On the Contradictions of Relativity of Simultaneity and the Synchronism of Clocks

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ABSTRACT: It is shown that the Theory of Special Relativity is not a theory free of contradictions. Putting apart our ingenious idea about clocks in a point (infinitesimal clocks), it is proved there are contradictions deriving from the synchronism of clocks. Other contradictions refer to the concept of relativity of simultaneity. One of these contradictions is proved through the idea of idealized experience: a simultaneous emission of two photons. Simultaneity related to an inertial frame of reference (inertial system) considered in movement, but whose system in movement stops moving between the first and the second emissions with respect to the steadied system (stationary system), ending up the experience "beforehand". Only one photon would have been emitted with respect to the system in movement, which would make our prior hypotheses contradictory.

KEY WORDS: Theory of special relativity, contradictions of special relativity, synchronism of clocks, relativity of simultaneity.

1. INTRODUCTION

When Einstein introduced the Theory of Special Relativity (T.S.R.), in 1905, he intended to eliminate the asymmetries included in Maxwell's electrodynamics applicable to moving bodies. He also intended to create, from two postulates, a simple and free of contradictions electrodynamics of moving bodies, far from the view of "luminiferous ether" and based on Maxwell's theory for bodies at rest. One can infer that from the first two paragraphs of the article which gave origin to T.S.R.[1]

Although the success reached by T.S.R. and its concordance to several experimental results are undeniable, it is known in accordance to Assis [2], that "the asymmetry of electromagnetic induction, mentioned at the first paragraph by Einstein, does not appear in Maxwell's electromagnetism, which leads to a contradiction regarding

his assertion. It is just shown as an interpretation of the specific Lorentz formulation regarding electrodynamics. Such asymmetry was not considered by Faraday, who discovered the phenomenon." (…) "Maxwell used to have the same points of view regarding that subject and he did not see any "clear distinction" to the explanation for Faraday's experiences. It did not matter whether it was a circuit or a magnet, which moved with respect to the laboratory." (…) "Such asymmetry pointed out by Einstein also does not appear in Weber's electrodynamics."

Moreover, in opposition to what Einstein also said, T.S.R. is not free of contradictions. Some of these contradictions are related to the definition of clocks' synchronism, which will be proved in section 2 through two different proofs. Other contradictions will be displayed in section 3, also referring to the relativistic time and regarding the relativity of simultaneity. Section 4 will draw a conclusion of this current work, added up to some comments.

Section 3, Relativity of Simultaneity, is the most important one in this work. The third proof is particularly special, as it describes an idealized experimental procedure, which proves one of the already mentioned contradictions, based on the definition of simultaneity accepted by T.S.R.

Two photons are emitted simultaneously with respect to an inertial frame of reference (inertial system) considered in movement. Both are emitted by two experimental physicists 1 and 2, at rest in this system. Although each one emits a photon upon the other, they are not emitted simultaneously with respect to the system considered stationary, with respect to which the first one moves. This way, according to T.S.R., at the stationary system there is an interval of time, which is not void, between the emission of one of the photons and the other.

If between the first emission (by physicist 1) and the other (by 2) the moving system stops to move, and by the same time, the two physicists, ending up the experience before the second emission, what would we infer about the existence of only one photon up to that moment? What would experimental physicist 1 (beholder 1) infer about his assurance that experimental physicist 2 (beholder 2) would also have emitted a photon, when, in reality, just the first one did so? That is a contradiction, either or one or none of

the photons would have been emitted with respect to the mobile system, but never only one.

In a similar way, what would physicist 2 infer about his assurance that 1 also did not emit any photon, once he himself had not, until the pause and the experience's ending? Notorious contradiction: nether 1, nor 2, would agree among themselves about the simultaneous emission of photons with respect to the moving system.

The next proofs of section 3 are similar among them and refer to relativity of simultaneity from the beginning until the end of the movement (Rectilinear Uniform Motion, R.U.M.) of two clocks when relative speed between both always equals zero. The relative distance between them also remains constant during the whole movement (with exception to the instantaneous variation caused by Fitzgerald-Lorentz contraction), it does matter if related to the system considered stationary, or to the system considered in movement. That is a contradiction, for if the beginning or ending of the movement is not simultaneous with respect to one of the systems, so at that system one of the clocks began or ended its movement before the other. That would lead to a variation of speed or relative distance between them, which does not happen (at least in T.S.R. domain).

Section 2, Synchronism of Clocks, holds two proofs of contradiction. Both compare the time presented by two different clocks, A and B, which are immobile with respect to each other. Both are placed at a non-null distance and move (R.U.M.) at the same constant speed $v \neq 0$ with respect to the system considered stationary. In the first one, one may use the stationary system time as an argument of comparison to these schedules. In the second, time is adopted to the moving system as the comparison argument of schedules. Time is standardized as equal to a schedule set by a third clock, C, stationary at the origin of the moving system.

At both proofs the simultaneity enclosed in Lorentz Transformation (L.T.) is used implicitly; as the correspondence between the coordinates (x, y, z, t) and (ξ, η, ζ, τ) to characterize any event E in T.S.R. domain. Such simultaneity is related to the system considered stationary, of spacetime coordinates (x, y, z, t), as well as of the system considered in movement, of coordinates (ξ, η, ζ, τ).

Simultaneity in which events? Of Events E_1, "Time measured at the stationary system (S) is t." (Or "Clocks $X_1, X_2, X_3, \ldots, X_n$ at rest at the stationary system indicate or

set time *t* in this system", *i.e.,* no matter the position (x', y, z) of measurement of time in S, even to $x' \neq x$), and E_2 "Time (or schedule, instant, time instant) measured at the moving system (S'), through a stationary clock at this system and at position (ξ, η, ζ), is given by τ."

Although T.S.R. accepts that simultaneity, only in case where x' and x are equal, if to $x' \neq x$, such events were not simultaneous with respect to the moving (and stationary) system, there would be a time interval $\Delta\tau$ (and Δt) between the occurrences of one and the other. Which of them would have happened first with respect to such system? The measure of time in S, placed in (x', y, z), $x' \neq x$, or the measure of time τ in S', placed in (ξ, η, ζ)?

As two clocks are at the same point P in space (case $x' = x$), with coordinates (x, y, z) in S and (ξ, η, ζ) in S', one of these clocks measures time *t,* stationary in S, while the other measures time τ, stationary in S', so, moving (R.U.M.) with respect to S, it is obvious that the observation of both schedules will be simultaneous for both systems, given the principle of constancy of speed of light and the null distance between the clocks at that moment of occurrence (in ideal conditions where the clocks' placement order with respect to the observer, and the clocks' dimensions, are worthless; in order not to interfere in the observation).

But if the clocks are not placed at the same point in space, *i.e., $x' \neq x$,* one can get to an old discussion whose key to understanding, in a philosophical point of view, is believed to be the following: the time of occurrence of an event in a system which does not depend on the moment of observation at that same system, or of its hearing, its perception, its notice, its registry in any equipment, *i.e.,* events happen although one is not aware of their occurrence, once that is what happens in a system considered at rest.

It was neither the view from the first man born on Earth, which created the Universe and its countless events, nor the view of the first alive being on Universe, intelligent or not, nor even the running of the first Physics Laboratory, nor measurement equipment. One could assert: observations do not create matter, that is the source for countless events. Precisely: observations do not create an observed event. It was not Einstein, nor Bohr, nor Newton, nor Aristotle, nor Adam nor any pre-historical animal

who has created matter, light, waves, strengths and fields and events in general. Closing our eyes, or turning off all possible measurement pieces of equipment, wouldn't the Universe and the Universe Events still be? Of course they would. We know that for good sense and personal experiences. This way, independently from visual observations and physical experiments, events happen, and therefore can be located in time (by convention), independently from any observers' position. If it was not this way, Big Bang's or other remote period's Cosmology (for example, the first three minutes of the Universe) would be contradictorial, once it is admitted that men, animals and their respective views, sensations and experiences were created a long time after Universe Creation, at a range of billions years of difference.

By physical and mathematical points of view, one can prove the simultaneity of two previous events E_1 and E_2. The proof to simultaneity with respect to S is trivial: τ is measured in *t* instant of S, according to L.T.

Upon the simultaneity with respect to S' one would have to prove that if E_1 was previous or later to E_2, one would reach a contradiction. In this way one would just have to appeal to the fact that clocks which measure time *t*, stationary with respect to S, and τ, stationary with respect to S', not punctual, but extensive, have got non-null dimensions. On the other hand, one can verify conceptual problems to be solved by T.S.R. at the immobility requirement of these clocks, at the system where time is measured: clocks need to be stationary with respect to the respective system, nevertheless, their main components are in (periodic) movement at the same system.

In 1946, in his *Autobiographical Notes*, Einstein wrote [3]: "The presuppositions of the existence (in principle) of (ideal, or perfect) measuring rods and clocks are not independent of each other; a light signal that is reflected back and forth between the ends of a rigid rod constitutes an ideal clock, provided that the postulate of the constancy of the light velocity in vacuum does not lead to contradictions". From a technical point a view, it is hard to consider that clock as ideal, perfect, once its running for a long time interval would be almost impossible: the photon would turn to be absorbed by the mirrors, once there is no mirror with perfect reflection, or other photons, *v.g.*, involved in all electromagnetic interaction or some lightening source from external environment,

which could be incorrectly registered by the clock, or even other photon would interact with the clock matter, or it would put itself out of its ideal way.

We understand that with the expression "ideal clock", Einstein intended to refer to a simply composed clock, with an easy explanation, and which would contain light (or photons) as one of its components. We accept that even this ideal clock has got hands (or digital displays) and all the non-null dimensions, for in failure of which, it would not lose its functionality: what is the purpose of a clock, which does not inform time or can not be observed? How could one wind it up with a conventional clock? How could one, wind up, in "real terms", two or more ideal clocks, separated in space, with no hands, no displays and unnoticeable (with infinitesimal dimensions)?

Let us base on Feynman's writings according to his famous course on Basic Physics, when he explained about time widening in a clock of light in movement (u is the clock speed) [4]: "it is also apparent that the greater u is, the more slowly the moving clock appears to run. Not only does this particular kind of clock run more slowly, but if the theory of relativity is correct, any other clock, operating on any principle whatsoever, would also appear to run slower, and in the same proportion" (…) "suppose we had two other clocks made exactly alike with wheels and gears, or perhaps based on radioactive decay, or something else. Then we adjuste these clocks so they both run in precise synchronism with our first clocks." (…) "*We need not know anything about the machinery* of the new clock that might cause the effect – we simply know that whatever the reason, it will appear to run slow, just like the first one."

That way we can imagine the traditional clocks with hands (or even digital displays) in the continuation of our reasoning. And it is irrelevant whether they were gearings, pendulums, atomic vibrations or light movements which have originated the measure of time.

In accordance to what Einstein has also written [5], "we understand by the "time" of an event the reading (position of the hands) of that one of these clocks which is in the immediate vicinity (in space) of the event. In this manner a time-value is associated with every eventh which is essentialy capable of observation." It is noticed that to the denomination of "time" it is given the same meaning of schedule, and not necessarily of duration, or interval between two schedules.

Let's suppose that to system S' event E_1 – the measure of t in S at the position (x', y, z), $x' \neq x$ – is before E_2 – the measure τ in S' at position (ξ, η, ζ) – and that between t and τ, and between (x, y, z) and (ξ, η, ζ), L.T. are valid. In this case we should have $x' > x$, supposing x, x' and speed v of S' are positive. But to which part of the clock that measures t corresponds the value of x'? Once every clock has got the same non-null dimensions, we should question ourselves: is the clock geometrical center, which is in x', or the center of its mass, or the part more to the right or more to the left? Is any part of the hour hand, or indicative digits of schedule or any other part of the clock which is, or should be, in x' ? According to Feymann's writings it is not necessary to know anything about clocks' functioning or mechanisms, and therefore we conclude it is also not necessary to know anything about clocks' dimensions and components, except that they can have any non-null dimension and that they must have components.

If the clock which measures τ had a dimension such that the point x' was contained in it during the measurement of this time τ, even if it was for just an instant (particularly the instant τ or t), any part or point of the clock which should correspond to x' could be assumed now. It is obvious that the whole internal part of the clock which measures τ is in time τ of S' – at the moment τ is measured. How can E_1 happens before E_2 if both clocks are placed at the same immediate vicinity (in space) during measurements?

We change case $x' \neq x$ into $x' = x$ through the dimensions' extension of the clock which measures τ. The measures of schedules must be, this way, simultaneous with respect to both systems. It is proved, therefore, the contradiction.

Similar proof can be withdrawn from the hypotheses that E_1 is after E_2, so that we get to the conclusion that E_1 and E_2 are simultaneous with respect to S', for any value of x', even to $x' \neq x$.

To make it simpler for our understanding, let's suppose our clock in movement, Σ, registers $\tau = 3$ o'clock, *i.e*, if its hour hand is parallel to the movement's direction and it contains abscissas points x and $x' > x$ at instant t, according to what was measured at the stationary system. It respectively corresponds to abscissas ξ and ξ', according to what was measured at the mobile system.

When Σ registers schedule τ, its hour hand will be η = *y* and it will simultaneously contain points *x* and *x',* with respect to S, respectively corresponding to ξ and ξ' in S'. Such positions are also simultaneously occupied at that system, for, other way, Σ would register another schedule, and its hour hand would present a slating position with respect to the movement's direction, instead of η = *y,* which would lead us to another contradiction. This way, measure *t* in *x'* (or *x*) and measure τ in ξ (or ξ') are simultaneous with respect to S'.

Such proof is the basis to advance in proofs of section 2, which follows, and will be admitted implicitly.

2. SYNCHRONISM OF CLOCKS

Intuitively, or in a non-mathematical way, what do we understand by synchronism?

Based on respectful Longman Dictionary, we have the following meaning to synchronize: **1** to (cause to) happen at the same time or the same speed: *You have to synchronize the soundtrack with the film.* (= make the sound fit the pictures). / *The soundtrack and the film don't synchronize.* **2** to set (clocks and watches) so that all show exactly the same time: *Let's synchronize watches.*

In 1905, Einstein adopted the term "common time" to A and B (*A und B gemeinsame "Zeit"*) to define synchronism between two clocks ([1], p. 894), and did it the following way ([6], pp. 39-40, translation into English):

"If at the point A of space there is a clock, an observer at A can determine the time values of events in the immediate proximity of A by finding the positions of the hands which are simultaneous with these events. If there is at the point B of space another clock in all respects resembling the one at A, it is possible for an observer at B to determine the time values of events in the immediate neighbourhood of B. But it is not possible without further assumption to compare in respect of time, an event at A with an event at B. We have so far defined only an "A time" and a "B time". We have not defined a common "time" for A and B, for the latter cannot be defined at all unless we establish

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by definition that the "time" required by light to travel from A to B equals the "time" it requires to travel from B to A. Let a ray of light start at the "A time" t_A from A towards B, let it at the "B time" t_B be reflected at B in the direction of A, and arrive again at A at the "A time" t'_A.

In accordance with definition the two clocks syncronize if $t_B - t_A = t'_A - t_B$."

With such definition to synchronism made by Einstein, primarily prepared to clocks at rest, temporal comparison of an occurrence, or event, between A and B gets sense. This way it is possible to give an answer for the apparently simple question: "What time does clock B point, to an event at the position of clock A?" Once both clocks, A and B are synchronous (with respect to a system in which they are at rest), and clock A points the instant of occurrence of that event, B must point out the same schedule, or time, instant, time instant, of A.

Without the intention to cause confusion of Einstein's words, we call and will call "clock A" the clock placed at point A in space, and, in a similar way, we call and will call "clock B" the clock placed at point B. We will also admit that different clocks can be placed at the same point in space.

This way, two different clocks, A and B, placed at the same point in space (ideal assumption) will be synchronous, while they show, point, or indicate, the same schedule, or time, or time instant. When clock A shows schedule t_A, clock B, if it is synchronous to A, will also show the same schedule, *i.e.*, t_A. If clock B is not synchronous to A, so B must show any other schedule t'_B at instant t_A pointed in A, so that $t'_B \neq t_A$.

Nor even in such definition it is required that clocks should run appropriately. Even broken, not working, or deregulated, if they point out the same schedule, in any moment, they are synchronous at that moment. When clocks do not point out the same schedule at any moment, they are not synchronous at that moment.

When both clocks are placed at different points in space, let's suppose both are located upon an axis of abscissas of any inertial system S, considered stationary. According to T.S.R.'s context in order to define the synchronism of clocks with respect to S it is necessary that both are at rest, one with respect to the other, and both at rest with respect to S, besides having identical functioning, as emphasized by Einstein.

It is also necessary that both clocks run appropriately, in a regular way. Einstein adopts the course of a light ray, in going and comming, in his definition to clocks' synchronism, as noticed. Before analyzing it in details, let's analyze any general speed, adopting our intuitive concept of synchronism, and reach light as an specific case.

If clock A is placed at position x_A of S, and clock B, in a similar way, is at position x_B of S, $x_B > x_A$, so, A and B, running identically and properly, if synchronous, will satisfy relation:

$$t_B = t_A + L / v_1, \tag{1}$$

where t_A is the instant pointed by A, where an (hypothetical) object considered punctual (infinitesimal) leaves from A to B, in a straight line, keeps a constant speed $v_1 > 0$ during its course, and reaches B at instant t_B pointed by B. L is the distance between A and B, i.e., $L = x_B - x_A$. All those measures are performed with respect to system S.

Let's understand why it is necessary that clocks run appropriately and why (1) itself can not define synchronism. Previous equation (1) could be valid and even so A and B would not be synchronous at any moment! Clock A's hands could be stationary, always pointing schedule t_A, as well as clock B's hands, always pointing schedule t_B. This way previous equation (1) would be valid by definition, but during the whole object's trajectory, the schedule pointed by A would not be equal to the schedule pointed by B. For example, $t_B - t_A >> 0$ (for $L / v_1 >> 0$), or either, both clocks A and B would not be synchronous as we expected (1) would guarantee.

On the other hand, A and B could be synchronous, meaning they point out the same schedule, but even so being stationary, i.e., they would not run appropriately, what would, for sure, disobey (1) to every finite v_1 and $L \neq 0$.

We would also be able to formulate even more complicated behaviors to the schedules pointed by A and B which would justify (1) but would not fit our "primitive" concept of synchronism, even admitting A and B have the same functioning. An example between clocks, which run identically and appropriately: A shows schedules very close to the value of t_A during the whole object's movement, for example, obeying some strict increasing function F(t) such that $F(t) \approx t_A$, B shows schedules very close to the value of

t_B during the whole object's movement, and such, that equation (1) is valid, but with A and B non-synchronous at any moment, *i.e.,* with A at any moment showing any schedule pointed by B during the movement, as well as B at any moment showing any schedule pointed by A.

If the (hypothetical) object leaves from B at instant t_B pointed by B and goes towards A, in a straight line, with constant speed $v_2 > 0$, reaching A at instant t'_A pointed by A, so, both A and B, once synchronous, also satisfy the relation

$$t'_A = t_B + L/v_2, \tag{2}$$

once again, if we admit that both clocks run identically and appropriately, in a regular way.

And what would we understand by proper functioning of clocks? For trying to an answer such question we should, beforehand, analyze Einstein's definition.

As $v_1 = v_2 = c$ and making the differences given by L/c equal in (1) and (2) one can reach Einstein's definition to synchronism of clocks at rest in an stationary system, *i.e.*,

$$t_B - t_A = t'_A - t_B, \tag{3}$$

where t_A is the instant pointed by A where the light ray leaves from A towards B, t_B the instant pointed by B where the light ray reaches B and returns to A, and t'_A the instant pointed by A where a light ray reaches A ([1], p. 894), both light trajectories are performed in a straight line.

Does definition (3) above really guarantee the clocks' synchronism as it intended to define? In a S system considered stationary, with clocks at rest in S, and without introducing any other system in movement with respect to it, it turns simple to understand the previous equation meaning. We just need to adopt our intuitive concept of clocks' synchronism, and Galileo-Newton cinematic to think about the problem (let's admit the vacuum and missing of any kind of strength). If time S is given by t and it is measured through synchronous clocks, which run appropriately and identically, and if clock A

points a schedule according to function $F(t)$ and B points a schedule according to function $G(t) = F(t) + d$, – constant d – so we could consider A and B have identical functioning, for their schedules fit the same function $F(t)$, excepting constant d.

If L is the distance between A and B and the equation (3) is verified, so to d it is obtained, value:

$$d= [F(t_0) + F(t_0 + 2 L/c)]/2 - F(t_0 + L/c), \qquad (4)$$

where t_0 is the starting instant to the departure of the light ray, measured in S, and c is the speed of light in vacuum.

This way, we verify that in a general case, d does not equal zero, according to what we expected it to be. For example, to a quadratic function $F(t)$ such that $F(t) = t^2$ so to d it is obtained value $d = L^2 / c^2$, which only equals zero if the distance L between clocks is null, or either, the previous definition (3) itself does not guarantee the clocks' synchronism. It is known that parameter d is void, meanwhile, admitting function F verifies the property of linear functions $F (at + bu) = aF(t) + bF(u)$, as it can be easily proved. Einstein implicitly admitted so, in his deduction about L.T., because of homogeneity proprierties we attribute to time and space ([1], p. 898).

So, what will we understand by proper functioning of clocks? It is the regular, continuous, non-fragmented, homogenous functioning of clocks, such that the synchronism definition (3) does not allow characterizing as synchronous, clocks of identical functioning, which show different schedules or time indication to the same instant of time adopted by the system in which they are at rest.

When in 1905, Einstein deduced L.T. ([1], § 3), he considered two systems of coordinates in stationary space. He called K the the system which remained at rest and k the system which moved with respect to it, with a constant speed v on its way to the increasing x, and admitted k movement could happen in such a way that at instant t ("t" always means time of the stationary system) the moving system's axes are (respectively) parallel to the axes of the stationary system. In the beginning of the movement the origin of both systems was common in a determined point.

It is said that: "let the time τ of the moving system at which there are clocks at rest relatively to that system by applying the method, given in § 1, of light signals between the points at which the latter clocks are located." ([1], p. 898; [6], p. 43).

He also affirmed, going through this reasoning: "If we place *x' = x – vt,* it is clear that a point at rest in the system *k* must have a system of values *x', y, z,* independent of time. We first define τ as function of *x', y, z,* and *t*. To do this we have to express in equations that τ is nothing else the summary of the data of clocks at rest in system *k*, which have been synchronized according to the rule given in § 1." ([1], p. 898; [6], p. 44).

The clocks' synchronization rule mentioned by Einstein, which is contained in its paragraph 1, and is defined in our equation (3), is no more than the shifting of lightning signals between points where the clocks are placed. It is primarily defined upon clocks at rest (let's say in absolute state of rest), and this rule is extended to systems in movement (in accordance to Relativity postulates), since clocks keep relative inactivity between each other.

This way, according to T.S.R., two immobile clocks with respect to each other, A and B, with appropriate functioning and identical between each other and R.U.M. (with respect to the system considered stationary) are synchronous (with respect to a system where A and B are at rest) if

$$\tau_B - \tau_A = \tau'_A - \tau_B, \tag{5}$$

where τ_A is the instant pointed by A when the light ray leaves from A to B; τ_B is the instant pointed by B when that light ray reaches B and returns to A and τ'_A is the instant pointed by A when the ray reaches A (in the original article, [1] p. 898, Einstein adopts τ_0 instead of τ_A, τ_1 instead of τ_B and τ_2 instead of τ'_A). Relation (5) must be true to any constant inferior speed, in module, to the speed of light and to any distance between A and B; it must be valid, particularly, when there is no system movement, where (5) is related only to definition (3). Although we know it is not as simple as that in the General Theory of Relativity (see, *v.g.,* Landau [7]), let's limit this reasoning to T.S.R.

Let's now suppose that A and B perform the same constant speed v movement from instant $t = 0$ upon the axis of abscissa of a triortogonal system of rectangular coordinates considered stationary, S (x, y, z, t), where (x, y, z) and t are the position coordinate as well as the instant, respectively, of an event E measured in S, and that S' (ξ, η, ζ, τ) is the other triortogonal system of rectangular coordinates, where A and B are considered stationary and where (ξ, η, ζ) and τ are the position coordinate and the instant, respectively, of that same event E when measured in S'.

If we admit that at instant $t = 0$ the origins of both systems were coincident and τ $(x = 0, t = 0) = 0$; that the axes of x and ξ are coincident and the axes of y and z are respectively parallel to the axes of η and ζ, and also that both clocks which measure instants t are synchronous with respect to S, according to (3), and those which measure instant τ are synchronous with respect to S', according to rule (5), so between S and S', according to T.S.R., L.T. are valid:

$$\tau = \beta \ (t - vx/c^2); \tag{6}$$

$$\xi = \beta \ (x - vt); \tag{7}$$

$$\eta = y; \tag{8}$$

$$\zeta = z; \tag{9}$$

where $\beta = 1/ (1 - v^2/c^2)^{1/2}$ and c is the speed of light in vacuum, considered independently of both, the observers', and the lightening source's speed.

Let's suppose, by hypothesis, A and B are clocks which point time in system S' according to transformation (6), with respect to t and x.

If clock A leaves in $t = 0$ of point x_{0A}, measured in a stationary system, so its motion equation in S will be $x = x_{0A} + vt$. Using such value for x in transformation (6) we obtain

$$\tau_A \ (t) = t/\beta - \beta \ vx_{0A}/c^2, \tag{10}$$

which will be indication of clock A in S', with respect to *t,* along its whole speed movement *v.* It is important to notice here that τ_A does not have the same meaning of τ_A value adopted in (5). Here τ_A varies with respect to time. There, it refers to the instant pointed by A from the departure of such ray, τ_A shows a constant value while the lightening ray goes and returns between A and B. Here we could also call it $\tau(A)$, $T_A(t),$ etc.

In a similar way, leaving B from point x_{0B} in $t = 0$, we have

$$\tau_B(t) = t/\beta - \beta\, v x_{0B}/c^2. \tag{11}$$

One should notice here again the previous τ_B also does not have the same meaning of τ_B adopted in (5). Here we could also call it $\tau(B)$, $T_B(t),$ etc. There, it corresponds to the instant registered by clock B in the lightening ray arrival at B, when the ray is emitted by A. Here, in (11) it will be the indication of clock B in S', with respect to *t,* during its whole speed movement *v* with respect to S. From now on, those will be the meanings of τ_A and $\tau_B,$ according to (10) and (11), respectively.

From Einstein's deductions about L.T. ([1], pp. 898-902) it is guaranteed clocks A and B verify the condition for synchronism given in (5) when they point, respectively, the values given in (10) and (11); what can also be verified through simple cinematic calculations, according to what was showed by Godoi [8] . To abbreviate it, let's omit here such demonstration.

Supposing $x_{0B} > x_{0A}$ and $v > 0$ we will have $\tau_A > \tau_B$.

Verifying the difference between times pointed by A and B we obtain

$$\Delta\tau_{AB} = \tau_A - \tau_B = \beta\, v(x_{0B} - x_{0A})/c^2 > 0. \tag{12}$$

From (12) it would be possible to immediately conclude, through good sense and through our intuition, that in fact, clocks A and B can not be synchronous, nether with respect to S, nor with respect to S', for the difference showed in (12) is never equal to zero and, *a priori,* what is expected from synchronous clocks is that they point out the

same schedule, ad do not present differences. According to what we have already mentioned, it is what Einstein called the "common time" to A and B (*A und B gemeinsame "Zeit"*) ([1], p. 894).

As such argumentation can be refuted from the principle that, according to T.S.R., two simultaneous events in a system are not simultaneous in another animated system with constant non-null speed with respect to the first one (relativity of simultaneity), let's prove through logical demonstrations that when one adopts the definition for clocks' synchronism given in (5) one may reach, in fact, a contradiction in T.S.R.. This way, our intuition and good sense turns valid (not intending, with that, to say that intuition or good sense may replace logical reasoning, in every or any problem: logical reasoning, I believe, must always be the final proof). We will adopt the simultaneity given by L.T., as mentioned in Section 1.

With respect to the mentioned refutation, based in the relativity of simultaneity, we will state the relativity of simultaneity is a conclusion of T.S.R., also contradictorial conclusion, whose contradictions' proofs are given in Section 3. In our two next proofs we will not adopt such conclusion.

We will adopt the clocks's synchronism with respect to system S' and the validity of L.T. to the movement of clocks on form $x = x_0 + vt$ with respect to the system considered stationary, S. About the validity of L.T. it is also guaranteed that clocks A and B are synchronous (according to (5)) at the moving system, S'.

Proof 1:

[A] If two clocks A and B are synchronous with respect to any inertial system S', so, when clock A points, at any instant τ of S', the schedule (or time, instant, instant of time) τ_A, clock B, which points schedule τ_B, also must point the same schedule τ_A, *i.e.,* $\tau_B = \tau_A$, at the same instant τ measured in S', may the distance between clocks A and B be of any sort, as well as τ and τ_A values and the speed v of system S' – speed measured with respect to a system S considered stationary.

Let's consider both clocks A and B are at rest with respect to each other and also at rest with respect to S', *i.e.*, both move with constant speed v with respect to S.

[B] If clock A points (in any instant τ of S') the schedule given by (10), *i.e.*, if it leaves in $t = 0$ from point x_{0A}, it moves in R.U.M. of constant speed v with respect to S on this system's axis of abscissas, considering L.T. and therefore $\tau_A = t/\beta - \beta\, vx_{0A}/c^2$, so there is a biunivocal correspondence between the value of τ_A and the value t, *i.e.*, when clock A points schedule τ_A, t value is unique, obtained from the inverse of (10) and such that

$$t = \beta\,(\tau_A + \beta\, vx_{0A}/c^2), \tag{13}$$

and for a given value of instant t, t_A value is also unique in the movement performed and obtained from the inverse of (13), which is equal to (10).

[C] If clocks A and B are synchronous with respect to S', according (5), and B leaves in $t = 0$ from point x_{0B}, − measurements with respect to S − so, clock B must point to every value of t the schedule given by (11), compatible to L.T., while the movement of constant speed v remains in S.

Obviously, there is also a biunivocal correspondence between the value of τ_B and the value of t: when clock B points schedule τ_B, value t is unique, obtained from the inverse of (11) and such that

$$t = \beta\,(\tau_B + \beta\, vx_{0B}/c^2), \tag{14}$$

and for a given value of instant t, the value τ_B is also unique in the movement performed and obtained from the inverse of (14), which is equal to (11).

[D] Once conditions [B] and [C] are satisfied for a given value τ_A registered by clock A at any instant τ of S', there will be only one corresponding value registered to instant t of system S at rest, and consequently, a only value τ_B registered by clock B to that same instant t, given respectively by (10) and (11), therefore, when clock A points the schedule given by (10), clock B must point the schedule given by (11), what satisfies definition or rule (5), according to what we have already seen, but not [A], once $\tau_B \neq \tau_A$ for every $x_{0B} \neq x_{0A}$ and $v \neq 0$, therefore, A and B can not be synchronous with respect to

S': contradiction. In other words, when A points τ_A (at any instant τ measured in S') clock B will not point (at the same instant τ measured in S') instant $\tau_B = \tau_A$, but $\tau_B \neq \tau_A$, what is a contradiction, for both clocks, by the hypothesis adopted in [C], should be synchronous with respect to that system.

The fact that we demand condition $\tau_A = \tau_B$ established by both synchronical clocks should not be strange, according to what we have done in [A], since we understand the meaning of such equality. If τ_A is the schedule pointed by clock A at any instant of system S' (*i.e.,* when A points τ_A in S'…) and if τ_B is the schedule pointed by B at the same instant, differently, therefore, from the meaning used to τ_A and τ_B in (5), so, necessarily $\tau_A = \tau_B$ if A and B are synchronous with respect to S'.

Let's notice what the previous explanation did without knowledge or time value adopted to the system S'. In other words, time or schedule τ adopted by mobile system S' with respect to S can even be different from the schedules pointed by A and B at that instant τ of S', but even so A and B must keep synchronism with respect to S' and at the instant τ, if $\tau_A = \tau_B$ at that instant, *i.e.,* even $\tau_A \neq \tau$, or $\tau_A = \tau$.

That mentioned comparison instant to the schedules pointed by A and B can be understood, this way, as the instant when A shows schedule τ_A, given by (10), instant, correspondent to instant t of the stationary system S (both events are simultaneous with respect to S', and also with respect to S). Corresponding to instant t measured in S is also the instant indicated by clock B, once it is equal to τ_B which is given by (11) (both events are simultaneous to S' as well as to S).

By hypothetical syllogism we can conclude the schedule showed by A, τ_A, given by (10), and the schedule showed by B, $\tau_A \neq \tau_B$, given by (11), are simultaneous with respect to S'.

That is the contradiction: not regarding any non-simultaneity between the respective schedules' marks τ_A and τ_B, but about the missing synchronism ($\tau_B \neq \tau_A$) with respect to the mobile system and at the same system instant.

So we could question: What schedule would an observer, located "infinitely close" to clock B and stationary with respect to B, say B shows when A points τ_A?

According to our proof, he would say it shows $\tau_B \neq \tau_A$, because of the lack of synchronism of both clocks with respect to S'. According to T.S.R., he would say it shows τ_A, because of the synchronism of both clocks with respect to S'. Only one of those answers can be correct.

Intending to avoid doubts regarding the dependence of τ_A and τ_B with respect to time t of the stationary system S, let's provide another proof of contradiction to the synchronism of clocks, but without using the comparison of equations (10) and (11) to the same argument t. Our argument of comparison will be time at the moving system. Instead of using the Greek letter τ for time indication at the moving system S', we are going to use the capital Latin letter T to indicate that time. This way we intend to avoid doubts and misunderstandings between the meaning of (5) and the meanings of (10) and (11). Time at the system considered at rest will remain being denoted by the small Latin letter t.

Proof 2:

If A and B are synchronous with respect to S' and both measure time T to that system, so if $T(A) = T_0 = T_A(T_0)$ is the time (or schedule) pointed by clock A at any T_0 instant of S', clock B, which points schedule $T(B) = T_B(T)$, also must point schedule T_0 when A points T_0.

Reciprocally, if $T(B) = T_0 = T_B(T_0)$ is the time (or schedule) pointed by clock B at that instant T_0 of S', clock A, which points schedule $T(A) = T_A(T)$, also must point schedule T_0 when B points T_0.

Let's suppose that a third clock, C, is located in the origin of the system in movement. Clock C will be our standard, which will provide the schedule or time adopted to the system S' and such that A and B must be synchronous with it in S'.

This way, A must point schedule T_0 and B must point T_0 at instant T_0 of system S', *i.e.*, when clock C in the origin of S' points schedule T_0: $T_A(T_0) = T_B(T_0) = T_C(T_0) = T_0$. If all those equalities are right, so we conclude that A and B are synchronous clocks with respect to S', otherwise, we will reach the same contradiction again, for A and B should be synchronous in S', by hypothesis.

Let's suppose the three clocks are in relative inactivity with respect to each other, but moving with the same constant speed *v*, non-null with respect to system S, considered stationary. The movement happens on the axis X of the abscissas. All other validity conditions for L.T. are obeyed in its simplest form, (6) to (9), particularly, at instant $t = 0$ of S, the origins of S and S' were common and coincident, and the clocks which used to measure instants *t* were synchronous with respect to S, as well the ones which used to measure instants *T*, with respect to S' (by hypothesis).

[A] If C shows schedule T_0 at the instant T_0 measured in S', *i.e.*, $T_C(T_0) = T_0$,, so the corresponding time t_0 measured at the system S is given by $T_0 = t_0/\beta$, *i.e.*, $t_0 = \beta T_0$. Introducing a new function, we have:

$$\Theta_C(t_0) = t_0/\beta = T_0, \tag{15}$$

where $\Theta_C(t_0)$ is equal to the schedule showed by C at instant t_0 of system S.

[B] At time t_0 clock A is showing schedule

$$\Theta_A(t_0) = t_0/\beta - \beta\, v x_{0A}/c^2, \tag{16}$$

where x_{0A} is the position of clock A in S at instant $t = 0$, equation similar to the one obtained in (10).

[C] In a similar way, at that time t_0 measured in S, clock B is showing schedule

$$\Theta_B(t_0) = t_0/\beta - \beta\, v x_{0B}/c^2, \tag{17}$$

where x_{0B} is the position of clock B in S at instant $t = 0$, equation similar to the one obtained in (11).

[D] We can now do a coordinates transformation so that the argument of functions which show clocks' A and B schedules is the time measured at system S', instead of the time measured in S, changing, this way, functions $\Theta_A(t)$ and $\Theta_B(t)$ and $T_A(T)$ and $T_B(T)$, respectively.

Performing replacement (15) in (16) we obtain:

$$\Theta_A(\beta T_0) = T_A(T_0) = T_0 - \beta\, vx_{0A}/c^2. \tag{18}$$

[E] In a similar way, performing replacement (15) in (17) we obtain

$$\Theta_B(\beta T_0) = T_B(T_0) = T_0 - \beta\, vx_{0B}/c. \tag{19}$$

[F] So, it is easily verified that the necessary condition to the synchronism of those clocks with respect to the mobile system has been violated, for it was obtained $T_A(T_0) \neq T_B(T_0) \neq T_C(T_0)$, to $x_{0A} \neq x_{0B} \neq 0$ and $v \neq 0$: contradiction.

3. RELATIVITY OF SIMULTANEITY

Reaching contradictions in a theory does not imply it is only possible to reach contradictions in that specific theory, or that it only contains contradictions. It is also possible to formulate non-contradictorial propositions or sentences in theories which contain contradictions, at least in a general case, excepting the "completely" contradictorial theories (evidently, such "theories" have no practical usefulness).

Let's think the following way:

"If $T_A(T_0) = T_0$ there must be some value to x_A and t_A measured in S − coordinates of clock A at that system − so that

$$\beta\,(t_A - vx_A/c^2) = T_0, \tag{20}$$

according to L.T. to time, (6).

In a similar way, if $T_B(T_0) = T_0$ there must be some value to x_B and t_B measured in S − coordinates of clock B at that system −, such that

$$\beta\,(t_B - vx_B/c^2) = T_0, \tag{21}$$

according to L.T. to time, (6).

Making the equality between (20) and (21) we obtawith respect

$$t_B - t_A = v\,(x_B(t_B) - x_A(t_A))/c^2, \tag{22}$$

where we use $x_A(t_A)$ to represent position x_A of clock A at instant t_A, and, in a similar way, we use $x_B(t_B)$ to represent position x_B of clock B at instant t_B – all those measures are performed with respect to system S.

With respect to S, if x_{0A} is the position of A at instant $t = 0$ and x_{0B}, in a similar way, is the position of B at instant $t = 0$, so all motion equations are verified as follows:

$$x_A(t_A) = x_{0A} + vt_A; \tag{23}$$
$$x_B(t_B) = x_{0B} + vt_B. \tag{24}$$

Applying (23) and (24) in (22), and considering $L = x_{0B} - x_{0A}$, the distance between the clocks at the stationary system, it is obtained

$$t_B = t_A + vL/(c^2 - v^2). \tag{25}$$

What can we understand from equation (25), obtained by the equality of (20) and (21), both according to transformation (6)?

The schedule, time, instant, time instant, pointed by clock A at position x_A and instant t_A of S corresponds, is equal, to the schedule, time, instant, time instant, pointed by clock B when it is located at instant t_B, given by (25), at position $x_B(t_B)$ of S. Both clocks will indicate, point, the same value T_0.

Supposing $v > 0$ and $L > 0$, it is obtained $t_B > t_A$ in (25). From such result and from the synchronism of clocks which measure time at the stationary system, it is concluded that there is no synchronism or simultaneity with respect to S at those two schedules' marks: events E_1, "A shows schedule T_0 at instant t_A of S", and E_2, "B shows schedule T_0 at instant $t_B \neq t_A$ of S", are not simultaneous with respect to S. In S there is a time interval, which is equal to $vL/(c^2 - v^2)$, between the first and second event occurrences."

There is no contradiction with T.S.R. in the previous conclusion.

And how is it possible to derive a contradiction from (25)? In other words, why, using validity of (6) and of equations (20) to (25), must the two previous events be simultaneous with respect to S': E_1, "A shows schedule T_0 at instant t_A of S", and E_2, "B shows schedule T_0 at instant $t_B = t_A + vL/(c^2 - v^2)$ of S"? The answer "Because they show the same schedule T_0 and A and B are synchronous with respect to S'." would be consistent, or even, would any answer similar to the previous one and derived from it be consistent ? No. That is what we intend to show next:

Proof 3:

Following Einstein's definition to simultaneity, very well explained by Nussenzveig [9],

"If an event 1 happens in P_1 at instant t_1, pointed by a lightening signal which leaves from P_1 at that instant – the same is valid to P_2 in t_2 (event 2) – we say those two events are simultaneous ($t_1 = t_2$) when the meeting point of both lightning signals is the medium point of segment P_1P_2.",

let's calculate in which position of S' the meeting of two lightening rays, cast at the same instant T_0 of that system, is given. One of the rays leaves from clock A towards B, to T_0 according (20), and the other leaves from clock B towards A, to T_0 according (21).

At instant t_A and position $x_A(t_A)$ measured in S, position given by (23), one of the lightening rays leaves from A towards B verifying motion equation

$$c_A(t) = x_{0A} + (v - c)\, t_A + ct,\, t \geq t_A\,. \tag{26}$$

In a similar way, at instant t_B and position $x_B(t_B)$ measured in S – position given by (24) and instant given by (25) – another lightening ray leaves from B towards A verifying motion equation

$$c_B(t) = x_{0B} + (v + c)\, t_B - ct, \ t \geq t_B. \tag{27}$$

Making (26) equal to (27) to obtain the meeting instant t to the rays, being assisted by (25), which results on

$$t = t_A + L/[2\,(c - v)]. \tag{28}$$

The position of A at instant t will be, adopting motion equation (23),

$$x_A = x_{0A} + v\{t_A + L/[2\,(c - v)]\}, \tag{29}$$

the position of B at that same instant t will be, adopting motion equation (24),

$$x_B = x_{0B} + v\{t_A + L/[2\,(c - v)]\}, \tag{30}$$

and (26) will be the respective meeting position x_{AB} of the lightening rays,

$$x_{AB} = x_{0A} + vt_A + cL/[2\,(c - v)]. \tag{31}$$

It is easy to check that the condition to simultaneity of events E_1 and E_2 is not valid with respect to S, because $x_{AB} \neq (x_A + x_B)\,/2$, or either, with respect to S the emission of both lightening rays is not simultaneous, what we already knew.

Let's now verify it with respect to S'.

Applying L.T. (7) in (29), (30) and (31), and using (28), we, respectively, obtain

$$\xi_A = \beta\,(x_A - vt) = \beta\, x_{0A}, \tag{32}$$

$$\xi_B = \beta\,(x_B - vt) = \beta\, x_{0B} = \beta\,(x_{0A} + L), \tag{33}$$

$$\xi_{AB} = \beta\,(x_{0A} + L/2), \tag{34}$$

verifying, this way, simultaneity condition $\xi_{AB} = (\xi_A + \xi_B)/2$ at the moving system, what is no contradiction in any way.

The contradiction finally comes from the bond or dependence that exist between the stationary and the moving systems during the procedure, or verifying simultaneity experimental test of the events, *i.e.,* during both lightening rays (photons) movement from a clock to the other.

If the meeting point ξ_{AB} of two lightening signals is the medium point of the segment $\xi_A\xi_B$ with respect to S', with respect to the system in movement, the two lightening rays' emission must be simultaneous at instant T_0 of S'. Before that instant there is no photon in S', by hypothesis, and from that instant until their meeting at ξ_{AB} there must be two photons in S', neither more, nor less. Specifically, there can not be one photon in S'.

With respect to S, according (25), there is a time interval equal to $\Delta t = vL/(c^2 - v^2)$ since the lightening ray emission from A to B, until the lightening ray emission from B to A.

If during that time interval, *i.e.*, between the instants t_A and t_B, but excluding those two instants, our system S' definitely stops moving with respect to S, as well as the clocks, how many photons were cast with respect to S' since the emission instant t_A until the stop instant t_f, $t_A < t_f < t_B$ (instants measured in S)?

That is reasonable question, but whose answer leads us to contradiction. As it is about an experimental procedure, we can compare it to a real experience, which, for any reason, can not be completed, can not come to an end because of some problem or unexpectation. At the same time, the experimenters would have access to every experiment historical performed until then.

Only one photon was emitted with respect to S, the one that left from A. The same happened with respect to S'. In such idealized experience, the observers (physicists, for example), located at the "endless close" clocks' surroundings, will (ideally) have conditions to inform which and how many photons were emitted or not. Either a photon was emitted from B towards A, or not. Missing the observers, they can be replaced by proper electronic equipment.

The second photon was not emitted, because the end of B movement happens before the instant T_0 with respect to S', by definition, the simultaneous instant of emission measured in S'.

This way, we reach a contradiction: with respect to S' there could not have been or have been emitted only one photon, at any moment, during the experience. Two photons should have been emitted with respect to S'.

That is a contradiction, which interferes, not only in our good sense and in our intuition, but mainly, also in our logic, in our reasoning power.

Let's now provide another proof of contradiction in T.S.R., valid for any distance or speed ($0 < v < c$).

Proof 4:

As already mentioned, according to T.S.R., two simultaneous events in a system are not the same in another system, which moves in R.U.M. with respect to the first one (relativity of simultaneity).

If our two clocks, A and B, begin their movement of constant speed v with respect to S at instant $t = 0$ of S, so, with respect to that system, A and B begin the movement simultaneously.

This way, with respect to S' the movement beginning of both clocks is not simultaneous according to T.S.R.: clock A begins its movement at $\tau_A = 0$, supposing $x_{0A} = 0$, and B at $\tau_B = -\beta\, vx_{0B}/c^2$, $\tau_B < \tau_A$ to $x_{0B} > x_{0A}$ and $v > 0$, therefore, before A. Here we are adopting the same meanings used in (10) and (11) to τ_A, x_{A0}, τ_B and x_{0B}.

On the other hand, if clock B begins its movement before A with respect to S', at that system the distance between A and B would increase, because of time, until remain constant when A started to move, what does not happen, for the distance between them is constant during the whole movement (measuring βx_{0B} with respect to S').

Moreover, speed B with respect to A is equal zero, even with respect to S' or S, therefore, there is no initial removal from A with respect to B, or either, we reach a contradiction: non-simultaneous events, by definition, showed to be simultaneous, by logical deduction.

In a similar way, we could provide a proof to the stop instant.

Proof 5:

If clocks A and B simultaneously stop movement of constant speed v with respect to S, let's suppose, that at instant $t = t_f$, with respect to S', they do not stop their movement simultaneously, according to T.S.R.

If with respect to S' they do not simultaneously stop their movement, one of them had already stopped its movement in S'. As $\tau_B < \tau_A$, supposing $x_{0B} > x_{0A}$ and $v > 0$, so B stopped its movement before A, with respect to S' (whether in S both simultaneously begin and stop their movement in S', clock B begins and stops its movement before A).

So, with respect to S', after B stops, clock A has come closer to B, until the moment A also stopped its movement.

But the position of A with respect to S' is equal $\xi_A = 0$ during the whole movement, supposing $x_{0A} = 0$, while B's is $\xi_B = \beta x_{0B}$, then, they keep the same distance $\Delta\xi = \xi_B - \xi_A = \beta x_{0B}$ among each other, since $t = 0$ until $t = t_f$ of S, in S'. This way, the expected final approach of A with respect to B does not exist.

Moreover, B's speed with respect to A, in S' and S, is equal zero during the whole movement, as it should be, in order to make it possible for A to get closer to B.

Then, we reach a contradiction.

It is easy to extend the two previous proofs to the case of negative speeds. If $-c < v < 0$ and $x_{0B} > x_{0A}$ we will have $\tau_A < \tau_B$, therefore clock A will be the one which begins and stops its movement before B. The contradiction happens again, for there is neither variation of distance and relative speed between A and B, nor with respect to S nor S', even adopting T.S.R.

4. CONCLUSION AND FINAL COMMENTS

This article intended to show something that is not of bare importance: T.S.R. contains very basic contradictions, opposing what Einstein stated.

Through logical reasoning, based on transitivity (hypothetical syllogism) we concluded there is a contradiction derived from the definition of clocks' synchronism adopted by T.S.R. Being p_i the logical propositions bellow,

p_0: A and B are synchronous with respect to S';

p_1: A indicates τ_A at instant τ measured in S';

p_2: time in S is t (simultaneously with p_1, with respect to S');

p_3: B indicates τ_B (simultaneously with p_2, with respect to S', therefore, simultaneously with p_1, with respect to S');

p_4: $\tau_B \neq \tau_A$ (to $x_{0B} \neq x_{0A}$ and $v \neq 0$) at instant τ measured in S';

p_5: A and B are not synchronous with respect to S',

we can symbolically show the reasoning adopted in our first proof:

$$((p_1 \Rightarrow p_2) \wedge (p_2 \Rightarrow p_3)) \Rightarrow (p_1 \Rightarrow p_3)$$
$$(p_1 \wedge p_3) \Rightarrow p_4 \Rightarrow p_5$$

Finally, the contradiction derives from the fact that both, p_0 and p_5, can not be true, once p_0 is a initial hypothesis and p_5, the negation of p_0, deduced from our other propositions, p_1, p_2 and p_3, compatible to T.S.R., *i.e.*,

$$(p_0 \wedge p_5) \Rightarrow \text{contradiction.}$$

Our second proof uses a third clock, C, located at the origin of our system in movement. It compares schedules pointed by A and B with the schedule of the clock considered standard and uses the functions' transformations on such comparison. The conclusion is very clear: $T_A(T_0) \neq T_B(T_0) \neq T_C(T_0)$, *i.e.*, we did not obtain the clocks' synchronism with respect to S', opposing our initial hypothesis.

Both proofs implicitly used the fact that it is impossible to have clocks in a point (infinitesimal clocks), more exactly, the fact that time measured in a system does not

depend on format, dimensions and internal mechanism of clocks and any periodical process adopted in measurement, since appropriately synchronized.

Through L.T. we have $\tau' \neq \tau$ if τ' corresponds to the abscissa x', different from the abscissa x, corresponding to τ, to the same time value t of the stationary system, and supposing the movement is towards axis x.

Then, but if our mobile clocks obey, by hypothesis, L.T. and if a clock Σ, which measures time at moving system S', contains points x and x' at instant t, (points ξ and ξ' with respect to S') it turns obvious that τ and τ' measurements must be simultaneous, even with respect to S', for x and x' (and ξ and ξ') are located at the the same spatial surroundings, which is immediate during measurements, *i.e.*, they belong to clock Σ interior space. It should make τ and τ' equal to time indicated by Σ, or either, events E$_1$, " Time measured at steadied system (S) is *t.*" (or "Clocks X_1, X_2, X_3, …, X_n, at rest at the stationary system, indicate or point time t in this system.", *i.e.*, for any position of (x', *y*, *z*) of time measure t in S, even to $x' \neq x$), and E$_2$, "Time (or schedule, instant, time instant) measured at moving system (S') through a stationary clock at that system and at position (ξ, η, ζ) is given by τ." are simultaneous with respect to S' (and S).

The third proof is even a contradiction proof for the Relativity of Simultaneity as well as a description of an idealized experimental procedure to test the validity of simultaneity and synchronism definitions for clocks in movement, used by T.S.R.

Again, we reach the contradiction: not only one, but two photons should have been emitted at the moving system.

Another class of contradictions was also showed. If two clocks simultaneously begin and stop a movement, at a constant speed $v \neq 0$ with respect to a system considered stationary (S), with respect to the system where the clocks are at rest (S'), one of the two began and stopped its movement before the other, according to T.S.R. If it worked that way, during such time interval there would be a non-null speed of one with respect to the other, with distance variation between them. But such does not happen, een adopting T.S.R.

More than attaining ourselves to exact values registered by each one of the clocks, which could never, experimentally, point negative schedules, nor even turn back in its

marks, L.T., applicable to time, essentially tell us that in S', the beginning or ending of clocks' movement is not simultaneous if it is simultaneous in S. And derived from that fact it was possible to show the contradictions.

As done by Einstein when he adopted L.T. to rigid moving bodies, as well as moving clocks ([1], § 4), and also when he deduced such Transformation, ([1], pp. 898-902), we do not use any transient in our reasoning. Other authors also adopt the same procedure when working with T.S.R.

Here it is possible to expect that transients, originated from very short accelerations which cause the beginning or end of clocks' movement, are entirely rejected, since the movement reaches and keep stationary movement, *i.e.*, while constant speed $v \neq 0$ is valid.

We can infer the movement has been originated, in fact, at $t < 0$ with some acceleration $a(t)$, variable or not. But at instant $t = 0$ clocks A and B, respectively, were at positions $x = x_{0A} = 0$ and $x = x_{0B} > x_{0A}$. Their speed with respect to S was equal v and both clocks remained at that speed until instant $t = t_f$. Such instant was considered a stop instant in our proof 5, Section 3. But, in fact, that instant is equal to the movement's beginning of negative acceleration, responsible for the effective clocks' stop in S. That will modify our conclusions in no point.

As a final comment, some words on the extraordinary success reached by General and Special Relativities.

Albert Einstein is considered the greatest physicist of XX Century, while for many he is considered the greatest scientist ever in World. Such admiration can not have a very justified reason. It certainly comes from the fact**,** experience after experience, decade after decade, that all forecasts of Relativity, Special or General, were confirmed in an exceptional way.

Since the electrons' movement in accelerators until the observation of dark holes, from the planes and rockets movement until the use of GPS, the atomic energy, the Elementary Particles Physics, the Astronomy, everything is in favor of Relativity.

With this article I do not intend to reject Relativity's honor or even deny its experimental data.

Even admitting time dilation and space contraction, both, true realities of Experimental Physics, I do not believe L.T. regarding time, (6), can be true, based on we proved here.

In my point of view it must not depend on positions, and it possibly shows as $\tau = t/\alpha$, in order to make its accordance to time dilation.

DEDICATION

I dedicate this work to professors Normando Celso Fernandes, André Koch Torres Assis and César Lattes.

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