A Little Correction About Special Relativity

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Abstract :

A small experimental inaccuracy could be the cause of a conceptual error in special relativity, an error which could hinder the resolution of problems in physics and cosmology.

INTRODUCTION :

« Everything is relative » is the mythical sentence attributed to Albert Einstein. Yet the theory of relativity is based on an absolute which is the constancy of the speed of light. How can we reconcile an absolute value with the relativity of time and space ? Does the absolute notion make sense when all parameters are variable ?

Max Planck already thought that the theory of relativity was a misnomer because it was based on an absolute : « *If space and time lose their absolute nature, it is not expelled from the universe. It is withdrawn further, in the metric of the four-dimensional continuous that units space and time, through the speed of light ».* He even came to question the sustainability of Einstein's relativity : *« Who can assure us that a concept which we now regard as absolute, must not be considered later on as relative, from a new point of view ? »* [1].

More recently, physicists are questioning the validity of special relativity : « *We talked at length about these paradoxes* [of physics]. *The root of the problem was clearly special relativity. [...] To build a coherent theory, we must begin abandoning special relativity »* [2].

1. The history :

Between 1881 and 1887 Albert Michelson and Edward Morley conducted an experiment that was supposed to explain the propagation of light by the existence of a luminiferous ether, absolute reference to any movement in the universe. This experiment measured the speed of light in two perpendicular directions, and was conceived to reveal a variation of 30 km/s, because the speed of the Earth around the sun was supposed adding or subtracting to the speed of light measured in a direction parallel to the movement of the Earth, which is not the case with a measurement perpendicular to that of the Earth. However, no difference was found in the measurements. The experiment was repeated many times to always give the same result, which inspired Einstein the brilliant idea which led to the development of the theory of special relativity in 1905: if the speed of light is independent of the speed of the Earth, it is space and time that are changing. The speed of light therefore is not added to that of the Earth, as expressed by Einstein: « *In empty space light is always propagated with a definite velocity which is independent of the state of motion of the emitting body »* [3].

2. A risky extrapolation :

The lack of difference in measurements of the speed of light during the experiments of Michelson-Morley, led Einstein to believe that the speed of light is constant in any frame of reference : « *Light when measured in the moving system always travels at the constant speed V* [which was later named c] *as required by the principle of the constancy of the speed* *of light and the principle of relativity »* [4].

To be able to verify it, we have to measure the speed of light before and after a change of the frame. There are only two ways to change frame, either by a change of speed or by a change of the gravitational field (ie enter into a less or more intense gravitational field as for example that of a black hole, but nobody knew it before 1915 and it was and it is still rather complicated to experiment). The problem in the Michelson-Morley experiment is that when we measure the speed of light in perpendicular directions, we stay in the same frame : the frame of the Earth moving in a constant speed. The misunderstanding is here : To state that the speed of light is not added to the speed of the one who measures it and to deduce that it is constant in all frames, without having experienced it by a change of frame is a baseless extrapolation.

3. Inconsistencies in different points of views :

Let's take a specific example to clarify the issue at best. Let us place a traveler who moves at the speed of 259,627 km/s, that is 86% of the speed of light. At this speed, the ratio between the time of an observer on Earth and the time of the traveler is 2, ie a second for the traveler has the same length as two seconds for the stationary observer. Looking through a porthole of his ship, the traveler perceives the events of the universe accelerated twice.

All this is well known and has been observed on particles. The extension of their " life " due to time dilation corresponds to what is predicted by the theory. From his point of view the traveler perceives his own speed in the universe accelerated twice, and that is what makes that journey twice less long than the observer would perceive on Earth and when he returns to Earth he has aged less. As the speed of light must be in principle an absolute constant, the traveler sees himself at twice 0,86c ie to 0,98c considering the addition of velocities in relativity. So each observer (the observer on Earth and the traveler himself) gives the traveler a different coefficient of dilation of time : for the observer on Earth the coefficient is 2, for the traveler who from his own point of view moves at 0,98c it is 6.6. There is an inconsistency of points of view. It is essential that each observer perceives the same coefficient of dilation of time between them, so the ratio v/c (0.86 in this example) must be the same from the perspective of each one. If the two observers talk among themselves, the observer on Earth hears the traveler speaking twice more slowly, so the traveler must hear the observer on Earth speaking to him twice faster but not 6.6 times.

4. Can we wonder whether the speed of light can vary ?

There are two ways to give the point of view of each observer for each one perceive the speed of the traveler at 0,86c, it is either assumed that the time dilation does not exist, which would amount to return to Newton's theory and its proved inconsistencies with respect to a finite speed of light, or to consider that the speed of light is not an absolute constant.

Special relativity shows that time passes more slowly for a traveler than for a stationary observer, which means that the unit of time of the traveler from the point of view of a stationary observer is longer, so during a longer second, light should go more distance. The speed of light must appear variable to any observer who changes frame of reference, not by adding it to its own speed, but varying in proportion to the dilation coefficient of time.

$$\gamma = 1 / \sqrt{(1 - v^2/c^2)}$$

So the speed of light is not an absolute constant, but a constant relative to the frame of reference of the observer. To calculate it from the point of view of a moving observer, the speed of light must be increased by the factor of time dilation of the observer :

So let's call c' the speed of light from the point of view of a traveler :

$$c' = \gamma c$$

v is the velocity of the traveler, we have:

$$c' = c / \sqrt{(1 - v^2/c^2)}$$

The variability of the speed of light depending on the time dilation coefficient of the one who measures it, does not contradict the Einstein's assertion. The speed of light is independent of the speed of the emitting body. If we measure the speed of a light emitted from a motionless source or issued from a traveler who turns on the front or the rear lights of his ship, we always find the same speed : c. If the traveler in the example at 0,86c measures the speed of a light emitted from a stationary observer, he will find the same value as for a source of light emitted from his ship, either towards front, back or sides; if he repeats in his ship the Michelson-Morley experiment he will still always find the same value : 2c, and he will also say that the
speed of light does not depend on the speed of the emitting body. To generalize to all frames, the speed of light is not equal to c, but to γc. Our frame on Earth corresponds to the particular case with $\gamma = 1$, or more precisely $\gamma \approx 1$, because we are not absolutely motionless, that is what will allow us to demonstrate it.

5. How to provide experimental evidence :

Earth orbits around the sun, so our speed in the universe changes during the year, and we should be able to check if the speed of light after a change of frame appears constant or not. The absence of luminiferous ether has certainly been what inspired Einstein the idea of relativity of motion, so the concept of absolute velocity in the universe was not acceptable to him. The relativity of motion means that two moving observers can only move relatively to each other and not relativrly to a universal frame. But the absence of ether does not necessarily mean that there is no universal frame. In the universe there is no reference of position, but there is a reference of speed. This frame is shown by the cosmic background radiation detected in 1965, ten years after Einstein's death, and photographed for the first time in 1992 by the satellite Cobe. This image is in the history of mankind, an event as important as the first steps of man on the moon. From this cosmological background, we can deduce our speed in the universe according to the redshift of the radiation measured in different directions. Any change in our speed in the universe, should result in a change in the coefficient of dilatation of the time we live in everyday life, and thus affect a change in our perception of the speed of light. Every year, when the speed of the Earth is added to that of the solar system around the galaxy, we are ourselves in the position of travelers compared to our situation six months before or later, when the speed of the Earth is subtracted from that of the solar system. Michelson and Morley should have detected a difference, not between two measurements in two perpendicular directions, but between two measurements six months apart.

6. Calculation of the variation of c :

Let's calculate the value of this difference :

The Earth moves at the speed of 29.75 km/s [5] around the sun. Every six months it changes its direction, what doubles the difference of speed.

The sun revolves around our galaxy, carrying with it the planets. The speed of the Earth does not add itself to the full speed of the solar system around the galaxy because there is an angle of 60.2° between the galactic plane and ecliptic plane. In the calculation of the halfyearly variation of c, we must take into account the cosine of this angle, which reduces it by about half.

Thus we get :

$$\Delta c = c \,/\, \sqrt{[\ 1 - (2\ v.\cos a)^2/c^2\ ]} - c$$

c : speed of light = 299,792.458 km/s
$1 / \sqrt{(1 - v^2/c^2)}$: coefficient of dilatation of time. v is replaced here by : 2v.cos a
v : speed of revolution of the Earth around the sun = 29.75 km/s
a : angle of 60.2 degrees between the galactic and the ecliptic plane.
cos a = 0.49697
2 : multiplier coeficient to reflect the change of direction of movement of the Earth around the sun. At this speed scale, we can consider that the speeds add up, and that there is no difference between the sum of the classical and relativistic speeds (the difference in the result appears on a scale less than the millimeter).

After calculation, we obtain :

$$\Delta c = 1.46 \text{ m/s}$$

The speed of light is varying of 1.46 m/s every six months, to return to its initial value after a year. Then we understand why Michelson and Morley did not detect any difference. 1.46 m/s compared to 299,792,458 m/s was completely undetectable at the time (the accuracy of measurements of c was in the order of a few kilometers, which was already noteworthy) and this error, or rather this small inaccuracy, let the speed of light appear as an absolute constant instead of a relative constant, which led Einstein to a misinterpretation.

This difference is even difficult to measure today because the speed of light is the reference for accuracy measurements. It was fixed once and for all in 1983 and is used as a standard for measurements relating to space or time. We will have to wait until one day technology requires such precision that anomalies are detected that indicate that every six months the meter or the second varies by a half hundred millionth (1/205,337,300). Such as one day in the distance Earth-Moon we'll find an annual anomaly that corrects itself after six months, or the day we'll wonder why we found more precision in the GPS at a specific time of year and a little less at another one, or when we ask why during space missions at least six months, ordered from Earth, we always have an error of position which fluctuates abnormally by itself every six months from zero to several kilometers, and when it raises enough problems for us to talk about the issue. And still, we'll have to make the connection between the periodicity of the anomalies and a change in the spatio-temporal frame of reference of the Earth during the year.

Besides having established the speed of light to the accuracy of the meter, is it not a sign that a variation of it could have been taken for an inaccuracy in the measures ?

7. Conditions to the limits :

A variation of 1.46 m/s compared to 299,792,458 m/s, is a detail, a trifle, in our scale of speeds but everything changes when approaching limits. Imagine a traveler whose speed approaches the speed of light. The dilation coefficient of his own time tends to the infinite, so his speed from his own point of view tends to the infinite, as the speed of light always from the perspective of the traveler tends to infinite, the traveler can still accelerate without ever reaching it.

If the speed of the traveler tends to the infinite, the duration of the trip tends to zero. Besides Einstein in his famous 1905 article "On the Electrodynamics of Moving Bodies" noted that *« the speed of light plays the physical role of an infinitely high speed. »*

Karl Schwarzschild went further. In February 1916, he wrote about the critical radius of a star below which one ends up at a singularity that would later be called a "black hole": *"The value of the pressure increases in direct proportion to the speed of light. At the center of the sphere, the speed of light and the pressure become infinite."* [6] He had discovered by calculation that the speed of light cannot be an absolute constant. Despite the accuracy of the calculations that resulted from it, this little sentence has been forgotten by science. Karl Schwarzschild died shortly afterward.

For a massless particle that travels at the speed of light like the photon, the speed of light is infinite and the universe is punctual. For massless particles, the highest possible speed is infinite, and from their point of view the universe is punctual, so this speed is also zero. The concepts of speed and distance have no meaning for a massless particle. When all parameters tend to the infinite or zero a speed of light at 300,000 km/s would be meaningless.

With the concept of relative constant, the traveler and the motionless observer have each one the same point of view in relation with the speed of light in their own frame. In this example near the limits, the observer still finds that the speed of the traveler goes to 100 % of a speed of light at 299,792 km/s, the traveler finds his own speed tends to 100 % of a speed of light which tends to the infinite. The ratio v/c from the point of view of the stationary observer, and the ratio v'/c' from the point of view of the traveler are the same.

When all parameters are variable, a constant cannot be an absolute numerical value. This is not the velocity of light which is the same for a traveler and a stationary observer, that is the same it is the ratio between the speed of each observer and the speed of light of their own frame, such as they could measure themselves. Whether the speed of an observer is less, equal, or higher than a traveler's, the coherence of the universe for all observers requires that the ratio v/c be the same for all observers in any frame, which cannot be the case with an absolute constant c.

If the theory is valid even to its limits, we can wonder whether all that has been taken for singularities of physics, was not the consequence on general relativity of this conceptual error in special relativity.

A speed is a distance run in a certain time (v = d/t).

When we write :

c = 300,000 km/s, we write an equality to the form :

v = d/t

Since Einstein we have known that the unit of time t is not the same for each observer in relation with each one's frame. It is essential to realize that the fact because of t is a variable which appears as a constant in any frame (whether our second is long or short, it always seems to have the same duration), when we measure the speed of light, we don't directly measure v but d which must therefore vary in the same proportions as t, otherwise v can't be a constant.

So c can neither be named an absolute constant nor a variable but a relative contant.

8. How to experiment the variation of c :

To verify the six-monthly variation of 1.46 m/s in the speed of light, one must choose the right periods. It is on December 17 that the trajectory of the sun around the galaxy and that of the Earth around the sun have tangents on parallel planes and go in the same direction. It is on this day, or as close as possible to this day, that the speed of light must be measured and compared with a measurement six months later, i.e. June 17 (or 18 depending on the year), because these are the two days when the speed of the Earth is added to or subtracted from that of the sun with the greatest amplitude.

When the variation of the speed of light is distributed over six months, it is found that c increases or decreases every day for about 8 mm/s, with a distribution that follows the same principle as the change in day length all around the year. Compare the measurement of speed of light in mid-March, and six month later, in mid-September, would give no significant results (as if the day length was compared mesured at the equinoxes). So, there are "relativistic equinoxes", in mid-March and mid-September, with a medium speed of light, and "relativistic solstices" in mid-December and in mid-June, when we can measure the maximum amplitude of 1.46 m/s of the variation of the speed of light.

9. Other variations of c :

Our local group of galaxies is moving at about 600 km/s towards a "Great Attractor" localized in the Coma cluster. The sun moves at 217 km/s around the galaxy in the opposite direction compared to the one of our local group. So we're moving in the universe :

600 – 217 = 383 km/s (here again, the classical addition of speeds gives us a sufficient accuracy given our approximate knowledge of the speed of movement of our galaxy). So there must be a relativistic effect of our speed in the universe, and the speed of light as we measure it is not a universal speed of light. The one which would be measured by a stationary observer relative to the universe should be a little lower. To calculate it, we just have to calculate the coefficient of dilation of time due to our speed of 383 km/s in the universe, and divide c by this coefficient, as we are in the situation of the traveler, we know c', which in fact is c, and we look for c that we might call c_0 for speed of light to an observer at speed zero, which corresponds to the lowest speed of light in the universe, at least in the present universe.

$$c_0 = c \cdot \sqrt{[1 - (v_g - v_s)^2 / c^2]}$$

v_g = velocity of our galaxy
v_s = velocity of the solar system
c_0 = 299792.213 km/s or 245 m/s less than c.

The solar system goes round our galaxy in about 250 million years. Currently the speed of the solar system is deducted from the speed of the galaxy, but in 125 million years, it will have changed of side and it will be added to the one of the galaxy. Our speed in the universe will be 2 x 217 = 434 km/s more than at present. We can therefore calculate c_m (maximum c), which takes into account the relativistic effect of our speed in the universe :

$$c_m = c / \sqrt{[1 - (2 v_s)^2 / c^2]}$$

c_m = 299792.772 km/s or 314 m/s more than at present.

It should be noted that if the angle between the galactic plane and the ecliptic plane was 90 degrees, we would not change our speed so not change our frame during the year, we would therefore have to wait until the solar system has covered a good part of the galaxy, that is several tens of millions of years, to be able to detect a variation of c.

10. Variations of the other constants :

So the speed of light varies every 125 million years a little more than a millionth (1/954,313). All physical constants related to time or space must also vary. The gravitational constant G varies in the same direction. Quantum constant such as the Planck constant h should vary inversely to relativistic constants. There may be physical constants that do not vary, they are unitless constants, composed by products or ratios of constants.

There is a constant called the Einstein constant[1] which implies that whatever the values of G and c, G/c^2 is a constant, which means that G doesn't varies in the same proportions as c, but in proportion to its square.

The gravitational constant $G = 6.67384.10^{-11}$ $m^3/kg/s^2$ with an approximation of $0.00080.10^{-11}$ $m^3/kg/s^2$. As it varies in proportion to the square of c, every six months it varies from 1/14,329, which gives us a variation of G of $0.00046.10^{-11}$ $m^3/kg/s^2$. Can't the fact that the calculation of the variation of G assigns the same decimal as the approximation of its measure, be, here again, a sign that a variation of G during the year could have been taken to an inaccuracy of its measurement ?

11. Consequence on General Relativity :

General relativity tells us that gravitation and acceleration have the same effects. An observer in a closed room does not make the difference between being in a gravitational field like that of the Earth, or being in upward acceleration. As we live permanently in the gravitational field of the Earth, the solar system, the Milky Way and even the entire universe, even still, our perspective is an accelerating traveler's, very low, but permanent. So the expansion of the universe should appear to us accelerating. And the accelerating expansion of the universe, discovered in 1998, is simply a relativistic effect of our permanent change of frame, caused by the gravitational field of the universe. It is therefore

1 $C = (-8\pi.G/c^4)T$

unnecessary to invent a dark energy to explain it.

Being in the position of a traveler in acceleration increases with time the coefficient of dilation of time, so the constants c and G increase with time, and the accelerating expansion of the universe accelerates. This well corresponds with observations.

The lengthening of the unit of time in the universe makes us underestimate its age because we measure it with the current unit of time, while in the past it was shorter. The closer we get to the origin of the universe, the more the difference becomes exponential and it is possible that in what we consider to be the first billion years of the universe, in reality about ten billion years have passed.

The universe therefore has no absolute age, but an age relative to the observer. If several billion years seem to be missing from the history of the universe, it is because the slowing down of the speed of the flow of time causes for the current observer a "packing" effect of past time that is all the more significant as this past is distant [7].

12. Possible objections to the concept of relative constants :

— *If this concept is correct, the Einstein's theory of relativity, for over a century, would have been at fault !*

Answer : If relativity with an absolute constant c has been verified, it is because we always carry out our experiments in the same frame, that of the Earth with an almost uniform motion.

In fact, Einstein wasn't mistaken. In the same way as Newton described a particular case of physics, valid at the low speeds of our daily life, Einstein even with physics expanded to high speeds and gravitation, has limited it to the particular case which concerns only the observers in our earthly frame. The Einstein's only error was to take this case for the generality. As long as we do not change of frame or we don't care for a tiny change in our frame, Einstein's physics have been checked and continue to be considered as the generality. But we may have a surprise if one day we can measure light speed while we move at high speed.

— *The Michelson-Morley's experiment was remade much later by others with more modern means and never showed any variation of c !*

Answer : Because you find only what you seek. Searching :

1) if the speed of a moving frame of reference adds to c, or ...

2) … a variation of c according to the coefficient of the dilation of time of the observer which measure it ...

... are not the same experiments. The difference is both technical and conceptual. The first one, could lead have to discover the second one, on condition, technically, to conduct it with an accuracy 10,000 times greater than that of the original experiments, to repeat it six months later (which has been done), and in good times in the year. Three conditions that were not necessary for the demonstration of the first one, and have therefore not been met for discovering the second one. And conceptually, still we had to think of searching for this purpose. Besides Michelson and Morley did not conclude that there was no difference between the measurements, but the difference was less than that the experiment could measure.

— *Science progresses by attempts to solve insolvable problems in the paradigm of the* *moment. The only problems reported here are simply a problem of terminology outlined by Max Planck, and the speculations of a physicist at least marginal, who seeks to explain the inflation of the universe through a supposed variation of c in the distant past. There's really nothing to put physics in question !*

Answer : Why waste time when you know that the problem will be one day. Even if the problem is not apparently related to relativity, it constantly arises through the inability to unify current physics and the lack of solutions to the issues of cosmology.

— Chapter 4, on line 88 : " time passes more slowly for a traveler [...] so during a longer second, light should go more distance. " No ! Because there should be equivalence of point of views between the traveler and the stationary observer. If the stationary observer sees the traveler evolving slowly, the traveler should see the stationary observer moving in slow motion, so the speed of light is the same for both !

Answer : This is an idea that is usually exposed in the famous Langevin twin paradox, of which no less than 54 different interpretations are referenced on the web [8]. Even scientists do not all agree with each other. Why such a lack of understanding of the phenomenon ? Because the paradox as it is usually exposed is very baddly presented : What we try to show is that when one twin stays on Earth and the other travels they will no longer have the same age at the return of the traveler. In the usual story, the traveler leaves Earth to get close to a nearby star to conduct a U-turn and return to Earth. Since a traveler's time runs slower than a stationary observer one, the observer on Earth should see the traveler evolving slowly and logically as the traveler must see events of the universe evolving faster, he should see the observer on Earth evolving faster. However, the most commonly accepted idea is that under the relativity of uniform motion that should not make a difference between the twins' views, each of them should see the other moving in slow motion, which indeed is true, at least on the outward journey, because the distance between the observer on Earth and the traveler is increasing. But here there is confusion between the relativistic effect and a Doppler effect which is superimposed, which distorts the understanding.
There is only one way to isolate the relativistic effect, it is not to make vary the distance between the observer and the traveler. The traveler must do a circular movement around the observer. But a circular motion which has no gravitational cause is comparable to an accelerated motion. The relativity of motion that concerns only the uniform motions is no longer valid, and the relativistic effect does not have to be symmetrical, and given the difference in flow velocity of time between our two observers, without disruptive effect Doppler the traveler must see the stationnary observer evolve in an accelerated movement like all events outside his ship.

But we must also consider the case where the traveler revolves around the observer in a gravitational field, such as the case where the observer would see the traveler in the space station passing by (to remove disruptive Doppler effect, the observer should theoretically be at the center of the Earth). Here the traveler's movement is a uniform motion in a curved space, so the relativity of motion should apply and involve an equity of points of view. But we can assume that every motion is relative only if there is no absolute frame of reference in the universe.

However, since the discovery of cosmic background radiation, we know that there is an absolute speed reference, which invalidates the relativity of motion, and the equivalence of points of view.

CONCLUSION:

In the universe there is a highest possible speed, which limits the quantity of space that can be covered in a shortest time. This niche is occupied by light and other massless particles at rest. This speed is an indicator of the relationship between space and time in a given frame of reference. Who changes speed, changes of frame and should measure a different speed of light, indicating that the relationship between space and time in his frame is no longer the same. So the speed of light is not c but γc. This is how relativity will be able to describe a coherent universe, but at the cost of abandoning its two postulates: the relativity of movement and the absolute constancy of the speed of ligh.

Now we can say with Einstein that everything is relative !

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