The Astonishing Conflict of the Constancy of the One-Way Speed of Light within Relativity

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Abstract

We show that if we assume the existence of a frame in vacuum where the one-way speed of light is c (c is the measured value of the two-way speed of light in vacuum) than for another frame moving with velocity v_1 in relation to that frame the speed of light in this another frame cannot be *c*. What is *c* in this another frame is the one-way Einstein speed of light. Although this has been known and affirmed several years ago, only recently we have an increase of publications stating the variability of the one-way speed of light. Therefore, since the constancy of the speed of light is sometimes considered an unquestionable postulate, we are assisting to an astonishing conflict between the "standard formulation of Relativity" and "Relativity with variable light speed". However, this conundrum can be easily resolved with the clarification of the conceptualization of simultaneity and synchronization.

Introduction

Recently one more interesting article questioned the accuracy of the postulate of the constancy of the speed of light has been published [1].
If the constancy of the speed of light is not true, the postulate must be reconsidered.
For an unwary reader we advise that the one-way speed of light in one frame can be *c/2* and infinite for the opposed direction and simultaneously the Einstein speed of light is *c*.
In 2002 it has been discovered [2-4] that the one-way speed of light is $\frac{c}{1+\frac{v_1}{c}}$ and $\frac{c}{1-\frac{v_1}{c}}$ for opposed directions and with Lorentzian clocks the Einstein speed of light continued to be c - we discover the intrinsic desynchronization that standard formulation of course cannot be aware [5, 6, 7-111]. Even today we assist to a permanent discussion of the twin paradox conundrum and the Sagnac effect conundrum [110, 111].

I. The Speed of Light in a Frame moving in relation to EF (Einstein Frame) the frame where the one-way speed of light is isotropic with the limit value *c*.

Standard formulation affirm that the speed of light is c whatever the frame considered. Therefore, we can consider one frame where the speed of light is c and consider another frame moving with velocity v_1 in relation to that frame and consider also that the two-way speed of light in this frame is c since in vacuum it is what we measure as also standard formulation assume.

If the constancy of the speed of light is not true, the postulate must be reconsidered. For an unwary reader we insist, the one-way speed of light can be *c/2* and infinite for opposed directions. It is not only the problem of experimental difficulty to measure.

With these premises we obtain the one-way speed of light as a result of Lorentz-FitzGerald contraction and Larmor Time dilation [7, 17] in relation to *EF*. Note that we are not assuming that we can consider every frame as *EF* because we can´t assume that as standard formulation does – the equivalence of the frames. This error is the origin of the astonishing conflict as Zbigniew Oziewicz refer [5, 6].

Indeed, consider frames *S* and *S´*. *S* is the *EF* and *S´* is a frame moving in a standard configuration in relation to *S* with velocity v_1. This standard configuration is *S´* moving through *x* of *S*. O´ the origin of *S´* coincide with O the origin of *S* and O´ moves through the *x* axis of *S* with v_1. When coincide with O light is emitted from O´ through *x´* and light is also emitted from O through *x*.

The one-way light-velocity is source-free in one and only one reference system. This reference system is said to be the Einstein lost frame (Abreu Axiom as Zbigniew Oziewicz define it [5]).

The light emitted through x' pass by x' with

$$x' = c't', \qquad (1)$$

c' is the speed of light and $t'$is the synchronized time of a clock located at x'.

This light emitted from O´ through *S* moves with speed *c* because *S* is the EF and the speed of light is independent of the speed of the source O´ from *S´* moving with speed v_1 [5]. The coordinate *x´* move through *x* with eq.

$$x = v_1 t + x'\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)} \qquad (2)$$

where t is the synchronized time of S, and $x'\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)}$ is the Lorentz-FitzGerald contraction.

Therefore, when light arrives at x we have,

$$ct = v_1 t + x'\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)} \qquad (3)$$

From (1) and (3)

$$ct = v_1 t + c't'\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)} \qquad (4)$$

$$(c - v_1)t = c' t' \sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)} \quad (5)$$

Since

$$t' = t\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)} \quad (6)$$

we obtain

$$(c - v_1)t = c' t \left(1 - \frac{{v_1}^2}{c^2}\right) \quad (7)$$

$$c' = \frac{c}{1 + \frac{v_1}{c}} \quad (8)$$

Therefore, only for $v_1 = 0$ $c' = c$. For the opposed direction

$$c' = \frac{c}{1 - \frac{v_1}{c}} \quad (9)$$

The two-way speed is c.

Therefore, we have a simple explanation for the astonishing acceptance of the obvious mistake in relation to the value of the speed of light. What is *c* is the Einstein speed of light as we are going to show in this context.

The Einstein speed of light is *c* of course because it is not the speed of light. It is the distance of the trip divided by the difference of the Lorentzian times of the clocks at arrival and departure. Since this clocks are desynchronized by the intrinsic desynchronization introduced by us [2-4, 5, 10] the value of the two way speed of light is obtained for the Einstein speed of light. Indeed, from (8) we obtain the intrinsic desynchronization, the following eq. (12)

$$\frac{x'}{c'} = \frac{x'}{c}\left(1 + \frac{v_1}{c}\right) = \frac{x'}{c} + \frac{x' v_1}{c^2} \qquad (10)$$

$$t' = t'_L + \frac{v_1}{c^2}x' \qquad (11)$$

$$t'_L = t' - \frac{v_1}{c^2}x' \qquad (12)$$

If light is emited from O´ to x' the clock at x' mark $t'_L = \frac{x'}{c}$ and is initiated when light arrives. This is the synchronization of Einstein (a desynchronization). Since a true synchronization correspond to $t' = \frac{x'}{c'}$ the value of the desynchronization is from (12) $\frac{v_1}{c^2}x'$.The Lorentzian clock mark $t'_L = \frac{x'}{c}$ and t'_L is the Lorentzian time.

II. Lorentz Tranformation from IST Transformation using intrinsic desynchronization.

From (2) and (6), Lorentz-FitzGerald contraction and Time dilation we have the IST Transformation

$$x = v_1 t + x'\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)} \qquad (13)$$

or

$$x' = \frac{x - v_1 t}{\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)}} \qquad (14)$$

$$t' = t\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)} \qquad (15)$$

From (6) and (14) with

$$t'_L = t' - \frac{v_1}{c^2}x' \qquad (16)$$

we obtain

$$t'_L = t' - \frac{v_1}{c^2}x' = t\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)} - \frac{v_1}{c^2}\frac{x - v_1 t}{\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)}} \qquad (17)$$

$$t'_L = t' - \frac{v_1}{c^2}x' = \frac{t - \frac{v_1}{c^2}x}{\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)}} \qquad (18)$$

$$x' = \frac{x - v_1 t}{\sqrt{\left(1 - \frac{{v_1}^2}{c^2}\right)}} \qquad (19)$$

and

$$t_L^{\prime} = \frac{t - \frac{v_1}{c^2}x}{\sqrt{\left(1 - \frac{v_1{}^2}{c^2}\right)}} \qquad (20)$$

Therefore, we obtain for S´´ moving with v_2

$$x^{\prime\prime} = \frac{x - v_2 t}{\sqrt{\left(1 - \frac{v_2{}^2}{c^2}\right)}} \qquad (21)$$

$$t_L^{\prime\prime} = \frac{t - \frac{v_2}{c^2}x}{\sqrt{\left(1 - \frac{v_2{}^2}{c^2}\right)}} \qquad (22)$$

And from ((19)-(22)) we obtain

$$x^{\prime\prime} = \frac{x^{\prime} - v_E^{\prime} t_L^{\prime}}{\sqrt{\left(1 - \frac{v^{\prime}{}_E{}^2}{c^2}\right)}} \qquad (23)$$

and

$$t_L^{\prime\prime} = \frac{t_L^{\prime} - \frac{v_E^{\prime}}{c^2}x^{\prime}}{\sqrt{\left(1 - \frac{v^{\prime}{}_E{}^2}{c^2}\right)}} \qquad (24)$$

with Einstein velocity given by

$$V_E^{\prime} = \frac{v_2 - v_1}{1 - \frac{v_1 v_2}{c^2}} \qquad (25)$$

We obtain the Lorentz transformation between two generic frames. We see that Einstein velocity tend to c when v_2 tend to c independently of the value of v_1.

Conclusion

We consider the emission of light by a source moving with velocity v_1 through a frame where the speed of light is isotropic independent of the movement of the source, independent of v_1. Since the speed of light two-way in vacuum has the value c the one-way speed of light is also c in this frame. It is calculated the speed of light in the frame of the source and this speed is no more c. However the speed of light one-way that standard formulation affirm to be c is of course another "speed". This "speed" is Einstein speed of light that has been introduced by Einstein with other definition. The problem is the circularity of the definition associated to the notion of synchronization. We have shown that the one-way Einstein speed of light is c through the intrinsic desynchronization that relate synchronized clocks with Lorentzian clocks. The value of the one-way speed of light only is c in the *EF*. This frame is unique.

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