The Light in the 4D-Aether Model.

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It is widely acknowledged that the Lorentz transformation is an extension of the Galilean one related to the case of big velocities when the theory of relativity ought to apply. Here we try to show that there is another possibility leading to correct Lorentz transformation. It seems to be produced by the simple rotation of the coordinate system on the angle depentent from the velocity and therefore has no appliance to the transformation between two reference frames moving with respect each other. An explanation of the result of Michelson-Morley experiment by using the Galilean transformation applied to 4D-aether model is based upon some quite convincing assumption about velocity of photon. Also an interpretation of known wave-particle duality is given.

1. The Lorentz transformation

For the beginning let us imagine that there is a body moving along the x-axis of the fixed reference frame on some distance from the observer which resides at the origin of the frame in the point A (Fig.1).

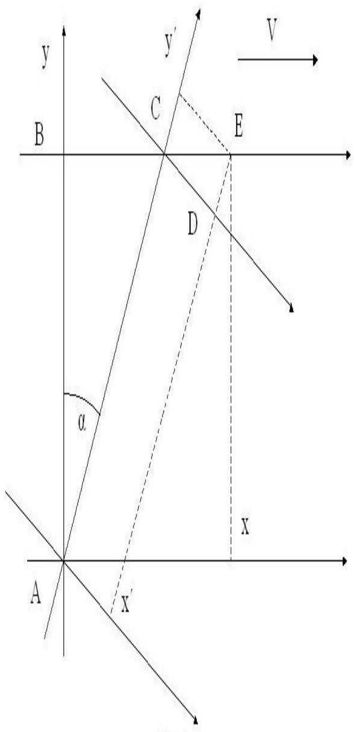


Fig.1

We assume that at the initial moment the body is at nearest distance from the observer in the point B on the y-axes. The light signal emitting in that moment will reach the body in the point C after some time interval t elapsed. For that time the light passed a distance equals ct while the body moved at the distance vt, where c is the light velocity that put constant here and v is the velocity of body. If the latter would be equal zero the light signal will reach the body for the less time interval t'. So we can take the angle CAB as the measure of the velocity. Denoting that angle as α the following definition of the velocity is arising

$$v = c \sin \alpha. \qquad (1)$$

As it follows from this expression, the velocity of the body cannot exceed the velocity of light. From the consideration of the triangle ABC it follows that the distance ct' is equal ct cos α, and, after reducing c and using Eq.(1) to express the angle α through the v, the time duration

$$t' = t \sqrt{(1 - (v/c)^2)} \qquad (2)$$

One may treat the last equation as the time dilation like in the theory of relativity. In that case we must prescribe time duration t' to the moving reference frame and give it the next notion. It is the time needed for the light signal to penetrate from the point B to the point A in the moving frame and hence from the point of view of the unmoving observer located at the point A it can erroneously consider as the same time as in his unmoving frame in the case when the velocity of the body is vanished. If so, there is a "time delay' caused by the movement.

However, we will get another interpretation of the picture. When the body displaced from point B to C it looks like a rotation of the coordinate system on the angle α. It may seem so to the observer at the point A. When he sees the light signal emitted from the point B, he may suppose that the body is rotating and therefore he can conclude that the coordinate system associated with the body turns relatively his system.

Now it is easy to determine the distance along x-axes in both coordinate systems. If to denote any point on the axe by x, the correspondent point lying on the path of the body considered marked by letter E on the Fig.1 will have the coordinate x' in the rotated coordinate system. The relation between these coordinates is

$$x = x'/\cos \alpha + ct' \tan \alpha \qquad (3)$$

Here an expression ct' as the coordinate along y-axes is put down because we measure the distance along that direction by means of light. Respectively, the distance along y'-axes can be wrote as

$$ct = ct'/\cos \alpha + x' \tan \alpha. \quad (4)$$

Here the first term is nothing else than Eq.(2) multiplied by c and the second one is an additional distance needed for light to surmount the length x'.

Substituting v from Eq.1 into Eqs. 3 and 4 we get formulas of Lorentz transformation:

$$x = (x'+vt') / \sqrt{1 - (v/c)^2}, \quad (5)$$
$$t = (t'+x'v/c^2) / \sqrt{1 - (v/c)^2} \quad (6)$$

Hereby it was shown that the Lorentz transformation can be represented as a rotation in usual space rather then in Minkovsky one. Instead of so called interval s of the theory of relativity determined as

$$s = \sqrt{(ct)^2 - x^2} = \sqrt{(ct')^2 - x'^2}, \quad (7)$$

which may receive imaginary values, here it is a real distance keeping constant value under rotation

$$d = \sqrt{(ct')^2 + x^2} = \sqrt{(ct)^2 + x'^2} \quad (8)$$

It is the length from point A to point E on Fig.1. As it seen from the last relations constancy of s is caused by constancy of d.

The following conclusions may be done from the analysis of derivation proposed here. We know exactly that the body is not really spinning around the observer. But we show that the Lorentz transfomation arises as a result of the simple rotation in 3D space, and therefore there is no need to use artificial 4D- space-time. There isn't a time slowdown as well because it can not change under rotation of the coordinate system. There are only the light paths which length changes as they are used as the coordinates in the coordinate systems. There is the Lorentz contraction as a imaginary change of one coordinate at the expense of another one in the course of rotation. By other words, the Lorentz constraction is only projection.

We stress that the rotation used here is not inherent to the nature but is involved to accommodate the point of view of unmoved observer with the moving body. That is why the Lorentz transformation in contrast of the Galilean one can't apply correctly to consideration of two reference frames moving each with respect to other.

It is easy to get Galilean transformation from the picture proposed if we release from the rotation. For this purpose one must associate moving point B with the beginning of the second coordinate system as a moving reference frame. Then the Galilean transformation may be put down as following

$$x = x'' + vt'', \quad (9)$$

where x" is the distance to the point E in the moving frame and t" is the time needed to the light to reach the beginning of second coordinate system from the beginning of the first one. Again here v is the velocity of the second system determined by the Eq.(1) and therefore its value can not exceed the velocity of light. It is the only constraint put on the Galilean transformation in the case of big velocities. Discrepancy with the Lorentz transformation seems may be caused by the fact that it was used in fact only one reference frame experienced the rotation around one point of view as it was shown above. If it is so, it is not quit rightly to apply the Lorentz transformation to moving reference frames.

2. The Michelson-Morly experiment

The Michelson-Morly experiment was a basic argument in favour of theory of relativity. By simple interferometer which scheme is shown on Fig.2 it was proven that there isn't the aether, a medium where proposed all matter might move in. Namely, it was found that the paths of light going from mirror 0 to mirror 1 and 2 are equal in any orientation and therefore are not dependant from the movement of the Earth though the aether even if it exists. The result of that experiment tried to explain either by Earth dragging of the aether or by the Lorentz contraction along the direction of Earth movement.

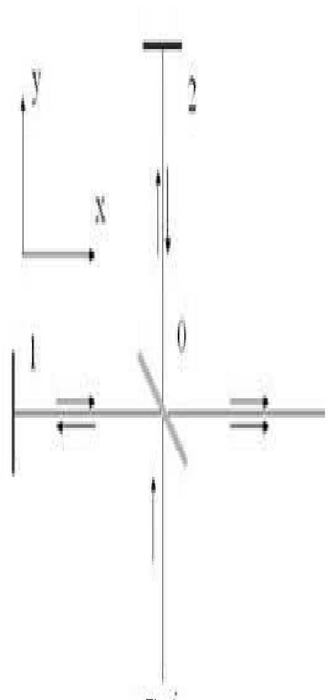


Fig.1

To make the next step we must clarify what the aether is represented here because now there are a lot of conceptions of this entity. Our vision on the subject was presented [1]. We imply that there are a 4D-medium consisted from the tiny particles. The medium may be called the aether is closed and has a bordor. There are vortices with different sizes in it represented the fundamental particles. The light is a sort of perturbation on the 3D border caused by the excited particles. An outing of the vortex in the form a mouth determines the position of the particle. The body is the connected set of vortices in this picture. That is why we (had been made from the vortices themselves!) always see objects only in 3D space. The rotation previously mentioned under the Lorentz transformation's derivation assumed to happen on the border of the medium.

Hereafter we put for simplicity that the body is the 1D line, or the string, and that the medium fills all the 4D-semi-space.

Now we try to show that if to think about aether as above the M-M experiment may explain by the Galilean transformation. For that purpose we consider the motion of the whole apparatus from the point of view of an observer connected with the medium.

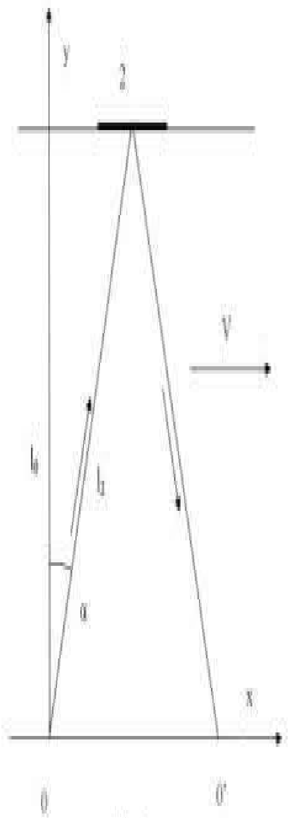


Fig.2

Let us suppose that the proposed motion proceeds along the x-axes. From the rendering Fig.3, where the light path in transverse direction respecting this motion, from mirror 0 to mirror 2, is shown, one may easily get the length of this path

$$l_2 = 2\, l_0 / \cos \alpha, \qquad (9)$$

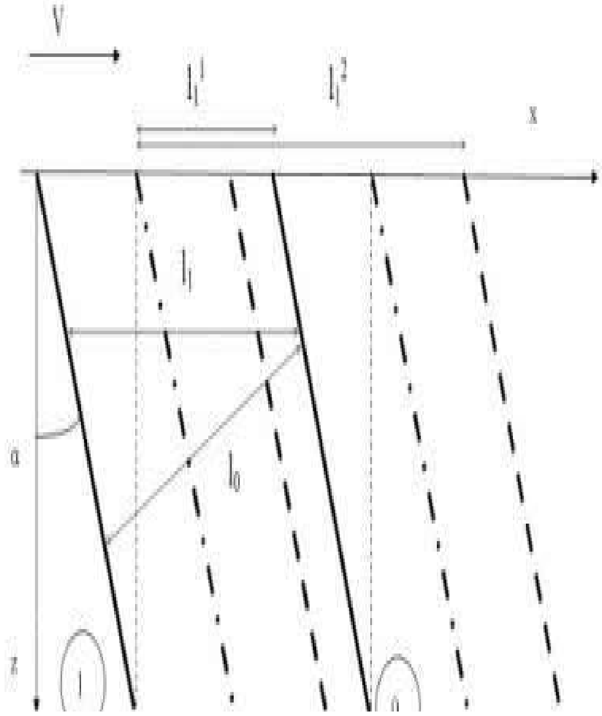
where l_0 is the distance between mirrors 0 and 2 being measured at rest, i.e. when the interferometer is unmoved with respect to observer. It is required a time interval to pass this distance

$$t_2 = l_2 / c. \qquad (10)$$

One should notice a resemblance between Eq.(9) and the first term of Eq.(3). All distance passed by whole device for the time t_2 is

$$s_2 = 2\, l_0 \tan \alpha. \qquad (11)$$

To consider the light path in the longitudinal direction, from mirror 0 to mirror 1, we cross the 4D-medium by the 2D-plane passing through these mirrors represented by two strings as it shown on Fig.4. If the following assumption is being made, it was quite easily to reach that purpose.



Namely, we suppose that the moving string is tilted with respect to the 3D border of the medium. The tilt is not constant but exists only in the vicinity of the border. So the string bents when it moves. The string situated normally to the border rests because the forces of the surface tension at the outing of the vortex are in equilibrium. Any slope of the vortex violates the equilibrium and causes the vortex to move in the tilt direction. Moreover, the value of velocity of the movement is assumed to be determined by the Eq.(1). The more rigid grounding of this statement is to be published elsewhere. Here we take it as an axiom. It is to note that the rotation used above under the derivation of the Lorentz' transformation could be applied without restrictions at any direction in the 3D-plane, or hypersurfice, situated normally to axis x and came by the point A on the Fig.1. In other words, we could use axis x_4 instead $y = x_2$. The rotations in 4D-space are came indeed from the 2D-plane.

First of all we must know if the distance between tilted strings is changed or not during their motion into the medium. Here one should distinguish a visual distance in 3D space and a hidden one in 4D-space. Obviously, it should be more strong and expansive force to make close two vortices in all 4D-space then only on the border. So we postulate that the distance between two mirrors is unchanged during their movement but the distance between their outings on the border enlarges. This statement is in acute contradiction with the Lorentz' contraction but lets easily to determine the distance between the mirrors 1 and 0 as $l_0 / \cos \alpha$

It will be the same path for light to pass as in Eq.(9) if one should suppose that in the moving reference frame the velocity of light is equal c, the velocity of light in the rest frame. Such supposition is made in the special theory of relativity, but we avoid it in favour of the Galilean transformation. For this purpose We are to consider the details of the light path in the reference frame connected with the medium.

Using the Galilean transformation the light path from mirror 0 to mirror 1 can be represented as

$$l_1' = vt_1' + l_0 /\cos \alpha \qquad (12)$$

and the reverse path from mirror 1 to mirror 0 as

$$l_1'' = -vt_1'' + l_0 /\cos \alpha \qquad (13)$$

Their sum is the common path of the light and their difference is the common displacement of the interferometer. The former gives the single solution

$$t_1' = t_1'' \qquad (14)$$

to reconcile with the result of the experiment:

$$l_1 = l_2 \qquad (15)$$

The latter should be the same as s_2 gotten from Eq.11. It gives the correct meaning of the displacement only if the velocity v satisfies Eq.1.

This result may mean that the velocity of light is not the same in the different reference frames and differs from that in the reference frame connected with the medium. As it is understood from the last equations the light passes the distance l_1' for the time instance t_1' with the velocity c+v and the distance l_1'' with the velocity c-v.

We may suppose the particles of light, photons, gain the additional impulse while reflecting from the moving mirror 0 and loose it while reflecting from mirror 1. On the other hand, the quantum mechanics demands the impulse of the photon having been determined by its wave vector in accordance with the Einstein's equation

$$p = \hbar k \qquad (16)$$

without changing velocity of photon. Although there are no otherwise evidences, it is left to surmise that there isn't any direct experiment on measurement of the velocity of light glanced from a high-speed moving mirror still.

One may try to explain the result by another manner. While the wave length is declined after the first impact with the mirror 0 in accordance with Eq.(16), its frequency is grown up to corresponding value so that the velocity of light is not being changed. The inverse effect is happened after the second impact at mirror 1, such that the common result is vanished and therefore can't be detected by the interferometer. The frequency alteration, however, might be fixed at the experiment mensioned above.

It is interesting to compare this results with those getting from the assumption of the theory of relativity. If the velocity of light is not changed after the mirror thrusts the particles of light, we must put down $l_1' = c\ t_1'$ and $l_1''= c\ t_1''$. Substituting these values into Eqs.(13) and (14) we can easily determine the path gone off by the light as

$$l_1 = 2\ l_0 / \cos^3 \alpha \qquad (17)$$

and the path gone off by the interferometer as

$$s_1 = 2\ l_0 \tan \alpha / \cos^2 \alpha \qquad (18)$$

The discrepancy with the experiment is obvious. Although the value $1/\cos^2 \alpha$ on which l_1 differs from l_2 is slightly differed from unity with small angles α and small velocities v, respectively, it grows as $1 + (v/c)^2$ and therefore might be determined by the experiment of Mickelson type. It seems hardly might be explained the distinction in values s_1 and s_2 as well.

It would be note also that in view of sutuation stated above one need to revise the concept of the reference frames in the case of 4D-space. The moving frame should be tilted as well to accommodate the noving body.

3. The "wave-particle" problem

In [1] we are presented the model of the atom as a spiral line instead of the point-like electron wound along the line of nucleus. If such atom is in the excited state, some loops of the spiral shrink and the excitation can move along the central line of the atom in a similar way as solitonic excitation. When it reaches the border of the medium the emission of the photon is happened. We may propose that the form of the photon is a spiral line too. However, its location is not normal to the border as for atoms but turned in such a way that its axis is directed along the border. Such form is expected to promote the fast motion of the spiral along the border of the medium. Therefore the photon can be considered as a part of electron because it is produced from the electron. It can be immersed by the atom with the specific sizes of the electronic system and emitted with specific parameters as well. The more determined model is to be published elsewhere. At that study one may detect that there isn't any intrinsic distinction between the "wave" and the "particle". The both entities are the same in scope of the 4D-model of the aether.

Moreover, if we consider the spiral as an atom of matter tilted with respect to the normal to the border of the medium, i.e. the moving atom, it is easy to notice that the loops of the spiral leave the waves on the border. Their wave vector is dependent from the tilt angle α as $\sin \alpha$ or, as we know, velocity of the atom. It is in the excellent accordance with the de Broyle formula for impulse of the "wave-particle" in the form of Eq.(16). The coefficient of the proportionality, the Plank constant $\hbar$, is related to the geometric parameter, the spiral spacing, which is determined by the properties of the medium considered.

[1] V.Skorobogatov. The light in 4D-Aether model (in Russian). vps137.narod.ru/article2.html, 2005.