT_2&=L-vT_2 \end{aligned} \tag{4}$$

From the solution of this system we have the following expressions

$$\begin{aligned} T_1+T_2&=\frac{2Lc}{c^2-v^2}=\frac{T}{1-v^2/c^2},\\ T_1-T_2&=\frac{2Lv}{c^2-v^2}=\frac{Tv/c}{1-v^2/c^2} \end{aligned} \tag{5}$$

Calculating the light speed by the dividing path to the time we again get the same light speed as in ARF,

$$c=\frac{(L+vT_1)+(L-vT_2)}{T_1+T_2}=\frac{2L}{T_1+T_2}+\frac{T_1-T_2}{T_1+T_2}v=c_0 \tag{6}$$

Again we see that it does not depend on the velocity v. So we confirm that the light speed is invariant with respect to the any IRF, If it is the same in transverse and longitudinal directions, it will be the same in any other directions because the velocity can be decomposed into two these components.

From the triangle on Fig.2 one can easily derive the next equation

$$\sin\alpha = \frac{v}{c} \tag{7}$$

Thus we see that from the point of view of ARF the paths of light rays and times which demands to overcome these paths are changing proportionally. It make us sure that the light speed is not changed under any uniform motions:

$$t_{tr} = \frac{t}{\cos\alpha} \qquad l_{tr} = \frac{l}{\cos\alpha}$$
$$t_{long} = \frac{t}{\cos^2\alpha} \qquad l_{long} = \frac{l}{\cos^2\alpha} \tag{8}$$

Such situation doesn't make any difference between ARF and IRF. An observer in any of them can't find any evidences which help him to understand where he is situates. It is in full correspondence with principle of relativity. Therefore it is no need to say about such effects in the theory of SR as time dilation and length contraction. Really in SR the time dilation doesn't depend from the position of the moving body. It states that time measured by the clock belonging to moving IRF goes slower then the proper time, time measured by the clock belonging to IRF adopted being at rest:

$$t^{SR} = \frac{t}{\cos\alpha} = \frac{t}{\sqrt{1 - v^2/c^2}} \tag{9}$$

It was used Eq.(7) in the last equality. Our consideration proved this formula only for transverse directions. Otherwise the length contraction touches only longitudinal side and leaves the transverse one unchanged in SR:

$$l_{tr}^{SR} = l$$
$$l_{long}^{SR} = l\cos\alpha = l\sqrt{1 - v^2/c^2} \tag{10}$$

As for lengths of material objects in our presentation, it must be said that they are unchanged in motion but the paths of light are depended from velocity of motion and from the angle Θ under which the IRF meets the light rays.

Addition of velocities

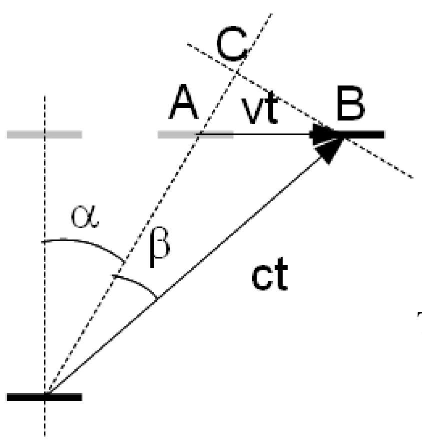


Fig.5. A body at point A moves to the point B.

Now we can derive the expression for sum of the velocities. We could calculate it from the Pic.5. Let us assume that there is IRF moving with velocity $V = c\sin\alpha$. In this IRF there is a body moving with velocity v which can be determine by considering right triangle ABC on Fig. 5. Cathet BC is equal to $ct\sin\beta = vt\cos\alpha$ So $v = c\sin\beta/\cos\alpha$.

The sum u'=V+v measured in ARF seems to be equal to, as it was obtained earlier.

$$u' = c\sin(\alpha+\beta) = V\sqrt{1=v^2/c^2} + v\sqrt{1=V^2/c^2} \qquad ($$

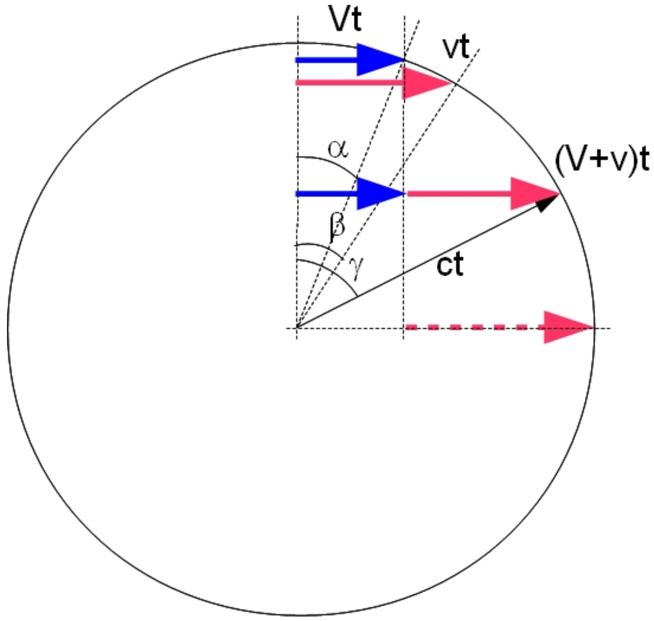


Fig.6. By blue color it is marked the velocity of the IRF and by red color the velocity of body in it. By dashed arrow it is marked maximum velocity of body under given velocity of IRF.

But to compare velocities we must take equal time and compare the paths gone for this time as it figured out on Fig.6. So if $V = c\sin\alpha$ and $v = c\sin\beta$, their common velocity is $V + v = c\sin\gamma$. Obviously, it can not be greater then the speed of light c. At given V maximum velocity can be equal to $v_{max} = c - V$.

By that reason the principle of relativity must be modify. If at the same time we take the second IRF moving with velocity v as a rest reference frame the maximum velocity of the body that can be reached in it will be equal to $c - V - v$ but not to $c - v$. Therefore it is appearing a possibility to detect V by searching maximum velocities in opposite directions where they are equal to $v^{\pm}_{max} = c - V \pm v$. If they are known, then $V = c - (v^{+}_{max} + v^{-}_{max})/2.$

It is to be underlined that this consideration concerns the movement of bodies but not of spreading of light. The latter always has constant velocity in any IRF $c = c_0$. Therefore the laws of physics must be the same in all IRF except the case of the moving bodies which has maximum velocity they can reach in every direction and the case of light which has its superior limit of velocity.

Conclusion

It is demonstrate that if there exist IRF where speed of light is not dependent from the velocity of light source, then there are exist all othere IRF with the same property and with the same speed of light. Thus the postulate of SR about the constancy of light speed obtains the proof. It must be said also that this conclution was appeared here by using of the classical consideration, by Galilean transformation. Therefore it can not but cause surprise that from these postulates in theory of SR is got the Lorentz transformation.