Special relativity: The old and the new theory

Lahcen Aderras[1]*
[1] *Sidi Yaakoub, Tahla, Taza, Morocco*
(Dated: April 23, 2019)

By adjoining the local time to the Newtonian mechanics together with the constancy of the speed of light; a new unprecedented and insightful derivation of the Lorentz transformation (LT) is proposed. The procedure consist of elementary arguments and simple but rigorous mathematical techniques. The usually assumptions concerning the linearity and homogeneity in the standard derivations of the LT are obtained as results. Moreover, an other, entirely new, transformation is established. As expected, a new special relativity theory ensue from this new transformation. Unlike the special relativity theory (SRT), with this new theory we can tame superluminal velocities.
Keywords: new special relativity; superluminal velocities; Lorentz transformation; proper time.

I. INTRODUCTION

The progress in studying the light and electrodynamics phenomena in the 19th century led to discovery of the Maxwell equations. Those equations state that the electromagnetic disturbances -light included- are waves which propagate with a velocity depending only on the specific capacity for electrostatic induction and magnetic permeability of the medium [1]. Maxwell ended his note on the electromagnetic theory of light [2] by the following statement: the number of electrostatic units in one electromagnetic unit of electricity is numerically equal to the velocity of light. This velocity is with respect to the ether that was perceived by Maxwell himself as a hypothetical medium which is capable of propagating electromagnetic vibrations in the same way as the air propagates the vibrations of sound. Maxwells equations were not found to satisfy the principle of relativity under Galilean transformation more precisely, the propagation equation of electromagnetic wave is non-invariant relative to Galilean transformation. Proposed by Maxwell in 1879 detector of aether seems, at a superficial glance, a simple device. Albert A. Michelson [3] tried to measure the relative motion of the Earth and aether by measuring the difference between the times for rays describing equal paths parallel and perpendicular respectively to the direction of the earth's motion. When his apparatus was rotated through a right angle, the expected displacement of the fringes could not be perceived. This means that no significant difference in times was found. The experiment was repeated by Michelson and Morley in 1887 [4] and the zero shift of fringes is invariably present in measurements. The null results of Michelson-Morley experiment is interpreted by admitting that the velocity of light is not affected by the motion of the frame of reference. I must recall here, the fact that this negative result also stands as proof of nonexistence of ether. I also should mention that other authors report having obtained a positive result from the said experiment. Dayton C. Miller reproduced Michelson experiment and observed non-zero fringe movement [5]. see Ref [6] ,for example, for more details and commentary. This is very marginal in relation to the subject of this work. The work proposed here needs neither this experience nor its positive or negative result. Nevertheless this experiment is the primordial generative cause of the SRT. This theory exit since more than a century. However, the rationality of its derivation process and its conclusions are still under suspicion. The literature about it is vast, although, for the sake of a minimal historical and biographical survey let us try to trace a historical path. To explain the negative result of Morley-Michelson experiment, Fitz Gerald has made a suggesion. In the issue of " Nature" for June 1892 [7], it was mentioned that Fitz Gerald supposed that the dimensions of material bodies contract minutely along the axis of movement relative to the aether while the dimensions in directions perpendicular to the motion remain unchanged. It should be noted that the transformation which implies length contraction had been applied to the equation of vibratory motions some few years before by Voigt [8] . Voigt's paper is a very remarkable work. It is very important because Voigt appears to be the first physicist who postulated the invariance of the wave equation in 'an elastic incompressible medium' (i.e., the aether or ether) [9]. Moreover, the most revolutionary idea is the fact that Voigt was the first one dared to violate the holiness character of the absolute time. He did this by introducing the local time even if the transformation does not include any time dilatation nor contraction. That is, the first one to have introduced the correct factor of the length contraction in its right place -the direction of the motion- was Larmor [10, 11]. He also introduced the time dilation [11] even if in an indecisive manner: "...the individual electrons describe corresponding parts of their orbits in times shorter for the latter system in the ratio $\epsilon^{-\frac{1}{2}}$ or $(1-\frac{1}{2}v^2/c^2)$,...". After this Lorentz [12] went further still and elaborated length contraction suggestion and was able to explain the negative results of the Michelson-Morley experiment. Effectively the achievement of this story was formulated by Lorentz in that paper. However it should be noted that he simply introduced a variables change by saying: "We shall further transform these formulae by a change of variables..." and he continued: "I take as new independent variables..." and so on. Thereby, this is a recognition of the experimental undetectability of kinematic SRT effects and, hence, of their actual absence (that is, of the primary Lorentz's viewpoint on the auxiliary character of the relativistic quantities introduced) [13] It was Poincaré

*Electronic address: Corresponding author
e-mail: l_aderras@yahoo.fr
Phone: +212 6 62 04 25 76 / +212 6 75 13 82 83

in 1905 [14] who first recognized the group property of the transformation and baptized it after Lorentz. The most important property on which the stoutness of this transformation lies is the composition law; namely, a succession of two LT is itself a LT. After Einstein's seminal paper [15] many authors have tried to derive LT. Most of them attempt to show that the second postulate is not necessary. The first attempt was made at an early date by Ignatowsky [16] in 1910. Its derivation of LT is based on the principle of relativity and the group axiom. Frank and Rothe [17] derived the LT by assuming that they form a homogeneous linear group, the validity of reciprocity principle and the dependency of the length contraction only on the relative velocity. Both Ignatowsky and Frank and Rothe derivations entering into them a constant of integration, which had the dimension of velocity, remained uncertain [18]. Since then and so far, the SRT does not stop to raise controversies if not attempts of derivation of the LT. With regard to the derivations; they are, roughly, only rediscoveries of the derivation of the Ignatowsky and Frank and Rothe work. Those derivations are essentially justified either by their simplicity or by their educational interest and remain more or less emotional ideas. Although difficult to make a classification, which is of little importance, we can distinguish four groups of authors. We can, with a little abuse, classify for example [19–21] among those who justify their derivation of LT by the simplicity and the educational interest. Alongside this current, we find another group of authors who discuss or dispute the significance of the two postulates and their necessity or not. For this type of authors I can quote [22–28] . Some times the discussion goes further on the speed of light if it is an invariant speed or a maximum one [29] even though in the Einstein's article [15] we can read: "Velocities greater than that of light have -as in our previous results- no possibility of existence.". Before presenting the ideas of the authors who make sincere objections to the theory, it should be noted that there is another group of experimenters who tried to test the SRT predictions, length contraction and time dilatation in particular [30–34]. Now, I shall pass to the group of physicists who express their refusal, partial or total, of the theory. To the best knowledge of the author, the most of the hostile work against SRT holds in a set of papers gathered in [35]. Still in the preface, we can read: "Einstein's theory of relativity is a mistake from beginning to end". Other offensive attitudes can be found hither and thither; the curious reader can see [36–38] and others. From this biographical overview of the theory, it is obvious that the SRT has never been accepted unanimously by physicists. As a result , the destiny of the theory was to remain, along its history, subject to derivations on the basis of mathematical rather than physical considerations.

The present author believes that the reason for this old debate is, as already mentioned above, that Lorentz did not amply justify his changes of variables. In addition, what prompted the author to not accept the theory of special relativity is, the fact that Einstein started from the equation [15]

$$\frac{1}{2}[\tau(0,0,0,t)+\tau(0,0,0,t+\frac{x'}{c-v}+\frac{x'}{c+v})] = \tau(x',0,0,t+\frac{x'}{c-v})$$

where the terms $c-v$ and $c+v$ appear, simultaneously in a founding equation, and certainly one of them is greater than c when $v \neq 0$ and ended up saying; I quote: "velocities greater than that of light have -as in our previous results- no possibility of existence" [15].

The work presented in this paper does not have the ambition to give only a new and unprecedented derivation of LT; but it also furnish an other entirely new theory. This paper is structured as follow:

The section II of this work present a completely new derivation of the LT on the basis of pure physical results. The only intervention of the author is a simple and plausible choice which consists in combining Maxwell's note [2] and the well known Galileo- Newtonian composition rule of vectorial velocities. To the best knowledge of the author, the establishment of LT presented in this work is unprecedented.

In the section III, new transformations are introduced. This is made by the same intervention mentioned above. The experimental test of the new transformation is relatively affordable in comparison to the LT. If the experiments confirm the predictions of this new transformation; so they will constitute the alternative theory of SRT. Moreover, in the light of the new transformation; the superluminal velocities may be, theoretically at lest, tamed.

II. RE-ESTABLISHMENT OF LT FROM GALILEO-NEWTONIAN MECHANICS

A. The relativistic factor

It is well known that in the frame of the Galileo-Newtonian mechanics the light speed is not infinite and its finite value was measured even in seventeenth century by Olaf Römer. By using the ordinary Galileo-Newtonian velocity addition rule Bradley [39] had understood that the apparent displacement of stars is due to the combination of the velocity of light with the velocity of Earth's orbital motion and he calculated the necessary time for the light to propagate from the sun to the Earth. Recently there are authors who make appeal to give again the leadership deserved to the Galileo-Newtonian mechanics [13, 35]. Andrzej K. Wróblewski [40] report that the bulk of physics remained classical.

To begin this work; I will refer to the vectors with the arrows over the characters. Let $\mathcal{R}$ and $\mathcal{R}'$ be two reference frames which coincide at time $t = t' = 0$ and whose axes of space are Ox, Oy and Oz for $\mathcal{R}$ and $O'x'$, $O'y'$ and $O'z'$ for $\mathcal{R}'$.

Let A be a moving point. The rule of the parallelogram can be written, using points A , O and O' , as

$$\vec{OA} = \vec{OO'} + \vec{O'A} \tag{1}$$

Let me calculate the velocity of the point A in the frame $\mathcal{R}$

$$\frac{d\vec{OA}}{dt}_{/\mathcal{R}} = \frac{d\vec{OO'}}{dt}_{/\mathcal{R}} + \frac{d\vec{O'A}}{dt}_{/\mathcal{R}} \tag{2}$$

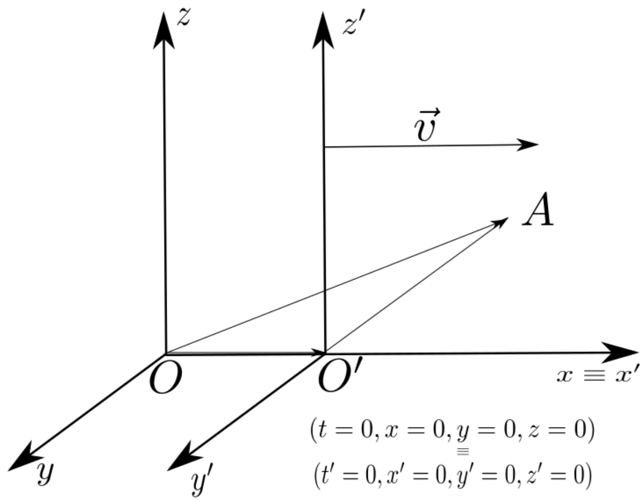

FIG. 1: The inertial motionless reference frame $\mathcal{R}$ and the frame $\mathcal{R}'$ moving along the axis x with a velocity v. Axes x , y , z of the frame $\mathcal{R}$ and the corresponding axes of the frame $\mathcal{R}'$ are equally directed, their origins at the moment $t = t' = 0$ coincide.

This is written, taking into account the prospective rotation of $\mathcal{R}'$ with respect to $\mathcal{R}$, as follows

$$\frac{d\vec{OA}}{dt}_{/\mathcal{R}} = \frac{d\vec{OO'}}{dt}_{/\mathcal{R}} + (\vec{\omega}_{\mathcal{R}'/\mathcal{R}} \times \vec{O'A}) + \frac{d\vec{O'A}}{dt}_{/\mathcal{R}'} \quad (3)$$

In the case where there is no rotation we have: $\vec{\omega}_{\mathcal{R}'/\mathcal{R}} = \vec{0}$. Without loss of generality, let us appropriate so that the translation movement is carried out along the common $Ox \equiv O'x'$ axis of $\mathcal{R}$ and $\mathcal{R}'$ with velocity v. Thus we have the classical scheme of figure.1, and the equation (3) becomes

$$\frac{d\vec{OA}}{dt}_{/\mathcal{R}} = \frac{d\vec{OO'}}{dt}_{/\mathcal{R}} + \frac{d\vec{O'A}}{dt}_{/\mathcal{R}'} \quad (4)$$

It is easy to recognise that $\vec{v} = \frac{d\vec{OO'}}{dt}_{/\mathcal{R}}$
And I get

$$\frac{d\vec{OA}}{dt}_{/\mathcal{R}} = \vec{v} + \frac{d\vec{O'A}}{dt}_{/\mathcal{R}'} \quad (5)$$

If now I ask someone to tell me the meaning of the term $\frac{d\vec{O'A}}{dt}_{/\mathcal{R}'}$; he will certainly answer that it is the speed of A relatively to $\mathcal{R}'$. Let me accept this answer and see what this will give if we combine it with Maxwell's note [2]. In other words: Let us accept the answer and figure out how to deal with the two Maxwell equations that contain the speed of light (This speed is what we normally designate,today, by the mathematical formula $c = 1/\sqrt{\varepsilon_0 \mu_0}$). In the case where the point A is an electromagnetic wave front or a photon, to be more expressive, this note imposes $\left(\frac{d\vec{OA}}{dt}_{/\mathcal{R}}\right)^2 = c^2$, and also imposes $\left(\frac{d\vec{O'A}}{dt}_{/\mathcal{R}'}\right)^2 = c^2$
If I square the equation (5), I will have

$$c^2 = v^2 + c^2 + 2\vec{v}\frac{d\vec{O'A}}{dt}_{/\mathcal{R}'} \quad (6)$$

If this is true; it must be so particularly when $\vec{v}$ is perpendicular to $\frac{d\vec{O'A}}{dt}_{/\mathcal{R}'}$ ($\vec{v} \perp \frac{d\vec{O'A}}{dt}_{/\mathcal{R}'}$).
This means that the the photon who travels perpendicularly to the $x-$axis must obey to the same physical low as all other ones and its velocity is c as well. This induces $v = 0$; which is absurd since we have an effective movement along the axis Ox.
To circumvent this absurdity; let me introduce, as Voigt did as long ago as 1887 in his paper [8], a local time t' into a moving reference system $\mathcal{R}'$ and note that the term $\frac{d\vec{O'A}}{dt}_{/\mathcal{R}'}$ does not represent the velocity of the point A relatively to $\mathcal{R}'$. The actually relative velocity of A regarding $\mathcal{R}'$ is the quantity $\frac{d\vec{O'A}}{dt'}_{/\mathcal{R}'}$
Then I must write

$$\frac{d\vec{O'A}}{dt}_{/\mathcal{R}} = \frac{\partial t'}{\partial t}\frac{d\vec{O'A}}{dt'}_{/\mathcal{R}'} \quad (7)$$

If A is a photon or an electromagnetic wave front, the equation of electromagnetic wave imposes
$\left(\frac{d\vec{OA}}{dt}_{/\mathcal{R}}\right)^2 = c^2$ and $\left(\frac{d\vec{O'A}}{dt'}_{/\mathcal{R}'}\right)^2 = c^2$
The accented quantities are for $\mathcal{R}'$ and unaccented ones are for $\mathcal{R}$. The indices $\mathcal{R}$ and $\mathcal{R}'$ have become dumb and will, henceforth, be omitted. By inserting equation (7) in the equation (5) and then evaluating the square of the resultant equation; I obtain

$$c^2 = v^2 + (\frac{\partial t'}{\partial t})^2 c^2 + 2\frac{\partial t'}{\partial t}\vec{v}\frac{d\vec{O'A}}{dt'} \quad (8)$$

This must be true especially for $\vec{v} \perp \frac{d\vec{O'A}}{dt'}$
Then

$$c^2 = v^2 + (\frac{\partial t'}{\partial t})^2 c^2 \quad (9)$$

And then I get

$$\frac{\partial t'}{\partial t} = \pm\sqrt{1 - \frac{v^2}{c^2}} \quad (10)$$

I shall be devoted only to the case $\frac{\partial t'}{\partial t} = \frac{1}{\gamma}$. Where $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$.
In summary, I have the following master equation.

$$\frac{\partial t'}{\partial t} = \frac{1}{\gamma} \tag{11}$$

Now the relativistic factor is introduced on the basis of plausible and legitimate considerations; otherwise, on the basis of well known physical results and any principle or postulate is required.

B. Lorentz transformation

The velocity v is supposed to be less than the speed of light c in the vacuum, unless stated otherwise. This means that γ is a real number. The relevant parameters of the problem are: t', x', v and c. Then the master equation $\frac{\partial t'}{\partial t} = \frac{1}{\gamma}$ can be integrated as follows

$$t = \gamma t' + F(x', v, c) \tag{12}$$

To determine the function F I use dimensional analysis [41–44]. This offers two possibilities.

$$F(x^{'}, v, c) = \begin{cases} \frac{x'}{c} f_1(1, 1, \frac{v}{c}) \\ \\ \frac{x^{'}}{v} f_2(1, 1, \frac{c}{v}) \end{cases} \tag{13}$$

It is not superfluous if I mention that $f_1(1, 1, \frac{v}{c})$ and $f_2(1, 1, \frac{c}{v})$ are two dimensionless functions of the ratios $\frac{v}{c}$ and $\frac{c}{v}$ respectively.
Furthermore; the numbers 1 which appear in the arguments of the two functions are inutile and I can simply write $f_1(\frac{v}{c})$ and $f_2(\frac{c}{v})$ instead. Then, I can quite simply write

$$F(x^{'}, v, c) = \begin{cases} \frac{x'}{c} f_1(\frac{v}{c}) \\ \frac{x^{'}}{v} f_2(\frac{c}{v}) \end{cases} \tag{14}$$

Every possibility in which the velocity v appears in the denominator yields to divergent expressions when v tends to 0 and must, henceforth, be ruled out once and for all. So let us continue with the first possibility; namely: $F(x', v, c) = \frac{x'}{c} f_1(\frac{v}{c})$.
The dimensional analysis says that the function $f_1(\frac{v}{c})$ is dimensionless. The problem has already evoked a dimensionless function of the ratio $\frac{v}{c}$ which is $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$.
It is well known that the dimensional analysis alone can not be evidence. For the sake of carefulness, I write $f_1(\frac{v}{c}) = \gamma a(\frac{v}{c})$ Where $a(\frac{v}{c})$ is still a dimensionless function of the ratio $\frac{v}{c}$ to be determined . One can obtain the following expression giving t as a function of t' and x'

$$t = \gamma t' + \gamma \frac{x'}{c} a(\frac{v}{c})$$

I started from the fact that the speed of light is the same in both $\mathcal{R}$ and $\mathcal{R}'$ and also the two reference frames coincide at $t = t' = 0$. Then I can write

$$c = \frac{x}{t} = \frac{x'}{t'}$$

Whence

$$x = \frac{x'}{t'} t = \frac{x'}{t'} \left(\gamma t' + \gamma \frac{x'}{c} a(\frac{v}{c}) \right) \tag{15}$$

What we can still write as follows

$$x = \gamma x' + \frac{\gamma}{c} \frac{x'^2}{t'^2} t' a(\frac{v}{c}) \tag{16}$$

In definitive; I have

$$x = \gamma x' + \gamma c t' a(\frac{v}{c}) \tag{17}$$

Then I obtain the following expressions of x and t as a functions of x' and t'

$$\begin{cases} x = \gamma x' + \gamma c t' a(\frac{v}{c}) \\ \\ t = \gamma t' + \gamma \frac{x'}{c} a(\frac{v}{c}) \end{cases} \tag{18}$$

Thereby linearity, assumed by Einstein without proof, and homogeneity are results explicitly demonstrated but not assumptions.
The transformation may be written in a matrix terms as

$$\begin{pmatrix} x \\ t \end{pmatrix} = T(v) \begin{pmatrix} x' \\ t' \end{pmatrix} \tag{19}$$

Where $T(v)$ is a 2×2 matrix given by

$$T(v) = \gamma \begin{pmatrix} 1 & c a(\frac{v}{c}) \\ \frac{1}{c} a(\frac{v}{c}) & 1 \end{pmatrix} \tag{20}$$

I can resort to the invariance of the Maxwell wave equation which is widely advertised in SRT to determine the function $a(\frac{v}{c})$; but according to some authors, the form invariance of the field equations is nothing more than an expression of the Doppler Effect [35]. If the nature, spontaneously, chooses what we call irreversible transformations; it does not prevent us, however, from going the opposite way. Chemical syntheses, for example and disproportionation reactions in particular, demonstrate this. So if we cannot rebuild a nucleus of Uranium from the products of its fission it is not because the nature forbids it; but because we do not have enough means to do so. Then, the opposite way is always possible.
Thus, I can obviously write

$$T(-v) = T^{-1}(v)$$

This means

$$\gamma \begin{pmatrix} 1 & ca(\frac{-v}{c}) \\ \frac{1}{c}a(\frac{-v}{c}) & 1 \end{pmatrix} = \frac{1}{\gamma^2[1-a^2(\frac{v}{c})]}\gamma \begin{pmatrix} 1 & -ca(\frac{v}{c}) \\ \frac{-1}{c}a(\frac{v}{c}) & 1 \end{pmatrix} \tag{21}$$

Two results follow from this. The first one concern the oddness of the function $a(\frac{v}{c})$ and we can go beyond it. The second one can be written as

$$\gamma = \frac{1}{\gamma[1-a^2(\frac{v}{c})]}$$

This gives

$$a(\frac{v}{c}) = \pm\frac{v}{c}$$

The case $a(\frac{v}{c}) = \frac{v}{c}$ for the direct transformation and the other case $a(\frac{v}{c}) = -\frac{v}{c}$ for the inverse transformation.
In summary; I have the following expression

$$\begin{cases} x = \gamma\left(x' + vt'\right) \\ t = \gamma\left(\frac{v}{c^2}x' + t'\right) \end{cases} \tag{22}$$

This system of equations is the well known LT of coordinates. It is out of the question that this transformation and all the incoming ones must be completed with $y = y'$ and $z = z'$. The matrix, T, may then be written as.

$$T(v) = \begin{pmatrix} \gamma & \gamma v \\ \frac{\gamma v}{c^2} & \gamma \end{pmatrix} \tag{23}$$

The group composition of two parallel transformations permit us to obtain the well known relativistic law for velocity addition.

$$T(v_1)T(v_2) = T(v_3)$$

In matrix form, this may be written as

$$\gamma_1\gamma_2 \begin{pmatrix} 1+\frac{v_1v_2}{c^2} & v_1+v_2 \\ \frac{v_1+v_2}{c^2} & 1+\frac{v_1v_2}{c^2} \end{pmatrix} = \gamma_3 \begin{pmatrix} 1 & v_3 \\ \frac{v_3}{c^2} & 1 \end{pmatrix} \tag{24}$$

It follows that

$$\gamma_1\gamma_2[1+\frac{v_1v_2}{c^2}] = \gamma_3 \tag{25}$$

Thus

$$v_3 = \frac{v_1+v_2}{1+\frac{v_1v_2}{c^2}} \tag{26}$$

The LT is now established on the basis of objective considerations without postulate or principle. The author modestly admits that he is not up to the task of erecting anything either at the level of a postulate nor at that of a principle. The only intervention on my part is the introduction of the proper time for each reference frame. It is only at this price that Maxwell's electromagnetic theory and Galileo-Newtonian mechanics can reconcile or, at least, coexist peacefully.

C. Other, a priori, expected issues

- **An other possible integration of the master equation.**
  The master equation (11) can also be integrated as follows
  $t' = \frac{1}{\gamma}t + G(x, v, c)$
  With reasoning similar to that of the previous subsection; one can easily obtain

$$G(x, v, c) = \begin{cases} \frac{1}{\gamma}\frac{x}{c}b(\frac{v}{c}) \\ \frac{1}{\gamma}\frac{x}{v}b'(\frac{c}{v}) \end{cases} \tag{27}$$

I should recall the aforesaid that the possibility $G(x, v, c) = \frac{1}{\gamma}\frac{x}{v}b'(\frac{c}{v})$ is to be excluded because of the divergence.
The reasoning is analogous to that in the preceding section and it gives the following expression for the transformation that I note this time Λ.

$$\Lambda(v) = \frac{1}{\gamma} \begin{pmatrix} 1 & cb(\frac{v}{c}) \\ \frac{1}{c}b(\frac{v}{c}) & 1 \end{pmatrix} \tag{28}$$

The reversibility criterion gives

$$\Lambda(-v) = \Lambda^{-1}(v)$$

So that

$$\frac{1}{\gamma}\begin{pmatrix} 1 & cb(\frac{-v}{c}) \\ \frac{1}{c}b(\frac{-v}{c}) & 1 \end{pmatrix} = \frac{1}{(\frac{1}{\gamma})^2[1-b^2(\frac{v}{c})]}\frac{1}{\gamma}\begin{pmatrix} 1 & -cb(\frac{v}{c}) \\ \frac{-1}{c}b(\frac{v}{c}) & 1 \end{pmatrix} \tag{29}$$

From where

$$\frac{1}{\gamma} = \frac{\gamma}{1-b^2(\frac{v}{c})}$$

Thusly

$$1 - b^2(\frac{v}{c}) = \gamma^2$$

Which leads to

$$b^2(\frac{v}{c}) = -\frac{v^2}{c^2}\gamma^2$$

This means that the function $b(\frac{v}{c})$ is pure imaginary. As a consequence; the transformation can not have a physical meaning and the composition of two transformations is not a tarnsformation of the same nature.

- **Case where $v > c$.**
  For this case the factor γ is pure imaginary. Once again the transformation cannot conduct.

III. THE NEW SPECIAL RELATIVITY THEORY

A. The new relativistic factor

One cannot resist the temptation of inversing the path from the beginning and write the equation(1) as follows

$$\vec{O'A} = \vec{O'O} + \vec{OA} \tag{30}$$

By differentiating the previous expression regarding $\mathcal{R}'$ endowed with its proper time t'; I obtain the following equation

$$\frac{d\vec{O'A}}{dt'} = \frac{d\vec{O'O}}{dt'} + \frac{d\vec{OA}}{dt'} \tag{31}$$

I recall that there is no motion of rotation between the reference frames $\mathcal{R}$ and $\mathcal{R}'$. Hence it is easy to deduce the following equality

$$\frac{d\vec{O'A}}{dt'} = \frac{\partial t}{\partial t'}\frac{d\vec{O'O}}{dt} + \frac{\partial t}{\partial t'}\frac{d\vec{OA}}{dt} \tag{32}$$

Furthermore

$$\frac{d\vec{O'A}}{dt'} = \frac{\partial t}{\partial t'}\left(\frac{d\vec{O'O}}{dt} + \frac{d\vec{OA}}{dt}\right) \tag{33}$$

By realizing that $\frac{d\vec{O'O}}{dt} = -\vec{v}$; this yields

$$\frac{d\vec{O'A}}{dt'} = \frac{\partial t}{\partial t'}\left(-\vec{v} + \frac{d\vec{OA}}{dt}\right) \tag{34}$$

Let us lift the previous equation squared and the point A correspond to a photon. The main idea is always the invariance of the speed of light. Similar steps as those used to establish the expressio of the relativistic factor, in the previous subsection II A are borrowed.The calculations being easy; one will get

$$(\frac{\partial t}{\partial t'})^2 = \frac{1}{1+\frac{v^2}{c^2}} \tag{35}$$

From where it ensue that

$$\frac{\partial t}{\partial t'} = \pm\frac{1}{\sqrt{1+\frac{v^2}{c^2}}} \tag{36}$$

First of all it should be noted that the factor $\pm 1/\sqrt{1+\frac{v^2}{c^2}}$ is always a real number whatever the value of v is. Be it greater or smaller than that of c. As it will be shown; this make a great difference between the LT and the new transformation which I will establish in the subsection III C bellow. The second thing which must be reminded is that I will take an interest only to the case $\frac{\partial t}{\partial t'} = 1/\sqrt{1+\frac{v^2}{c^2}}$; the factor which I indicate, henceforth, by λ . Once more; I shall be succinct since the main idea is always the same. I mean dimensional analysis.

B. First possible; but unsuccessful integration

The equation $\partial t/\partial t' = \lambda$ may be integrated as

$$t = \lambda t' + H(x', v, c) \tag{37}$$

As it has become an ordinarily practice in this work; the dimensional analysis allows us to write

$$t = \lambda t' + \lambda \frac{x'}{c} d(\frac{v}{c}) \tag{38}$$

Where $d(\frac{v}{c})$ is a dimensionless function of the ratio $\frac{v}{c}$. With a similar procedure ,as in the foregoing section, one can easily obtain the following expression for the coordinate x

$$x = \lambda x' + \lambda c t' d(\frac{v}{c}) \tag{39}$$

In matrix notation; this may be written as

$$\begin{pmatrix} x' \\ t' \end{pmatrix} = \Theta(v) \begin{pmatrix} x \\ t \end{pmatrix} \tag{40}$$

Where the matrix $\Theta(v)$ is given by

$$\Theta(v) = \lambda \begin{pmatrix} 1 & cd(\frac{v}{c}) \\ \frac{1}{c} d(\frac{v}{c}) & 1 \end{pmatrix} \tag{41}$$

Let me, as I did above, write $\Theta^{-1}(v) = \Theta(-v)$. This will give

$$d^2(\frac{v}{c}) = -\frac{v^2}{c^2} \tag{42}$$

Then it is obvious that the function $d(\frac{v}{c})$ is pure imaginary. Consequently; the transformation can not have a physical meaning. Furthermore the composition of two transformations can never be a transformation of the same nature.

C. The successful integration: The new theory

The equation $\frac{\partial t}{\partial t'} = \lambda$ can be integrated as

$$t' = \frac{1}{\lambda} t + E(x, v, c) \tag{43}$$

The function $E(x, v, c)$ is to be written as $E(x, v, c) = \frac{1}{\lambda} \frac{x}{c} e(\frac{v}{c})$ where $e(\frac{v}{c})$ is yet an unknown dimensionless function of the ratio $\frac{v}{c}$ to be determined.
Thus I have the following expression for t' as a function of x and t

$$t' = \frac{1}{\lambda} t + \frac{1}{\lambda} \frac{x}{c} e(\frac{v}{c}) \tag{44}$$

To establish the expression of x' as a function of x and t, I recall that I have

$$c = \frac{x}{t} = \frac{x'}{t'}$$

Thus one can easily obtain the following expression

$$x' = \frac{1}{\lambda} x + \frac{1}{\lambda} c t e(\frac{v}{c}) \tag{45}$$

Then I have the following resultant transformation giving x' and t' as a functions of x and t

$$\begin{cases} x' = \frac{1}{\lambda} x + \frac{1}{\lambda} c t e(\frac{v}{c}) \\ t' = \frac{1}{\lambda} \frac{x}{c} e(\frac{v}{c}) + \frac{1}{\lambda} t \end{cases} \tag{46}$$

I denote by the symbol Ω the matrix of this new transformation. The matrix Ω is then given by

$$\Omega(v) = \frac{1}{\lambda} \begin{pmatrix} 1 & ce(\frac{v}{c}) \\ \frac{1}{c} e(\frac{v}{c}) & 1 \end{pmatrix} \tag{47}$$

Now I have to determine the function $e(\frac{v}{c})$. To this purpose I write $\Omega^{-1}(v) = \Omega(-v)$. I obtain the function $e(\frac{v}{c})$ as $e(\frac{v}{c}) = \pm\lambda\frac{v}{c}$. For the transformation giving x' and t' as a functions of x and t ; I take $e(\frac{v}{c})$ as $e(\frac{v}{c}) = -\lambda\frac{v}{c}$ and for the reciprocal transformation I take $e(\frac{v}{c})$ as $e(\frac{v}{c}) = \lambda\frac{v}{c}$. Thus I have

$$\Omega(v) = \begin{pmatrix} \frac{1}{\lambda} & -v \\ -\frac{v}{c^2} & \frac{1}{\lambda} \end{pmatrix} \tag{48}$$

The transformation giving x and t as a functions of x' and t' is given by the following matrix; which I denote by the symbol Π (evidently $\Pi = \Omega^{-1}$)

$$\Pi(v) = \begin{pmatrix} \frac{1}{\lambda} & v \\ \frac{v}{c^2} & \frac{1}{\lambda} \end{pmatrix} \tag{49}$$

In an explicit manner, this can be writen as

$$\begin{cases} x = \frac{1}{\lambda} x' + v t' \\ \\ t = \frac{v}{c^2} x' + \frac{1}{\lambda} t' \end{cases} \tag{50}$$

This transformation gives the length contraction and time dilatation as shown hereafter.
If I take a rod having a length L_0 in the moving frame in which the rod is at rest. This rod has the length L in the frame in which the rod is moving with velocity v. Between L and L_0 I have the relationship $L = \lambda L_0$. The duration τ measured in the moving frame experiences a dilatation and its measure in the frame at rest is t_1 . The two measures are related as $t_1 = \frac{1}{\lambda}\tau$. I should recall that $\lambda = 1/\sqrt{1 + \frac{v^2}{c^2}}$. Moreover, one can easily ensure that this new transformation let invariant the propagation equation of the electromagnetic wave.
It should be noted that it is expected that one, at least, of the two cases (subsections III B and III C) may, a priori, give again the LT; whereas no one of them does not, a posteriori, do. Thus, this gives a non negligible credibility to what Arteha [13] has remarked and commented on the fact that the SRT formulas include the square of velocity only. But it is rightful to make the Arteha remark more precise by restrict-

ing it to the relativistic factor.

The composition of two parallel transformations, $\Pi(v_1)$ and $\Pi(v_2)$, is a transformation of the same nature as well and one can obtain the new formula giving the theorem of addition for velocities. This formula is given by

$$v_3 = \frac{\lambda_1 v_1 + \lambda_2 v_2}{\lambda_1 \lambda_2} \tag{51}$$

Clearly, the above formula has the non-relativistic Galilean results as a limit when v_1/c and v_2/c tend to 0.

D. On the electromagnetism and the rest energy

The electromagnetic tensor is constructed on the basis of the Maxwell equations that are untouched. It is therefore always the same. Paragraphs similar to those in part two of the Einstein's 1905 article can still be formulated on the basis of the transformation established in the subsection III C above. I say similar paragraphs; the results do not always coincide with those of Einstein and I leave the reader the freedom to make them himself. However, I want to point out that unlike Einstein who resort, in his paper, to the principle of relativity and the reasons of symmetry; I start my reasoning with the above mentioned result: The new transformation keeps the invariance of the propagation equation of the electromagnetic wave. That is; since the propagation equation of the electromagnetic wave derives directly from Maxwell's equations these equations must be valid in the referential $\mathcal{R}'$. To be simple, I adopt, here, Einstein's notation and terminology. I denote by X, Y, and Z the components of the electric force and by L, M and N those of the magnetic force in the reference frame $\mathcal{R}$. X', Y' and Z' and L', M', and N' are the corresponding components respectively in the referential $\mathcal{R}'$. ϵ and m are reserved for the elementary charge and the mass of the electron respectively. Then, I get easily $X = X'$. So the analog of the formula, from paragraph 10 of Einstein's article, giving the expression of kinetic energy as follows

$$W = \int \epsilon X dx = m \int_0^v \beta^3 v dv = mc^2 \{ \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} - 1 \}$$

becomes, on the basis of the new theory, as follows

$$W = \int \epsilon X dx = m \int_0^v \frac{1}{\lambda^3} v dv = \frac{1}{5} mc^2 \{ (1 + \frac{v^2}{c^2})^{\frac{5}{2}} - 1 \}$$

An other thing to report is the fact that the development of the term $mc^2/\sqrt{1 - \frac{v^2}{c^2}}$ given by Einstein in [45] does not coincide with the development of the analogous term which is $\frac{1}{5} mc^2 (1 + \frac{v^2}{c^2})^{5/2}$.

The first term in Einstein's development is the rest energy, which accounts for the energy balance of nuclear and annihilation reactions. If we attribute the first term of the development, established on the basis of the new theory, to the rest energy; we have the new energy balance of the nuclear and annihilation reactions $\Delta E = \frac{1}{5} \Delta mc^2$.

Some authors argue that the equation $E = mc^2$ is questionable [35]. Therefore, a precise and rigorous energy balance of nuclear and annihilation reactions is a willing arbiter between the two theories.

IV. GENERAL REMARKS: MINKOWSKIAN FORMULATION AND TEMPTATION OF GENERALIZATION

A. Minkowskian formulation

In this section, I adopt the Minkowskian space-time vocabulary and I denote vectors, which are four-vectors, with bold characters.

Like the LT; the new transformation, given by the equation (50), lends itself easily to the Minkowskian formulaion. However there are differences which will be pointed out where it is necessary.

Let $M_1(ct_1, x_1, y_1, z_1)$ and $M_2(ct_2, x_2, y_2, z_2)$ be any two events of space-time, denoted $\mathscr{E}$. The new transformation makes the following equality appear $\Delta s^2 = c^2(t_2 - t_1)^2 - (x_2 - x_1)^2 - (y_2 - y_1)^2 - (z_2 - z_1)^2 = c^2(t'_2 - t'_1)^2 - (x'_2 - x'_1)^2 - (y'_2 - y'_1)^2 - (z'_2 - z'_1)^2 = \Delta s'^2$. This scalar quantity, which is therefore invariant by Galilean reference change, is called the square of the interval between the two events. In a natural way, this leads us to define, on $\mathscr{E}$, the following pseudo-metric g:

$$\begin{aligned} g \colon \mathscr{E} \times \mathscr{E} &\longrightarrow \mathbb{R} \\ (\mathbf{x}, \mathbf{y}) &\longmapsto g(\mathbf{x}, \mathbf{y}) = \eta_{ij} x^i y^j \end{aligned} \tag{52}$$

where the contravariant coordinates of the vectors $\mathbf{x}$ and $\mathbf{y}$ are defined with respect to any orthogonal basis of $\mathscr{E}$, denoted $\mathscr{B} = \{\mathbf{e}_i\}, \forall i \in \{0, 3\}$, in which the basic time vector is $\mathbf{e}_0$ and $\{\mathbf{e}_1, \mathbf{e}_2, \mathbf{e}_3\}$ the usual physical space basis .

The coordinates of the metric tensor, in such a base, are then defined by,

$$\begin{gathered} \forall i \in \{0, 3\}; \eta_{0i} = g(\mathbf{e}_0, \mathbf{e}_i) = \delta_{0i}, \\ \text{and} \\ \forall (i, j) \in \{1, 3\}; \eta_{ij} = g(\mathbf{e}_i, \mathbf{e}_j) = -\delta_{ij}. \end{gathered} \tag{53}$$

Where, δ denote the Kronecker symbol.

This metric is a pseudo-Euclidean one of a signature $(+, -, -, -)$. The invariance of the square of the interval between two events, during a change of Galilean reference, is simply expressed by the invariance of the square of the pseudo-norm, equal to $g(\mathbf{x}, \mathbf{x})$, of the vector $\mathbf{x} = \mathbf{M}_1\mathbf{M}_2$ connecting two arbitrary events. The square of the interval between the two events is zero when $M_1 = M_2$ or when $c^2(t_2 - t_1)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2$.

In the latter case, the two events can be connected in $\mathscr{E}$ only by a signal or interaction propagating with the speed w which is greater than or equal to c . We thus define, in $\mathscr{E}$, three types of vectors, according to the sign of the square of their pseudo-norm:

- If $g(\mathbf{x},\mathbf{x}) = 0$ then $\mathbf{x}$ is a null vector or it is a light-like vector.
- If $g(\mathbf{x},\mathbf{x}) > 0$ then $\mathbf{x}$ is a time-like vector. The two events can be connected by a signal or interaction propagating with the speed w which can be even less than c.
- If $g(\mathbf{x},\mathbf{x}) < 0$ then $\mathbf{x}$ is a space-like vector. The two events it connects are not causally disconnected as in the frame of the SRT; but the two events can be connected only by a signal or interaction propagating with the speed w which must be greater than c. As it was shown above; the new theory does not exclude the superluminal vilocities.
  I prefered preserve the appellations light-like, time-like and space-like, however their characterization regarding causality relation is not the same as in SRT.

B. Attempt of generalization

It appears that the two theories, SRT as well as the new theory, are deduced in parallel on the basis of the same logic. As a result, SRT and the new theory are themselves relative. Obviously, it is enviable to try to bring these two theories together into one that is not relative.
The most obvious way to do this is to write a general transformation as a linear combination of the two transformations T (equation (23)) and Π (equation (49)) like this:

$$\Gamma = \alpha T + \beta \Pi$$

To determine the coefficients of the linear combination, α and β , the following boundary conditions are used. When the velocity v tends to zero; we must obtain the identical transformation and we get in that way $\alpha + \beta = 1$. When the velocity v tends to c ; the values of the coordinates of the event must remain finite. This can only be achieved if the coefficient α is identically zero. It turns out that the new theory takes precedence over SRT at the superluminal speeds. The immediate test to which this new theory must confront is that of the energy balance of nuclear reactions.

V. DISCUSSION

First of all let us remark that according to the theory introduced in this paper; when $x' = 0$ we have $x = \lambda vt$. This is an important point, not like the flaw in Einstein's theory that subtracts Newton's theory into one-point limit theory. In effect the Newtonian mechanics and its result $x = vt$ is not a limit for $x' = 0$ - like in Einstein's theory- but essentially for $c = \infty$. Since $c < \infty$ we have the result $x = \lambda vt$ for $x' = 0$ and if, in this expression, we tend c to ∞ we get the well known Newtonian result $x = vt$.
It can be seen from the derivation given in the present paper that LT follow only from the combination between Maxwell's electromagnetic theory and the adjunction of the local time to the Newtonian mechanics, i.e. no explicit postulates nor principles are required. LT still hold unshakable, however their relationship to the Galileo-Newtonian mechanics is inversed. Namely: LT have become a daugther. So it is highly unlikely that a sane man can try to demolish the theoretical Galileo-Newtonian structure. Even the Coulomb's law, giving the expression of electrostatic force between two point charge, which is a corner stone of the electromagnetic theory, is calked on the universal attraction law of Newton. It outcomes, from this, that any objection to the SRT or to the new theory is to be made against the relativity of time or against the Maxwell's equations. The requirement that these equations be invariant with respect to transformations of coordinates and time is rather vacillating, since if only the measured effects of these fields correspond to the values really observed in the experiment, then the fields and equations for them can be introduced in many ways [13]. The external confirmation is essential to special relativity, since the other physical theories should not only be correct, but also true [46]. The experimenters especially, have to conceive and design experiments which will be able to refute or confirm, in a clear and clear way, the predictions of the SRT. Such experiences cannot, in my opinion, be of Michelson experiment type; since a perfectly viable solution to the negative result of the Michelson-Morley experiment is a motionless Earth [38]. For all problems related with energy, the law of conservation of energy is the only truth; other laws will be derived from or verified by the law of conservation of energy [35]. The new formula $E = \frac{1}{5}mc^2$ may stand up for the iconic formula $E = mc^2$ of the SRT. A parenthesis on Dirac equation may unfold here; but it is unnecessary to dwell on this subject, instead I would like to lean to other thing. As it is well known in thermodynamics, we have two types of physical quantities; intensive ones and extensive ones. It seems that one can surmise that the both SRT and the new theory introduce a subdivision in the physical quantities: contractible ones and dilatable ones. That is; the target quantity of the experiment must have a relationship with the space component only or with the time component only of same four-vector. For the SRT this is not an easy task as well since contractible quantities and dilatable quantities intervene often in the expressions of space components and time components of all four-vectors -except in the Maxwell's equations which are a corner stone of the SRT-. Then it is very difficult to experimentally test the predictions of that theory. Indeed this is a consequence of the fact that the relativistic factor γ is a common factor in the transformation of space and time. In other words; the factor γ appear in each term of the matrix given in the formula (23). The new transformation introduced in this work does not present this hindrance. More precisely; the new relativistic factor λ appears only in the diagonal terms (see formula (49)). Consequently the experimental test of this transformation is relatively more easy in comparison to Lorentz's one.
On the other side, the transformation given by the equation (50) keep the invariance of the Maxwell's equations. Moreover, together with the velocity addition theorem, given

by the equation (51), this transformation form a group of transformations as well. Over all this; superluminal velocities seem really to create a difficulty for the principle of relativity. With the new transformation we can carry off when being faced with the superluminal velocities evoked hither and thither by some authors [29, 47, 48].

By the end; I would like to mention that the methodological side and simplicity are not lacking for the procedure introduced in this work, even for the LT or for the new transformation established in the present work. This procedure has also a clear pedagogical advantage for undergraduate teaching. Indeed, in the light of the present work both SRT and the new theory can be taught as a paragraph or even as a remark in the course of the frame change chapter. This can be done, without previous knowledge of Maxwell's equations, by introducing the proper time, the Vaschy-Bukingham theorem and an ultimate velocity which is the same in any inertial reference frame.

---

[1] J. C. Maxwell. *A Treatise on Electricity & Magnetism*, volume 2. Dover Publications, INC, 3 edition, 1954.

[2] M.A. F.R.S W. D. Niven. *The Scientific Papers Of James Clerk Maxwell*, volume Two. Dover Publications, INC., New York.

[3] A.A.Michelson. The Relative Motion of the Earth and the Luminiferous Ether. *Am.J.Sci*, 22:20–129, 1881.

[4] A.A.Michelson and E.W.Morley. On the Relative Motion of the Earth and the Luminiferous Ether. *Am.J.Sci*, 34:333–345, 1887.

[5] D. C. Miller. The Ether-Drift Experiment and the Determination of the Absolute Motion of the Earth. *Revs. Of Modern Phys.*, 5:203–242, July 1933.

[6] J. DeMeo. Does a Cosmic Ether Exist? Evidence from Dayton Miller and Others. *J. of Scientific Exploration*, 28(4):647–682, 2014.

[7] G. F. FitzGerald. The Ether and the Earth's Atmosphere. *Science*, 13:390, May 1889.

[8] W. Voigt. Ueber das Doppler'sche Princip. *Nachrichten Gesellschaft der Wissenschaften Goettingen*, (2):41–51, 1887.

[9] E. Andreas and J-Ping Hsu. First Proposal Of The Universal Speed Of light by Voigt in 1887. *Chin. J. Phys.*, 39(3):211–230, 2001.

[10] J.Larmor. A Dynamical Theory of the Electric and Luminiferous Medium.— Part III Relations with Material Media. *Philos. Trans. R. Soc*, 190:205– 300, 1897.

[11] J.Larmor. *Aether And Matter*. 1900.

[12] H.A. Lorentz. Electromagnetic phenomena in a system moving with any velocity smaller than that of light. *Proceedings of the Royal Netherlands Academy of Sciences of Amsterdam*, 6:809–831, 1904.

[13] Arteha S.N. *Criticism of the Foundations of the Relativity Theory*. Publishing House LKI, 2007.

[14] H. Poincaré. Sur la dynamique de l'électron. *Rendiconti del Circolo matematico di Palermo*, 21:129–176, 1905.

[15] A. Einstein. Zur Elektrodynamik bewegter Körper. *Ann. Phys.*, 17:891–921, 1905.

[16] W. Ignatowsky. Einige allgemeine Bemerkungen zum Relativitätsprinzip. *Berichte der Deutschen Physikalischen Gesellschaft*, 1910.

[17] P. Frank and H. Rothe. On the Transformation of Space-Time Coordinates from Stationary to Moving Systems. *Ann. Phys.*, 34(5):825–855, 1911.

[18] E. G. Bessonov. One way to Lorentz's Transformations. *UFN*, 168(5):537–541, 2016.

[19] J-M. Lévy-Leblond. One more derivation of the Lorentz transformation . *Am. J. Phys.*, 44(3), March 1976.

[20] J. A. S. Lima and F. D. Sasse. Can Lorentz transformations be determined by the null Michelson-Morley result? *Revista Brasileira de Ensino de F ́sica*, 39(3), 2017.

[21] V. Berzi and V. Gorini. Reciprocity Principle and the Lorentz Transformations. *J.Of Mathematical Phys.*, 10(8):1518–1524, August 1969.

[22] Gordon Liu. A New approach to Special Relativity. *Phys. Essays*, 27(1):1–20, 2014.

[23] W. Engelhardt. Relativistic Doppler Effect and the Principle of Relativity. *Apeiron*, 10(4):29–49, October 2003.

[24] A. Drory. Special Relativity Cannot Be Derived from Galilean Mechanics Alone. *Found Phys.*, 43(5):665–684, 2013.

[25] J.H Field. A new kinematical derivation of the Lorentz transformation and the particle description of light. *Helv. Phys. Acta*, 70:542–564, 1997.

[26] N.D. Mermin. Relativity without light. *Am. J. Phys.*, 52(2), February 1984.

[27] A. Sfarti. Response to Comment by A. Drory. *ARPN J. of Science and Technology*, 4(2):67–69, February 2014.

[28] R. Baierlein. Two myths about special relativity. *Am. J. Phys.*, 74(3):193–195, March 2006.

[29] Stefano Liberati, Sebastiano Sonego, and Matt Visser. Faster-than- c Signals, Special Relativity, and Causality. *Annals of Physics*, 298:167–185, 2002.

[30] R. J. Kennedy and E. M. Thorndike. Experimental Establishment of the Relativity of Time . *Phys. Rev.*, 42:400–418, 1932.

[31] J. Bailey et al. Measurement of the Relativistic time dilatation for positive and negative muons in circular orbit. *Nature*, 268:301–304, July 1977.

[32] P. S. Cooper et al. Experimental Test of Special Relativity from a High-γ Electron g-2 Measurement. *Phy. Rev. Lett.*, 42(21):1386–1389, May 1979.

[33] M. Kaivola, O. Poulsen, and E. Riis. Measurement of the Relativistic Doppler Shift in Neon. *Phys. Rev. Lett.*, 54(4):255–258, January 1985.

[34] N. Easwar and D. A. Maclntirea. Study of the effect of relativistic time dilation on cosmic ray muon flux—An undergraduate modern physics experiment . *American Association of Physics Teachers*, 59(7):589–592, 1991.

[35] F. Smarandache et al. *Unsolved Problems in Special and General Relativity 21 collected papers*. Educational Publishing & J. of Matter Regularity (Beijing), 2013.

[36] Florentin Smarandache. *Absolute Theory Of Relativity & Parameterized Theory Of Relativity & Noninertial Multirelativity*. Societe Marocaine D'impression Et D'équipement S.A.R.L Somipress, 1982.

[37] R. M. Kassir. The Critical Error in the Formulation of the Special Relativity. *International J. of Phys.*, 2(6):197–201, 2014.

[38] A. Sungenis and J. Bennett. *Galileo Was Wrong The Church Was Right The Evidence from Modern Science*. Published by Catholic Apologetics International Publishing, Inc., 2013.

[39] J. Bradley. A letter from the Reverend Mr. James Bradley Savilian Professor of Astronomy at Oxford, and F. R. S. to Dr. Ed-

mond Halley Astronom. Reg. &c. giving an account of a new discovered motion of the fix'd stars. *Philos. Trans.*, 35:637–661, January 1728.

[40] Andrzej K. Wróblewski. Physics 1909: A Portrait Of The Field Hundred Years Ago. *Acta Phys. Pol. B*, 41(2):229–248, 2010.

[41] A. Vaschy. *Annales Télégraphiques*, 19:25–28, 1892.

[42] D. Riabouchinsky. Méthodes des variables de dimension zéro et son application en aérodynamique. *L'Aérophile*, pages 407–498, 1911.

[43] Bukingham E. The Principle of Similitude. *Nature*, 96:396, dec 1915.

[44] R. Saint Guilhem. *Les principes de l'analyse dimensionnelle, invariance des relations vectorielles dans certains groupes d'affinités*. fascicule 152. 1962.

[45] A. Einstein. *Relativity The Special And General Theory* . Henry Holt And Company, 1920.

[46] R. D. Borges de Meneses. The Sense Of Special Relativity: Between Physics And Philosophy. *Philosophy, Sociology and Psychology*, 4(1):21–28, 2005.

[47] Z. L. Horváth et al. Acceleration of femtosecond pulses to superluminal velocities by Gouy phase shift. *Appl. Phys.*, 63(B):481–484, July 1996.

[48] A. Dogariu et al. Superluminal light pulse propagation via rephasing in a transparent anomalously dispersive medium. *Optics Express*, 8(6):344–350, March 2001.