

Michelson-Morley, LIGO, and the True Genesis of Gravity

Leandro Meléndez-Lugo

*Instituto Nacional de Investigaciones Nucleares,
Centro Nuclear de México, Departamento de Física,
La Marquesa, Ocoyoacac, C.P. 52750 Edo. De México*

Abstract

In scientific research, experimentation doesn't always have the final say. However, it often proves to be the most reliable source for certain assertions. This article reviews facts related to the famous Michelson-Morley experiment (1887), specifically showing that the null result is not, as some claim, truly null. It emphasizes that the main problem in detecting the ether wind is the low speed of the moving observer—the speed of the Earth. This topic relates to the Lorentz invariant, and some misconceptions are clarified. Important details are also analyzed, and an interpretation is given of some LIGO results regarding the detection of gravitational waves, within the context of famous experiments like the Michelson-Morley experiment—details that leave much to be desired. The results of the LIGO experiment are, of course, questionable. Do they truly detect gravitational waves? Finally, what is considered to be the true genesis of gravity is established: the electromagnetic field, which has always been there, which manifests itself in polarization, the dipolar character of almost all matter.

Keywords: *LIGO, famous experiment, Lorentz invariant, special relativity, ether wind, gravity, electromagnetic field*

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I. Introduction

Albert Einstein developed, among other things, the famous theories of relativity. Both were highly controversial, but undoubtedly revolutionary, to the point that, more than 100 years after the publication of the special and general theories of relativity, they remain highly relevant on the international scientific stage. Interestingly, in his early articles on this subject, Albert Einstein referred to the term "principle of relativity." Max Planck used the term "relativtheorie" in 1906 to describe the Lorentz-Einstein equations for the motion of a charged particle. It appears that the first to use the term "relativitätstheorie" or "theory of relativity" was the physicist Alfred Heinrich Bucherer. Einstein himself adopted the term after 1907.

It is therefore important to go back to the origins and review how things happened.

Supposedly, one of the basic considerations, among others, for Albert Einstein in formulating his theories of relativity was the contradictory results of the Michelson-Morley experiment at the end of the 19th century [1-3]. In his article, "On the Electrodynamics of Moving Bodies" [2], Einstein mentions the unsuccessful attempts to detect the Earth's motion relative to the "luminous medium," which is connected to the concept of absolute rest. In that same article, he states that the introduction of a "luminous ether" is superfluous. Einstein proposes two postulates: 1) "The laws of electrodynamics and optics will hold for all coordinate systems in which the equations of mechanics govern, as has already been shown for first-order quantities." He says, "We will elevate this conjecture (whose content will henceforth be called the 'principle of relativity') to the status of a postulate and introduce another postulate, which is only apparently incompatible with it, namely, 2) That light always propagates in empty space with a defined speed that is independent of the state of motion of the emitting body."

Note that the postulate concerning the speed of light only mentions a defined speed and the speed of the source, not the motion of an observer. Furthermore, source independence is a characteristic of all wave motions, such as sound. However, Einstein generalizes, and in point 3 of the article in question, he states, "Thus, our wave is also a spherical wave with propagation speed V when observed in the moving system." Here, in this work, it is shown that some of Einstein's assertions are not fulfilled. The wavefront transformed by the Lorentz transformations is not spherical. Numerous works have been published attempting to contradict the theories of relativity [3], and it has also been shown that there are more general transformations than the Lorentz transformations [4]. These theories have proven true at a certain experimental level. Despite all this, the present work highlights some controversial aspects of both the Michelson-Morley experiment, in relation to Lorentz transformations, and the postulate of the speed of light, in relation to the ether that never quite dies. It reviews and

emphasizes that Lorentz transformations do not do what Albert Einstein claims they do. It continues with a contrasting study of the results of the LIGO experiments for detecting gravitational waves, which appear highly questionable in light of a new theory about the true nature of gravity—a concept that has proven elusive over the years and which now has an explanation, a causality that has been present all along, in the polarization of matter.

II. Michelson-Morley experiment

The following data is taken from *The American Journal of Science* and the first page of the original 1887 Michelson-Morley publication [1]. The article's first author, Albert Michelson, conducted several studies on light before performing the famous experiment. One of his successes was determining, with improved accuracy for the time, the speed of light to be 186,350 miles per second in 1879, probably with an error of about 30 miles per second. After this triumph, Albert Michelson and Edward Morley faced the next challenge: detecting the ether wind. Although the original idea for the experiment was based on James Bradley's observation of the aberration of starlight, Bradley had in 1725 observed an apparently seasonal change in the position of a star called Draconis, located at the zenith, which seemed to move in a nearly circular orbit with a period of one year.

This phenomenon is called aberration and is due to the finite speed of light and the speed of the Earth in its orbit around the sun. However, Michelson himself clarified the purpose of the experiment by suggesting that, just as the speed of sound is relative to air, so too could the speed of light be relative to the ether. A medium supposedly composed of a substance that has neither molecules nor electrons, in principle, appears to be something distinct from all existing matter. The word "substance" comes from the Greek "ousia," which was translated into Latin as "essentia." The Greek term was used by Parmenides, Plato, and Aristotle.

At this point, Michelson had an idea for detecting the ether wind. His daughter recounted how Michelson clarified the problem for his children with a very simple example. Suppose we have a river with a width, say, 100 feet. Two swimmers both reach a speed C in still water (say, 5 feet per second). The river flows at a constant speed V of 3 feet per second. The swimmers compete as follows: they start from the same point, very close to one of the riverbanks. One swims directly perpendicular to the river's current, aiming to reach the nearest point on the opposite bank, then turns around and returns to the starting point. The other swimmer swims upstream a distance exactly equal to the width of the river, then returns to the starting point. Who is the winner?

The cross-country swimmer must try to reach not the nearest point on the opposite bank, but a point slightly upstream, as the current tends to pull them in the direction of the water flow. Given a swimmer's speed of 5 feet per second and a current speed of 3 feet per second, which tends to pull them off course, the effective cross-country speed is 4 feet per second. They cross in 25 seconds and take another 25 seconds to return to the starting point, for a total of 50 seconds. Note that the cross-country speed is equal to the return speed. A second longitudinal swimmer swimming upstream has an effective speed of 2 feet per second and therefore takes 50 seconds to cover the 100 feet. On the return journey, their effective speed relative to the riverbank is 8 feet per second, and they take 12.5 seconds to return, for a total of 62.5 seconds. The cross-country swimmer wins by a margin of 12.5 seconds.

Michelson's idea was to construct a similar path for light pulses, with the ether wind instead of the river. There would be a reference frame, supposedly at rest, which would be the ether. The Earth, or an observer on Earth, would move with a relative velocity of 30 km/s. For a trajectory transverse to the Earth's motion, a triangle would be formed, as in the case of the river; there would be a square root. The outward speed would be equal to the return speed, $\sqrt{c^2 - V^2}$ as in the case of the river; therefore, the transverse time is

$$T_{tr} = (2W/C) / \left(1 - \frac{V^2}{c^2}\right)^{\frac{1}{2}} \approx (2W/C) \left(1 + \frac{V^2}{2c^2}\right) \quad (1)$$

For displacement in the direction of Earth's movement, the speed of the light ray must be added and subtracted, the speed of the Earth for time in favor of and then against the ether wind, one would have

$$T_{lo} = W/(C + V) + W/(C - V)$$

$$T_{lo} = (2W/C) / (1 - V^2/C^2) \approx (2W/C) \left(1 + \frac{V^2}{c^2}\right) \quad (2)$$

The approximate difference is:

$$\Delta T \approx (2W/C) (V^2/2C^2) \quad (3)$$

This difference here is minimal compared to the case of the river and the swimmers. The speed of the Earth, the speed of the observer, is very small compared to the speed of light. Basically, that's what makes the Michelson-Morley method so extremely difficult. If, in the case of the river and the swimmers, the speed of the current were ten thousand times smaller ($\times 10^{-4}$) than the speed of the swimmers, that is, 3×10^{-4} feet per second, it would make it much more difficult to determine the winner.

III. Experiment Details

When the values for the Earth's orbital speed and the speed of light are substituted into the previous equations, with the equipment dimensions W equal to 1 m, we find that $\Delta T \sim 10^{-17}$ s. This is the time that the

Michelson-Morley experiment was trying to measure. In that time, light travels a distance of approximately $\Delta x \sim 10^{-8}$ m (on the order of one hundred angstroms; the radius of a hydrogen atom is approximately 0.5 of an angstrom), or one-hundredth part of a micron. That distance could be exceeded by an error in the position of either mirror. The measurement W would hardly be the same for both paths. Furthermore, on page four of the original 1887 article, Michelson and Morley, among other things, state that they used yellow light waves to reduce errors by trying to maintain a single wavelength to generate the interference pattern. On the same page, they also point out that rotating the apparatus produced distortion, which was practically impossible to avoid. Another problem was the extreme sensitivity to vibration. This was so great that it was impossible to see the interference fringes, except for brief intervals when they were working in the city, around two in the morning. This last difficulty, they state on page five, was solved by increasing the light path by about tenfold with repeated reflections off the mirrors. On the same page, they indicate that the light used was produced by an argon burner. The entire optical portion was covered with wood to prevent sudden temperature changes, since after each rotation of the apparatus, they had to wait half a minute before taking a reading because during this time there were distortions that they assumed were caused by temperature changes within the interferometer. They had a screw to adjust the position of a mirror, which, in turn, varied the length of the light path. On page seven they say the screw that altered the path length moved slowly (one turn of the 100 threads per inch screw altered the path by about 1000 wavelengths). With one complete turn, the screw advanced approximately a few tenths of a millimeter. To vary the length of the light path in millimeters, $\Delta x \approx 10^{-5}$ the screw would have to be turned a tiny fraction of a turn, approximately 10^{-2} degrees. This indicates that it is extremely difficult to achieve a path W that is identical for both paths. The interference fringes were observed through a lens that rotated with the apparatus, so the observer had to run around it along with the apparatus.

Finally, it should be noted that, as they clearly state on page eight, it seems fair to conclude from the figure that there is a displacement due to the relative motion of the Earth and the luminiferous ether; this displacement cannot be much greater than 0.01 of the distance between the fringes.

It is worth noting here that Michelson and Morley had great difficulty with differences in the paths of light on the order of $\Delta x \sim 10^{-8}$ m. It is astonishing to consider that, according to the LIGO researchers in the 2015 detection of gravitational waves, they were able to detect variations in the position of the interferometer mirrors ten orders of magnitude smaller $\Delta x \sim 10^{-18}$ m.

Since the molecules in the LIGO mirrors are not at 0° Kelvin temperatures, they have thermal motion that produces displacements much greater than the fraction of the diameter of a proton that they claim to measure..

IV. The ether

Approximately 200 years before Michelson measured the speed of the ether wind, Newton suggested that light consisted of tiny particles generated by a hot object. Newton's arch-rival, Robert Hooke, argued that light must be some kind of wave motion. A strong argument for describing light as a particle is that light travels in a straight line. Sound, which is a vibration of the air that travels, can be heard around a corner at a distance without directly seeing the source, but it is not possible to "see" something around the corner. If light were a wave, what is vibrating, since even in a vacuum, between the Earth and the Sun, light travels?

Some time after these speculations around the year 1800, it was finally established that light is a type of wave. It was somewhat natural to assume that light propagates through a mysterious material medium (the ether). If the ether existed as a tactile medium through which light waves propagate, it would have to possess special properties. These properties could be:

- a) Its "immaterial" parts would have to vibrate in the same way that air vibrates when transmitting sound waves. If there is no air, there is no sound; if there is no ether, it seems that there is light.
- b) As with a material wave, the speed of light does not depend on the speed of the emitter (Einstein's postulate regarding the emitter also applies to sound waves). Since, in relativity, light is the medium of communication between observers, a theory of relativity can be established, using sound waves, for the blind or for bats.
- c) If the speed of waves increases as the elasticity of material media increases, then the ether should be very elastic.
- d) As a medium becomes lighter, the speed of sound waves decreases; it is greater in liquids than in gases and greater in solids. Therefore, the ether should be extremely dense, contrary to what it appears to be—extremely light?
- e) Because both material bodies and light do not experience friction when moving through the ether—at least, that seems to be the case—they behave like electrons (Cooper pairs) in a superconductor, and the ether would turn out to be a superconductor of matter and energy. If the theory of tired light, introduced in 1929 by, among others, the Swiss-American astronomer Fritz Zwicky, were confirmed, the friction with the ether would turn out to be minimal.
- f) One characteristic of the ether appears to manifest itself through the acceleration of the universe. Currently, a vacuum force, sometimes represented by Einstein's cosmological constant, is considered to be accelerating the

universe's expansion. This effect is attributed to so-called "dark energy," distinct from the equally ethereal "dark matter" used to explain the excessive rotation speed of stars and galaxies. This dark energy has supposedly been detected through the observation of supernova explosions, whose light appears to be affected by the accelerating expansion of the universe. Therefore, there must be something more than pure emptiness, something very subtle that acts upon space, not matter, but which presumably accelerates the expansion of the universe.

g) The characteristics of light propagating in the ether appear to be very similar to gravitational waves propagating in Einstein's spacetime. Would the curvature of spacetime affect the propagation speed of gravitational waves? Could one envision a theory of relativity for the blind and deaf based on gravitational waves? Gravitational waves were reportedly first detected in 2015.

h) Could the Cosmic Microwave Background Radiation, detected by Penzias and Wilson, be an integral part of the ether and, therefore, serve as an absolute frame of reference?

V. Some points for reflection

Experiments have been conducted that confirm the "null" result of the original Michelson-Morley experiment [5], and many that do not obtain a "null" result [6].

Some authors, such as Dayton C. Miller [6], who had a strong disagreement with Einstein, claimed to have measured an Earth speed through the ether of approximately 10 km/s. He argued that the solar system moves through the galaxy at approximately 200 km/s perpendicular to the ecliptic.

In fact, it is highly speculative to claim that the Michelson-Morley experiment could determine an ether wind speed of at least 30 km/s. Besides the planet's own motions (rotation and revolution) and the solar system's motions with respect to the galactic center, there are undoubtedly the movements of the galaxy itself within the Local Group and also the movements of the entire cluster through the ether. In any case, determining the direction and speed of the ether wind appears to be extremely complicated.

The "zero" result does not appear to be possible, from an experimental point of view, a fact confirmed by Michelson and Morley when they state, on page eight of their article, that, if it exists at all, the displacement sought should not exceed 0.01 fringe. This comment in the original Michelson-Morley article raises the possibility of having some value for the speed of the ether wind.

On the other hand, there have been other famous experiments in which monumental errors have occurred. For example, Einstein's predictions about the deflection of light when it passes near relatively large gravitational masses could not be verified immediately in 1915 because of the First World War. It wasn't possible to do so until 1919, when two British expeditions observing an eclipse, one in East Africa, demonstrated that light was indeed deflected by the sun just as the theory predicted. Stephen W. Hawking, in his book *A Brief History of Time*, recounts that [7]: "This verification of a German theory by British scientists was recognized as a great act of reconciliation between the two countries after the war. Ironically, a subsequent examination of the photographs taken by that expedition showed that the errors made were as large as the effect they were trying to measure."

Returning to the topic of the ether, it seems to come and go. Albert Einstein, who considered the introduction of a luminiferous ether superfluous, in a way replaced it with spacetime, which curves in the presence of matter and energy, and within which moving objects travel along geodesic paths. Spacetime, undoubtedly, also possesses special properties like those attributed to the ether. Similarly, in Relativistic Quantum Mechanics, particularly in relation to the spectra of solutions to the Dirac equation, it became necessary to introduce the existence of a kind of ether called the Dirac sea, which was also endowed with very peculiar properties. Now, with the discovery of the Higgs boson in 2012 at CERN, a particle that supposedly gives mass to other particles, the ether picture becomes even more complex, since the Higgs field could be considered part of the ether. This raises the question: Does all of this exist? Ether, Dirac sea, spacetime, quantum vacuum, and Higgs field?

Returning to Einstein's postulate of the speed of light, which also holds true for the propagation of mechanical waves through a material medium, numerous experiments have been conducted. A significant portion of the scientific community considers the postulate regarding light to have been experimentally proven. In a certain type of experiment, it is possible to produce neutral pions traveling at 185,000 miles per second. At this speed, they decay in a small burst, emitting gamma rays [8]. The speed of this emitted light is measured and found to be 185,300 miles per second.

A key issue that is troubling from the perspective of traditional physics is that the speed of light is the same for all observers. This fact contradicts the law of nature that states that the speed of material waves depends on the speed of the observer relative to the medium. The argument is that these are not material waves but light waves. This undoubtedly indicates that light is something extraordinary in nature. On the one hand, light is attributed two important properties that material waves possess: it is a wave motion, and its speed does not depend on the speed of the emitter. On the other hand, a law is formulated that does not exist in any other case in nature. It travels at the same speed for all observers. This, as already stated, is part of a postulate. One must be careful with postulates; for example, postulating the non-existence of the ether or some medium that transmits light waves contradicts Newton's third law. If something like the ether did not exist, there would be the action of the electromagnetic field, but not the reaction of the medium.

Certainly, it's not easy to find observers traveling at high speeds. The fastest observer Michelson-Morley found was the Earth, traveling at only 30 km/s. This speed turns out to be far too small, compared to the speed of light (approximately 300,000 km/s), to satisfy the skeptics.

VI. The Lorentz invariant

Lorentz symmetry is a fundamental issue, debated for many years, particularly in relation to attempts to unify gravitational interaction with quantum mechanics.

In 1904, Hendrik Antoon Lorentz supposedly showed how to explain the failure of all experiments attempting to detect motion through the ether, specifically the Earth's motion through the ether. In this regard, he established the so-called Lorentz transformations. Lorentz symmetry, or the Lorentz invariant, is derived from these transformations [4], [9].

The null result of the Michelson-Morley experiment would, in a way, demonstrate Lorentz invariance. Basically, this fact of Lorentz invariance was established from the Lorentz transformations (a name given by Poincaré), which, among other things, maintain the constancy of the speed of light for two observers moving with relative uniform motion and reproduce the image of a wavefront in the stationary system for another observer in relative uniform motion [2], [10], [11].

Specifically, it will be shown here that there is an inaccuracy in this argument. The effect of the Lorentz transformations turns out to be different from Einstein's conception. Einstein's conception, with these transformations, is that a spherical wavefront in the stationary frame becomes another spherical wavefront, centered in the frame in uniform relative motion [2]. It will be shown that, according to the Lorentz transformations, the moving observer does not detect a spherical wavefront. The Lorentz transformations do not maintain isotropy; for the moving observer, the wavefront they perceive does not maintain simultaneity in their perception, nor is it centered in their frame of reference. As time passes for them, the wavefront is reconfigured, becoming circles that shift with time. To demonstrate this argument, let's see what the Lorentz transformations do when applied to a spherical wavefront for the stationary observer [2]:

Lorentz transformations [2]:

$$\begin{aligned} \xi &= \beta(x - vt) & \eta &= y & (4) \\ \zeta &= z \\ \tau &= \beta(t - vx/c^2) \end{aligned}$$

with

$$\beta = (1 - v^2/c^2)^{-1/2} \quad (5)$$

Where v is the relative velocity of the two observers.

The mathematical function of the transformations is assumed to have a spherical wavefront in the stationary system as its domain, and a wavefront, supposedly also spherical, in the moving coordinate system as its codomain. This is in accordance with Einstein's assertion. Here, it is established that this is not the case. The transformed wavefront is not spherical but rather consists of circles separated by different values of the proper time of the moving observer.

The reference frame (x, y, z, t) is assumed to be at rest, and the system (ξ, η, ζ, τ) it moves with constant speed relative to the first one, in the direction x .

Following the argument of Einstein's original work, he states the following [2]:

At the instant $t = \tau = 0$, when the two observers coincide, the origin of coordinates is common to both observers ($x = 0, y = 0, z = 0, t = 0$). At that instant, a wave with a spherical wavefront is emitted from the system at rest. See Figure 1 a). Any point with coordinates contained in that wavefront satisfies the equation

$$x^2 + y^2 + z^2 = c^2 t^2 \quad (6)$$

Which is a sphere of radius ct .

Substituting the coordinate values in the moving system into this equation, which constitutes the codomain of the transformations, that is, the resulting equation in the moving system, is

$$\xi^2 + \eta^2 + \zeta^2 = c^2 \tau^2 \quad (7)$$

At this point, Albert Einstein states in his original article [2]: "Thus, our wave is also a spherical wave with propagation speed c when observed in the moving system."

With careful analysis, it can be shown that equation (7) is not a sphere as Einstein claims. It will be shown that the supposedly constant radius $c\tau$ is not actually constant. The Lorentz transformations do not keep the radius $c\tau$ constant for all points on the spherical wavefront of the domain.

Another very important point in Einstein's conception is that equation (7) cannot and should not be a sphere centered at the origin of the moving system's coordinates. This would be equivalent to the moving observer being able to carry the emitted pulse along with them. From a physical point of view, this is definitely not possible, as will be shown later.

Let's look at it this way: starting from the spherical wavefront for the stationary observer, the Lorentz transformations are applied. To simplify the calculations, let's assume that the speed at which the moving observer is traveling is

$$v = 0.8660254c \tag{8}$$

With $c = 1$, the Lorentz transformations become

$$\begin{aligned} \xi &= 2(x - 0.8660254) \\ \eta &= y \\ \zeta &= z \\ \tau &= 2(t - 0.8660254x) \end{aligned} \tag{9}$$

Now, these transformations are applied to various points on the spherical wavefront. With $c = 1$, the wavefront of the domain is a sphere

$$x^2 + y^2 + z^2 = 1 \tag{10}$$

The selected points are shown in Figure 1.

For point 1, we have

$$\begin{aligned} (x, y, z) &= (1, 0, 0) \\ t &= 1 \end{aligned} \tag{11}$$

Under Lorentz transformations, point 1 is transformed into

$$\begin{aligned} (\xi, \eta, \zeta) &= (0.268, 0, 0) \\ \tau &= 0.268 \end{aligned} \tag{12}$$

Points 2, 3, 4, 5, on the plane have coordinates

$$\begin{aligned} (x, y, z) &= (0, \pm 0.707, \pm 0.707) \\ t &= 1 \end{aligned} \tag{13}$$

They transform into

$$\begin{aligned} (\xi, \eta, \zeta) &= (-1.732, \pm 0.707, \pm 0.707) \\ \tau &= 2 \end{aligned} \tag{14}$$

Finally, point 6

$$\begin{aligned} (x, y, z) &= (-1, 0, 0) \\ t &= 1 \end{aligned} \tag{15}$$

It transforms into

$$\begin{aligned} (\xi, \eta, \zeta) &= (-3.732, 0, 0) \\ \tau &= 3.732 \end{aligned} \tag{16}$$

Expressions (12), (14), and (16) indicate that for the same wavefront in the stationary system, the proper time of the moving observer is not unique. Consequently, expression (7) does not result in a sphere.

All these points with their respective images are shown in Figure 1. It is clear that the intermediate positions at these points, if included, would complete the image of a quadric surface, which is definitely not a sphere, as Einstein states in his writing. The Lorentz transformations acting on a spherical electromagnetic wavefront, for an observer at rest, do not transform into another centered spherical wavefront but rather into a decentered ellipsoid of revolution.

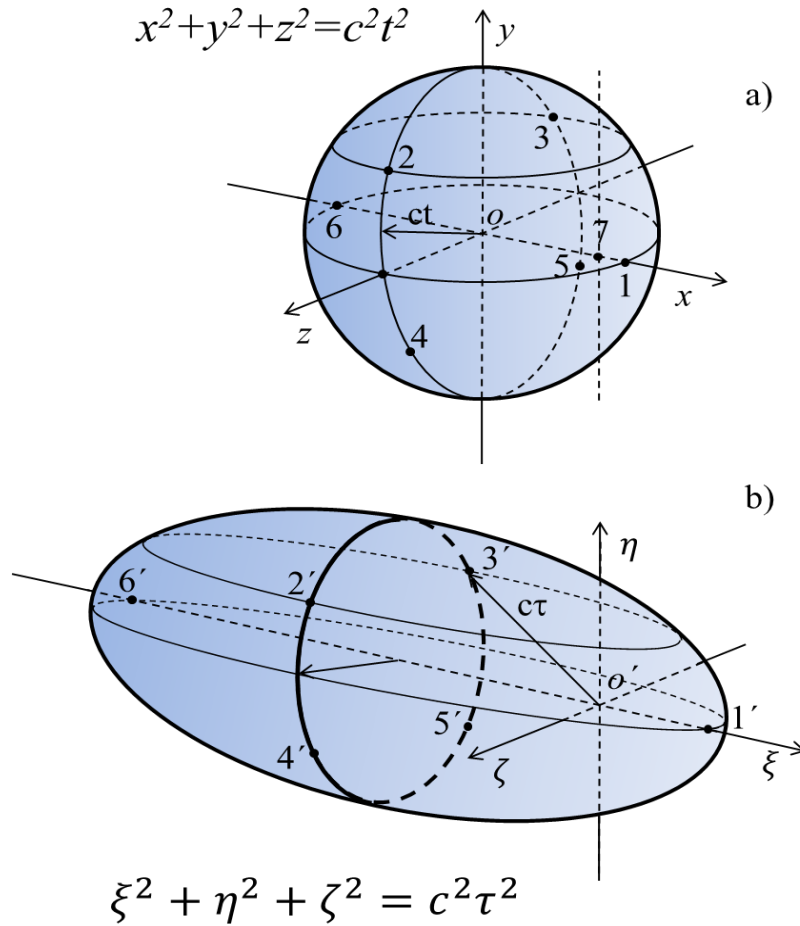


Figure 1 Equation (a) shows the domain of the Lorentz transformations, in this case, a spherical wavefront. The six numbered points are chosen. Under the transformation, these points are transformed into the prime points. The codomain of the transformation, the equation in (b), turns out not to be a spherical wavefront. This is because the radius is not constant for all points. In fact, the codomain is an ellipsoid.

It is a mistake to consider equation (7) as also representing a spherical wavefront. The Lorentz transformations tell us otherwise; it is actually an ellipsoid of revolution.

We can see what happens as follows. For the spherical wavefront, for the stationary observer, it takes values x in the interval $[-1, 1]$. This implies that the proper time of the moving observer, for the same wavefront seen by the stationary observer, takes different values contained in the time interval $[0.2679492, 3.7320508]$. Therefore, the moving observer does not perceive the entire wavefront; rather, to perceive the entire wavefront, they must allow the specified time interval τ to elapse. For each value of time τ , the moving observer perceives only a circle of the wavefront, and at the extremes of the values ξ , they perceive only a point on the wavefront.

They perceive the wave as traveling in planes of ξ constant and perceive circles at each instant of time τ .

The moving observer perceives the first point, point 1, of the wavefront at a certain time $\tau = 0.268$, and the last point, point 6, is perceived some time later $\tau = 3.732$.

The transformations that transform a spherical wavefront in the stationary frame into another spherical wavefront in the moving frame can be established relatively quickly.

$$\begin{aligned} \xi &= \lambda(x - vt) \\ \eta &= \lambda y \\ \zeta &= \lambda z \\ \tau &= \lambda t \end{aligned} \tag{17}$$

with $\lambda = \lambda(v)$

With these transformations, the points on the spherical wavefront $x^2 + y^2 + z^2 = c^2 t^2$ are transformed into points on a spherical wavefront $(\xi + v\tau)^2 + \eta^2 + \zeta^2 = c^2 \tau^2$. In this case, the center of the sphere is displaced from the origin of coordinates. Since, for all points on the wavefront in the system at rest, there will only be one value of

the proper time τ . From these transformations, in equation (17), it is observed that the codomain cannot be centered at the origin.

It is concluded here that Lorentz transformations do not do what Albert Einstein says they do. They do not transform one spherical wavefront into another spherical wavefront [2], [10].

VII. The LIGO experiment and gravitational waves

The acronym LIGO stands for Laser Interferometry Gravitational-wave Observatory. Construction began in 1984, spearheaded by Kip S. Thorne, holder of the Feynman Chair at the California Institute of Technology (Caltech), and Rainer Weiss, Professor of Physics at the Massachusetts Institute of Technology (MIT), with an initial development and operating cost of \$365 million, which later doubled. Construction, including instruments and calibration, was completed in 2004. The total cost has exceeded one billion dollars. It wasn't until September 2015 that the first gravitational waves were supposedly detected, later hailed as the great discovery of the century. After a little over thirty years of effort, the first detection of gravitational waves was announced [12]-[14].

The story of gravitational waves begins when Albert Einstein proclaimed their existence, after finding their theoretical basis in the field equations of General Relativity. A major problem then arose for their detection, should they exist, since the prediction was that, if such waves existed, their intensity would be minuscule. This observation is interesting: the smallness. How is it possible that such a small signal, after traveling a distance of a billion light-years, can be detected, when its intensity, already small, has been reduced over this distance? There would be approximately one factor $\sim 10^{-50}$ in the reduction. The work of James Clerk Maxwell, who mathematically demonstrated the existence of electromagnetic waves using the field equations of electrodynamics [15]-[18], was replicated by Albert Einstein, who mathematically demonstrated the existence of gravitational waves using his tensor equations. It should be noted that Maxwell's starting point was phenomenological laws, such as the Ampere-Maxwell law, Gauss's laws, and Faraday's law. Einstein's demonstration, however, was based on his equations of general relativity, which state that the presence of matter, momentum, and energy affects the tensor of the spacetime metric.

Among the first experiments conducted in this direction, detecting gravitational waves, was that of Joseph Weber, a physicist at the University of Maryland [19]. Using two aluminum cylinders, each weighing 1400 kg and separated by a distance of one thousand kilometers, with piezoelectric crystals placed on their surfaces. Weber hoped to detect displacements, supposedly produced by gravitational waves, when there was a simultaneous response in both cylinders. Interestingly, he expected to detect displacements on the order of $\Delta x \sim 10^{-18}$ meters, similar to the perturbation supposedly detected by LIGO. He carried out measurements for more than ten years, and in 1969 he dared to report that he had detected gravitational waves. Radio astronomers from five British observatories, including Harwell and Jodrell Bank, diligently searched for the radio signals supposedly associated with Weber's detection, with negative results [19]. It is now difficult to imagine that five observatories like LIGO could repeat the supposed detections of gravitational waves. The scientific method requires that an experiment be replicable anywhere and as many times as necessary. These observations fall outside that. In one of his books, Richard P. Feynman provides a definition of what he considers to be science: "Science is the belief in the ignorance of the experts." Here, the experts might be measuring something else entirely, not gravitational waves. Many arguments can be made to support this possibility. For example, among many other things, the surface of the mirrors where the LIGO laser beam strikes probably does not appear as a flat surface to the light, since it interacts with the molecules and atoms of the mirror material. The molecules will have a thermal vibration whose displacement far exceeds the displacement of the mirror (a small fraction of the diameter of a proton). The laser's heat output is in the hundreds of watts. It is said that the tunnel where the laser beams travel must be free of material particles, in a vacuum, and practically without impurities because even a tiny particle of material would ignite under the laser's power. Many disturbances affect the separation between the mirrors [12]-[14].

The black holes that supposedly collide to produce gravitational waves are typically found in galactic centers surrounded by numerous stars, with high stellar density near the galactic center, very close to the black hole. This implies the collision of two galaxies, particularly their galactic centers, which would result in an extremely catastrophic event lasting much longer than the LIGO detection time, which they claim was only a few tenths of a second. There are serious doubts.

Michelson and Morley had great difficulty achieving the desired precision of $\Delta x \sim 10^{-8}$ m. In the LIGO experiment, a precision ten orders of magnitude smaller than $\Delta x \sim 10^{-18}$ m must perhaps represent something practically impossible to achieve in this case. Perhaps LIGO can detect what Michelson and Morley were looking for: the ether wind.

At this point, it is worth quoting Charles Darwin: "Ignorance often breeds confidence rather than knowledge itself." That is to say, those who know little, not those who know much, are the ones who correctly predict that this or that problem will never be solved by science.

As the saying goes in philosophy, "Never say never." It is reasonable to think that we should wait; with time, things will become clearer.

VIII. The true genesis of the force of Gravity

Scientific research has concluded that there are four fundamental forces in nature [11]. This assertion seems, at the very least, strange to many of us. Four is not a mystical number. Furthermore, if there were a creator of the universe, it is unlikely that he would have constructed a universe with four forces. I believe he would have preferred a universe with only one force. Albert Einstein only knew of two of the four forces.

In basic physics courses at the early school levels, we are taught that the electric force and the gravitational force have the following mathematical expressions [15]-[18]

$$\vec{F} = Qq/(4\pi\epsilon_0 r^2)\hat{u}_r \quad (18)$$

Coulomb's force, where Q and q are two interacting electric charges and

$$\vec{F} = GMm/r^2\hat{u}_r \quad (19)$$

Newton's force, where M and m are two interacting masses [11].

It is immediately apparent that the functional dependence is identical. Both are central forces. The dynamic equations must be the same. However, the formulations of Newtonian mechanics and electrodynamics remain separate, primarily due to their different conceptualizations. Newton mainly deals with the concepts of mass as the source of gravity, force, and acceleration, which, along with inertia and action and reaction, comprise what is known as Classical Mechanics. Maxwell deals with the concepts of electric and magnetic fields, whose sources are charges at rest and in motion. Furthermore, the variation of one field can generate the other. Together with electromagnetic waves, these are integrated into what is called Classical Electrodynamics, more commonly referred to as Maxwell's Equations [15]-[18].

The sources of the gravitational field are masses, while those of the electric field are electric charges. Almost all masses have charges. Both mass and charge have remained in a kind of limbo, unable to be adequately explained. The charge of the electron does not appear to be concentrated at its center. An enormous force would be required to keep its charge contained within a given volume. Would its mass also be concentrated at its center? This conceptualization is also reflected in the Standard Model. According to the Standard Model, there exist, in a sense, particles with no mass and no charge, such as the photon. There is also matter with mass that has no charge, like the Z boson. The neutron is essentially a tripole composed of three quarks. However, there appear to be no charged particles without mass. If there is charge, there will necessarily be mass, but not vice versa. When we speak of mass, we are usually, implicitly, referring to both positive and negative charges in a state of neutrality. Here we can see that the source of the gravitational field, mass, is also, in a way, implicitly a source of the electric field. If we replace it GMm in equation (19) with $Qq/4\pi\epsilon_0$, we obtain equation (18). In this sense, the expressions are identical.

Now let's move on to something else that is also fundamental in most material bodies.

Material bodies are generally composed of positive and negative electric charges. Given this, it is said that, in general, matter is neutral. This neutrality in most matters is sometimes misunderstood as nullity. In some undergraduate courses, we are left with the impression that neutrality is equivalent to nullity. If it is neutral, it has nothing. However, this is not the case. Material bodies, despite this neutrality, possess at least an electric field and, notably, sometimes a magnetic field. This is mainly because negative charges are not located in the same place as positive charges. Most material bodies form electric dipoles of varying intensity [15]-[18]. The electric field "far" from a standard rigid dipole varies as $\sim 1/r^3$. For an adjustable dipole, depending on the circumstances, as happens with ordinary matter, the variation is different; also, near charges, the variation can be extremely different. A dipole, in the vicinity of the area of the charges, can produce very large forces.

An example worth analyzing is the dipole that exists in the neutron. The three quarks that compose it generate dipolar fields; in this case, a tripolar field. Unlike a traditional dipole, within the neutron, the dipolar forces are of a different type; the three charges act in proximity, not far from the charges as in a traditional dipole. The functionality of the force must be very different.

In this context, let's first look at the common cases.

In another dimension, this can be seen as follows:

Let's imagine a celestial body far removed from any contact with other bodies; its electrical neutrality appears symmetrical and balanced, Figure 2.

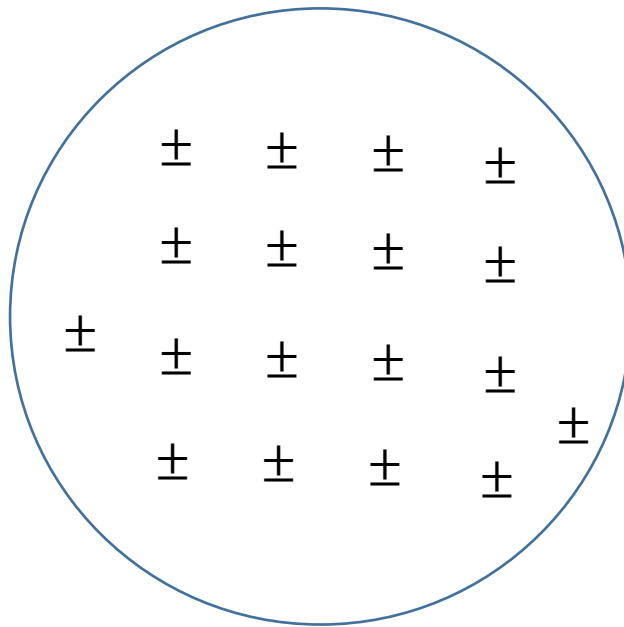


Figure 2 Any material body, isolated in outer space, will appear neutral, though not completely so, since the positive and negative charges are not located in the same place; they generate a dipolar field. Its pairs of positive and negative charges will have an approximately uniform distribution.

Now suppose another body approaches under similar conditions. The proximity of another body, which is also a dipole, gives rise to an interaction between dipoles. These dipoles are not rigid, like those discussed in elementary physics courses, but rather the dipole fields adjust in terms of the amount of electric charge and the separation of the charges. The interaction is more or less as shown in Figure 3.

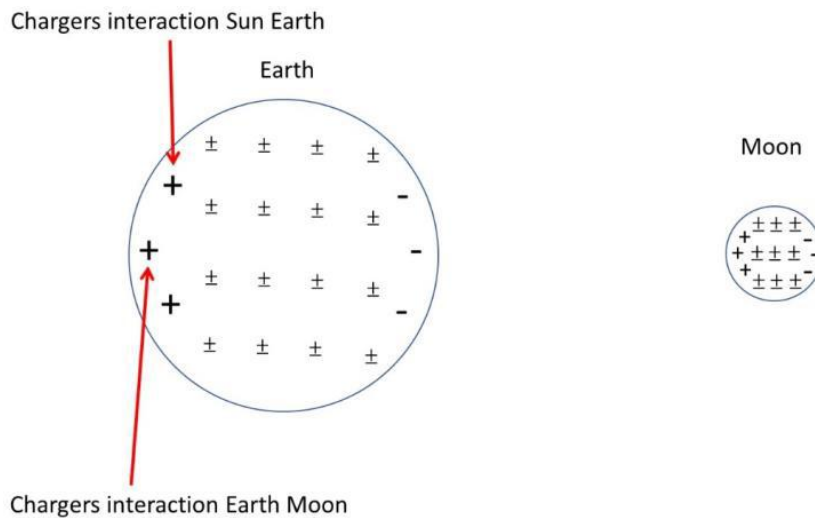


Figure 3 The interaction between these two bodies produces a more pronounced polarization; that is, the separation of charges at the two ends of the bodies intensifies. We can assume this is the Earth-Sun interaction or the interaction between the Earth and the Moon. In both cases, the bodies remain at a certain distance, rotating: the Earth around the Sun and on its own axis, and the Moon around the Earth and also on its own axis. The centripetal force is, in fact, electrical attraction.

What truly exists in this interaction, besides angular momentum, is a centripetal force that keeps the Moon orbiting the Earth.

Just as a brushed comb attracts small pieces of paper, the presence of the dipolar field of one of the two bodies in the figure induces a more pronounced separation of charges in the other. The unbrushed comb exerts the same

effect, only much less intensely, making it difficult to notice the paper pieces moving. Once brushed, it acquires additional electrons from the hair, and the intensified field increases the attractive effect, which becomes physically perceptible.

This new theory on what is ultimately the Genesis of Gravity specifies the definition:

“This dipolar force of attraction between material bodies, relatively small due to its dipolar nature, is the true cause of the force of gravity.”

Its dipolar nature and its distance from charges make it the weakest of the four interactions mentioned. However, in the vicinity of charges, the situation can change radically.

This is a statement that undoubtedly moves and shakes the mind upon encountering something unexpected. The fact is that the genesis of the force of gravity has always been very close: the very constitution of matter, positive and negative charges that are not located in the same place and that adjust to each other to produce the interaction between two massive bodies, which, far from charges, is ultimately proportional to $\sim 1/r^2$.

How can such a radical and definitive claim be proven?

There are several ways to prove this claim.

Considering that mass is thought to be the source of the gravitational field, let's elaborate a bit on the concept of mass. On the one hand, the material polarization described above always exists, and nothing needs to be proven. This polarization is always present and produces attraction. This explains several things, such as the fact that negative masses do not exist. The mass that Newton dealt with has never been found and explained at the microscopic level. The existence and essence of mass have never been explained by quantum mechanics. Mass appears in the Schrödinger equation, but the theory itself does not define what it is.

In another area of knowledge, justification can also be found for the emergence of this polarization and the manifestation of this induced charge in a considerable magnitude:

The magnetic field of some bodies in the Solar System can shed some light on this claim regarding the true origin of gravity. A body like the larger one in Figure 3, due to the induced electric charge, will produce a magnetic field proportional to its rotational speed if it rotates on its own axis. This field is visible to an observer on the surface of the rotating body. Electric current is generated by the rotation. The Earth rotates on its own axis, and its interaction with both the Sun and the Moon produces electric current and therefore a magnetic field. The Sun's influence on the Earth's magnetic field is less than the Moon's influence. This is due to the Earth's greater distance from the Sun.

1. The Moon's Magnetic Field

Although the Moon rotates on its own axis, it always presents the same face to Earth. The induced charge on our satellite is always located in the same place on the Moon and produces practically no magnetic field. It is thought that this gravitational coupling between the Earth and the Moon developed over time. Tides consume energy. The Earth-Moon system is constantly adjusting its dynamics. The Moon is moving away from the Earth at a rate of slightly less than four centimeters per year, and its rotation is adjusting to conserve angular momentum. It is thought that in the distant past, the Moon and Earth rotated faster on their axes, and the Moon had a magnetic field [20]-[33].

2. The Earth's Magnetic Field.

The dynamo theory of the magnetic field, proposed by Walter Maurice Elsasser in 1939, is based on the idea that celestial bodies must have a complex core of moving parts at high temperature, where convective displacements of incandescent material are generated. These displacements, along with the Coriolis force, give rise to electric currents that ultimately generate the magnetic field of planetary and satellite bodies. This theory is extremely complex and difficult to accept. While accepting, for the sake of argument, that part of the field of celestial bodies could be produced in this way, this paper argues, under a new theory, that the very genesis of the field may be even more intricate, but perhaps more credible, than the dynamo theory alone. In particular, it is known that there are bodies in the solar system with probable complex cores that nevertheless do not possess their own magnetic fields, as is the case with the planet Venus [34]-[41].

3. The magnetic field of Venus

This planet has a retrograde rotation on its own axis; its day (rotation on its own axis) lasts slightly longer than its year (rotation around the Sun). These rotation periods are very similar. It can be said that, due to its rotation, it does not produce a magnetic field; the induced charges remain practically in the same place [39]-[45].

4. The Magnetic Field of Mars

This planet, relatively far from the Sun, has two very small moons. They are too small to induce sufficient charges, and consequently, their magnetic field is very weak. Mars rotates on its own axis in a manner very similar to Earth's, but since it has virtually no body like the Moon nearby, it does not generate a significant magnetic field like Earth's. Phobos and Deimos are very small bodies [39]-[45].

4. All other planets have moons and also a magnetic field, except Pluto and its moon Charon, because they maintain what is known as synchronous rotation or tidal locking; Pluto and Charon both present the same face and do not have a significant magnetic field [39]-[45].

5. This dipolar effect has recently been detected in the neutron, although its field is neutral; it is not zero. Its neutrality does not imply nullity. The dipolar field is much more complex than the traditional field of rigid dipoles. It is actually a tripolar field; quarks interact with a dipolar field, but in this case the charges are very close to each other and influence one another [46].

IX. The Devil's Advocate

“An example that is put forward to prove that the force of gravity is different from the dipolar force that has been described is the following [47]:

Consider a hydrogen molecule, composed of two hydrogen atoms separated by a distance $r = 0.745 \times 10^{-10}$ m. The mass of each hydrogen atom is $m = 1.673 \times 10^{-27}$ kg. Therefore, the gravitational attraction of the two atoms corresponds to a potential energy

$$E_p = -Gmm/r = 2.22 \times 10^{-54} J = 1.39 \times 10^{-35} \text{ eV} \quad (20)$$

However, the experimental value for the dissociation energy of the hydrogen molecule is $7.18 \times 10^{-19} J = 4.48 \text{ eV}$, which is 10^{35} times larger than the gravitational energy [47].

The explanation is that, in this case, the bodies (hydrogen atoms) are very close to each other and, of course, very close to the dipole charges. The field of a dipole, very close to the charges, no longer varies as much; $\sim 1/r^3$ very close to the charges, the value of the field can be extremely large.

X. Comments and conclusions

Detecting the ether wind is, in principle, very difficult. The Earth, moving around the sun at a speed of 30 km/s, doesn't seem to be affected; perhaps if it were moving at a much higher speed, it might exhibit some effect as it moves through the ether. This is in relation to absolute frames of reference.

In the theory of relativity, the fact that the Lorentz transformations don't do what Albert Einstein predicted—that the moving observer doesn't perceive the complete spherical wavefront—leads to a significant modification of the theory. The equation of the wavefront in the frame of the moving observer is not a sphere, since the radius of this quadric surface is not constant for different points within the domain.

In the Michelson-Morley experiment, they expected to be able to detect a displacement between the mirrors $\Delta x \sim 10^{-8}$ m when the interference pattern varied by 0.01 fringes in the interferometer. However, LIGO claims to have much better precision, ten orders of magnitude, better than in measuring the ether wind. The variation in the separation between the mirrors of 4000 m plus or minus one ten-thousandth of the diameter of a proton is certainly possible, but most likely undetectable. In other words, the distance between the splitting mirror and the reflecting mirror in one of the LIGO instruments is four kilometers. It is said that due to the perturbation that the gravitational wave produces in the structure, this separation distance varies by four kilometers plus or minus one ten-thousandth of the diameter of a proton. It is a fact that there are many more factors that will produce a much larger variation than that produced by the supposed gravitational waves. Therefore, part of what LIGO does is compile statistics on the perturbations, in addition to trying to eliminate unwanted disturbances. It is claimed that these statistics yield a sigma of 5.1, allowing them to assert that they are detecting gravitational waves, even though they do not directly perceive them. Scientific researchers at the Niels Bohr Institute in Denmark question precisely the statistical strategy they use to determine gravitational waves.

One way to demonstrate that the interaction of two celestial bodies manifests a separation of charges, as described in Figure 3, is through the existence of magnetic fields in the bodies of the Solar System. The charge induced by satellites on the orbiting planet will typically produce a magnetic field for an observer on that planet. This induced charge, part of the components of the electric dipole, generates gravitational attraction, which will be a much weaker force than other known forces due to its dipolar nature. This force can be much stronger in the vicinity of dipolar charges or masses.

It is likely that the misunderstanding that the word "neutrality" implies nullity has influenced us to some extent, allowing us to coexist for many years with the true genesis of gravity without understanding it in this way.

The dream of scientific researchers to achieve the Grand Unification of the forces of nature could now appear as a reality. The Lagrangian, which describes the unification of the electromagnetic force with the weak nuclear force, has already been established. Now, with the electric force integrated as the true genesis of gravity, the Grand Unification is closer. The different interactions would be determined by proximity to the charges of the dipole. Very close to the charges, the interaction is stronger.

There will surely be much speculation on this subject in the future. Undoubtedly, this is a good year to reflect on this and other revolutionary questions in science.

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