The velocity of neutrino in the 4D medium model

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The simple explanation of the neutrino's velocity anomaly is presented in the frame of the 4D medium model. It is shown that there is no the faster then light motion in our Unverse. The effect of neutrino detection before the light with supernova SN1987A is also discussed.

The experiment on the measurement of the velocity of neutrino made recently [1] shows that the distance between the source at CERN in Switzerland and the detector at OPERA in Italy neutrino goes faster then light as it follows from the postulate of the constancy of the light speed in the Special theory of relativity (STR). This fact can be simply explain in the frame of the model of the 4D medium [2]. In accordance of this model the Universe is bounded in the 4D space by the 3D border which we call the World. The light can penetrate only along the geodesics lying on this border hypersurface. The fundamental particles, atoms and bodies can be modeled by so called 4D vortices, the peculiar objects creating the eddies on the hypersurface of the medium with the form

$$x_4 = \frac{b^2}{r}$$

(1)

where b is the parameter of the vortex bound with the mass by the relation

$$m = \kappa b^2$$

(2)

The coefficient of the proportionality κ is equal $2.5 \, 10^{12} \, кг/м^2$ by the one estimation made on the analysis of the movement of the satellites of the planets [3] or $0.5 \, 10^{12} \, кг/м^2$ by the other estimation where the perihelion orbit shift of the planets of the Earth group was taken into account.

Then the explanation of the neutrino faster then light movement comes from the fact that the geodesics which the light path associated with is not the straight lines. The mean curvature in the presence of the whirl can be determined by the expression [3]

$$H = \frac{2 b^6}{r^7 (1 + b^4/r^4)^{3/2}}$$

(3)

and added from the three main curvatures

$$\lambda_{1,2} = -\frac{b^3}{r^4 (1 + b^4/r^4)^{1/2}}, \quad \lambda_3 = \frac{2 b^3}{r^4 (1 + b^4/r^4)^{3/2}}$$

(4)
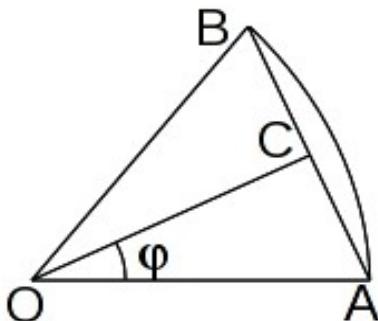
The curvature λ_1, that is the most correspondent to the experiments made on the surface of the Earth, is the inverse of

the radius of curvature $R = 1/\lambda_1$. It is shown on the figure as the part of the circle with such radius, the arc AB, that interconnect the source of the neutrinos with its detector. In our usual 3D World this distance seems us as the straight line coming through under the surface of the Earth and linking the CERN and OPERA in this case. The neutrinos are slightly interacting with the matter and therefore it is supposed the these particles move namely in such manner. But we may assume that the neutrinos move along the straight line that is the chord of the arc AB lying in the 4D space behind the hypersurface boundary. The difference between the arc length and the chord subtending it counts the value

$$\Delta l = 2 R (\phi - \sin \phi) \qquad\qquad (5)$$

where the angle ϕ is equal the half of the arc AB. For r in the first Eq.(4) equals the radius of the Earth and for the distance AB equals 730.53 km under the κ taken from [3] the outrunning $\Delta t = \Delta l/c$ amounts the value of 31.3 ns that only two times less then the value given in [1]. One can set $\kappa = 3.95 \; 10^{12} \, kg/m^2$ for to get the needing outrunning or suggest that the arc AB comes not along the main cross-section where the curvature reaches the upper value. It must be in 1.4 times less to obtain the agreement with the experiment.

Generally speaking the curvature of the geodesics lying on the hypersurface may take any values between λ_1 and λ_3 . Therefore to made the exact counting it needs to know such things like the spread of the density along the path except the exact positions of the source and the detector. The detector OPERA is situated on the depth of the 1.7 km underground and the influence of the λ_3 must be taken into account. The third variant when the coefficient κ is corrected and the geodesics not lying on the main cross-section seems also to be possible.

Discussion

So it is shown in the work that the velocity of the neutrinos may not exceed the speed of the light as it can be concluded ftom [1] but remain equal to the upper available velocity. However one must acccept for this that our Universe is in the 4D space and the Earth, as all other bodies and fundamental particles, is something like a funnel described by Eq.(2) which of cause is the rough approximation valid only on the sufficient large distanced from the center of gravitation.

There is the open quastion whether the path of the neutrinos comes through the emptiness, through 4D vacuum, or throught the medium in the bulk of the Universe. As the curvature of the geodesics is between the absolute values of λ_1 and λ_3 , the second case is more appopriate. One can suggest from this that the neutrino is the thorus-like whirl having the property to move through the medium like the rings of the smoke. Because such formation has no contact with the hypersurface as all other particles, the neutrino can't be named the fundamental particle in the proper sense. This property explanes thier extremely low interaction activity with the matter.

Also it is tempting to try to explane by Eq.(5) the effect with neutrinos accuring under the supernova SN1987A in the Large Magellanic Cloud in 1987 [4]. Then the neutrinos were be detected before 3 hours to the emission of the visible light. But to get such outrunning one need to take the raduis of the Universe be equal only 740 bln light-years that is only the tenth of the common taking value. The other explanation is that the Universe has no strictly spherical form near the Milky Way region.

[1] Measurement of the neutrino velocity with the OPERA detector in the CNGS beam http://arxiv.org/abs/1109.4897 , 2011.
[2] V. Skorobogatov The gravitation in the 4D medium model (in Russian)

http://vps137.narod.ru/phys/article12.pdf, 2009

[3] V. Skorobogatov The anomaly of the orbit of Mercury in the model of the 4D medium (in Russian)
 http://vps137.narod.ru/phys/article12.pdf. 2009

[4] http://en.wikipedia.org/wiki/SN_1987A