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Neutrinos from CERN, Reaching Too Early to Gran Sasso, Do Not Exceed the Velocity of Light. They in Fact Reveal the True Physical Mechanism of Gravity

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Abstract

In 2011 neutrinos from CERN in Geneva-CH were announced to reach to the OPERA Lab in Gran Sasso-IT 60 ns earlier than light. In reality, the velocity of the neutrinos was compared, not with the measured one-way velocity of light, however with the *presumed* velocity of light *c*. As this conclusion breaks the light postulate, the data were withdrawn. In fact, to compare the neutrino velocity with the presumed velocity of light violates a fundamental precept of scientific methodologies. Such a comparison could make a sense only if the velocity of both neutrinos and light had been measured along the same path in vacuum. Actually the absence of the solar gravitational slowing of the GPS clocks, absence of light anisotropy with respect to earth etc. demonstrates that the Higgs Quantum Fluid Space (HQFS), giving mass to the elementary particles and thus ruling their inertial motion, is moving round the sun according to a Keplerian velocity field, consistently with the planetary motions. It is also moving round earth consistently with the orbital motion of the Moon. The Keplerian velocity fields are the quintessence of the gravitational fields. In the earth's field, the velocity of the HQFS achieves 7.91 km/sec on surface and drags both the neutrinos and light toward the East. In the South-East direction, from CERN to OPERA Lab, making ~58 degrees with the Meridians, this drag adds 6.7 km/sec to the conventional light velocity *c*, making neutrinos from CERN (and light) to reach the OPERA Lab ~60 ns earlier than *presumed* by the current theories.

Keywords

Fundamental Physics, Theory of Relativity, Relativistic Effects, Relativistic Experiments, Gravitational Physics, Higgs Theory, Neutrino Physics

1. Introduction

From the view of the Special Theory of Relativity (STR) [1] [2], empty space contains nothing that can be a reference for rest and for motions, nor contains a medium of propagation for light. Also time intervals and distances depend on the relative velocity in the observer's reference. Within this scenario, the velocity of light, *measured in free space* (*vacuum*) *by light go-return round-trips between two mirrors and a clock*, is an invariant and a universal constant *c*. Moreover, according to the STR, the rate of the time evolution t of all physical processes (clocks) depends of the relative velocity v according to:

$$t = t_0 \left(1 - v^2/c^2\right)^{-1/2}. \quad (1)$$

where t_0 is the time interval in a proper reference. Although the basic postulates of the STR are well confirmed by experimental observations, many paradoxes remain unsolved or badly resolved.

According to general relativity (GR) [1] [2], the rate of evolution of the coordinate time, within a gravitational field, is seen as an effective velocity c' along the time axis. It is given by $c'(r) = c\left(1 - 2U/c^2\right)^{1/2}$, where $2U = 2GM/r$ is the square of the local escape velocity from the gravitational field. The oscillation period $T(r)$ of the time standard, by which a clock counts time intervals, is given by $T(r) = T_0\left(1 - 2U/c^2\right)^{-1/2}$, where T_0 is the period of the time standard in the absence of gravity. Clocks count time in terms of the frequency of the time standard. Therefore, measuring the velocity of light by the method of light go-return round-trips between two mirrors and a clock, within a gravitational field, gives the same value as in free-space, independently from $U(r)$. It simply is the ratio of the frequencies of the light roundtrips and of the clock's time standard. In particular, from the view of an external observer, the velocity of a light pulse, along the radial coordinate, decreases toward the gravitational center.

In GR, the gravitational acceleration is due to spacetime curvature. This curvature is characterized by the invariant length of the line element d*s* that for weak fields, has the approximate form:

$$\mathrm{d}s^2 \approx \left[1 - \frac{2U}{c^2}\right]^{-1} \mathrm{d}r_0^2 + r^2 \mathrm{d}w^2 - c^2 \left[1 - \frac{2U}{c^2}\right] \mathrm{d}t_0^2 \quad (2)$$

in which the negative sign before the last term accounts for the orthogonality of the time axis with respect to ordinary space coordinate axes. The coefficients $\left(1 - \frac{2U}{c^2}\right)^{-1}$ and $-c^2\left(1 - 2U/c^2\right)$ are respectively the diagonal g_{11} and g_{44} components of the Schwarzschild metric tensor.

The first indication of shortcomings of GR became evident from the absence of the gravitational slowing of the solar field on the GPS clocks, moving with earth round the sun. GR associates the gravitational time dilation with the escape velocity that is fixed at each point of space. Hence, the gravitational time dilation by the solar field should not be affected by the orbital velocity of the

GPS clocks with earth round the sun. Current theories explain this absence in terms of the principle of equivalence [3]. Accordingly, the orbiting earth is free-falling in the solar field. It is asserted that the orbital velocity of earth cancels locally the effects of the solar gravitational field. It cancels locally the gravitational slowing, the local spacetime curvature, the gravitational pull, and all the other effects of the solar gravitational field on matter, on light and on clocks. Strangely however, motion of the GPS clocks within the GPS satellites round earth in exactly the same conditions does not cancel the gravitational slowing by the earth's field.

Another much more serious trouble, which however also is much more difficult to realize, is that the model of the free-falling inertial references of GR cannot give rise to the observed gravitational pull. It cannot because the free-fall velocity of the inertial references at each fixed point r_0 does not change with time ($\mathrm{d}v/\mathrm{d}t|r_0 = 0$). In order to turn this model able to create the observed gravitational pull, it would be necessary that locally $\mathrm{d}v/\mathrm{d}t|r_0 = g(r_0)$. This however would rapidly increase the free-fall velocity beyond the velocity of light.

In order to create a central field of centrifugal effects (gravitational pull) toward the gravitational center, it is necessary that the local inertial references (IRs) be not free-falling, however be rotating, in the ordinary space, *round an over-head axis*. Rotating references are well-known to be non-inertial references. However, if it is *the physical space, ruling the inertial motion of matter-energy* that is itself so rotating, things are quite different. Such *rotating inertial references* can be created if this physical space circulates like a fluid round earth according to a circular velocity field, in which *the velocity increases toward the gravitational center*. In such a velocity field, a body, stationary in the ordinary space, will locally be *implicitly* moving along an opposite circular path round the same over-head axis as the local rotating IRs. This motion is implicit because it cannot be described in ordinary space. This body will be stationary within a *non-IR*, implicitly rotating within the local true IR. The Higgs theory introduces exactly such a physical space.

The Higgs theory [4] [5] introduces profound changes in the current view about the nature of empty space. According to this theory, a quantum fluid medium, stabilized by a huge energy gap exists, which, according to the Glashow-Weinberg-Salam electroweak model achieves 200 GeV. This quantum fluid medium fills up the whole of space and is described by a complex order parameter. It gives inertial mass to the elementary particles by the Higgs mechanism, providing them with mechanical properties. This Higgs Quantum Fluid Space (HQFS) is much more than simply a reference for rest and for motions. It literally governs the inertial motion of matter-energy and is the local *ultimate reference* for rest and for motion.

The Higgs mechanism is closely analogous to the Meissner effect [6] in superconductivity that gives inertial mass to the electromagnetic field quanta (photons) within superconductors [7]. The HQFS materializes the local Lorentz frames (LFs) turning them into local proper LFs, *intrinsically stationary with respect to the local HQFS* [8] [9]. LFs moving with respect to the local HQFS are not proper LFs. Velocity with respect to the local HQFS and *not relative velocity*, is the origin of all the effects of motion. Within this context, the one-way velocity of light c is fixed with respect to the local HQFS and not with respect to all possible inertial references. The velocity of light c in free (empty) space is the maximum velocity at which the HQFS can propagate the phase perturbations in its order parameter.

The superconducting condensate (SCC) can be put in motion by an electromotive forces (or of a varying vector potential). In the presence of a magnetic field, it develops a velocity field of the SCC, screening, confining and quantizing it, or expelling it out from the superconductor by the Meissner effect, thereby reducing its own energy. Analogously, the Higgs condensate or HQFS in the presence of weak and strong nuclear fields develops a screening velocity field, confining and quantizing them by the Higgs mechanism. This screening velocity field of the HQFS, thrusts the matter fields toward large matter agglomerates, where the Higgs order parameter is weakened, thereby too reducing its energy. The HQFS governs the inertial motion of matter-energy and is the ultimate reference for rest and for motion. Therefore, a uniform velocity field of the HQFS drags the matter waves of particles and of light. However, a non-uniform velocity field drags and *refracts the matter waves*, thereby creating inertial dynamics, which, according to Einstein's principle of equivalence, is gravitational dynamics.

Within the context of the HQFS dynamics, the effects of the gravitational fields must be explained in terms of a non-uniform velocity field of the HQFS, instead of spacetime curvature. This means that Einstein's spacetime curvature, created by astronomical bodies and the model of the free-falling IRs must be replaced by a velocity field of the HQFS, in which the local IRs are rotating round a fixed overhead axes. Actually a large number of experimental observations systematically and definitely show that the HQFS is moving round the astronomical bodies according to a Keplerian velocity field, consistent with the local orbital motions. In terms of spherical coordinates (r,θ,ϕ) this Keplerian velocity field of the HQFS has the very simple form:

$$\boldsymbol{V}(r)=(GM/r)^{1/2}\,\boldsymbol{e}_{\phi} \qquad (3)$$

where G is the gravitational constant, and M is the mass of the gravitational source. In this Keplerian velocity field the magnitude of the velocity of the local HQFS is spherically symmetric.

The Keplerian velocity field round the sun is consistent with the planetary orbital motions and round earth it is consistent with the orbital motion of the Moon. *The Keplerian velocity field of the HQFS is the quintessence of the gravitational fields*. It naturally and accurately gives rise to the gravitational pull, the gravitational acceleration and the orbital motions within the gravitational fields. Keplerian velocity fields of the HQFS perfectly and accurately create all the observed effects of the gravitational fields on matter, on light and on clocks. References [8] [9] give the full details. Most importantly, the Keplerian velocity field of the HQFS Equation (3) is the only possible physical mechanism, able to implement the ingenious *outside-inside and inside-outside centrifuge mechanism*, and create the central field of *centrifugal accelerations toward the gravitational center*. No other imaginable physical mechanism is able to create this intriguing inertial dynamics. It also naturally and appropriately creates all the observed effects of the gravitational fields on light and on clocks.

In the solar Keplerian velocity field, earth and the GPS clocks, moving with it, are stationary with respect to the local moving HQFS and with respect to the local proper LFs, which predicts the absence of the gravitational slowing of the GPS clocks by the solar field, exactly as observed [8] [9]. It also straightforwardly predicts the absence of light anisotropy with respect to the orbiting planet earth, exactly as shown by a large number of light anisotropy experiments. The velocity of light is isotropic with respect to earth, not because of the intrinsic isotropy of light, however because earth is stationary with respect to the local HQFS that is the medium propagating light. The Keplerian velocity field of the HQFS round the sun predicts correctly the excess time delay of radar signals in go-return round-trips from earth to Venus and back to earth within the solar system (Shapiro effect) [10]. It predicts very precisely the observed light lensing effect by the solar field. It predicts the non-synchronous arrival of the Pulsar signals to equidistant earth-based antennas along the orbital motion of earth, however the synchronous arrival to antennas along transverse directions to the earth's orbital motion etc. Ref. [8] gives the full details.

In its turn, the earth's Keplerian velocity field of the HQFS precisely predicts the observed first order anisotropy effect of 8 km/sec of the electromagnetic signals between the twin satellites of the GRACE project in the same polar orbit round earth. This anisotropy is due essentially to the orbital velocity of these satellites. Clocks moving round earth along direct, circular equatorial orbits, analogously as in the motion round the sun, are predicted to be not slowed by the earth's gravitational field, an experiment that to now has not been realized. The earth's field also predicts the very small light anisotropy, with respect to the earth-based laboratories, that is due only to the local earth's Keplerian velocity field, a very small (10^{-10}) second order effect, observed by only a few of the most sensitive *Michelson light anisotropy experiments*. It also predicts correctly the gravitational time dilation, observed by the atomic clocks stationary in the earth's gravitational field, which also is predicted by general relativity. It predicts precisely the gravitational slowing of the GPS clocks, moving round earth along non-equatorial orbits, by the earth's field. It predicts the spectral red-shifts, measured by Mössbauer experiments in earth-based laboratories. Detailed description of all these observed effects can be seen in Ref. [8]. Here, it is shown that this HQFS dynamics gravitational mechanism too predicts very precisely the *too early arrival* of the neutrinos from CERN-CH to Gran Sasso-IT by closely 55 ns, which is a first order effect, due to the earth's Keplerian velocity field. This observation does not show that neutrinos exceed the velocity of light, but simply shows that the one-way velocity of neutrinos and of light is anisotropic, due to the drag by the earth's field. The HQFS is the medium propagating light and neutrinos. Therefore, its motion according to Equation (3) drags and causes anisotropy on the velocity of light and of neutrinos.

2. Precise Time of Flight of Neutrinos from CERN-CH to OPERA Lab IT

Recently the one-way time of flight of neutrinos, from CERN in Geneva-CH to the OPERA laboratory at the Gran Sasso Mountains-IT, distant 732 km South-East and direction making ~58˚ with the Meridians, have precisely been measured. These very precise measurements are possible thanks to help by the tightly synchronized atomic clocks of the GPS clocks. The CERN and Gran Sasso laboratories can precisely be localized and their local atomic clocks can be tightly synchronized. In 2011 the neutrinos were announced to speed faster light, reaching the OPERA Lab 60 ns earlier than expected for light [11]. Later the data were put in doubt because these data run into conflict with the light postulate [12]. It was informed that, because of this conflict the distance between CERN and the OPERA Lab was monitored by a common view technique with the help of a GPS satellite. From the present viewpoint this method can be very precise along North-South directions. However, along West-East directions, it incorporates the effect of the Keplerian velocity field of the earth's field that can introduce deviations of tens of meters in the localizations on the earth's surface. The effect of this velocity field is decreasing the apparent distance from CERN to OPERA by about 19 m. Due to the rotation of earth, during the neutrino flight of 2.44 milliseconds, the Gran Sasso Lab displaces it by nearly one mater toward East. Hence, the true displacement of the common view method is 18 m. Calculating the time of flight for light, by using this decreased distance, leads to the conclusion that light and neutrinos complete the flight in the same 2.44 milliseconds.

Within the scenario of the HQFS gravitational mechanism, the Keplerian velocity field drags both neutrinos and light, reducing their time of flight with respect to the presumed time of flight of light c by 55 ns (please see calculations in the coming Section hereafter). From this viewpoint the too early arrival of the neutrinos does not exceed the velocity of light and does not break the light postulate. In reality this observation simply shows that the one-way velocity of the neutrinos and of light is anisotropic along the path from CERN to the OPERA lab. If neutrinos and light could be sent the opposite sense, from Gran Sasso do Geneva, both would reach to CERN *too late* by nearly the same 55 ns. Adding up the effects for complete cycles of go-return round-trips, would give for both neutrinos and light very closely an average value of c. In this case, the second order effect, of only a fraction of a picosecond, would fall within the experimental error. This second order effect however is sufficient to cause a gravitational slowing of the atomic clocks on ground by (6.16×10^{-10} sec/sec).

3. The Physical Mechanism Responsible for the Apparently Faster than Light Motion of Neutrinos

In the solar Keplerian velocity field the orbiting earth is stationary with respect to the local moving HQFS (proper LFs) and the solar system is stationary in the velocity field of the Milky-Way galaxy etc. This is why the GPS clocks, moving with earth round the sun, do not show the gravitational slowing by the solar field and also is why the velocity of light is isotropic with respect to earth. This orbital velocity effectively cancels locally all the effects of the solar field. The HQFS too moves round earth according to a Keplerian velocity field, consistently with the orbital motion of the Moon. On the earth surface, the velocity of the HQFS reaches 7.91 km/sec from West to East. As earth rotates only very slowly, the earth-based laboratories are not stationary with respect to the local HQFS. The HQFS is flowing through the earth-based laboratories from West to East at nearly this velocity.

The fixed velocity of the neutrinos as well as of light *with respect to the local moving HQFS* is closely 3×10^5 km/sec. The South-East path of the neutrinos from Geneva to Gran Sasso makes ~58 degrees with the Meridians. The path is along a straight line from CERN to Gran Sasso, passing deeply, up to 12 km, under-ground. There is no problem, because the neutrinos practically do not interact with ordinary matter. Along this path the average velocity of the HQFS through the neutrino path is estimated to be about 7.92 km/sec. The velocity component of the HQFS along the neutrino path is:

$$7.92 \times \sin 58^\circ = 6.716541 \text{ km/sec}. \tag{4}$$

This is the velocity that the neutrinos get because of drag by the moving HQFS in the Keplerian velocity field, creating the earth's gravitational field, an effect analogous to the drag of flowing water on the water waves. Note that this velocity is exactly the excess velocity of the neutrinos as estimated by the CERN neutrino team. This velocity adds up to the fixed speed ($c = 3 \times 10^5$ km/sec) of the neutrinos with respect to the local HQFS, giving:

$$300000 + 6.716541 = 300006.716541 \text{ km/sec} \tag{5}$$

The time spent by the neutrinos in the travel from CERN to the OPERA Lab at Gran Sasso is:

$$732/300006.716541 = 0.00243994537 \text{ sec} \tag{6}$$

According to the current theories, light would spend more time:

$$732\big/\left(3 \times 10^5\right) = 0.002440 \text{ sec} \tag{7}$$

The difference between Equation (7) and (6) is:

$$0.00244 - 0.00243994537 = 54.63 \text{ ns}. \tag{8}$$

The Gran Sasso Lab moves about 1.112 m toward East during the 2.44 ms of the neutrino flight, due to the rotation of earth of 330 m/sec at the latitude of the experiment, which makes ~280 m/sec along the neutrino path. In 2.44 ms this corresponds to the total of ~0.6 m. The additional travel time of the neutrinos takes ~2 ns. Therefore, the neutrinos are predicted to reach about ~53 ns too early to the actual position of the OPERA laboratory at Gran Sasso.

No doubt that, if the too early arrival of the neutrinos from CERN to the OPERA Lab is confirmed, *it will be one of the most significant discoveries about the nature of the gravitational fields and of their effects on light and on clocks*. It will provide direct and unquestionable evidence that the Keplerian velocity field of the HQFS, creating the gravitational fields, effectively exists. In reality the too early arrival of the neutrinos to the Gran Sasso laboratory is not due to a faster than light velocity. It is an obvious effect, due to drag by the moving HQFS, creating the earth's gravitational field. This observation is not at all an isolated predicted observation. Practically all of the observed effects, listed at the end of the Introduction, are directly created by the Keplerian velocity field of the sun or of earth.

The wrong step by the leaders of the neutrino experiment was imputing the too early arrival of the neutrinos to faster than light velocity c, without giving any reasonable justification. The velocity of light c is the maximum velocity at which any measurable effect can be transmitted by the HQFS. It is one of the most extensively verified and well established observational facts. The hypothesis of the faster than light neutrinos has set off very strong criticisms by the scientific community. In the context of the HQFS dynamics gravitational mechanism, the fixed velocity of light c too is the maximum velocity at which the HQFS can propagate perturbations of its order parameter. However, this velocity is fixed with respect to the local HQFS and not with respect to every possible observer as stipulated by the theory of relativity. If the HQFS moves through the laboratory, at a velocity $\boldsymbol{V}$, this velocity adds up to the velocity $\boldsymbol{c}$ at which it propagates light.

In the scenario of the HQFS dynamics, the apparent faster than light neutrinos with respect to the earth-based laboratories, like CERN and OPERA, which are nearly stationary in the ordinary space within the earth's gravitational field, is a fundamental prediction. It unquestionably and perfectly corroborates the HQFS dynamics gravitational mechanism and, if confirmed, will constitute one of the most significant experimental achievements from all times.

Within the Keplerian velocity field of the HQFS, creating the gravitational fields, the effect of this HQFS velocity field on the effective velocity of light $(\boldsymbol{c}'=\boldsymbol{c}+\boldsymbol{V})$ and of neutrinos, depending on the direction of the path with respect to the direction of the local Keplerian velocity field of the HQFS, the *effective* one-way velocity, can be smaller or larger than c. On earth the one-way velocity of light or of neutrinos (c') along North-South or South-North directions is predicted to be smaller than c: $c'_{N,S}=\left(c^2-V^2\right)^{1/2}$ where V is given by Equation (3). However, for Eastward or Westward neutrinos or light, the one-way velocity is $c'=(c\pm V)$ respectively.

In the mega neutrino experiment, being developed in the USA, neutrinos will be sent underground from Fermilab (Chicago) to Stanford (South Dakota), distant ~1300 km *toward the West*. In this case, the neutrinos are predicted by HQFS dynamics gravitation to reach Stanford more than 115 ns *too late*. Again the neutrinos do not move slower than light *c*. Light along the same path in vacuum too would reach 115 ns too late to Stanford. The reason of this simply is the anisotropy, due to the opposite drag by the earth's Keplerian velocity field of the HQFS. Neutrino anisotropy measurements could turn into an excellent and powerful technique to map up the HQFS velocity field, inside and outside earth. However, at the Polar Regions this map up would be especially interesting and important.

4. Conclusion

The apparent faster than light neutrinos from CERN to OPERA Lab does not break the light postulate. It in fact reveals anisotropic velocity of neutrinos and of light, caused by the Keplerian velocity field of the HQFS, creating the earth's gravitational field. The apparent faster than light neutrinos, precisely and unquestionably, corroborates a fundamental prediction of the HQFS dynamics gravitational mechanism. It directly and fully ratifies the implications of the large number of observations, listed at the end of the Introduction, which all thoroughly back the HQFS dynamics gravitational mechanism. This affair is about to turn into an immense scientific discovery, the discovery of the Higgs quantum space dynamics that creates and governs our universe.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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