A NEW APPROACH TO CONCEIVE THE MEASUREMENT OF THE ONE-WAY SPEED OF LIGHT BASED ON AN ASTONISHING CONFLICT WITHIN RELATIVITY

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Abstract

The measurement of the speed of light one-way can be easily conceived since we can consider a rod with length l_1 between the extremities *A´* and *B´* and emit light from *A´* to *B´* and reciprocally emit light from *B´* to *A´*. If we measure the time *A´B´* and the time *B´A´* we know the speed of light *A´B´* and *B´A´*. However, standard approach affirm astonishingly that this is not possible. Because we need to know the speed of light to synchronize the clocks at *A´* and *B´*, to measure the times *A´B'* and *B´A´*. Why? Because standard approach accept the necessity to have synchronized clocks. And astonishingly also affirm that the one-way speed of light one-way is the two-way speed of light measured in one-clock with the value *c* in vacuum. In the following approach we defend that this standard approach can not subsist based on the conceptualization of the measurement one-way. For this we use a new method using a gap of synchronization that standard approach can not be aware.

Keywords: simultaneity and synchronization, Abreu´s axiom, gap of synchronization, one-way speed of light, two-way speed of light, preferred frame, experimental determination, Relativity Principle, Einstein frame, Einstein synchronization, Lorentzian time, intrinsic desynchronization, Lorentz transformation, IST transformation, time dilation and contraction, Lorentz-FitzGerald contraction and dilation, Einstein simultaneity, new method, Einstein method, synchronized time, Lorentzian time, conventionalism controversy.

1. Introduction

"De Abreu proposed to abandon the Relativity Principle in favour of 'restricted Relativity Principle' that allows the absolute space with a preferred reference system, referred to as 'the Einstein's lost frame'. This idea was future developed in [De Abreu 2002, 2004; De Abreu & Guerra 2005; Guerra & de Abreu 2006]. The velocity relative to the preferred reference system is said to be the absolute velocity, and a velocity relative to non-preferred system is said to be the Einstein velocity [De Abreu 2004]. The starting point of De Abreu (and jointly with Guerra) is the observation that the Einstein synchronization of clocks can be made in one and only one reference system. Analysis of the clock synchronization (related to one-way versus two-ways light velocity) leads Authors to consider the abandoning of the Relativity Principle (that all reference systems are equivalent)." [1-13]
(https://ui.adsabs.harvard.edu/abs/2011arXiv1104.0682O/abstract)
Based on this new approach we develop a protocol to experimentally measure the one-way speed of light.

2. The Method

2.1 Simultaneity and Synchronization

If the simultaneity of the emissions of light at *A´* and *B´* can be conceived and operationally implemented, we can emit light at *A´* and *B´* simultaneously with the initialization of the clocks marking zero at *A´* and *B´*. Therefore, if this is so we can measure the light times *A´B´* and *B´A´* and therefore measure the one-way speed *A´B´* and *B´A´*. Indeed, the clock *A´* measured the time of light emitted by *B´* and the clock *B´* measure the time of light emitted by *A´*. We have the problem solved. For achieve that we can use a generalization of Einstein method based on the time gap of the new approach [1, 26].

2.2 Einstein Fram

Einstein affirm that the one-way speed of light is *c* in every frame. This cannot be so. Indeed if we assume the existence of a frame where the one way speed of light is isotropic with the value *c*, the value measured for the two-way speed of light, the frame designated by us [5] Einstein Frame (*EF*), for this frame we can synchronize clocks at distance with light using Einstein method. Therefore if we assume the existence of *EF* than for a frame moving with velocity v_1 in relation to that frame we calculate the speed of light one-way and this speed cannot be *c* [16]. Zbigniew Oziewicz also emphasize "Abreu's Axiom", the independence of the speed of light in *EF* of the speed of the frame of the emitter, the source of light [1].

Since the speed of light one-way cannot be *c* in every frame the axiom of the constancy of the one-way speed of light cannot subsist and we must construct another theory. This has been accomplished [1-26]. Based on the existence of Einstein Frame. The unique frame where the speed of light is isotropic with the value *c*.

2.3 The Synchronization of Clocks for a frame moving with speed v_1 in relation to Einstein Frame.

If we consider a rod *A´B´* moving with speed v_1 in relation to *EF* and if we calculate the speed of light *A´B´* and *B´A´* we obtain [6],

$$c'_{A'B'} = \frac{c - v_1}{1 - \frac{v_1^2}{c^2}} = \frac{c}{1 + \frac{v_1}{c}} \qquad (1)$$

and

$$c'_{B'A'} = \frac{c + v_1}{1 - \frac{v_1^2}{c^2}} = \frac{c}{1 - \frac{v_1}{c}} \qquad (2)$$

This is the speed of light based on the Lorentz-FitzGerald contraction and Time dilation valid only in relation to *EF* [3, 4]. Therefore, we can calculate the times *A´B´* and *B´A´* since we can synchronize the clocks with light using the real speed that is not *c*. We know that the one-way speed of light is not *c* (isotropic) except in *EF*. This is not only an experimental problem. *The experimental verification can not be yet achieved*. And an experiment only can corroborate or not a theory. However, we know that standard approach contradicts itself, it is not internally consistent. Since if we assume the existence of a frame where the one-way speed of light is *c* for another frame the one-way speed of light cannot be *c*.

Indeed, when light is emitted from *A´* to *B´* and the clock at *B´* is marking $\frac{l_1}{c}\left(1 + \frac{v_1}{c}\right)$ when light arrive at *B´* the clock is synchronized with the clock at *A´* (from eq. (1)). Therefore, we have the clocks at *A´* and *B´* marking the same time. And after *10 s* the clocks continue synchronized and can be resected to zero (and continue synchronized) and emit light to the other. And we obtain for the times *A´B´* and *B´A´*

$$T'_{A'B'} = \frac{l_1}{c}\left(1 + \frac{v_1}{c}\right) = \frac{l_1}{c} + \frac{l_1}{c}\frac{v_1}{c} = \frac{l_1}{c} + \delta \qquad (3)$$

$$T'_{B'A'} = \frac{l_1}{c}\left(1 - \frac{v_1}{c}\right) = \frac{l_1}{c} - \frac{l_1}{c}\frac{v_1}{c} = \frac{l_1}{c} - \delta \qquad (4)$$

Then we have for the two-way speed of light the value *c*,

$$T = T'_{A'B'} + T'_{B'A'} = \frac{2l_1}{c} \quad (5)$$

As expected, and consistently we obtain for a first order approximation the classic result (see eq. (1) and (2)) contrary to the standard relativistic approach that is rigorously *c* – does not depend on v_1. With this new approach based on the existence of *EF* we show that the standard approach affirming the constancy of the one-way speed of light cannot subsist [3, 4 , 6]. And with this new approach we can develop a method to synchronize the clocks also in the frame with velocity generic v_1. Although we don´t know v_1 *ab initio*. This is possible because we previously discover the existence of a conceptualization of simultaneity and synchronization different of the obtained in *EF*, that the standard formulation cannot be aware as Zbigniew Oziewicz refer (Einstein synchronization is valid only in *EF*). Indeed when v_1 is different from zero we have a gap of “synchronizations” and “simultaneities” that permit the extension of the conceptualization and consequent experimental implementation of this gap.

We can introduce the several values of the one-way speed of light between zero and a generic v_1 by

$$c'_{A'B'} = \frac{c}{1 + \frac{\propto v_1}{c}} \quad (6)$$

and

$$c'_{A'B'} = \frac{c}{1 - \frac{\propto v_1}{c}} \quad (7)$$

with $\propto \epsilon$ $[0,1]$. Therefore we have a gap of “simultaneities” and synchronizations” since we have emissions and receptions between zero and 1.

Therefore, we have

$$T'_{A'B'} = \frac{l_1}{c}\left(1 + \frac{\propto v_1}{c}\right) = \frac{l_1}{c} + \frac{l_1}{c}\frac{\propto v_1}{c} = \frac{l_1}{c} + \delta \qquad (8)$$

and

$$T'_{A'B'} = \frac{l_1}{c}\left(1 - \frac{\propto v_1}{c}\right) = \frac{l_1}{c} - \frac{l_1}{c}\frac{\propto v_1}{c} = \frac{l_1}{c} - \delta \qquad (9)$$

And we maintain the two-way speed of light for the several “synchronizations” begin with “Einstein synchronization” (with $\propto = 0$) the assumption that the one-way speed of light is really *c*.

$$T = T'_{A'B'} + T'_{B'A'} = \frac{2l_1}{c} \qquad (10)$$

Therefore, it is very simple. At *B´* the clock is waiting the arrival of light from *A´* marking “Einstein synchronization” $\frac{l_1}{c}$. After *10 s* the clocks are resected to zero and if they are really synchronized the times measured are

$$T'_{A'B'} = \frac{l_1}{c}\left(1 + \frac{0 \times v_1}{c}\right) = \frac{l_1}{c} \quad (11)$$

$$T'_{B'A'} = \frac{l_1}{c}\left(1 - \frac{0 \times v_1}{c}\right) = \frac{l_1}{c} \quad (12)$$

Of course, the speed of light is the same, but this “synchronization” is a desynchronization (when $v_1 \neq 0$) that originates the experimental result $\frac{l_1}{c}$.

It is obvious that we can introduce a drift correspondent to other values of $\propto$ and only when $\propto = 1$ we obtain the correct result. And for this real synchronization we obtain the last two-way speed of light with the protocol. If this is so this can be observable and the value of v_1 can be experimentally conceived. Indeed we can understand that if we initiate the experimental process with a rod with length l_1 between *A´* and *B´* and if we consider that rod moving with v_1 in relation to EF and if we emit light at *A´* initiating the clock at *A´* marking zero and at *B´* we can have a Lorentzian clock waiting marking $\frac{l_1}{c}$ that is initiated by the arrival of light emitted by $A´$. If the clock at $B´$ is really synchronized must mark $\frac{l_1}{c}(1+\frac{v_1}{c})$. Therefore, we can consider the two clocks that are initiated by the arrival of light from $A´$. Therefore, when light arrive both clocks initiate and of course mark two different times. Since the speed of light is $c/(1+\frac{v_1}{c})$ the clock that is synchronized is the synchronized clock marking $\frac{l_1}{c}(1+\frac{v_1}{c})$ and not the other as Einstein stated, a Lorentzian clock. When we consider the reset to zero at $A´$ after 10s at $B´$ there is not reset yet with the Lorentzian clock and therefore at $B´$ we don´t have emission yet. Therefore, the emission at $B´$ correspond to other position of the rod in EF. The emissions are not really simultaneous although similar since we proceed with Lorentzian clocks as with synchronized clocks. This is Einstein simultaneity since Einstein affirm that Lorentzian clocks are synchronized. But it is operational, we don´t need to know v_1. The emissions are not simultaneous and therefore we obtain $\frac{l_1}{c}$ at the receptions as we expect if the speed of light was *c*. It seems, but it is not. The introduced desynchronization originates the experimental result observed but does not signify the *c* value assumed by Einstein. The reset to zero is local and because of that when we reset to zero l_1 is not in the same position correspondent to the position of the rod when the clock at $A´$ reset, the emissions are not simultaneous and therefore we have the difference of times for the several "synchronizations"

$$T'_{A'B'} = \frac{l_1}{c}\left(1+\frac{\propto v_1}{c}\right) \qquad (13)$$

$$T'_{B'A'} = \frac{l_1}{c}\left(1-\frac{\propto v_1}{c}\right) \qquad (14)$$

$$T = T'_{A'B'} + T'_{B'A'} = \frac{2l_1}{c} \qquad (15)$$

What we need to know and don´t know yet is for $\propto = 1$. But when experimentally the gap is exceeded, we don´t obtain

$$T = T'_{A'B'} + T'_{B'A'} = \frac{2l_1}{c} \qquad (16)$$

Therefore, it is through experiment that we obtain v_1. It is "ontic". It is not conventional. Of course, this is so in a new context of Relativity. With 3 frames. And one is the unique Einstein Frame.

Conclusion

We consider the emissions from the extremities $A´$ and $B´$ of a rod moving with velocity v_1 in relation to Einstein Frame (*EF*), the frame with isotropy of the one-way speed of light *c*. Since the formulation must consider *EF* with $v_1 = 0$ we need to consider 3 frames, and this is a new result that evince why the standard formulation is internally inconsistent. It is crucial to understand the difficulties that originates on the terminological confusions of relativity and construct a new language. We obtain new results when we consider the mathematical relations between two moving frames with two velocities v_1 and v_2 in relation to *EF* with $v = 0$. We obtain a gap of desynchronizations to the times at $A´$ and $B´$ with the extremes at $A´$ and $B´$ with synchronized clocks. We can define this gap with a parameter $\propto$ between *zero and one* that we obtain from the several values of the velocities between $zero\ and\ v_1$. We can therefore experimentally discover the values of v_1 when experimentally the gap is surpassed. Since the observed value of the tway speed of light does not satisfy the internal value of the gap. This solves also the controversy about conventionalism.

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