The Michelson-Morley experiment in the model of 4D matter

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On the basis of the model of 4D matter it is shown that the effect in the experiment made by Mickelson and Morley in 1887 is of third order with respect to the ratio of the velocity of the motion to the speed of light.

The Michelson-Morley experiment is considered as the key experiment in the favor of the special theory of relativity (STR) because its «null result» is fully correspontent to the known postulates of this theory. Here it is presented the explanation of this result on the basis of the model of the 4D matter.

In this model it is supposed that the fundamental particles are the vortex-like objects in the special media extented in the additional fourth dimension. It was shown [1] that they have ability to move along the border hypersurface of the 4D Universe consisted of this media if their positions has the tilt with resect of the border. That is why the physical bodies in this representation similat to those used in the string theories are also correspontent to the objects having some extension in the fourth dimension which is invisible for us. Such representation of the particles is similar to that used in theories of the strings but a lot less dimensions and the existence of the border the light can spread along with makes difference with them. The germ of the idea of the 4D matter model is rather close to the 5D Kaluza theory where used the fifth dimensional space-time. However, here the time is the usual independant parameter with no any relations with the space. It is the same in the whole Universe,

On the Fig.1 the horizontal line embodies the border hypersurface separating 4D medium from the emptyness and representing the usual 3D World. Here it is supposed that the border can be consider as the flat threedimensional space for the huge Universe having presumably the spherical form on the whole. By other words, 3D World approximates by the tangent space of the 4D Universe which is the Euclidian space with the usual three dimensions. The 4D whirl is pictured by the dash lines in the start moment of the time and in the moment t. Altermatively there are pictured two whirls moving in sequence in 3D visual space on the distance Vt. The real distance between the whirls in the 4D space is less and makes $Vt\cos\alpha$. By that it is supposed that the real distance between the whirls is not changed under the movement. It seems to be logocal to consider the volume position in 4D space of the particles or bodies as more formidable circumstance then the surface effect of the visual 3D image.

From the Fig.1 one can suppose that the wave moving with the speed of light penitrades along the whirl which is correspondent to the charge particle. The direction of the wave movement might point out to the sign of the charge. In the case when the particle is in the excited state, e.g. as in the electron in the atom, the spontaneous radiation of the photon occurs. The inner wave in the 4D space correspondent to the excitment and having the form of the solitary wave, of the soliton, pushes out to 3D World in the form of the light or other electromagnetical wave the frequency and the wave length are determined by the construction and the geometrical parameters of the atom, of the particles which are made of from the whirls. Therefore our World becomes visible.

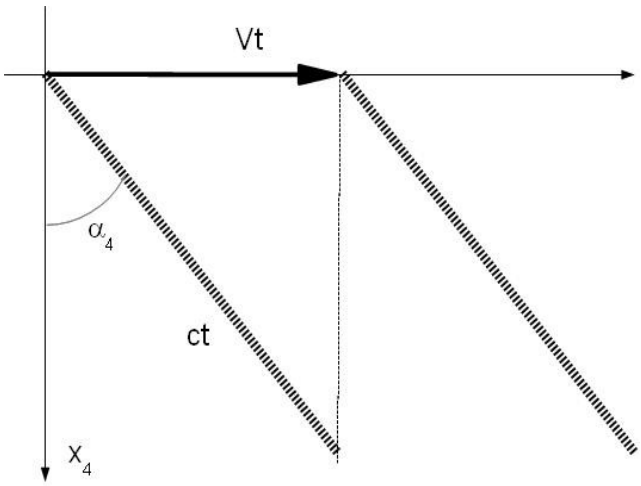

Fig.1

From the said above it is following that there is the absolute reference frame (ARF) in the local part of the Universe which is related with it and in which there is the body of reference situated in the fourth dimension normally to the border. All other inertial reference frames (IRF) is related with the whirls as the body of reference having the constant tilt with the border.

One can see from the Fig.1 that the absolute value of the velocity of the tilted whirl along the hypersurface, in usual three-dimensional space, is equal to

$$V = c \sin \alpha_4 \qquad (1)$$

where c is the speed of the light. The components of the four-dimensional vector of the velocity are determined by the direction cosines of the angles α_i (i=1,2,3,4) and ones of the three-dimensional vector by the guide cosines of the angles β_i (i=1,2,3) or by the angles of the spherical coordinate system ϕ and $\Theta = \beta_3$

$$\boldsymbol{V} = c \begin{pmatrix} \cos\alpha_1 \\ \cos\alpha_2 \\ \cos\alpha_3 \end{pmatrix} = V \begin{pmatrix} \cos\beta_1 \\ \cos\beta_2 \\ \cos\beta_3 \end{pmatrix} = V \begin{pmatrix} \sin\Theta\cos\phi \\ \sin\Theta\sin\phi \\ \cos\Theta \end{pmatrix} \qquad (2)$$

The angles are linked by the following relations

$$\cos^2\alpha_1 + \cos^2\alpha_2 + \cos^2\alpha_3 + \cos^2\alpha_4 = \cos^2\beta_1 + \cos^2\beta_2 + \cos^2\beta_3 = 1 \qquad (3)$$

The experiment made by Mickelson and Norley in 1887 [3] had the aim to detect the so called «ether wind» that in our case means to fix the absolute velocity, the vilocity with respect to the Universe. It consisted in the determining of the bringe shift in the installation called interferomiter the scheme of which can be found in the previous works on this theme [4,5].

Let us L to be the length of the interferometer arms in the reference frame of the Earth. We will consider it as the «real» arm length. Then if to choose the axes x_1 and x_2 of the coordinate system along the arms, the lengths of these arms in IRF determined along the border will be

$L_1 = \dfrac{L}{\sin\alpha_1}$ and $L_2 = \dfrac{L}{\sin\alpha_2}$.

One can form the following expressions for the path gone by the light between the central half-transparent mirror and the mirror 1 on the either arm the movement of which is marked by the thick lines on the Fig.2

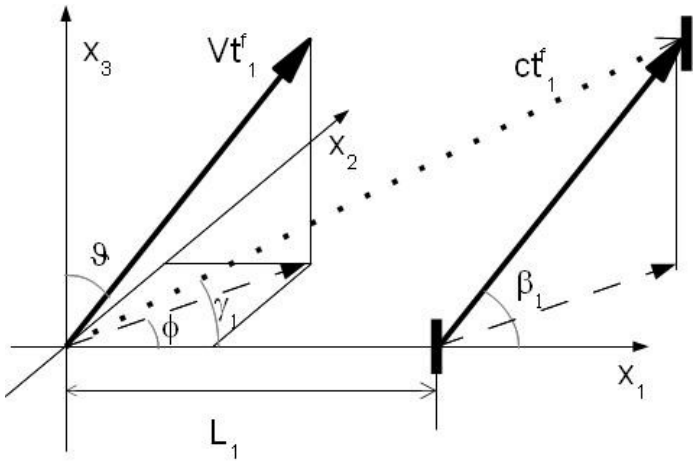

Fig.2

$$ct_1^f \cos\gamma_1 = L_1 + Vt_1^f \cos\beta_1 \tag{3}$$

$$c\,t_1^f \sin\gamma_1 = V\,t_1^f \sin\beta_1 \tag{4}$$

where t_1^f is the time needed for light to go this path, γ_1 is the angle under which the light is gone with respect to the asis x_1 . The similar expression may be composed for the backward time t_1^b needed for light to go the way from the mirror 1 to the center

$$ct_1^b \cos\gamma_1 = L_1 - Vt_1^b \cos\beta_1 \tag{5}$$

The common time $t_1 = t_1^f + t_1^b$ for the two-way path can be found from these equations

$$t_1 = \frac{2Lc\cos\gamma_1}{\sin\alpha_1 (c^2\cos^2\gamma_1 - V^2\cos^2\beta_1)} \tag{6}$$

Excluding γ_1 with the help of (4) and α_1 and β with the help of (2), one can get

$$t_1 = \frac{2L\sqrt{1 - V^2\sin^2\beta_1/c^2}}{c\sin\alpha_1(1 - V^2/c^2)} = \frac{2L}{c(1 - V^2/c^2)}\sqrt{\frac{1 - V^2/c^2 + V^2\sin^2\Theta\cos^2\phi/c^2}{1 - V^2\sin^2\Theta\cos^2\phi/c^2}} \tag{7}$$

The same expression where the $\cos\phi$ is changed by $\sin\phi$ will get for the mirror 2. The difference of the times $\Delta t = t_2 - t_1$ will consist in the following value if one leaves in the expansion of the roots only the terms of the second order with respect to the ratio V/c

$$\Delta t \approx \frac{2LV^2}{c^3}\sin^2\Theta\cos 2\phi \quad . \tag{8}$$

The lapse of the paths of the two rays is equal $\Delta l = c\,\Delta t$. It is proportional to the second order of the ratio V/c but one can not consider it as the shift of the fringes which might be detected in this experiment. Really, the phases of these rays coincide as it sees from its comparison

$$k l_1 - \omega t_1 = k l_2 - \omega t_2. \tag{9}$$

where k is the wave vector and ω is the frequence of the light, l_1 and l_2 are the paths of the light gone to the mirrors 1 and 2 and backward. From it we get

$$\Delta l = l_2 - l_1 = \omega / k \, \Delta t = c \, \Delta t \qquad (10)$$

Therefore this difference of the paths doesn't create the interference of the rays unlike the value $\Delta s = V \Delta t$ which is the path gone by the interferometer for the time (8). The phases of the two rays will be distinguish from each other on the value of $k \Delta s$ that gives the shift of the interference fringes as a result

$$\Delta s \approx 2L(V/c)^3 \sin^2\Theta \cos 2\phi \qquad (11)$$

Earlier it was suspected that the effect in the experiments of the Michelson-Morley kind must be of the second order of V/c. It even gave the hope to determine of the velocity of the Earth advance along the orbit around the Sun. But the estimation of the fringe shift obtained above for the arms length of $L \approx 10$ used in the experiment of Michelson and Morley excludes such possibility.

Meanwhile for the velocity of our galaxy with respect to the bachground microwave radiation about of the 600 km/s the maximum of the fringe shift estimates as $6\,10^{-7}$ m that is comparable with the lengths of the light waves of the optical range and therefore points out to the sufficient sensibility of the interferometer of this kind for such measurements.

So one must take into account the dependence of the angle of slope of the vertical axis of the interferometer to the supposed direction of the «ether wind». There is a reason to carry out the round-the-clock measurements with the constant positions of the arms of the interferometer. The existence of the galaxy halo, however, seems create the effect similar to the classical «ether dragging» that bring to naught such measurements. The stars in the Milcky Way galaxy as in many other spiral galaxies rotates rather then the solid state body but not as the system governing by the Newton law of gravitation [6]. It may mean that there is the ARF in the range of the galaxy. But then the velocity of the «ether wind» will be determined only by the velocity of the Earth movement on the orbit around the Sun to determine which by the method of the interference one needs to reach the sensability to the rather high level. The success in the test of the STR, at least partly, also can be explain by the fact that the IRF linked with the Solar system is the ATF in the essence.

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