Witte-Ulianov Rotation Anisotropy Effect
Rotating the Einstein's light clock, to show that the neutrinos travel at the light speed in OPERA and MINOS experiments

Policarpo Yōshin Ulianov

"A scientific theory is just a mathematical model we make to describe our observations. It exists only in our minds. A theory is a good theory if it satisfies two requirements: It must accurately describe a large class of observations on the basis of a model that contains only a few arbitrary elements, and it must make definite predictions about the results of future observations"

Stephen Hawking

Abstract

This article explains why the neutrinos apparently are travel faster than light in the OPERA and MINOS experiments. This will be do with base in the Coriolis effect, Witte effect and some relativistic effects observed by rotating the light clock proposed by Einstein.

These factors combined make the WURA effect (Witte-Ulianov Rotation Anisotropy effect) that generates a phase error between two clocks perfectly synchronized, due to rotation of the earth and its movement in space, during the travel time of a light signal between the clocks.

For the OPERA experiment, the WURA effect describe a systematic timer error, that generate a theoretical time reduction of about 77.2ns, a value very close to the neutrino anticipation that was observed experimentally in the OPERA.

This result indicates that in OPERA and MINOS the neutrinos are actually moving at the light speed.

1 – Introduction

The OPERA[1] neutrino experiment at the Gran Sasso Laboratory obtained a measurement of the muon neutrino velocity that seems be faster than light.

This article explain why the neutrinos in OPERA experiment are arriving 60.7 ± 6.9 (stat.) ± 7.4 (sys.)ns ahead of schedule. The same explanation can be applied to the MINOS experiment [2] where the neutrinos are also arriving 126 ± 32 (stat.) ± 64 (sys.)ns ahead of schedule.

The author believes that this is anticipation of the neutrino arrival time is due to a systematic error caused by a new relativistic effect which was called by the author WURA (Witte-Ulianov Rotation Anisotropy) effect.

The WURA effect comes from the combination of the Coriolis effect, connected is to Earth rotation, with the Witte effect, that depending on the Earth displacement in the space.

In this article the WURA effect is deducted, based on the relativistic equations obtained when we rotate the clock light, which was proposed by Einstein[8], to explain the time dilation in the context of the Special Relativity (SR) theory.

Initially a brief history of the evolution of this work we will be done. In sequence the Witte effect and the WURA effect will be described and analyzed.

Finally the theoretical "neutrino earlier time" is the calculated for the OPERA experiment, given a delay time value of about -77.2 ns. This result shows that in OPERA and MINOS experiments the neutrinos actually do not moves faster than light speed.

2 – Work History

Assuming that the neutrino speed in the OPERA experiment was being affected by the travel of the Earth in space, the author initially write a paper [3] where a Earth moving speed detection experiment was proposed. This experiment is based on measuring the phase delay between two atomic clocks, connected by a fiber optic link. If we running this experiment phase shift delays are expected to be measured between the clocks. This delay also will be synchronized to the Earth's rotation, and will occur in function of Earth moving speed on the space.

After the publication of this work the author was informed that the delays that are expected theoretically in [3] was obtained in practice in an experiment conducted by R. D. Witte [4] in 1991, using coaxial cables to connect two sets of atomic clocks. The Witte effect[5] describe a phase delay variation between two atomic clocks, generating a sinusoidal function, with period equal to the sidereal day, which indicates that the Witte effect is caused by the Earth moving in the space.

The author believes that the Witte effect could also be observed, if the two OPERA atomic clocks were connected by a coaxial cable. Thus the author proposed[6] that the Witte effect need to be considered in order to understand measurement of the neutrino speed in OPERA.

Like the Earth movement generate a relativistic contraction (in the speed vector direction), the neutrinos path length also varies as a function of sidereal time. So the author realizes that the sinusoidal phase variation with about 7us, that will appear in OPERA if the Witte effect is monitored will, be compensated by the neutrino path relativistic variation. However, this compensation is not exact, and so we can observe a residual time shift between the two OPERA clocks, which can explains the 60ns observed in the OPERA experiment, as will be shown in this article.

Considering the Coriolis effect, the author observe the analysis performed by M. G. Kuhn [7], where the Coriolis influence in the OPERA is very small, generating a theoretical reduction in neutrinos arrival time of only 2.2ns. However if we apply the Coriolis effect together with the Witte effect we can calculate a delay of 77.2 ns for the OPERA experiment. This results explain that neutrino don’t travel faster than light and open a new window to explore de space time considering absolute moves with no contradiction of the SR.

3 – The Witte Effect

The effect Witte [5] was first observed by R. D. Witte [4] in 1991 in performing a 177days experiment. In this experiment Witte monitored the phase delays between atomic clocks separated by a 1.5 km length coaxial cable.

Figure 1 shows the delays observed by Witte in one direction, while in the opposite direction are observed the same phase delays, but with opposite sign. In this figure we can observe an sinusoidal phase delays variation, which has an period close to the sidereal day.

The value Δt represents the sinusoidal amplitude observed in the Witte effect, and can be calculated by the following equation:

$$\Delta t = L\frac{v_E n^2}{c^2} \tag{1}$$

Where L is the cable length, n is the cable refraction index, and the c vacuum light speed. The speed v_E is connected to the Earth travel speed the in space.

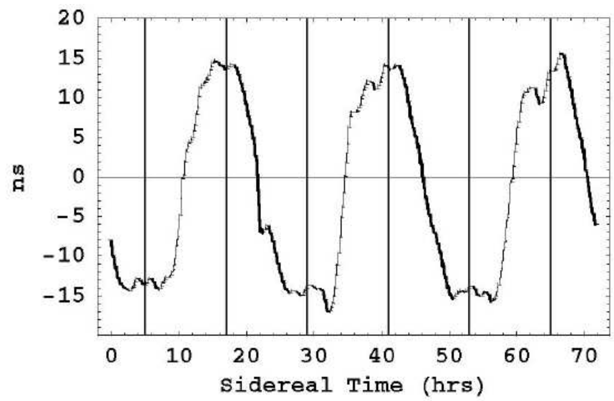

Figure 1 – Phase drifts, as observed by Roland De Witte in 1991

Witte was unable to publish their experimental results, because they apparently contradicted the SR. And so, the Witte effect was recognized as true only in 2006, when R. T. Cahill[4] showed that Witte effect can be explained without any contradiction with the principles of Einstein's relativity.

From the Witte experiment a 15ns phase delay was identified, like shown the graphic in Figure 1. By this value the equation (1) allows to calculate an Earth speed (v_E) of about 400km/s. According to Cahill [4] this Earth speed is fully compatible with a series of other experiments that have never been widely accepted by contemporary physics because they also apparently contradicted the SR.

4 – Rotating the Einstein's light clock

The Einstein's light clock [8], shown in Figure 2, is the most popular examples of relativistic time dilatation.

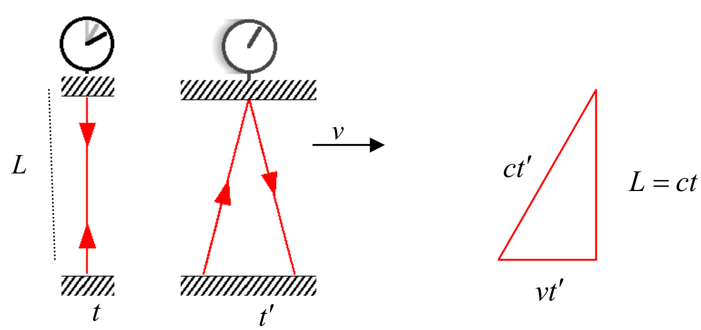

Figure 2 – Einstein's light clock

From the triangle shown in Figure 2 we can deduce the following equations:

$$(ct')^2 = (ct)^2 + (vt')^2 \quad ; \quad \frac{(ct')^2}{c^2} = \frac{(ct)^2 + (vt')^2}{c^2} \quad ; \quad t'^2\left(1-\frac{v^2}{c^2}\right) = t^2 \quad ; \quad t' = \frac{t^2}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$t' = Yt \qquad ; \qquad Y = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \qquad (2)\ ;\ (3)$$

Figure 3 shows a variation of the Einstein's light clock experiment. This new experiment is based on a dual light clock, on with two light pulses traveling on perpendicular paths. There is vacuum inside the clock room, and so the light beams propagate in the clock at vacuum light speed *c*.

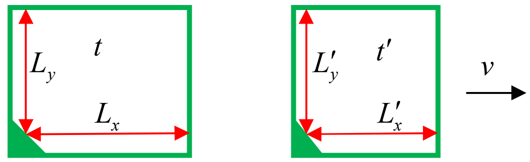

Figure 3 – Einstein's double light clock.

In Figure 4 the dual clock is presented in a time sequence for two situations: with the clock stopped and with the clock moving at a v speed.
If we consider that the watch is a perfect square, when it is stopped, we can observe the time sequence $(t_0, t_1, t_2, t_3, t_4)$ shown in Figure 4. In this sequence the two light pulses have basically the same movement, going out and returning at the same time.

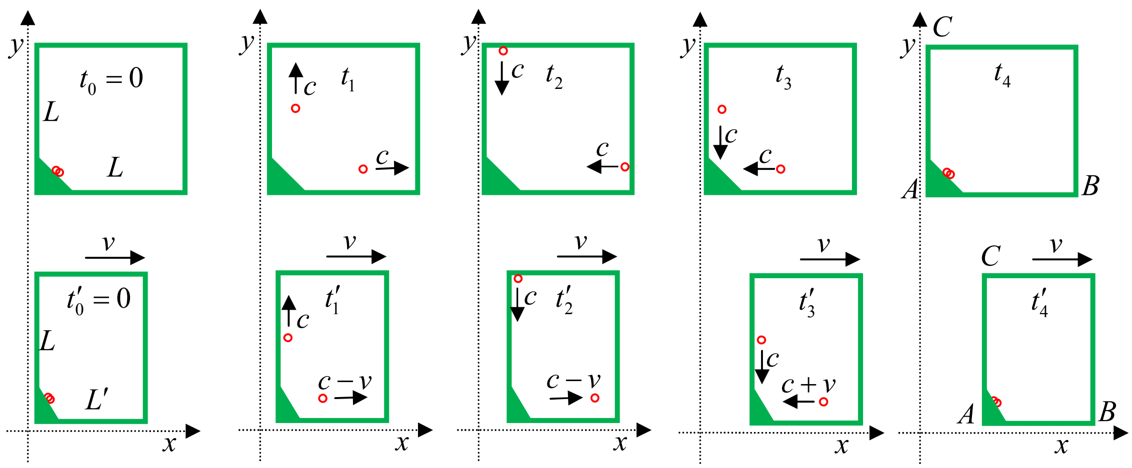

Figure 4 – Moving the Einstein's double light clock.

Observing the moving clock, we can see that the light pulse in AC path, up to the top of the box in time t'_2, hit the mirror and begins to return. At this time the light pulse in AB path not arrived in the mirror because the point B is "running away" from these pulse, generating a relative velocity slightly less than the light speed $(c - v)$. On the other hand when the light pulse in the direction BA returns, the relative speed is a little above the light speed $(c + v)$ and so the two pulses arrive together.
Note that one observer inside the moving clock will see the same condition of one stopped clock, with all light pulses moving at the vacuum light speed.

Based on equations (2) (3) and observing Figure 4, we can obtain the following relations:

$$(t_{OPERA} + dt_{OPERA}) = \sqrt{(t_{OPERA})^2 + (\Delta t_N)^2}$$

$$(\Delta t_N)^2 = \left(\frac{L_{OPERA}}{c} + dt_{OPERA}\right)^2 - \left(\frac{L_{OPERA}}{c}\right)^2$$

$$\Delta t_N = \sqrt{\left(\frac{L_{OPERA}}{c}\right)^2 + 2\frac{L_{OPERA}}{c}dt_{OPERA} + dt_{OPERA}{}^2 - \left(\frac{L_{OPERA}}{c}\right)^2}$$

$$\Delta t_N = \sqrt{2\frac{L_{OPERA}}{c}dt_{OPERA}}$$
$$\Delta t_N = \sqrt{2\frac{L_{OPERA}}{c}\Delta t_{MaxOPERA}\frac{\omega_E L_{OPERA}}{c}}$$
$$\Delta t_N = \pm\frac{L_{OPERA}}{c}\sqrt{2\omega_E \Delta t_{MaxOPERA}} \qquad (17)$$

In Figure 4, t_2 represents an average time for both the two clock motion cases:

$$t_2 = \frac{t_4}{2} = \frac{L}{c}$$
$$t_2 = \frac{t_{AB} + t_{BA}}{2}$$
$$t_2' = \frac{t_{AB}' + t_{BA}'}{2} \qquad (5)$$

On this way, from Equation 5, a phase delay Δt can be calculated as follows:

$$t_{AB}' = \frac{L'}{c} + \Delta t'$$
$$t_{BA}' = \frac{L'}{c} - \Delta t'$$
$$2\Delta t' = t_{BA}' - t_{AB}' = \frac{L'}{c-v} - \frac{L'}{c+v} = L'\frac{2v}{c^2 - v^2}$$
$$\Delta t' = \frac{vL'}{c^2\left(1-\frac{v^2}{c^2}\right)} = Y^2\frac{vL'}{c^2}$$
$$\Delta t = \frac{vL}{c^2} \qquad (6)$$

It may be noted that the delay shown in equation (6) is equivalent to the delay indicated for Witte effect in equation (1), except that the refraction index was not used in equation (6), because the Einstein's light clock operates on vacuum.

Figure 5 shown an Einstein's light clock, that was assembled in order to rotate as it moves.In this case two atomic clocks are used, one at each end of the light clock. These atomic clocks are synchronized by the "hits" of the light clock.
Also in Figure 5, the rotating angle α was defined on the way that for a null angle, the light clock has a its maximum size.

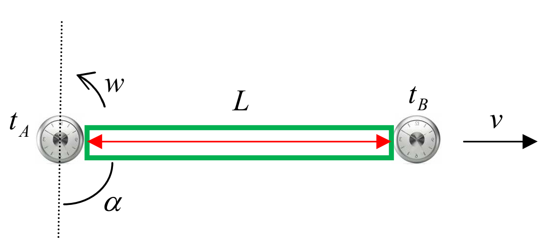

Figure 5 – Rotating the Einstein's light clock.

In the Figure 5 experiment, the length of the light clock can be calculated according to the α angle, through the equations:

$$L_n(\alpha) = \sqrt{L_x^2 + L_y^2}$$
$$L_n(\alpha) = \sqrt{(\frac{L}{Y}\sin(\alpha))^2 + (L\cos(\alpha))^2}$$
$$L_n(\alpha) = L\sqrt{(1-\frac{v^2}{c^2})\sin^2(\alpha) + \cos^2(\alpha)}$$
$$L_n(\alpha) = L\sqrt{1-\frac{v^2}{c^2}\sin^2(\alpha)} \qquad (7)$$

In equation (7) the space contraction factor is "modulated" by the α angle. Thus for a null angle the light clock length is not affected and so for a 90^o angle to the length reaches a minimum value.

In Figure 5, A clock does not rotate and so the t'_A time is not affected by system rotation. The B clock, in turn, will present a t'_B time and a t'_{AB} propagation delay, which varies according to the α rotation angle:

$$t'_B(\alpha) = t'_A + t'_{AB}(\alpha)$$
$$t'_{AB}(\alpha) = t'_B(\alpha) - t'_A \qquad (8)$$

Based on the Figure 4 experiment of, and using equations (2) to (6), four values can be obtained for the t'_{AB} propagation delay:

$$\alpha = 0 \quad \Rightarrow \quad t'_B = t'_A + \frac{L'}{c} \quad \Rightarrow \quad t'_{AB}(0) = \frac{L'}{c}$$
$$\alpha = \frac{\pi}{2} \quad \Rightarrow \quad t'_B = t'_A + Y^2\frac{L'}{c} + Y^2\frac{vL'}{c^2} \quad \Rightarrow \quad t'_{AB}(\frac{\pi}{2}) = Y^2\frac{L'}{c}(1+\frac{v}{c})$$
$$\alpha = \pi \quad \Rightarrow \quad t'_B = t'_A + \frac{L'}{c} + \quad \Rightarrow \quad t'_{AB}(\pi) = -\frac{L'}{c}$$
$$\alpha = \frac{3\pi}{2} \quad \Rightarrow \quad t'_B = t'_A - Y^2\frac{L'}{c} - Y^2\frac{vL'}{c^2} \quad \Rightarrow \quad t'_{AB}(\frac{3\pi}{2}) = -Y^2\frac{L'}{c}(1+\frac{v}{c})$$

On this way the time variation (as a function of α angle) can then be calculated similarly to equation (7), using the following equation:

$$t'_{AB}(\alpha) = \sqrt{\left(Y^2\frac{L'}{c}(1-\frac{v}{c})\right)^2 \sin^2(\alpha) + \left(\frac{L'}{c}\right)^2 \cos^2(\alpha)} \qquad (9)$$

It is important note that in equation (9) times cannot simply be added, being necessary to use a quadratic metric for calculating the “temporal distance”. This occur because, in the context of the SR, the time dimension behave similarly to special dimensions, forming a four-dimensional continuum space-time.

An alternative explanation, proposed by the author [9], for the metric observed in equation (9), considers that time is a complex variable and so the relativistic time dilation occurs due to a object displacement of the in the imaginary time axis.

Equation (9) is valid both for rotation directions (clockwise and counter-clockwise), and thus should be considered the two possible signs defined in the square root function, as for example:

$$t'_{AB}(0) = \sqrt{(\frac{L'}{c})^2} = \pm\frac{L'}{c}$$

$$t'_{AB}(\frac{\pi}{2}) = \sqrt{\left(Y^2\frac{L'}{c}(1-\frac{v}{c})\right)^2} = \pm Y^2\frac{L'}{c}(1-\frac{v}{c})$$

Using some basic trigonometric relations the equation (9) can be simplified to:

$$t'_{AB}(\alpha) = \frac{L'}{c}\left(Y^2 - \frac{v}{c}\sin(\alpha)\right)$$

$$t'_{AB}(\alpha) = Y^2\frac{L'}{c} - \frac{L'v}{c^2}\sin(\alpha)$$

$$t_{AB}(\alpha) = \frac{L}{c} - \Delta t\sin(\alpha) \qquad (10)$$

Similarly we can calculate:

$$t_{BA}(\alpha) = \frac{L}{c} + \Delta t\sin(\alpha) \qquad (11)$$

Figure 6 shows an experiment similar to Figure 5 experiment, also held in a vacuum, but now with two atomic clocks generating periodic laser pulses at the same frequency.

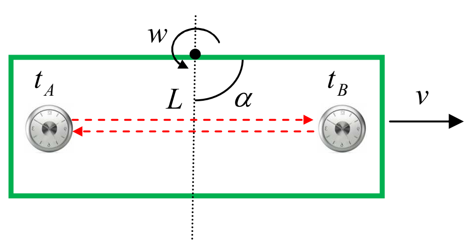

Figure 6 - Rotating two atomic clocks connected by two pulsed laser beams

In this condition the equations (10) and (11) point to the fact that the pulses will have its phase changed during the clock rotation. On this way a measurable phase delay will be generated, as shown by the red dot lines in Figure 7.

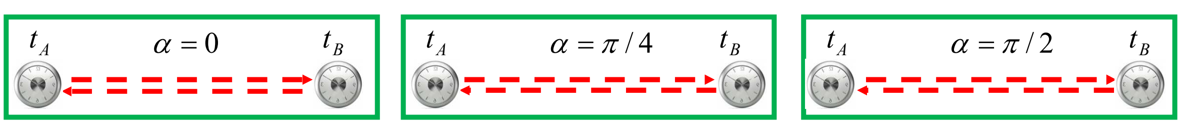

Figure 7 – Witte effect observed when comparing the light pulses phase shifts.

If this experiment is mounted on the Earth surface, the phase delays will vary according to the sidereal time, with a sinusoidal wave form given by equation (10). The wave amplitude will be function of the transmission channel characteristic and so function of the Earth speed like predict by the Witte effect.
Thus, as shown in this section, rotating the Einstein's light clock we can calculate the Witte effect, without any contradiction with the SR mathematical formulation.

5 – Appling the Witte effect to the OPERA experiment

The results presented above shown that if we can connected the two OPERA atomic clocks, by a coaxial (or fiber optic) cable phase we will observe delays, which vary according to the sidereal time considered.
From Figure 8 we can see that the Witte experiment has a 70^0 direction, while the direction of OPERA experiment is about -43.5^o. These angles are important because they define a relative length (L_{eq}) to the equatorial plane that will be affected by Earth's rotation.

Figure 8 – OPERA and Witte experiment directions.

Based on equations (1) and (6) we can calculate the phase delays for the two experiments. If we consider a unitary refraction index for the "hypothetical cable" that can connect the OPERA clocks, the Witte effect delays can be calculated as flows:

$$\Delta t_{MaxWitte} = L_{eqWitte} \frac{v_E n_{Witte}{}^2}{c^2}$$

$$\Delta t_{MaxOPERA} = L_{eq\,OPERA} \frac{v_E}{c^2}$$

$$\Delta t_{MaxOPERA} = \frac{\Delta t_{MaxWitte} L_{eq\,OPERA}}{n_{Witte}{}^2 L_{eqWitte}} \qquad (12)$$

Based on the information available for the OPERA and the Witte experiments, the Witte effect phase delay for the OPERA is 459.07 times larger than observed by Witte in 1991, with a total value of 6.886 μs .
In a first analysis, we would expect that these Witte effect delays would affect the measurement speed of neutrinos, but the fact is that the size of Earth in the direction of motion also varies in proportion to the sidereal time considered, which can be seen in equations (7) and (10) which vary according to the sine of the angle considered.
This same phenomenon occurs when we rotate the clock light of Einstein. Thus an observer inside the watch can identify the phase delays between clocks, but the measured speed of light pulses will be constant.

However, this compensation is not perfect and for longer distances, as is the case of OPERA, whereas the neutrinos is moving, the Earth rotates, causing a fixed phase delay that is very small, but that can be experimentally observed.
Whereas the sidereal day is about 86164s (23h 56min and 4s) Earth's angular frequency is given by:

$$\omega_E = \frac{2\pi}{86164} = 72{,}921\mu rad/s$$

During the neutrinos trajectory in OPERA, the Earth rotates an angle given by:

$$\alpha_{OPERA} = \frac{\omega_E L_{OPERA}}{c} = 177{,}695 nrad \tag{13}$$

This rotation generates a time delay that is not compensated, because the condition of the Earth in the neutrinos emission is slightly different at the neutrinos arriving time.

Thus we can consider the angle defined in equation (13) applied in equation (10):

$$\begin{aligned} dt_{OPERA} &= \Delta t_{OPERA} \sin(\alpha_{OPERA}) \\ dt_{OPERA} &\approx \Delta t_{OPERA}\, \alpha_{OPERA} \end{aligned} \tag{14}$$

The time delay obtained by equation (14) is only 1.192 picoseconds and so can not directly explain the -60ns delay observed in OPERA experiment.

However the equation (9) used to calculate the time (in the Einstein's light clock rotation) within a square metric, which also generates a multiplier effect.
Note: This multiplier effect can be easily observed if we calculate the value of a square triangle hypotenuse where one side is much larger than another. For example, for one triangle that has 1000m and 1m sides lengths, the hypotenuse length will be 1000.0025m. In case of this hypotenuse length will be increase by 2mm, due to the variation of the smaller side, this side should increase by 1.23m to generate this 2mm value.

In this context, the time for the arrival of neutrinos, moving at light speed in OPERA is given by:

$$t_{OPERA} = \frac{L_{OPERA}}{c} \tag{15}$$

And also, the experimental time (t_N) at which the neutrinos are observed in the OPERA will be affected by a Δt_N delay:

$$t_N = t_{OPERA} + \Delta t_N \tag{16}$$

Thus, based on equation (9) metric, we can establish the following equations:

$$(t_{OPERA} + dt_{OPERA}) = \sqrt{(t_{OPERA})^2 + (\Delta t_N)^2}$$
$$(\Delta t_N)^2 = (\frac{L_{OPERA}}{c} + dt_{OPERA})^2 - (\frac{L_{OPERA}}{c})^2$$
$$\Delta t_N = \sqrt{(\frac{L_{OPERA}}{c})^2 + 2\frac{L_{OPERA}}{c} dt_{OPERA} + dt_{OPERA}{}^2 - (\frac{L_{OPERA}}{c})^2}$$
$$\Delta t_N = \sqrt{2\frac{L_{OPERA}}{c} dt_{OPERA}}$$
$$\Delta t_N = \sqrt{2\frac{L_{OPERA}}{c} \Delta t_{MaxOPERA} \frac{\omega_E L_{OPERA}}{c}}$$
$$\Delta t_N = \pm\frac{L_{OPERA}}{c}\sqrt{2\omega_E \Delta t_{MaxOPERA}} \qquad (17)$$

On this way, the Δt_N value can be finally calculated, by:

$$\Delta t_N = \frac{730534{,}61}{c}\sqrt{2 \times 7{,}292 \times 10^{-5} \times 6{,}886028 \times 10^{-6}} \qquad (18)$$
$$\Delta t_N = 77{,}2ns$$

This delay value is slightly above the average of 60ns observed in OPERA, but still in the uncertainty range considered. Always remember that the available data for the experiments Witte are only partial and so, to validate the equation (17) Witte experiment must be performed again.

6 – MINOS Experiment

The delay value calculated by equation (17) can be positive or negative. On this way, should be observed the same criteria used for the Coriolis effect (cross product of the displacement vector by the angular velocity Earth vector) to determine the delay direction.

Figure 9 shows the WURA Δt_N delay, considering four paths of neutrinos in the north hemisphere. Fortunately in OPERA and MINOS experiments the Δt_N value is negative, thus creating a strong opportunity to identify this phenomenon.

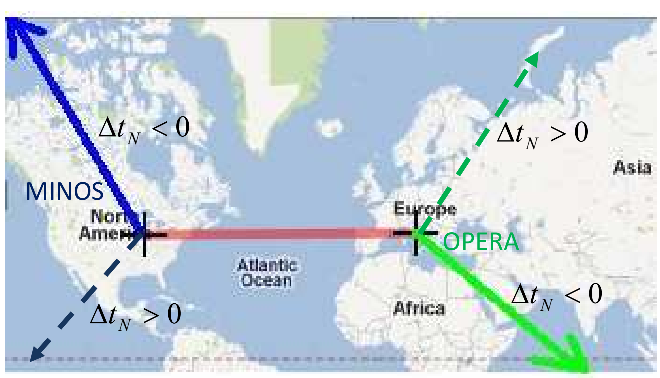

Figure 9 – OPERA and MINOS WURA delay signals.

As the length of neutrino path at MINOS (734298.6m) is very close to the length observed in the OPERA using equation (17) for the MINOS case generates a similar delay in the order of 80ns.

7 – Conclusion

This paper presented a new explanation for the neutrino speed measurement in OPERA and MINOS experiments, estimating a systematic error in neutrino arrival time measuring. This error occur in function of Coriolis and Witte effects, respectively associated with the rotation and displacement of the Earth in space.

The relativistic phenomenon that generates this time measurement error was called by the author as WURA (Witte-Ulianov Rotation Anisotropy) effect.The WURA effect in case of OPERA experiments become from relativistic effects due to the Earth motion at a high speed, around 1/1000 of light speed.

The WURA effect predict that any experiment that uses atomic clocks (in rotation), to measure some channel time propagation delays, will introduce a WURA phase delay, that can be calculated by the following equation:

$$\Delta t_{WURA} = \pm \frac{nL}{c^2} \sqrt{L_{ROT}\ 2\,\omega\, v_{ROT}} \qquad (19)$$

Where L is the length of the communication channel, and n its refraction index. The parameter ω is the angular velocity of the considered system (or frame that contains it), and v_{ROT} is the projection of the displacement speed on the rotation plane. The parameter L_{ROT} is obtained by the projection of the total length L on the considered rotation plane.

For the OPERA experiment the WURA effect delay was calculated by equation (17) (why we do not know exactly Earth motion direction and so the v_{ROT} value of our planet can't be calculated), as -77.23 ns which is in according to the OPERA experimental results. It is important to remember that in Witte experiment the cable refraction index not is precisely known, because Witte experiment the data are lost. This happened why the Witte work was not accepted for publication, because apparently the Witte effect was not compatible with the SR.

It is interesting to note that until the publication of this work, the data generated in OPERA and MINOS also seemed to go against the SR. Fortunately in this experiments the volume of human and material resources evolved, prevented that the SR unexpected results was simply "discarded". It should also remember that Roland De Witte fell into a deep depression because of his work was not recognized, what may have been a cause of his untimely death. Besides, even Witte effect as an experimental phenomenon that can be easily detected, the Witte effect was relegated to obscurity for more than two decades,.

Considering the history of Witte and OPERA experiments we can also observe two amazing aspects of modern physics: On the one hand they are spending billions of dollars to build a particle accelerator that can confirm some gaps in the standard model (such as the Higgs boson) and for other hand, the scientific community refuses to publish experimental data perfectly valid, but that put in doubt some "sacred" pillars that sustain its models. Thus the Witte experiment, what can be implemented at very low cost (and even has the potential to detect Earth speed variations, due to gravitational waves, like proposed by Cahill in [4]) was not played again until the present date.

The analysis performed in this paper shows that the Einstein's SR mathematics can be used to explain the Witte effect. On this way some experiments involving atomic clocks (or other signal source which fix frequency) in rotation, can be used to measure absolute velocities, such as the Earth speed. Thus the effective "relativity" of SR should be more thoroughly evaluated, because there is "something out there" creating an absolute speed referential. On the other hand, the Witte effect delay (that can be ease measured for the OPERA, with about 7us of variation) does not directly affect the measure speed of neutrinos. This leads to the intriguing conclusion, that the neutrino path also change in function of the sidereal hour canceling the Witte effect phase variation. On this way, the Earth (and everything in it) undergoes a variation (as predict in SR) in size (around one part per million) throughout the day when our home planet move into space at point one percent of light speed. So everything around us is constantly changing in size, even without any direct way to see that’s this changing is happening.

Depending on the analysis performed on this paper and WURA delays value of 77ns calculated to de OPERA, the author believes to have found the exact explanation for the neutrino early arriving time in OPERA and MINOS experiments.On this way the author can conclude that the neutrino in fact move at light speed!

Despite the fact that WURA effect have simple mathematical deduction, it’s still only one speculative theory.Stephen Hawking's citation, at this paper beginning, clearly shows that WURA effect, in addition to predicting the delay in OPERA and MINOS, should also be able to predict results of experiments not yet performed.

Currently there is a belief that Witte effect cannot be observed in optical cables. This is probably a hypothetical argument that appeared to restrict the scope of the Witte effect, thus avoiding major clashes with the SR.

So in first time, the effect Witte should be monitored again with greater precision in a long-term experiment, linking two atomic clocks with both coaxial and fiber optic cables. Both results should be similar, as provided in equation (1), that specifies that only the refraction index the channel, and not the kind of wave that travels on it.

Secondly, the author proposes the construction of the IPD-WURA(Investigating Delays in Witte Ulianov Positive Rotation Anisotropy) experiment, to measure the speed of neutrinos in a similar way to the Opera, but with the detector installed in Portugal, as shown in Figure 10.

Figure 10 - Neutrino trajectory in the proposed IPD-WURA experiment.

The IPD-WURA experiment could be made near from Lisbon, generating an optimal trajectory for comparison with OPERA neutrino trajectory. This occurs because the path, shown dotted in Figure 10, is above the equator and go until the Europe western.

The neutrino path in IPD-WURA experiment have a small slope and a greater length than in the OPERA experiment. Thus IPD-WURA experiment will generating a positive delay, about 2 times longer than the anticipation of neutrinos observed in OPERA, in the range of 110 to 120ns.

References

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Acknowledgements

The author dedicates this paper in memory of Roland De Witte, who died before his work was recognized.

This work is also dedicated to the physicists like D. Miller and R. T. Cahill and all those who fight for the advancement of theoretical and experimental physics, without being shackled to the dogmatic bases that limit the evolution of contemporary physics.

The authors acknowledge the support received from people who read your articles about OPERA experiment and contributed to obtaining the results here presented, especially Paul Jonas Negreiros, Abba Cohen Persiano and Thadeu Penna.

The author also thanks the members of the NPA (http://www.worldnpa.org/main/) especially Brant Callahan, who point to Witte experiment that provided the basis to this work.

The author also thanks to D. A. Simoon by pointing out the 177nrad Coriolis effect angle, related to the OPERA experiment, as a key to explain the speed of the neutrino.

This article was translated with the help of Google Translate (http://translate.google.com/), and so the author also tanks to Google Inc for freely available of this excellent tool.

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http://www.atomlig.com.br/poli/WURA-IG.pdf

The author has some new ideas for measuring the displacement of the Earth with greater precision (even in the north south direction) and so detect gravitational waves. On this way they like to establish partnerships with institutions that want perform these experiments.

Contact the author can be performed at the following email: policarpoyu@gmail.com