The Witte Effect: The Neutrino Speed and The Anisotropy of the Light Speed, as Defined in the General Theory of Relativity

Policarpo Yōshin Ulianov
Changing Rivers by Oceans
policarpoyu@gmail.com

Abstract

In 1991, R. D. Witte performed an experiment to observe phase drift between two clusters of atomic clocks linked by a coaxial cable.
Surprisingly, data from Witte observations showed cyclical phase drift variation with a periodicity very close to one sidereal day, in a phenomenon which along the present paper will be called "Witte effect".
Witte's data were not accepted for publication, because they seemed to contradict the Einstein's Special Relativity Theory.
The Witte effect was thus ignored by the prevailing scientific paradigm until 2006, when R. T. Cahill found that the results by the Witte experiment were correct and could be explainable in the context of general relativity, due to an anisotropy in the speed of light that arises from the interaction between gravitational fields.
Initially, Witte effect happens regardless the kind of signal is used to link the atomic clocks, be it RF (as used by Witte himself), light pulses or even bursts of neutrinos.
Associating the OPERA experiment to the one by Witte (theoretically or linking the OPERA clocks with a coaxial cable), initially it will be observed phase drifts that vary according to the sidereal time when the experiment is being performed, a concern that is not known to have been regarded by the physicists designing the OPERA experiment.
In the light of such facts, there are reasons to believe that the Witte effect explains why OPERA's neutrinos seem to move at speeds above the light speed.

1 – Introduction

The present paper proposes an explanation for the fact that neutrinos in the OPERA (Oscillation Project with Emulsion-tRacking Apparatus) experiment [1] seem to move at speeds above the light speed when travelling from Switzerland to Italy.
There are reasons to believe that neutrino arrival time is being affected by the Witte effect, a phenomenon causing cyclical variation of phase drift in atomic clocks linked by a coaxial cable.
The Witte effect was firstly observed by R. D. Witte [2] in the year 1991, in an experiment devised to monitor phase drifts in cesium atomic clocks.
In the aforesaid experiment, besides the expected random drifts, Witte observed significant phase drifts that showed sinusoidal variation as a function of the sidereal time in which the experiment was performed.
Witte did not manage to have his experimental data published, because they seemed to contradict Einstein's theory of Special Relativity, something which was not welcomed by the scientific community.
The Witte effect was thus only acknowledged in the year 2006, when R. T. Cahill published a paper [2] showing that the phase drifts as observed by Witte was real and the experimental results could be explained without contradicting Einstein's relativity theories at all.
In this paper, R. T. Cahill states:
"Ever since the 1887 Michelson-Morley experiment to detect absolute motion, that is motion relative to space, by means of the anisotropy of the speed of light, physicists in the main have believed that such absolute motion was unobservable, and even meaningless.
This was so after Einstein proposed as one of his postulates for his Special Theory of Relativity that the speed of light is an invariant

quantity. However, the Michelson-Morley experiment did observe small fringe shifts of the form indicative of anisotropy in the speed of light. The whole issue has been one of great confusion over the last 100 years or so. This confusion arose from deep misunderstandings of the theoretical structure of Special Relativity, but also because ongoing detections of the anisotropy of the speed of light were treated with contempt, rather than being rationally discussed."

This analysis by Cahill was further confirmed by D. Rabounski (chief editor of the journal Progress in Physics) who, due to the material importance of this theme, prefaced the paper by Cahill [2] as follows:

"Therefore the anisotropy of the observed value of the velocity of light does not contradict Einstein's Principle of Relativity. On the contrary, such an experimental result can be viewed as a new verification of Einstein's theory."

In this context, after knowledge about the Witte experiment from reference [2], the following points were regarded as noteworthy:

a) The Witte experimental apparatus was based on atomic clocks linked by coaxial cables, in a setting very similar to the one for a previously proposed experiment [3] devised to improve neutrino speed assessment in the context of the OPERA experiment;
b) Theoretical analyses by Cahill and Rabounski point to the fact that space may have a gravitational potential in direct proportion to c^2 and, within this potential, the speed of light may behave anisotropically without contradicting the principles of Einstein's theory of Special Relativity at all.

Thus, it is possible to realize, with no resort to mathematical tools used by Cahill and Rabounski to build their argumentation, that the Witte experiment is not measuring the Earth's speed towards the "Ether", but the speed at which the gravitational field of Earth dislocates towards the gravitational fields generated by the Sun, the Milky Way and all nearby galaxy clusters.

It is thus possible to compare Earth, in a crude analogy, to a surfer "riding" a wave in the ocean. Here, the "surfboard" of such a surfer would be the gravitational field of Earth and the "wave he is riding" would comprise several superimposed waves, each one pertaining to wider and wider gravitational fields. The "final wave" then would be so wide as to cover the whole ocean, with such small amplitude as to be pretty much the same the undisturbed surface of the ocean, so as one could mistake it for the ocean surface itself.

In the case of Earth, the longest "wave" can be as wide as the observable universe; in such a context, the speed of Earth would have as reference a so wide gravitational field that one could use it to define a kind of absolute space.

Regardless of the explanation for the Witte effect, it is real and its experimental verification is simple.

When replicating the Witte experiment by linking two buried atomic clocks, that are on the Earth's surface, with a coaxial cable, the resulting phase drift is to vary as a function of the present sidereal hour. Initially, this variation depends on the cable type, its length and the direction along which it stretches out, but is not affected by the type of the deployed atomic clock.

It is thus possible to design an experiment in which the two atomic clocks, that bases the OPERA experiment, are linked by a coaxial cable extending from Geneva to Rome, replicating the Witte experiment with a 500 times longer cable and more accurate clocks.

In this experiment, the Witte effect should cause phase drift varying (as a function of the sidereal hour in which it is performed) in the ±7μs range. This delay value is much greater than the time of 60ns with that neutrinos arrive ahead in OPERA.

However it should be taken into account that the Earth itself will "shorten" in the motion direction, decreasing the distance between the clocks (or the size of the cable), according to the sidereal time considered.

So there is a tradeoff, because when the cable direction is equal to the direction of Earth travel, time reaches a minimum value (because phase delay is in a maximum negative value) and the path will also have a minimum value. Also when the cable direction is perpendicular to the direction of displacement, the path size is maximum and the phase delay is null.
But while the neutrino moving, the earth changes its angle, affecting this compensation and may explain the 60ns of phase advance observed in OPERA.

2- The Witte experiment

R. D. Witte's original goal was to assess variations in the frequencies of two clusters of cesium atomic clocks (three clocks per cluster) set apart by 1.5 km, over long periods.
To assess the relative delays among the available clocks, Witte derived from each clock a RF signal with an approximate 5Mhz frequency.
For the clocks within the same cluster, the RF signals were directly connected to a phase shift comparator. In this case, Witte found them to randomly vary about 5ns a day.
Clocks in different buildings were equally compared, and their RF signals were transported along a coaxial cable, as shown in Figure 1.
Observe that in the experiment shown in Figure 1, only one propagation direction along the cable (from A to B) is regarded. In the full experiment, Witte propagated the RF signal in both directions, with a second phase shift comparator installed near clock A.

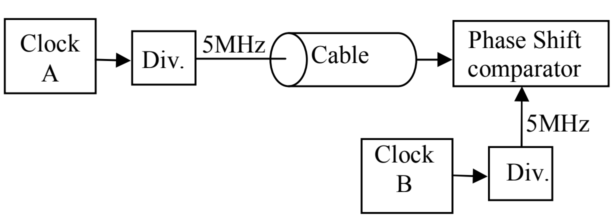

Figure 1 – Witte experiment for signal travelling through the cable in one direction only.

In the experiment in figure 1, one would expect clocks A and B to feature the same drift as that by clocks working side by side.

Nevertheless, Witte found phase drift to behave along the cyclic curve shown in Figure 2, which has amplitude of about 15ns and period very close to one sidereal day.

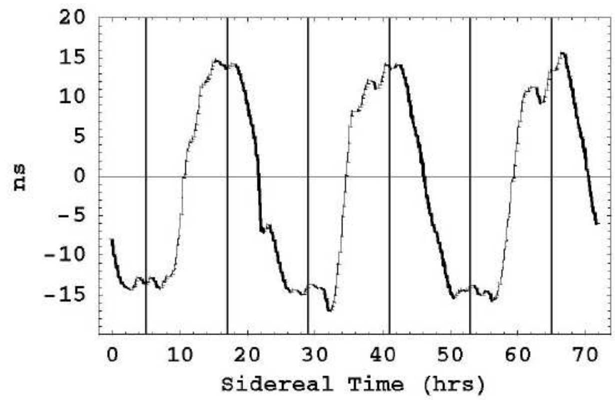

Figure 2 – Phase drifts, as observed by Witte.

Although R. D. Witte did not publish those data from his experiments in official academic media, they were divulgated through emails and webpages, thus preserving the main experimental features of Witte experiment and part of the acquired data.
As shown by Cahill in [2], the phase drift (Δt) observed in the Witte effect can be calculated as a function of the speed (v_p) of the Earth's gravitational field relative to the surrounding gravitational fields, as per the following approximation equations:

$$\Delta t \approx 2\frac{L}{c/n}n\frac{v_p}{c}$$

$$\Delta t \approx 2L\frac{v_p n^2}{c^2} \tag{1}$$

Where c is the speed of light, L the length of the deployed coaxial cable and n its refraction index.

Thus, once phase drift is known the speed can be calculated as:

$$v_p \approx \frac{\Delta t\, c^2}{2L\, n^2} \tag{2}$$

For the Witte experiment (L=1,500 m; n=1.5 and Δt=30 ns), the value obtained for speed is 400 km/s.

According to Cahill, this speed is in line with the value measured in 1926by Miller interferometer[5], which was 420±30 km/s.

4 – Developments from the Witte experiment

The importance of the Witte experiment is not limited to allow for a compensated calculation of neutrino speed, but it also demonstrates how the Earth's gravitational field interacts with the many gravitational fields surrounding it.
Moreover, according to Cahill [2] the Witte experiment could also be detecting as well variations in gravitational fields that may be related to gravitational waves.
With those facts considered, the replication of Witte experiment with improved accuracy using a longer coaxial cable and more accurate clocks can bear significant fruits.
Some other developments on the original Witte experiment are hereby suggested, such as replacing coaxial cable by optic fibers, which could transmit light pulses instead of RF signals.
Nevertheless, the original Witte experiment has a weak point: it does not determine the complete direction of the Earth's movement, but only its projection onto the Equatorial plane.
Thus, unless steps are taken to rectify this situation, it requires some modifications in order to allow for it to be performed along the North-South direction.

This is the context in which the Witte-Ulianov experiment is proposed, using two atomic clocks linked by an optic fiber cable or, optionally, a coaxial cable.
Figure 3 shows the basic diagram of the Witte-Ulianov experiment, with two atomic clocks A and B linked by optical communication channels.
In this experiment, each clock activates a 1PPS (one pulse per second) circuit, sending a light pulse through the optical channel at every second. A datalogger associated to each clock records the moment in time in which each pulse is emitted and received.
Across the performance of this new experiment the travelling time of pulses emitted in both the AB and BA directions will be recorded every second.
The subtraction of those travel times will have as its results values for Δt which are similar to the phase drift observed in the original Witte experiment.
Thus, setting a Witte-Ulianov experiment along the East-West direction will bring as a result values for Δt varying as a function of the sidereal hour in a fashion that is similar to the graph shown in Figure 2.

On the other hand, setting the Witte-Ulianov experiment along the North-South direction will allow for obtaining a near constant value for Δt that, substituted into equation (2), allows for assessment of the speed of Earth along the North-South direction.

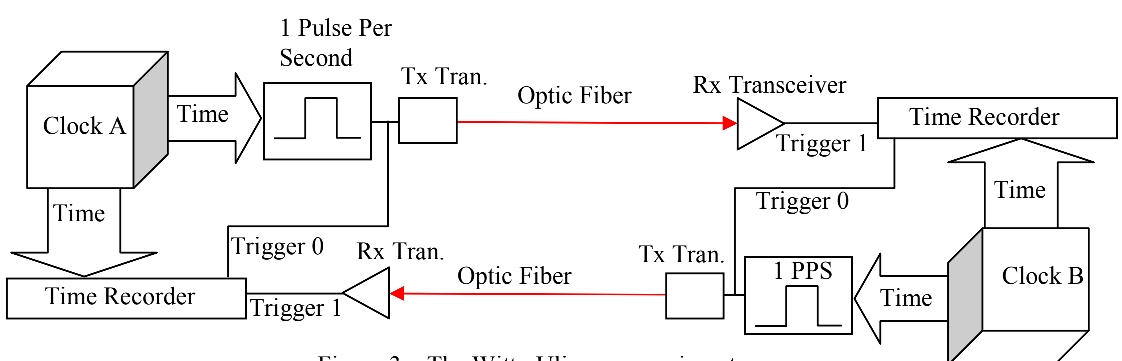

Figure 3 – The Witte-Ulianov experiment

It is worth noting that for the correct operation of the Witte-Ulianov experiment the two clocks must be initially synchronized side by side, and thus taken to their respective experimental locations.
In order to mitigate relativistic effects that emerge from the clocks' displacement, they must be moved at low speed (or abiding to the same acceleration curves), so as to ensure the required uncertainty level for time measurements.

5 – Applying the Witte experiment to OPERA

Figure 4 shows two maps, with the respective orientations of OPERA and Witte experiments. In this figure, it is possible to see that the red lines (indicative of the spatial orientation of each experiment) may be decomposed along vector components in the East-West and North-South directions.

For cables featuring propagation speed near to the speed of light ($n = 1$), the phase drift for the Witte experiment applied to the OPERA clocks can be estimated in the ±7 μs range.

Figure 4 – Orientations of the OPERA and Witte experiments.

Measurement of neutrinos speed rely directly on time measurements by the two atomic clocks. In this context, phase drift induced by the Witte effect are significant and vary periodically as a function of the sidereal hour in which each measurement is taken, a phenomenon which is probably not being accounted for by the physicists performing OPERA.

Likewise the size of Earth "shortens" in the motion direction and so the distance traveled by neutrinos in OPERA also varies depending on the sidereal time considered.

At first these two effects tend to cancel, but due to the rotation of the Earth during the time when the neutrinos are moving, the cancellation is not perfect, generating a time difference that practically does not vary with the sidereal time.

This difference could in principle explain why neutrinos are coming to OPERA 60ns ahead of schedule, even if they are moving at light speed, or slightly below this value.

6 – Conclusions

In the year 1991, R. D. Witte studied variations over cesium atomic clocks, obtaining significant phase drifts varying as a function of the sidereal hour.
Those results were not accepted for publication at the time, because they were indicative of a phenomenon (hereby called the Witte effect) which seemed to contradict the principles of Einstein's Special Relativity Theory.
In spite of this, as shown by Cahill in [2], the Witte is real and received empirical confirmation by Cahill himself, who replicated Witte's experimental settings and procedures.
The Witte effect is thus confirmed as a real phenomenon causing significant phase drift varying as a function of the sidereal hour.

The author believes that it is not possible to understand exactly what is happening in the OPERA experiment, without taking into account the Witte effect, which arises because the Earth is moving through space at approximately 400km/s.

Thus the first step to get the real speed of neutrinos passing through a deeper study of the effect Witte, repeating the Witte experiment with greater precision and more accurate also performing interferometry experiments (or the Witte-Ulianov experiment proposed here) in order to obtain the actual direction of Earth travel in the space.

These experiments may also be useful for astronomers and cosmologists.
As per proposed by Cahill [2], the Witte experiment may be used also to detect gravitational waves.

7 - References:

[1] D. V. Naumov, V. A. Naumov, *Neutrino Velocity Anomalies: A Resolution without a Revolution.* 2011.
Available at: http://arxiv.org/pdf/1110.0989

[2] R. T. Cahill The *Roland De Witte 1991 Experiment (to the Memory of Roland De Witte)*, PROGRESS IN PHYSICS July, 2006.
Available at:
http://www.orgonelab.org/EtherDrift/CahillDeWitte2006.pdf

[3] P. Y. Ulianov, THE *KING IS NAKED! The reason why neutrinos appear to be moving faster than light*, 2005.
Available at:
www.atomlig.com.br/poli/Neutrinos-IG.pdf

[4] D. Miller, *Significance of the Ether-Drift Experiments of 1925 at Mount Wilson*, Science, 63:433-443, 30 April 1926.

About the Author:

Policarpo Yōshin Ulianov is a Power Systems Engineer, holding a master's degree in electronic holography and PhD in Artificial Intelligence. Self-taught physicist, studies theoretical physics and collected and matured a series of original ideas over 20 years that considered interesting, thus developing the **Ulianov Theory (UT)**, a fictitious model of the Physical Universe based on a few intuitively developed basic concepts.

The author is available for contact at:
policarpoyu@gmail.com

The present paper is available at:
www.atomlig.com.br/poli/WitteEffect-IG.pdf

The author thanks Solução Supernova Staff Team (www.solucaosupernova.com.br) for all support and services regarding the translation of this paper from Portuguese to English.

Some UT models

A complex time model:
www.atomlig.com.br/poli/ImaginaryTime-IG.pdf

A new String Theory:
www.atomlig.com.br/poli/UST-IG-V8.pdf

A new way to see the space:
www.atomlig.com.br/poli/USN-IG-V9.pdf

The proton size variation in muonic hydrogen:
www.atomlig.com.br/poli/UST-muonic-IG.pdf