A Critical Analysis of Special Relativity in Light of Lorentz's and Michelson's Ideas

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On the basis of the Michelson-Morley experiment, the physical models of Einstein's and Lorentz's theories are discussed, together with their respective logical and mathematical processes, both leading to the same transformations by Lorentz. Our analysis evidences logical coherence problems between Einstein's model and the Lorentz transformations, as well as in the "light postulate" itself. Replacement of the SRT transformations are thus proposed, describing apparent space-time alterations due to the relative motion of a wave source and an observer in a light medium. The main experimental proofs of SRT are also discussed.

Keywords: (Special Relativity, Einstein, Lorentz, Michelson)

Introduction

As is well known, in the second half of the 19th century Physics was dominated by Maxwell's electrodynamics, which, by incorporating light into the electromagnetic wave family, implied that the supposed medium for these waves, that is the ether, necessarily permeated the entire universe. In 1887 Michelson and Morley tried to obtain an indirect proof of the ether's existence by detecting its "wind," theoretically present on the Earth's surface because of the Earth's motion around the Sun.* In order to do this, they used a new kind of interferometer with perpendicular arms designed by Michelson. In the case of motion through the ether, on the basis of Maxwell's principles, light should have traveled the two arms at different velocities, giving rise to an observable fringe shift. What follows is the conclusion of Michelson's and Morley's historical report about their experiment.[1]

> *The actual displacement was certainly less than the twentieth part of this (the predicted fringe shift / author's note), and probably less than the fortieth part. But since the displacement has to be proportional to the square of the velocity, the relative velocity of the earth and the ether is probably less than one sixth the earth orbital velocity, and certainly less than one fourth.*

Thus, Michelson and Morley found a smaller than expected but not null result.† For reasons that go beyond the aims of this paper, their

* An analogous experiment had already been tried by Michelson in 1881, but publicly invalidated by Lorentz because of errors in the evaluation of the theoretical effect (Michelson had not taken into account the light velocity alteration occurring in the interferometer arm perpendicular to the "motion through the ether" axis) - A.A, Michelson, *The relative motion of the earth and the luminiferous ether*, Journal of Science, xxii, 120 (1881).

† Of all experiments carried out to detect the ether, almost none gave a true null result. For a thorough analysis of this subject, see Hector A. Munera, *Michelson-Morley experiment revisited, systematic errors, consistency among different experiments and compatibility with absolute space*, Apeiron Vol.5 Nr.1-2 January - April.

result was generally interpreted as a null result.* In order to explain this "null result," in 1887 Voigt proposed a set of transformations that let the "light equation" unvaried,[2] subsequently quoted by Larmor.[3] In the following years, Fitzgerald and Lorentz, independently of one another, advanced the same hypothesis of a length contraction along the axis of motion through the ether, capable of exactly equalizing the two light paths of a Michelson interferometer, making it impossible to detect the ether with such a device.

1. Lorentz's model

In 1904 Lorentz proposed a theory[4] unifying his length contraction idea and Maxwell's electrodynamics. Lorentz's model contains therefore two founding postulates:

1. The existence of a light medium, that is, the ether.†
2. A real length contraction caused by motion through the ether.

From these two postulates the following effects derive, real and objective since they are due to motion through the ether, and therefore are detectable by all observers:

- A light speed alteration caused by motion through the ether.
- A length contraction along the "motion through the ether" axis.

Furthermore, Lorentz considers an apparent time alteration - the "local time" introduced by Voigt - which in such a context represents

* Briefly, a smaller than expected but not null result could be ascribed to a dragging effect on ether caused by a massive moving body like the Earth. Nevertheless, the complexity of a fluid ether model drove most of scientists to ignore that not null result and instead prefer a simpler stationary ether model, to eventually abandon even this last one in favour of the Einstein's SRT model.

† Lorentz's contraction is here considered as a postulate, since in fact it is an undemostrable assumption.

a formal utility or convention, consisting in interpreting the two above anisotropic real alterations as an isotropic time alteration. Thus, Lorentz considers two kinds of systems only:

- Systems at rest relative to the ether, in which no alterations occur.
- Systems at motion relative to the ether, in which alterations occur.

From this it follows that, in the context of Lorentz's model, in order to correctly describe a system at rest and a system at motion, both relative to the ether, two kinds of symbols are enough in principle.

2. Einstein's model

The physical model proposed by Einstein in 1905,[5] though featuring transformations and a length contraction identical to those by Lorentz, drastically differs from Lorentz's model as to concepts and principles. *In primis* because of the revolutionary postulate of the light speed constancy (with the consequent elimination "tout court" of the light medium predicted by classic electrodynamics), that implies a true reversal of points of view with respect to the Lorentz's model. In fact, whereas this last one considers motion relative to an "absolute rest" reference (ether), the SRT (Special Relativity Theory) considers motion relative to the observers. But the advantage, in terms of economy of explicative elements, represented by the elimination of ether, is counterbalanced by the introduction of a new reference of "absolute motion," the constancy of light speed. Thus, whereas Lorentz considers systems at motion relative to the ether, Einstein considers systems at motion relative to one another, but all of them at rest relative to light motion. SRT model is therefore based on the following three postulates (the third one not openly declared by Einstein, but nevertheless necessary to the SRT logical consistency):

1. Principle of Galilean relativity.
2. Constancy of light speed *in vacuo* relative to inertial observers.
3. Non-contradiction between the two above postulates.

Differently from what happens in Lorentz's model, the light postulate makes SRT effects reciprocal and apparent - each of two observers moving relative to one another views the same apparent effects in the other's system. Main SRT effects are:

- Apparent and reciprocal length contraction along the motion axis.
- Apparent and reciprocal dilatation of absolute time.
- Apparent and reciprocal slowing of velocities.

Kinds of systems considered in SRT are therefore the following ones:

- Systems of proper coordinates viewed by observers at rest relative to them, or the same, moving with them, who view no alterations in them.
- Systems of improper coordinates viewed by observers at motion relative to them, who view alterations in them.

From the fact that SRT alterations are apparent and subjective, it follows that, differently from the Lorentz's model context, in order to unambiguously describe two systems moving relative to one another, in SRT, four kinds of symbols are in principle necessary,*

* Practically, in this context three kinds of symbols are enough, two kinds to indicate the two systems, and a third kind to distinguish proper from improper coordinates.

corresponding to the four possible points of view predicted by the SRT model: *k* seen by k, K seen by *K*, *K* seen by *k* and *k* seen by *K*.

3. Discussion of the Einstein's process

Contradicting the requirement exposed at the end of the previous paragraph, both in the SRT first exposition and subsequent ones[6], in order to describe two systems moving "relative" to one another, Einstein uses two kinds of symbols only. Particularly, in the 1905 article, ξ, μ, ζ, τ represent the "proper" coordinates of a point in the system assumed "at motion" *k*,[*] and *x*, *y*, *z*, *t* represent the "improper" (apparent) coordinates of the same point, if viewed from the assumed "at rest" system *K*.

Considering this ambiguity of symbols with unprejudiced eyes, the risk of obtaining erroneous transformations is high. Our doubts about the correctness of Einstein's process are strengthened by a more than legitimate question: how can he, starting from principles opposite to those by Lorentz, arrive to the same final transformations? In order to answer this question it is necessary to analyze the inspiring principle of both Einstein's and Lorentz's theories, that is the already mentioned Michelson-Morley experiment, obviously according to its "null result" interpretation accepted both by Lorentz and Einstein.

3.1 The Michelson-Morley experiment

As already said, this experiment was aimed at detecting a light anisotropy due to the Earth's motion through the ether. The operation of the interferometer Michelson designed with this aim in mind is

* Hereafter the words "at motion" (or "moving") and "at rest" in inverted commas are referred to these two states as intended in the totally relative meaning Einstein gives them, antithetical to Lorentz's motion and rest with respect to ether.

based on a beam of monochromatic light split by a partially reflecting 45° mirror and forced to cover two right angled arms of the same length *D*. By means of two other totally reflecting mirrors, each placed at the end of each arm, the two beams are reflected again towards the 45° mirror and then made to coincide, after having traveled identical back and forth paths, but perpendicular to one another.*

According to Maxwell, in such an interferometer, if at motion through the ether, the two light routes should be no more identical, the light route in the "parallel to the motion axis" arm becoming $Dc/(c+v)+Dc/(c-v)$, that is $2D/(1-v^2/c^2)$, and that in the "perpendicular to the motion axis" arm becoming $2D\big/\sqrt{1-v^2/c^2}$, (2*D* being the light route in each arm of an identical interferometer at rest relative to the ether). The theoretical difference between the two perpendicular routes is thus, neglecting fourth order terms, Dv^2/c^2, but since in this kind of interferometer a fringe shift is obtainable after having put in phase the two light final beams and then rotated the device plan by 90°, the measurable difference doubles, becoming $2Dv^2/c^2$. This last quantity is what Michelson and Morley expected to find. A null result for this experiment thus means explaining the absence of this difference.

3.2 Lorentz's interpretation

According to Lorentz, the non observation of this fringe shift is due to a contraction of the interferometer arm parallel to the "motion through

* The 1887 interferometer had multiple mirrors that, letting unvaried its operational principle, multiplied its performances by repeated reflections, obtaining a 11 meters total light route.

the ether" axis, due to this motion. The Lorentz coefficient $\sqrt{1-v^2/c^2}$ acts therefore as an equalizer of the two altered light paths, capable of making both equal $2D/\sqrt{1-v^2/c^2}$. This way a moving interferometer shows no fringe shift, even though this is not due to a true absence of effects, but to the interaction of two real distinct effects (the Lorentz contraction and the slowing of light speed), that partially compensate each other, making it impossible to detect their "sum" by means of an interferometer - the resultant isotropic alteration is then regarded by Lorentz as a *by convention* dilated time. Thus, in this context, a real absence of effects (true null effect) could only occur in an interferometer at rest relative to ether.

3.3 Einstein's interpretation

Even if not explicitly,[*] Einstein also intended to explain the M.&M. (Michelson-Morley) experiment, but on the basis of all different premises. In fact, according to SRT, the terrestrial observer moving with Earth of the M.&M. experiment views no fringe shift in his interferometer simply because a postulate introduced *ad hoc*, that on the c constancy, imposes him to see both interferometer light routes equal $2D/c$.[†] This way, the non-observation of the M.&M. theoretical result, that Lorentz adduces to mechanical causes (a real

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[*] Einstein always declared that at the time of his first SRT 1905 article he totally ignored works and ideas by Michelson, Morley, Lorentz and Poincaré, Lorentz transformations included.

[†] A Michelson interferometer can measure a difference between two light routes, but cannot discriminate between a null effect and a null result, that is between two light routes both equal $2D$ (Einstein's interpretation) and two light routes both equal $2D/\sqrt{1-v^2/c^2}$ (Lorentz's interpretation). It is just this limit that allows two different interpretations of the same null result.

length contraction), that is, using causal logic, is instead explained by Einstein by an apparently illogical assumption, the light postulate. But this M.&M. theoretical result, far from being really eliminated, reappears untouched for an interferometer "at motion" relative to the observer. In this case, in fact, the light postulate states that an observer "at rest" views the two perpendicular light routes as altered two different ways, $2D/\left(1-v^2/c^2\right)$ and $2D/\sqrt{1-v^2/c^2}$, quantities corresponding to the light anisotropy predicted by Michelson. In order to obtain from these quantities a time alteration, Einstein has to equalize them some way, since the time flux must be isotropic *by definition*, at least at a macroscopic scale.

3.4 Einstein's length contraction

Whereas Lorentz equalizes the two above quantities by his real length contraction, Einstein cannot do it, since he intends to obtain the Lorentz transformations by means of his two postulates only, and his light postulate equalization only applies to an interferometer "at rest" relative to the observer. Thus, in the SRT context a correct equalization of the two light routes of a "moving" interferometer is possible only by means of a decomposition (and not by a further correction factor) of one of them. That in physical terms means considering the quantity $2D/\left(1-v^2/c^2\right)$ as altered by two distinct effects, a time dilatation and a length dilatation along the motion axis (instead of a length contraction!), each by a factor $1/\sqrt{1-v^2/c^2}$. In other words, excluding the possibility of adding a third postulate that introduces an *ad hoc* length contraction, the only other possible way of obtaining an apparent isotropic time dilatation in a "moving" interferometer (explaining at the same time why light takes an extra time to travel the arm parallel to the "motion" axis), is assuming this last arm got longer and not shorter.

The fact Einstein instead obtains the same result as Lorentz means he does not derive the Lorentz length contraction from the SRT postulates, as he should, but introduces it in a forced way as a third postulate!

3.5 Einstein's and Lorentz's processes

Tables 1a and 1b (pages 12, 13) synthetically compare the logical-mathematical route leading Lorentz to his transformations (1904), and the one leading Einstein to the same transformations (1905). Despite of the differences between the two theories founding principles and of the ambiguity of Einstein's symbols, in order to make it possible a comparison between Einstein's and Lorentz's models, altered and not altered by motion coordinates have been considered. ξ, μ, ζ, τ represent not altered coordinates (of a system at rest relative to the ether in Lorentz's view and of a system viewed by an observer integral with it in Einstein's view - proper coordinates), and x', y', z', t' represent altered coordinates (of a system at motion relative to the ether in Lorentz's view and of a system viewed by an observer "at motion" relative to it in Einstein's view - improper coordinates).

Finally, x, y, z, t represent altered coordinates after a Galilean transformation, according to the process: ξ, μ, ζ, $\tau \rightarrow$ Relativistic transforms $\rightarrow x'$, y', z', $t' \rightarrow$ Galilean transforms $\rightarrow$ x, y, z, t. Therefore, the ξ, μ, ζ, τ $\rightarrow x'$, y', z', t' passage is a transformation between units of measurement, that is a metrics transformation, whereas the x', y', z', $t' \rightarrow x$, y, z, t passage is a Galilean coordinates transformation incorporating a metrics transformation.

The peculiarities of Lorentz's and Einstein's original processes have been here maintained. In Table 1b (Einstein's process) an hybrid system *x'*, *y*, *z* (declared by Einstein independent of time!) appears, and the symbol *a* represents a function introduced by Einstein and then declared by him to equal 1. in Table 1a (Lorentz's process) symbol *x''* distinguishes a really altered (contracted) coordinate along the motion axis from an apparently altered coordinate *x'* (according to Einstein all alterations should instead be apparent), and Galilean transformations are not included, because Lorentz himself did not.[*] From this last fact follows that Lorentz intends his transformations as between metrics, whereas Einstein intends his as between coordinates.

"Theoretical and observed results" are referred to the M.&M. experiment (unaltered coordinate ξ can represent the M.&M. unaltered distance *D*), whereas the "effects redistribution" consists in a reinterpretation of the "observed results" as alterations of the time flux, operation present in both Einstein's and Lorentz's processes.

* The Lorentz's process is here "reconstructed," since Lorentz introduces his transformations without derivation, simply calling them a "change of variables."

Lorentz's ether model (1904)

Postulates:	1. The existence of a light medium. **2.** A real length contraction along the "motion through the ether" axis.			
Theoretical result *(non-null result predicted for an interferometer moving through ether).*	$\tau = \dfrac{t'}{\beta^2} - \dfrac{x'v}{c^2}$	$x'' = \dfrac{x'}{\beta^2}$	$\eta = \dfrac{y'}{\beta}$	$\zeta = \dfrac{z'}{\beta}$
Lorentz correction *(postulate of a real length contraction along the motion axis).*	↓	↓ $\xi = x''\beta$	↓	↓
Observed result *(according to Michelson and Lorentz).*	$\tau = \dfrac{t'}{\beta^2} - \dfrac{x'v}{c^2}$	$\xi = \dfrac{x'}{\beta}$	$\eta = \dfrac{y'}{\beta}$	$\zeta = \dfrac{z'}{\beta}$
Effects redistribution (*assuming a by convention time alteration in the system moving relative to ether).*	*Multiplying all right sides by* β ↓			
Observed result *(after the effects redistribution).*	$\tau = \dfrac{t'}{\beta} - \dfrac{vx'\beta}{c^2}$	$\xi = x'$	$\eta = y'$	$\zeta = z'$
Final metrics transformations *(without the application of the Galilean transforms).*	$\tau = \dfrac{t'}{\beta} - \dfrac{vx'\beta}{c^2}$	$\xi = x''\beta$	$\eta = y'$	$\zeta = z'$
Alterations *(due to motion relative to ether).*	• Real length contraction along the motion axis. • Real alterations of light velocity. • "By convention" time alteration (local time).			

Table 1a $\beta = 1\Big/\sqrt{1 - v^2/c^2}$

Einstein's Special Relativity model (1905)				
Postulates:	1. Galilean relativity principle 1. Constancy of light speed relative to inertial observers 2. Non contradiction between the two above postulates			
Theoretical result *(non-null result seen in a "moving" interferometer by an observer "at rest").*	$\tau = a\left(t - \frac{vx'}{c^2 - v^2}\right)$	$\xi = ax'\beta^2$	$\eta = ay\beta$	$\zeta = az\beta$
No correction possible	↓	↓	↓	↓
Observed result *(all quantities must remain unchanged).*	$\tau = a\left(t - \frac{vx'\beta^2}{c^2}\right)$	$\xi = ax'\beta^2$	$\eta = ay\beta$	$\zeta = az\beta$
Effects redistribution *(assuming an apparent time alteration in the "moving" system).*	*Dividing all right sides by* β *(placing* $a = \frac{1}{\beta}$*)* ↓			
Observed result *(after the effects redistribution).*	$\tau = \frac{t}{\beta} - \frac{vx'\beta}{c^2}$	$\xi = x'\beta$	$\eta = y$	$\zeta = z$
Final transformations *(applying the Galilean transforms).*	$\tau = \left(t - \frac{vx}{c^2}\right)\beta$	$\xi = (x - vt)\beta$	$\eta = y$	$\zeta = z$
Alterations *(due to "motion" relative to the observer).*	• Apparent length contraction along the motion axis • Apparent time alteration			

Table 1b $\beta = 1\big/\sqrt{1 - v^2/c^2}$

3.6 Remarks on the Einstein's derivation

First of all, a reconstruction of the SRT 1905 missing algebraic passages shows that, contrarily to what affirmed by Einstein, the quantity a cannot equal 1 but $\sqrt{1-v^2/c^2}$, meaning all right members of his transforms are multiplied by this factor in a not declared way*; (also in the Lorentz's process a quantity l appears, here omitted since it really equals 1). Then, since both Lorentz and Einstein intend to correct the M.&M. theoretical light anisotropy, both SRT and LET processes should start from this last one.

Tables 1a and 1b instead show that, given the great difference between SRT and LET founding principles, it is possible for Einstein to obtain the same Lorentz's results only by means of an incorrect exchange between proper and improper coordinates (already present in the first "theoretical result" step), that allows Einstein to obtain a length contraction instead of a length dilatation; (because of this exchange, in the "redistribution of the effects" step Lorentz's right terms are multiplied by β, whereas Einstein's right terms are divided by β).

This exchange occurs at the very beginning of the 1905 derivation, by means of the contradictory meaning attributed to the symbol x'. In fact, in the Einstein's starting relation:

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* The following interpretation was kindly suggested to me by Prof. Umberto Bartocci, Perugia University: in the first steps of Einstein's process, a is a function $\phi(v)$, then determined to equal 1. But after substituting for $a = \phi(v)$, the right sides of SRT transformations are inexplicably multiplied by $\sqrt{1-v^2/c^2}$, meaning it is not $a = \phi(v)$, as Einstein claims, but $a/\sqrt{1-v^2/c^2} = \phi(v)$.

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

x' represents an unaltered length in the "moving" system, according to $x'=x-vt$, and therefore undergoing the same theoretical alterations predicted by Michelson for his length *D*. But in the subsequent Einstein's passage $\xi = ax'/\left(1-v^2/c^2\right)$ ("theoretical result" of Table 1a and 1b), ξ represents an unaltered or proper length, and therefore *x'* must represent an altered or improper length! Though revealing itself by the incorrect process here evidenced, this wrong inversion is fundamentally a conceptual problem, therefore concerning not only the SRT 1905 exposition, but also the SRT founding principle according to which it is possible to obtain the Lorentz transformations from the SRT two postulates only. In fact, all subsequent Einstein's SRT expositions, though using algebraic processes differing from the 1905 one, still show the same ambiguity of symbols making it possible to obtain, by means of redundant operations, transformations "identical" to those by Lorentz. *

Concluding, another kind of SRT derivation can be found, that treats SRT transforms as a special case of GRT (General Relativity Theory) equations; (as a rotation by an imaginary angle of a tetra dimensional coordinates system). But this last demonstration, since it derives SRT from a theory, GRT, which is derived from SRT, is clearly tautological.

* Most of published derivations of SRT transformations are based on the few ones, all showing ambiguity of symbols, Einstein himself offered in his writings.

3.7 The SRT time transformation*

In the SRT 1905 exposition τ is the time of the "moving" system *k* viewed on his own clock by an observer in *k*: that is a proper time. *t* is the time marked by the same above clock in *k*, but viewed by an observer placed in the system "at rest" *K*: that is an improper time.

Since in SRT improper time is slowed relative to proper time, it follows that, assuming all clocks previously synchronized to mark the time O when systems *K* and *k* are coincident, an observer "at rest" in *K* should view a clock in *k* marking an improper time *t* lesser than the proper time τ viewed on the same clock by an observer in *k* (and lesser by the same amount than the proper time viewed by this observer in *K* on his own clock). Thus, it should be $\tau > t$. But this basic requirement is contradicted by the SRT time transformation

$$\tau = \frac{t - \frac{xv}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

(where *x* can represent the distance $(x' + vt)$ between an observer at the origin of *K* and a clock placed along the ξ axis of the system "at motion" *k*), in which it is $\tau < t$ and not $\tau > t$ as it should be. This is even more evident if the positions of clocks and observers coincide with the origins of systems *K* and *k*, case defined by $x' = 0$, $x = vt$, by which the SRT time transformation becomes $\tau = t\sqrt{1 - v^2/c^2}$, implying again $\tau < t$.

* Given the different meanings Einstein and Lorentz attach to the Lorentz transformations, hereafter, if considered in the SRT context, these transformations will be called SRT transformations.

This problem is again due to an inversion between the points of view of observers, (that is, between proper and improper time), and is not evident as it should because of the erroneous interpretation, confusing metrics for coordinates, the STR time transform usually undergoes. In fact, a time coordinates transformation is a relation between time intervals based on a common metric and a common time 0, (thus requiring previously synchronized clocks). Whereas a time metrics transformation is a relation between different time units of measurement or equal multiples of such units, not necessarily based on a common time 0, (thus not requiring in principle previously synchronized clocks). Therefore, saying that an SRT observer "at rest" views 10 o'clock on his clock (proper time coordinate) and 8 o'clock on a "moving" clock (improper time coordinate lesser than the proper coordinate), is the same as saying that an 8 h time interval measured on this "moving" clock by an observer integral with it (proper time metric), is viewed as a dilated 10 h time interval by the above observer "at rest", (improper time metric greater than the proper time metric).

Clearly, we are now dealing with two complementary interpretations of the same effect (obtained exchanging proper and improper points of view), the first one referred to coordinates, the second one to metrics. Since the SRT time transformation expresses a time dilatation, it is clear is usually intended as a metrics transformation. But this interpretation contradicts the definition Einstein himself gives of his transformations, always calling them "transformations of coordinates"; (this contradiction does not arise in LET, because, as already said, Lorentz offers his transformations only in the metrics form, without applying the Galilean transformations).

Let us then consider the relation $\tau = t\sqrt{1-v^2/c^2} - \dfrac{vx'/c^2}{\sqrt{1-v^2/c^2}}$, implicit passage in Einstein's 1905 article and change of variables in Lorentz's 1904 article. In this relation the subtraction from the dilated time t of the quantity $\frac{v}{c}\frac{x'}{c\sqrt{1-v^2/c^2}}$ is an additional correction for the constant time delay taken by light to cover with a velocity $(c-v)$ the contracted distance *x'* (placed in the moving or "moving" system) in the direction of the increasing *X* (if light covered the distance *x'* in the opposite way, with a velocity $(c+v)$, the above quantity should instead be added). Therefore, this additional time delay can be only viewed by an observer placed at *x'* in a clock placed at the origin of the moving system. In the Lorentz context, in which time dilatation does not depend on the observers, but only occurs in a system moving through the ether, assuming an observer in the moving system who views this additional time delay is quite licit.

But in SRT, in which an observer *by definition* views relativistic effects only in a system "moving" relative to him, assuming that the total time dilatation is the sum of the time dilatation which an observer "at rest" views in a "moving" system, and of an additional time delay viewed by another observer integral with the "moving" system, is a contradiction in terms (moreover, this assumption contradicts the Einstein's assertion, contained in the 1905 article, that the "moving" clock is placed at the point *x'*).

3.8 SRT Doppler equation

Differently from Lorentz, Einstein offers a revised version of the classical Doppler equation. His reasoning is clear: if an observer "at rest" views the oscillation of a "moving" light clock as altered, he will view as altered also the frequency of a "moving" wave source. The SRT (1905 article) Doppler relation (for separating motion) is

$$\nu' = \nu \frac{1 - \cos\phi\, v/c}{\sqrt{\left(1 - v^2/c^2\right)}}$$

(where ν is the frequency of the wave source, ν' is the frequency perceived by the observer, and ϕ the angle between the motion axis and the connecting line "source-observer"), that for $\phi = 0$ (longitudinal Doppler), assumes the form

$$\nu' = \nu \frac{\sqrt{1 - v/c}}{\sqrt{1 + v/c}},$$

and for $\phi = 90°$ (transverse Doppler), becomes

$$\nu' = \nu \frac{1}{\sqrt{\left(1 - v^2/c^2\right)}}.$$

The case for which the classical Doppler equation predicts no effect, since the distance between source and observer does not change.

The SRT Doppler equation contains therefore two factors, the classical Doppler factor $\left(1 - v/c\right)$, taken from the classical Doppler equation, and the SRT time dilatation factor $\frac{1}{\sqrt{\left(1 - v^2/c^2\right)}}$. But this last one is here applied in a reversed way, absurdly implying that the frequency emitted by a time slowed "moving" wave source becomes higher, giving rise to a blue shift! It is then to be noted that if both SRT longitudinal Doppler and SRT time corrections are applied on the same clock frequency, we have

$$\nu' = \nu \frac{\sqrt{1 - v^2/c^2}\sqrt{1 - v/c}}{\sqrt{1 + v/c}},$$

that is $\nu' = \nu(1 - v/c)$, (*ossia* a classic Doppler equation!).

4. Arbitrariness of the light route chosen by Einstein

Taking as a model a Michelson interferometer, Einstein uses a back and forth light route to describe apparent time-space alterations viewed by SRT observers. This light route can be a good way to measure the "vibration" of a particle. But using it to measure macroscopic quantities measurable by rods and clocks, as Einstein does, is completely arbitrary, since a length measurement based on light depends on the light route chosen. In fact, according to the light postulate, given a "moving" length *D* parallel to the "motion" axis, its measurement is $Dc/(c-v)$ if made by a single light trip in the direction of motion; $Dc/(c+v)$ by a single trip in the opposite way; $D/(1-v^2/c^2))$ by a back and forth light trip; $D/\sqrt{1-c^2/v^2}$ for an identical trip, but perpendicular to the motion axis, and so on.

Thus, all the above quantities must be considered as no more than apparently altered length measurements, depending on the kind of light route chosen to measure them. Whereas only a single light route from source to observer can represent the apparent space time alteration viewed by this observer.

Thus, also the back and forth light route of a Michelson interferometer cannot represent the entire effect viewed by an observer, but just the only possible light route to detect a light anisotropy due to a pure translatory motion. Basing his model on a back and forth light route, Einstein therefore confuses the measurement limit of a device with the entire theoretical effect taking place. But the Einstein's light route cannot even represent the time of a system.

In fact, the light anisotropy occurring in a "moving" interferometer shows that the rate of a "moving" SRT light clock depends on the angle between its oscillation axis and its "motion" axis - orientation anisotropy - (this because of the arguments exposed in paragraph 3.4); and that its "light pendulum" exhibits an anisotropy in its two oscillation ways, $(c+v)$ and $(c-v)$ - directional anisotropy. Both facts contradict the idea itself of time, isotropic *by definition*. In the Lorentz's ether model a "light clock" does not show orientation anisotropy, due to a licit application of the length contraction correction, but however shows a directional anisotropy, meaning also in LET a "light clock" cannot in principle represent the time flowing.

5. Further remarks on time and clocks behavior

Despite of the fact time appears in most physical laws, neither a complete nor satisfactory definition of its very nature exists. Consequently, a rigorous definition of what a time measurement is, also does not exist. In fact, if the direction of time flowing - a time arrow - can be identified with the entropy law, much more difficult is to define the flowing of time itself. We could identify it with the velocity fundamental forces act. But this is however an incomplete and practically useless definition, since a device to measure time cannot take into account all four fundamental forces.

A clock is instead based on a single stable repetitive phenomenon, which under certain conditions can be assumed to represent time flowing, and basically consists in a frequency device (generator of periodic events) and a counter of this frequency (integrator, adder or accumulator).

Obviously, were the frequency of a pendulum clock altered by an external cause, like an increase in temperature dilating the pendulum support wire, or a mechanical action on the pendulum itself, no one would conclude that the flowing of absolute time has been really altered. So, be the frequency of an atomic clock altered by a mechanical cause, like motion through the Lorentz's ether, or by in immaterial cause, like the Einstein's light postulate, are we legitimated to conclude that the flux of absolute time, and therefore also our biological aging, has been altered, too? As already seen, the oscillation of a light clock cannot in principle be identified with time flowing. But, since the frequency emitted by an atom is in fact due to an oscillation as well, it is arguable that also the frequency of an atomic clock cannot in principle be identified with time flowing.

5.1 Mechanical behavior of clocks in Lorentz's and Einstein's models

As far as we know, Lorentz wisely did not attach any real physical meaning to his "local" altered time: as already said, his real alterations only regard light velocity and lengths, whereas his time dilatation is a simple convention, consisting in interpreting the interaction of the above two real effects as a time alteration. Einstein's point of view is instead contradictory. He calls his light postulate no more than a convention:

> ..... *in fact nor a supposition neither an hypothesis on the physical nature of light, but a convention which I can assume at my will in order to come to a definition of simultaneity*[7]

But a question arises from this affirmation: can a simple convention give rise to real consequences? In "The Meaning of Relativity," referring to length contraction and time dilatation Einstein writes:

> *These two consequences, that "mutatis mutandis," hold good for every reference system, express the meaning, cut of any formalism, of the Lorentz transformation.*

clearly meaning that SRT effects are apparent and reciprocal. In the first part of his 1905 article, as to the length contraction seen by an observer "at rest" in a "moving" system, he gives the same interpretation:

> *It is clear that the same results hold good of bodies at rest in the "stationary" system, viewed from a system in uniform motion.*

But soon after, in the same paragraph, he adds:

> *If we assume that the result proved for a polygonal line is also valid for a continuously curved line, we arrive at this result: If one of two synchronous clocks at A is moved in a closed curve with constant velocity until it returns to A, the journey lasting t seconds, then by the clock which has remained at rest the travelled clock on its arrival at A will be $\frac{1}{2} t v^2 / c^2$ second slow.*

clearly meaning SRT effects are real and non-reciprocal.

5.2 The Twin Paradox

From the above Einstein's thought experiment of clocks, the well known "twin paradox" derives, in which the two clocks are replaced with two twins, one of them making a space journey at a velocity near that of light, therefore, according to SRT, aging slower than the twin remained on Earth. The paradox arises from the fact that, exchanging the points of view of the observers on the basis of the relativity postulate, that is considering the twin on Earth as "at motion" and the traveling twin as "at rest," the twin to age slower should be the one remained on Earth.

This contradiction is usually solved by considering as "really moving," and therefore as "really aging slower," the twin who underwent accelerations, that is the traveling twin. But this escamotage is unacceptable. First, because it contradicts the SRT basic requirement that all SRT effects must be apparent and reciprocal. Second, because it involves General Relativity, that is, a theory conceived about ten years after SRT.

Third, and most important, because it is based on the principle that inertial motion preceded by acceleration differs from inertial motion not preceded by acceleration: meaning to decide which of two systems is really moving and therefore undergoing a real time dilatation, we should know the entire history of all previous accelerations of both systems - one system might have accelerated one year ago, but the other one might have accelerated ten years ago, and so on. Clearly, an unacceptable point of view. Referring to SRT effects, Einstein himself excludes this interpretation:

> *It is essential to these argumentations to assume that the behaviour of the samples of measurement is independent of the history of their previous motion.*[8]

The only other possible solution of this paradox consists in considering as apparent both points of view. But this means each of two twins views the other one aging more slowly, till they meet again and their reciprocal illusion abruptly disappears. Clearly, another unacceptable view. In this light, the "twin paradox" must be considered nothing else but an illogical consequence of an illogical model. Despite of the coherence problems here raised, the "effects as real" interpretation has prevailed. This is mainly due to the fact the Lorentz transformations are tailored on the real and non-reciprocal effects predicted by the Lorentz ether model, and cannot in principle describe apparent and reciprocal effects. Furthermore, it seems that, whereas the "mechanical" cause of Lorentz alterations gives them a mechanical character, too, the immaterial (and almost metaphysical) action of the light postulate instead gives SRT effects a sort of aprioristic truth. Due to the real and non-reciprocal effects predicted, in the LET context a twins paradox cannot arise, since motion is considered relative not to observers but to ether, meaning only the moving "relative to ether" twin undergoes Lorentz's effects. Moreover, LET time dilatation does not effect the biological aging of the moving twin, but at the most the rate of his clock.

5.3 Clock alterations in an ether model without length contraction

The coherency of the Lorentz's model does not exclude other kinds of ether models may be possible, since light isotropy is far from being really proved, and no experimental evidence of length contraction exists. Moreover, coincidences like an Earth just at the center of universe, or like a length contraction just exactly equalizing the two light routes of a Michelson interferometer, are historically too benevolent and perfect to be true. This said, we must point out that the predictions by an ether model without length contraction would slightly differ from LET's ones. In fact, in this case, a "moving relative to the ether" light clock (and possibly an atomic clock), should exhibit anisotropic alterations by a factor

$$1\Big/\sqrt{1-\cos\varphi\, v^2/c^2}\,\sqrt{1-v^2/c^2}$$

depending on the angle φ between its oscillation axis and its motion axis (a right angle giving rise to the same dilatation predicted by Lorentz). Obviously, coordinates transformations in such context do not make sense, because of the impossibility of interpreting an anisotropic light velocity alteration as an isotropic time alteration.

6 Logical consistency of the postulate of the c constancy

At this point we intend to inquire whether even the SRT light postulate, on which the entire SRT theoretical foundation lies, is logically consistent or not. Clearly, being *by definition* an undemonstrable assumption, it cannot be directly contradicted.

But, like every postulate, it cannot contradict factual evidence or/and causal logic. Leaving aside by now any critique to its factual evidence, we intend to restrict ourselves to test its logical consistency. In order to do that, we propose a simple thought experiment. Let us imagine a rod with at its ends *A* and *B* two observers with previously synchronized clocks, and at its middle *O* a sensor capable of emitting a flash only if receiving simultaneously two light signals from *A* and *B*. Let's then assume this rod be "at motion" relative to an observer "at rest" at *C*.

If at the same instant clocks at *A* and *B* emit two light signals, according to the light postulate, by an observer "moving" with the rod the two signals will take the same time $AO/c = BO/c$ to reach the sensor at *O*: that is they will arrive simultaneously to the sensor, which therefore will emit a flash. But, according to the observer at *C* "at motion" relative to the rod, to reach *O* the two light signals will take times $AO/(c-v)$ and $BO/(c+v)$, respectively. That is, they will not arrive simultaneously at the sensor, which therefore will not emit any flash. We face now a strange scenario. We know that, according to the light postulate, different relative moving observers must see the same event at different instants of their own time.

But what now changes is not only “when” they see this event, but also “what” they see. In fact, whereas observers in the system *AOB* see the sensor emitting a flash, according to the observer at *C* this flash will not be emitted. In this case, therefore, different observers see different events, capable of affecting in different ways the course of future events - for instance, assuming the sensor at *O* be connected with a bomb programmed to explode if a flash is emitted, according to the light postulate observers in *AOB* would see this bomb explode, being eventually killed, whereas the observer at *C* would see the bomb not explode and observers in the rod AOB keep living.

At this point only two interpretations are possible: to admit that also in macrocosms physics a superposition of events is possible, as quantum mechanics predicts for microcosm physics; or to reject the light postulate, since it contradicts the necessary requirements of a coherent description of reality in accordance with the causality principle. Since the first interpretation involves an excessive “metaphysical luggage,” we must consider the light postulate as logically unacceptable.

7. Transformations of coordinates describing apparent alterations due to a finite speed of light

The fact that from the light postulate it is not possible to correctly obtain the Lorentz transformations, together with the logical inconsistence of the light postulate itself, clearly proves that the SRT model is incoherent, but does not mean that the Lorentz transformations are incoherent, (since these last ones are obviously compatible also with the Lorentz’s ether theory). Neither does it mean that the basic aim of SRT, that is to describe apparent space-time alterations viewed by relative moving observers because of the finite speed of light, is incoherent. We intend now to obtain transformations accomplishing this SRT basic aim, and therefore not substitutive of those by Lorentz (concerning real and non-reciprocal alterations in light velocity and lengths due to the ether wind), but of SRT transforms (in principle concerning apparent space time alterations). These apparent alterations can be explained as follows: *due to the time light takes to travel from a source to an observer, at a given instant of absolute time an observer sees a moving wave source at a point of space-time coordinates not corresponding to the point this source really is; these space time alterations are apparent and disappear with the disappearence of the distance between observer and source.* In particular, we can distinguish two kinds of apparent time alterations:

i. **Constant time delay - with no apparent alteration of the time flux** (due to a fixed distance between observer and source).
ii. **Changing time delay - with apparent dilatation or compression of the time flux** (due to a variable distance between observer and source).

All these time alterations are ascribable to the following principle: every kind of wave transmission involves a physical link between data and wave structure, which is set up at the moment a wave is generated and cannot be set aside anymore by any analog process. Due to this link, a dilated frequency emitted by a "moving away" source involves a dilatation of the information flux - apparent time dilatation-, and a compressed frequency emitted by an "approaching" source involves a compression of the information flux - apparent time compression. This last principle, equally valid for both optics and acoustics, and of paramount importance for a full description of relativistic effects, is curiously not treated by most of physics texts. A simple recording taken by a station at rest of a moving sound source diffusing a sound sample of known duration, can easily prove an apparent alteration of the time flux also in sound propagation.*

From what said it is clear we can confer to any kind of wave propagation, sound or light, the only capability of carrying information about reality, but we must not confuse this information with reality. When we consider time alterations due to the finite speed of light, we are in fact considering velocity and delay in a light transmission of information, and the time flux we relate with this information flux is nothing else but a connection we operate among consequential single pieces of information. In agreement with the ideas and concepts exposed in this and previous paragraphs, we intend to base our space time transformations, that hereafter will be called WPAE (Wave Propagation Apparent Effects) transformations, on the following elements:

a) A single light route from source to observer (instead of the back and forth light route considered by Einstein).
b) A light medium, relative to which, motion, that of light included, is considered.
c) Ideal clocks whose rate is independent of any kind of mechanical influence.

Let us consider two systems, K of coordinates x, y, z, t at rest relative to the ether, and k of coordinates ξ, μ, ζ, τ moving along the X axis at a constant velocity v relative to the ether (and obviously relative to the system K), both systems being coincident at the instant of proper time $\tau_o = t_o = 0$ (time coordinates are here to be intended as time values

* This test, carried out by the author in May, 2005, is reported in the appendix 1 of this article.

marked by ideal clocks previously synchronized to mark the time 0 when the two systems are coincident. Let us first consider moving away motion, here corresponding to instants following the instant $\tau_o = t_o = 0$.

Assuming the observer at rest be at the origin of the system *K*, and the moving wave source be at a point ξ_1 of the system *k* (a source can conveniently be imagined as an ideal clock-transmitter), an electromagnetic wave carrying time information of a certain instant τ_1 in *k* (for instance a snapshot of the clock display), will take a time delay $(\xi_1 + v\tau_1)/c$ to travel from source to observer. More generally, our observer will receive time information from *k* at his proper time

$$t_o = \tau + \frac{(\xi + v\tau)}{c}, \text{ that is } t_o = \tau\left(1 + \frac{v}{c}\right) + \frac{\xi}{c}$$

By an analogous reasoning, during the time interval $(\xi + v\tau)/c$, in which light covers the distance $\xi + v\tau$ from source to observer, this source will have covered another length $(\xi + v\tau)v/c$. Therefore, the real or proper distance x_o between source and observer will be

$$x_o = \xi + v\tau + (\xi + v\tau)v/c, \quad \text{that is} \quad x_o = (\xi + v\tau)(1 + v/c).$$

Since *by definition* the other two coordinates must remain unchanged, for the case considered we have the following transformations:

$$t_o = \tau\left(1 + \frac{v}{c}\right) + \frac{\xi}{c},$$

$$x_o = (\xi + v\tau)\left(1 + \frac{v}{c}\right),$$

$$y_o = \eta ,$$

$$z_o = \zeta \tag{1}$$

where symbol $_o$ distinguishes proper or not altered coordinates (belonging to the system where the observer is assumed to be), from improper or altered coordinates (belonging to the system where the wave source is assumed to be). If we instead consider a moving observer and a source at rest, always both relative to ether, the time taken by light to travel from the source to the observer will be $(vt-x)/(c-v)$, thus we have $\tau_o = (vt-x)/(c-v)+t$ and $\xi_o = (vt-x)+v(vt-x)/(c-v)$, from which we obtain the following transformations:

$$\tau_o = \frac{t-\frac{x}{c}}{1-\frac{v}{c}},$$

$$\xi_o = \frac{x-vt}{1-\frac{v}{c}},$$

$$\eta_o = y ,$$

$$\zeta_o = z \tag{2}$$

Since we consider motion relative to ether, transformations 1) slightly differ from transformations 2), meaning each of two relative moving observers views similar, but not identical effects in the other's system (as for the classical Doppler effect).

For approaching motion, we must instead consider instants preceding the instant $\tau_o = t_o = 0$ when systems k and K are coincident, that is, negative values of τ and t (whereas time metrics negative values make no sense, time coordinates negative values are perfectly licit, being values marked by time counters whose time 0 is established *by convention*). Since in this case light moves in opposite ways with respect to the "moving away" motion case, we must invert the sign of c in our transformations 1) and 2), obtaining from 1):

$$t_o = \tau\left(1 - \frac{v}{c}\right) - \frac{\xi}{c},$$

$$x_o = (\xi + v\tau)\left(1 - \frac{v}{c}\right),$$

$$y_o = \eta,$$

$$z_o = \zeta \qquad (3)$$

and from 2):

$$\tau_o = \frac{t + \frac{x}{c}}{1 + \frac{v}{c}},$$

$$\xi_o = \frac{x - vt}{1 + \frac{v}{c}},$$

$$\eta_o = y,$$

$$\zeta_o = z \qquad (4)$$

The first order coefficient appearing in WPAE transformations make them predict space-time dilatation for separating motion and space-time compression for approaching motion. Whereas, because of the squared quantities *c* and *v*, (making a change of sign in them do not effect the final result), SRT transformations always predict time dilatation and space contraction for both kinds of motion.

8. Remarks on the meaning of WPAE time transformations

Given the difficulty, not to say the impossibility, in obtaining a precise length measurement without involving time and light velocity parameters, and given the fact in my knowledge no direct experimental evidence of length contraction exists, the following discussion will be focused on time transformations, on which tests are however difficult but possible. Assuming for simplicity that the source and the observer are placed at the origins of their respective systems, conditions obtained by placing ξ and x equal 0 in our time transformations, from the relation (1) for observer at rest and moving away source we obtain

$$t_o = \tau(1 + v/c) \quad \text{(1a),}$$

and from (3) for approaching source

$$t_o = \tau(1 - v/c) \quad \text{(3a).}$$

(As already said, a wave source can be imagined as an ideal clock transmitter, making no difference whether an observer sees the display of this moving clock by a telescope or receives its clock rate code via an electromagnetic transmission). If we consider metrics instead of coordinates, since proper time coordinates correspond to improper time metrics, and vice versa (see 3.7), from (1a) we obtain

$$\Delta t = \Delta\tau_o\left(1 + v/c\right) \quad \text{(1b)},$$

and from (3a):

$$\Delta t = \Delta\tau_o\left(1 - v/c\right) \quad \text{(3b)}.$$

So, for instance, according to the coordinates relation 1a) an observer at rest views 10 o'clock on his clock (proper time), and simultaneously views 8 o'clock on a moving away clock (improper time), meaning it is $t_o > \tau$. Whereas according the corresponding metrics relation 1b), an observer integral with this moving clock measures an 8 h proper time interval on this clock, and 2 hours later, when the light information of this measurement reaches the observer at rest, this last one measures this 8 h proper interval as a 10 h improper interval, meaning it is $\Delta t_o < \Delta\tau$ (time metrics dilation by a factor $\left(1 + v/c\right)$).*

For an approaching source, in accord with the coordinates relation (3a), an observer views –8 on his clock (proper time) and –10 on an approaching clock (improper time), always being $t_o > \tau$. But according to the relation (3b), since in a metrics relation intervals must be positive *by definition*, it is $\Delta\tau_o > \Delta t$, - time metrics compression by a factor $\left(1 - v/c\right)$. Analogously, we find simplified time relations for an observer at motion and a wave source at rest:

$$\tau_o = t/\left(1 - v/c\right) \quad \text{(2a) (separating motion), and}$$

$$\tau_o = t/\left(1 + v/c\right) \quad \text{(4a) (approaching motion),}$$

* As already said, we are dealing with two complementary interpretations of the same effect, the second relation consisting in an inversion between proper and improper points of view, here made possible by a loss of simultaneity in measurements.

corresponding to the metrics transformations

$$\Delta\tau = \Delta t_o / (1 - v/c) \qquad \text{(2b), and}$$
$$\Delta\tau = \Delta t_o / (1 + v/c) \qquad \text{(4b).}$$

8.1 Possible experiments to test WPAE and SRT time transformations

Our WPAE time metrics transformations are the most suitable to be compared to the SRT time transformation, this last one in fact used as a metrics relation. According to our WPAE transformations, a time sample transmitted by a moving away source will be viewed by an observer at rest as dilated by a factor $(1 + v/c)$, whereas according to SRT, an observer "at rest" should view it dilated by a factor $1/\sqrt{1 - v^2/c^2}$.

But the greatest difference regards an approaching source, for which, according to SRT, an observer "at rest" should view a time sample dilated by the same factor $1/\sqrt{1 - v^2/c^2}$, whereas according to WPAE transformations, he should view it compressed by a factor $(1 - v/c)$.

As to the already mentioned Einstein's thought experiment of the two clocks (5.0), in which a clock following a circular route walks slower than a clock at rest along the same route. For the same situation our WPAE model instead predicts that an observer contiguous to the clock at rest, views the moving clock walking slower during its "separating" motion, and walking faster during its "approaching" motion, regaining its time delay, to eventually view the traveling clock marking the same time of that at rest, once both returned contiguous.

Since tests on time alterations need high relative speeds, a possible test could involve the ISS (International Space Station) as receiver, and a satellite inscribed in an almost identical but opposite orbit as wave source, (both provided with atomic clocks oriented the same way with respect to the Earth), so obtaining a relative velocity of ≈15,5 km/s! The path covered by the two bodies during each test should be a small part of their entire orbit, so that both paths can be considered as rectilinear. The satellite should send an electromagnetic transmission of known duration before passing the ISS, and repeat it when moving away from it. Assuming an ECI (Earth Centered Inertial) ether model (the most plausible ether model on the basis of the available experimental data), based on the idea of a light medium almost totally dragged by the Earth's motion around the Sun (because of Earth's mass and gravitational field), but not dragged by Earth's rotation, both receiver and source can be considered as moving at the same velocity relative to ether. In this case we must use a more general form of our WPAE time metrics transformations,

$$\Delta t_o = \Delta t \left(\frac{1 - \frac{v_r}{c}}{1 + \frac{v_s}{c}} \right) \qquad (5),$$

(where Δt_o is the real duration of the transmission -proper time interval-, Δt its apparent duration as viewed by the receiver -improper time interval-, v_s the velocity of the source and v_r that of the receiver, both relative to ether). Since source and receiver move in opposite ways at about the same ≈7,7 km/s velocity relative to ether, for a 100 s transmission, corresponding to about 1555 km covered by these two bodies, for the approaching motion, relation (5) gives a ≈−5,185 μs compression, whereas SRT predicts a ≈+134 ns dilatation.

For the moving away it motion gives ≈+5,185 μs dilatation, whereas SRT predicts the same ≈+134 ns dilatation. Thus, according to SRT, the two transmissions should appear to the ISS as equally dilated, that is, identical, whereas according to our transformations they should differ by about 10 ms!

The same above system of ISS and satellite in opposite orbits, in this case each in both roles of receiver and source, could be used to compare an ether model with SRT. ISS and satellite clocks should be synchronized with each other by an electromagnetic time signal during a close passage, and then exchange another time signal after a given time interval, during a subsequent close passage. We have the following possibilities:

i. According to SRT, that considers ISS and satellite as "moving" relative to one another, that is each equally "at rest" or "at motion," each system should find the same reciprocal and apparent clock rate dilatation in the other system;*
ii. According to an ether model, that considers ISS and satellite as moving relative to ether, atomic clocks in both systems should undergo symmetric real rate alterations, meaning that each system should find no clock rate alteration in the other system.

A continuous monitoring of orbiting clocks by means of atomic clocks on Earth during one single orbit could instead discriminate between LET (considering ISS and satellite as moving at variable velocity relative to a stationary ether, and thus predicting variable clock rate alterations in their clocks), and the ECI ether model, (considering ISS and satellite as moving at constant velocity relative to an Earth centered inertial ether, and thus predicting constant clock

* Obviously, a possible clock rate deviation viewed by the satellite in the ISS should be transmitted to an Earth control station.

rate alterations in their clocks). Lorentz length contraction could instead be verified by testing clock rate isotropy in an atomic clock moving through the ether with different angles relative to its motion axis. Concluding, testing a stationary ether model without length contraction would require a repetition of the M.&M. experiment in space, for example onboard of the ISS.

9. Experimental evidence proving SRT

Even though criticism and objections until now moved to SRT have widely shown its logical and mathematical inconsistency, it is not possible to ignore the great deal of experimental results seemingly confirming it, and that in the opinion of many people represents a proof stronger than any flaw detected in its theoretical part. First of all, it is to be noticed that all experimental evidences proving SRT transformations prove in principle also LET ones. In the light of the two main discriminating elements between SRT and LET (SRT effects are apparent and reciprocal whereas LET effects are real and non-reciprocal; motion in SRT is relative to observers whereas in LET is relative to ether), most of these evidences prove LET (or more generally an ether model), and disprove SRT. Then, in case the appearance (or reality) of effects cannot be checked, for "separating" motion and high relative velocities, that is the "astronomical" most common case, WPAE and SRT transformations give similar results. But, in the author's opinion, the main reason of the SRT great experimental consent lies in the way these experiments were (and are) carried on, and/or interpreted. In fact, in most cases, a deeper analysis reveals hidden tautological processes and/or manipulations of parameters, if not even forced adjustments of experimental data to fit theoretical predictions.* Even though an exhaustive analysis of SRT experimental evidences goes beyond the aims of this paper, we include here a brief analysis of main SRT experimental proofs (every experiment description is followed by a short discussion).

9.1 Hafele-Keating experiment

In October, 1971, Hafele and Keating flew four atomic cesium clocks on commercial airlines along opposite equatorial routes, and then compared them to the atomic clock in the Washington U.S. Naval Observatory. The observed time deviations, - 59 ns for the eastern travel and +273 ns for the western travel, were judged in good agreement with SRT and GRT theoretical predictions.[9]

First of all, SRT time alterations are *by definition* apparent and reciprocal, but the clock rate alterations here observed are instead real and non-reciprocal, and therefore prove in principle the Lorentz's ether theory. Then, Hafele's and Keating's predictions and observed data, reported in Table 2, give rise to strong perplexity.

Table 2 (a positive value is here to be intended as a time gain, a negative one as a time loss).

Average altitude: 9000 m	**Eastern travel** (41,2 h)	**Western travel** (48,6 h)
Kinematical effects predicted by SRT	–184 +/–18 ns	96 +/– 10 ns
Gravity effects predicted by GRT	+144 +/– 14 ns	179 +/– 18 ns
Sum of predictions by both theories	– 40 +/– 23 ns	275 +/– 21 ns
Observed effects	– **59 +/– 10 ns**	**273 +/– 21 ns**

* These proofs are thus likely to the layered sedimentations of errors collected in thousands of years in favour of the Aristotelic-Ptolemaic system, and that, till the coming of the Copernican Revolution, apparently demonstrated the irrefutable validity of the geocentric model.

Flights features show that the most similar conditions for eastern and western travels were searched, so to make it easier a comparison between them. Since the altitude and the flight duration are about the same in both flights, obviously also the GRT theoretical time alterations due to the difference of gravitational potential are likewise, too: 144 ns for the eastern travel and 179 ns for the western travel. The velocities of flights being about the same, too, we should expect that the two SRT time alteration values, both relative to an observer "at rest" on the Earth's surface, to be about the same, too. But, as Table 2 shows, these alterations are not the same at all, the eastern travel's one being −184 ns, and the western travel's one +96 ns. We thus now face two completely different values, the first one about twice the second one, and more disconcerting, one of the two values being positive! This means that clocks in the western travel run faster than Earth's clocks, that is, they underwent a real temporal compression doubly impossible in SRT (dealing with time dilatation and apparent effects only).

How is this possible? The only explanation is that Hafele and Keating chose as reference an *ad hoc* ECI (Earth centered inertial) frame, without which calculations make no sense. But this way they contradicted the relativity principle itself. In fact, this is like as reintroducing in SRT an absolute rest reference (ether), but this way this experiment result turns out to be not a proof in favour of SRT, but of the ECI ether model. Furthermore, a deeper analysis by A.G. Kelly of the original 1971 test report by Hafele, obtained by Kelly direct from the United States Naval Observatory, reveals how observed data were strongly altered to fit theoretical predictions.[10]

Table 3 (from Kelly's article) evidences the great corrections made on observed data, much greater than the final observed averages, this fact itself representing a contradiction in terms. The discordance among observed values is so great to put under discussion the principle itself of operating an average among them.

Table 3

	Original data of the H.&K. Test / alterations in nanoseconds					
	Eastern travel			**Western travel**		
Clock No	**Observ. Data**	**First correction attempt**	**Definitive correction**	**Observ. Data**	**First correction attempt**	**Definitive correction**
120	**- 196**	-52	-57	**+413**	+240	+277
361	**- 54**	-110	-74	**- 44**	+74	+284
408	**+166**	+3	-55	**+101**	+209	+266
447	**- 97**	-56	-51	**+ 26**	+116	+266
Averages	**- 45**	-54	-59	**+124**	+160	+273

Just because of this problem, this experiment was greatly criticized by Louis Essen*, designer and builder of the first operational atomic clock, who questioned the reliability itself of atomic clocks for long periods. Therefore, in the light of what was said, the probatory value of this experiment can be considered null.

9.2 Experiments on muon's decay - Rossi-Hall and analogous ones

In 1941 Rossi and Hall[11] measured, by means of scintillators, muon fluxes at different altitudes originating from cosmic rays interactions with the high atmosphere. Observed fluxes were 550 muons/h at the Mount Washington 6000 ft altitude and 422 muons/h at the base of this mountain, with a 550/422 muon fluxes ratio for this altitude

* English physicist Louis Essen (1905-1997) built in 1955 the first operational cesium atomic clock, and made the first light speed accurate measurement, adopted by the Radio Scientific Union. After these historical achievements, he wrote some articles strongly criticizing SRT, that led to the end of his scientific career and to his banishment from the academic world.

difference. The high percentage of muons reaching the lower detector, apparently contradicting the much smaller muons theoretical flux calculated on the basis of their average time decay when at rest, was considered an indirect proof of the SRT time dilatation for speeds approaching that of light, that would lengthen the life of muons, allowing them to easily reach sea level.

First of all, the result of this experiment (and analogous ones) can be otherwise explained out of the SRT context, assuming for muons a superluminal speed such as to allow them to easily reach the sea level within their life duration when at rest.

Just to avoid a possible violation of the SRT light speed limit, it was instead preferred to ascribe this effect to the SRT time dilatation. But this last interpretation is undermined by a clear tautological process, since the light postulate is introduced “a priori” in the explanation. Moreover, assuming as muons speed an arbitrary “SRT consistent” aprioristic value of about 0.989 c fitting observed data, as it is done, legitimates in principle the handling of this value in such a way to justify any muon fluxes ratio, fact that, on the basis of a simple Popperian logic, takes off any probatory value from this proof, since it is not falsifiable.

Therefore, the SRT interpretation of this effect cannot be considered a proof in favour of SRT, but at the most a possible explanation in accordance with this theory. Furthermore, this interpretation contradicts the principle that SRT effects must be apparent and reciprocal, since the lengthened life of muons is not here proved by visual observations, but by the physical passages of these particles in plastic scintillators, a fact possible only in case of a real effect.

9.3 Bailey experiment on muons decay

In the Bailey experiment[12] and analogous ones a “produced in laboratory” muons beam is accelerated to relativistic speeds in a particle accelerator and then detected by plastic scintillators. Again, muons average life seems to get longer.

This kind of experiment seems to be a further proof of the dilated life of muons when at motion. But also in this case, since the observed alterations are real and not apparent, the same critique already raised on the Rossi-Hall experiment about the non-pertinence of real effects with SRT is still valid. Moreover, this pertinence with SRT, dealing *by definition* with translatory motions only, is here also invalidated by the enormous accelerations muons undergo in order to reach relativistic speeds, and by the tremendous centrifugal forces due to the curved route of a particle accelerator.

9.4 Relativistic Corrections in the GPS

This proof, considered by many as the strongest one in favour of SRT, consists of the rate alterations observed in GPS orbiting atomic clocks. The sum of ≈ +45,900 ns/day time gain predicted by GRT and ≈-7,200 ns/day time loss by SRT, is in accord with to the observed ≈ +38,700 ns/day time gain.

As already said, SRT effects must be apparent by definition, but the clock rate alterations here observed seem to be quite real. Moreover, these data were observed in a single test carried out on the first GPS atomic clock put in orbit, whose clock rate deviation was measured after 20 days. Therefore, only one single clock was used, and no monitoring of possible rate variations during one single orbit was made. After this test, all following clocks put in orbit were, and keep being, continuously reset by GPS Earth stations, because of the already mentioned unreliability of atomic clocks in long periods, proved by the great discordance among clocks occurred after only two days in the Hafele-Keating experiment.

Then, as already said, the main relativistic effects directly corrected on the frequency (clock rate) of the GPS atomic clocks are those predicted by GRT - blue shift due to the difference of gravitational potential - and by SRT - red shift due to time dilatation - called a little misleadingly by some authors second order Doppler shift, implying it is the SRT transverse Doppler shift.

It is first to be noted that, according to Einstein himself, this last effect gives rise to a blue shift, and not to a red shift (see paragraph 3.8). But the greatest contradiction arises from the fact GPS receivers on Earth apply first order classical Doppler corrections (and not SRT Doppler corrections) to track the frequencies of the GPS orbiting clocks, fact that clearly proves again an ether model.

Concluding, it is to be added that SRT effects acting on the "moving" GPS clocks are calculated not relative to the observers (GPS Earth stations), but to an ideal ECI frame, again contradicting the SRT relativity postulate and instead proving an ether model. Moreover, since in this ideal frame, satellites circularly orbit around a point in which the observer is assumed to be, their distance from this point does not change. But this means the satellites do not move relative to the observer, but to the space around the observer, that is, relative to the ether!

9.5 Michelson-Morley experiment and analogous ones

This kind of experiment searches for a possible light anisotropy due to the Earth's rotation. The null result usually reported is considered in accordance with SRT.

First of all, a null result in this kind of experiment proves not only SRT but also LET (both theories being tailored on this result), and therefore cannot be considered a true proof supporting SRT. Then, having already treated the M.&M. experiment and its meaning in 3.1, it is to be reaffirmed that, beyond the official interpretations (dictated more by diplomacy than objectivity criterions), almost none of the most known experiments of this kind (Tomascheck, Kennedy, Illingworth, Michelson, Pease and Pearson, Piccard e Stahel, Joos, etc.)[13] gave a real null result. All of them instead revealed a fringe shift, undeniably smaller than that predicted by a stationary ether model, but fully consistent with an ECI ether model.

But an ether drift is most of all confirmed by the long and impressive research carried out by Dayton Miller* from 1902 to 1926, alone and with Morley, consisting of more than 200,000 measurements and 12,000 turns of observation taken in different year epochs, the latest of them made at Mount Wilson at a 6000 feet altitude, by means of more and more sensitive interferometers (up to a 64 meters optical route interferometer, obtained by repetitive reflections). In 1936[14] Miller wrote:

> *The curves of observation… give directly the values of the maximum velocity of relative motion of the earth and ether, as observed in the plane of the interferometer, for the four epochs;…….The present results strikingly illustrate the correctness of this method, as it now appears that the forty six years of delay in finding the effect of the orbital motion of the earth in the ether-drift observations have been due to efforts to verify certain*

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* Dayton Miller, (1866-1941), President of the American Physical Society and Acoustical Society of America, Chairman of the Division of Physical Sciences of the National Research Council.

predictions of the so called classical theories and to the influence of traditional points of view.

9.6 Sagnac effect

This effect is a light anisotropy detected by Georges Sagnac in 1913 by means of a particular interferometer designed by himself, in which light is forced by mirrors to travel a closed route in opposite ways. When the interferometer is at rest, light travels in opposite ways at the same velocity. When the interferometer rotates, light travels in opposite ways at different velocities, giving rise to an observable fringe shift.

As contradicting the SRT light postulate, the Sagnac effect is the only relativistic effect here treated no way compatible with SRT. Just because of this, it is generally considered a *sui generis* alteration, extraneous at all to SRT (ironically, Sagnac designed his interferometer just to falsify SRT).

Sagnac electromagnetic anisotropy

The optical principle of the Sagnac interferometer, intended as an optical gyroscope capable of detecting a rotatory motion with respect to the fixed stars, is widely used and tested. Early in 1925, Michelson and Gale measured the Earth's rotation by means of a gigantic Sagnac interferometer featuring an impressive rectangular route spanning 320 x 640 meters.[15] Nowadays a great variety of technological applications based on this effect exists, such as the Fiber Optical Gyros, mounted on inertial platforms of airplanes, missiles and space vehicles, and the Ring Laser Gyros, like the G (gigantic) Ring Laser by C. Zeiss used to monitor Earth's rotation. Sagnac anisotropy is also detected in terrestrial electromagnetic transmissions, that, because of Earth's rotation, travel at $\left(c+\omega_e r\right)$ westward and at

$(c-\omega_e r)$ eastward, being ω_e the Earth's angular velocity and *r* the Earth's radium (in this case the Earth itself behaves like a gigantic optical gyroscope). This effect, that for a complete Earth's equator round amounts to ≈± 207 ns, since it is a first order light anisotropy detected by observers integral with the moving system, clearly contradicts the postulate of the constancy of *c*.

Some texts try to solve this contradiction by holding the extraneousness of the Sagnac effect to SRT, because of the curved route of light, and offer an alternative Newtonian interpretation, ascribing this effect to the geometrical displacement of the reference points occurring in a rotating system. But this explanation is seriously incomplete, because, since it considers rotational motion relative to the "fixed stars," implicitly introduces an absolute rotatory rest based on the Mach principle* and at all extraneous to Newton's mechanics (the first one to evidence the lack of a rigorous definition of rotational motion in Newton's physics was George Berkeley in the 18th century).

Moreover, this explanation raises some embarrassing questions: why light should obey Newtonian physics when traveling in a rotating system, and Relativity when traveling in a translatory moving system? Why a simple Galilean addition of light velocity and Earth's rotational velocity is in such a good accordance with experimental data, with a nanosecond precision absolutely unmatched by any prediction based on SRT? Why curved motions analogous to Earth's rotation, like GPS satellites orbits and equatorial routes in the Hafele-Keating experiment, are instead considered pertinent with SRT? (As

* Ernst Mach (1838-1916), physicist, mathematician and philosopher, whose main contributions concern researches on sound propagation and a foundation of a philosophy of science. His definition of the centrifugal force as a consequence of a rotatory motion relative to the universe (fixed stars), or at least a local portion of it, is commonly known as the "Mach principle."

already seen, Einstein himself applies SRT transformations to a curved route - see 5.1). From this, it is clear that the Sagnac electromagnetic anisotropy is fully consistent with an ether model, and therefore contradicts SRT.

Sagnac clock rate alteration in Earth's clocks

Within the Sagnac realm another effect due to Earth's rotation is classified, consisting in an alteration observed in the rate of Earth's atomic clocks, and by the same amount of Sagnac light anisotropy. If ascribed to a synchronization problem, this effect could be considered as a direct consequence of the Sagnac light anisotropy: in fact, if we use an electromagnetic signal to synchronize a ring of clocks placed along the Earth's equator, after a complete westward/eastward Earth's round of the signal, the last clock will show a 207 ns advance/delay with respect to the first one.

But if referred to the rate itself, (oscillation), of the clocks, as reported on many papers on this subject, this effect cannot be considered a first order alteration, like the Sagnac light anisotropy, but a second order one. The contradiction arising from two different factors giving rise to the same result, can be explained in the ambit of an ether model. In fact, whereas the time delay/advance due to the Sagnac light anisotropy for a full Earth's equator round is

$$2\pi r/(c \pm \omega_e r) - 2\pi r/c \qquad 6),$$

corresponding to the observed $\pm \approx 207$ ns, as to the Sagnac clock rate alteration, the theoretical delay in the rate of an atomic clock placed along the Earth's equator, (its oscillation parallel to the motion axis), for a complete Earth's rotation is

$$2\pi \Big/ \omega_e \sqrt{1 - \omega_e^2 r^2 / c^2} - 2\pi / \omega_e \qquad (7)$$

including Lorentz length contraction, corresponding to ≈ 103 ns, and

$$2\pi/\omega_e\left(1-\omega_e^2 r^2/c^2\right)-2\pi/\omega_e \tag{8}$$

not including length contraction, corresponding to ≈207 ns! The equality of values given by the quantities (6) and (8) is because for very low velocities relative to the light speed, as for the Earth's rotational velocity, quantities (6) and (8) can be approximated to

$$2\pi\omega_e r^2/c^2 \tag{9}$$

and seems to confirm an ether model without length contraction.

Sagnac clock rate alteration in slowing moving clocks on Earth

A third kind of Sagnac clock rate alteration, again ≈±207 ns for an entire equatorial Earth round, is observed in portable clocks slowly moving westwards or eastwards on the Earth's surface (effect tested by atomic clocks onboard of airplanes[16] and trucks[17]).

If apparent, also this effect could be easily explained as arising from an asymmetric clocks synchronization based on the Sagnac light anisotropy (being two distant clocks along the equator line synchronized taking into account the Sagnac anisotropy, if one of the two clocks is subsequently slowly moved till it reaches the other one, its time advance/delay relative to the other clock will correspond to the Sagnac effect, and it will be independent of the approaching velocity).

But, since this clock rate anisotropy is reported to be real, it can be only identified with the difference between the rate alteration of a clock moving integral with Earth and that of a clock slowly moving relative to Earth, both motions considered relative to an ECI frame, that is, relative to ether. In this case, assuming that both clocks are placed along the equator with their oscillation axis parallel to their motion axis, the clock rate delay/advance for an entire Earth's round trip of the slowly moving clock is, without taking into account the Lorentz contraction:

$$\frac{2\pi}{\omega_c}\left[\frac{1}{1-\frac{(\omega_e+\omega_c)^2 r^2}{c^2}}-\frac{1}{1-\frac{\omega_e^2 r^2}{c^2}}\right] \qquad (10),$$

and including the Lorentz contraction:

$$\frac{2\pi}{\omega_c}\left[\frac{1}{\sqrt{1-\frac{(\omega_e+\omega_c)^2 r^2}{c^2}}}-\frac{1}{\sqrt{1-\frac{\omega_e^2 r^2}{c^2}}}\right] \qquad (11)$$

(where ω_c is the angular velocity of the portable clock relative to Earth). For very low velocities - about 100 km/h - the quantity (10) is ≈400 ns, and the quantity (11) is ≈200 ns. So, also this kind of Sagnac effect is consistent with an ether model, even though the best accordance with observed data is here obtained including Lorentz length contraction. It is however to be pointed out that, in case of a clock oscillation perpendicular to the motion axis, the quantity f) is valid also for a model without length contraction, letting the length contraction an open question. Concluding, the impression is that all relativistic data in open disagreement with SRT or GRT are indistinctly thrown in the container called "Sagnac effect," where they lay in an oblivion granted by the scarce literature and poor theoretical interest about this subject. Anyway, the fact all kinds of Sagnac effect can be physically explained only in the ambit of an ether model, clearly contradicts SRT.

9.7 Trouton-Noble experiment and similar ones

In 1902 Trouton and Noble[18] used a suspended parallel plates capacitor to detect the theoretical electromagnetic torsion acting on the plates because of their motion through the ether. The null result they found is considered a proof in favour of the SRT light postulate.

The Trouton-Noble experiment is considered the electrostatic equivalent of the M.&M. optical experiment, since its aim was revealing the Earth's motion through the ether by means of an electromagnetic effect instead of an optical one. With the difference that, whereas in a M.&M. type of test the theoretical fringe shift can be calculated with extreme accuracy, once the velocity of this motion is established, in a Trouton-Noble type of test it is difficult not only to establish the theoretical amount of the theoretical effect, but also its features. Emblematic is the great discordance of opinion on this subject, among main scientists at the beginning of the 20th century.

In fact, Trouton believed that the electromagnetic energy of the capacitor should have had its lowest value when the plates were perpendicular to the "motion through the ether" axis. Larmor instead believed this electromagnetic energy should have had its lowest value when the plates were parallel to this motion axis. Finally, Lorentz agreed with Larmor's premises but with Trouton's conclusion.[19]

As we all know, Trouton and Noble found a null result. But afterwards Chase identified some important sources of error in their experiment and in 1924 repeated this test[20] by means of a more sensitive device, taking as ideal reference of the "ether drift" velocity the Miller's determination of about 10 km/ s. Chase also obtained a null result, but honestly interpreted it on the basis of his device sensitivity limit, setting a 4 km/s upper limit of the ether drift. In 1994, Hayden designed a much more sensitive electrostatic device, to detect the Earth's rotational motion instead of its translatory one, but nonetheless obtained a null result, that drove him to judge this kind of experiment as not appropriate to decide about the ether existence:

> *The present experiment was designed to be the electrostatic equivalent of the Michelson-Gale experiment, which was performed to detect the rotational velocity of the earth and which yielded a nonnull result. The present experiment is 105 times as sensitive as the original TN experiment, but yields a null result nonetheless.*[21]

Again, recently, by means of an apparatus based on partly different principles, Cornille and Naudin repeated the Trouton-Noble experiment obtaining a clear non null result.[22] These researchers hold this effect is small or zero if the charges on the surfaces of the plates are the only charges which participate to the effect, but the charges inside the plates can give a more important contribution to the predicted effect, provided a voltage higher than 40 kV is used (Trouton and Noble used a very lower voltage). Thus, the discordant results obtained in this kind of experiment cannot be considered as a proof in favour of SRT.

10. Conclusions

Main goal of Special Relativity seems to be demonstrating that, from its starting two postulates only, it is possible to derive the same transformations by Lorentz. Our analysis instead proves that this derivation is not possible, and that Einstein obtains it only thanks to an ambiguous use of symbols, together with redundant algebraic operations. Therefore, Lorentz transformations turn out to be conceptually incompatible with SRT principles, and can be considered valid only in the ambit of the LET (Lorentz ether theory), in which they describe real alterations of lengths and light velocity due to the motion through the ether. Moreover, since the SRT founding postulate of the *c* constancy contradicts causal logic, as shown in paragraph 6, the SRT physical model itself turns out to be inconsistent, too.

For this reason, transformations free from contradictions accomplishing the basic aim of SRT, that is to describe apparent space time alterations due to a finite speed of light, are proposed in section 7 (WPAE transformations), on the basis of a single light route from source to observer, and on the assumption of a light medium. Our transformations, since they contain a first order coefficient, predict time dilatation for separating motion and time compression for approaching motion, and can be considered derived from an enlarged interpretation of the classical Doppler effect, referred not only to the frequency of a wave, but also to the information in it contained. In this view, only two kinds of "relativistic" alterations are possible:

1. Real alterations effecting light velocity, of which the LET model is an interpretation based on a length contraction assumption, and the ECI ether model is an interpretation not requiring a length contraction assumption (once more, it is to be reminded that no direct experimental evidence of any length contraction exists).
2. Apparent alterations due to relative motion and effecting time and lengths, described by our WPAE model and transformations (1),(2),(3),(4).

(In this light, SRT can be considered an incorrect attempt of referring Lorentz transformations to a model based on apparent alterations.)

As more specifically to time and clocks, Lorentz transformations describe second order real alterations occurring in the oscillation of a "moving through the ether" light or atomic clock, treating them as *by convention* time alterations (thanks to the Lorentz length contraction equalizing action), whereas the ECI ether model considers the same clock rate alterations as anisotropic (because no length contraction is assumed), and therefore cannot treat them as time alterations.

WPAE transformations instead concern first order apparent time alterations viewed by an observer in an ideal clock (independent of any mechanical influence) moving relative to him, and in which the light medium plays a marginal role: it is not the cause of the effects, but of their asymmetry. (In fact, WPAE alterations would also be valid in a Ritz emission model, in a totally symmetric form.)

Our short critical analysis of SRT main experimental proofs shows that most of them contain tautological processes or/and arbitrary handling of parameters, like Rossi-Hall and Hafele-Keating ones, and that those consisting of real and non-reciprocal clock rate alterations (SRT effects must instead be apparent and reciprocal), or/and calculated relative to an ideal not rotating Earth –ECI frame (SRT motion must instead be relative to the observer), which in fact prove an ether model and not SRT.

Moreover, if objectively judged, all tests on light anisotropy, Sagnac evidence included, clearly prove an ether model. As to the proper meaning to attach to all the observed real clock rate alterations, our discussion shows that, provided they are not due to clock rate random deviations, they cannot in principle be considered as real changes in the flowing of time. Possible observed apparent time alterations can instead be referred to our WPAE model (derived from the classical Doppler effect).

Reassuming, all experimental data prove an ether model, particularly an ECI model, but they are too few to give definitive answers about its features. Clearly, a century of faith in SRT has prevented any serious research about the ether properties.

Experiments like those suggested at the end of section 8.1 could probably answer most of these questions.

In conclusion, I want to point out that the speed of light, in the context of the ideas exposed in this article, does not represent anymore a limit speed, but acquires a meaning analogous to that of the sound barrier in acoustic, beyond which a body does not cease existing, but only being perceived.

References

[1] A. A. Michelson and E.W. Morley, *On the Relative Motion of the Earth and the Luminiferous Ether*, Am. Journal of.Science (3rd series) 34 333-345 (1887).

[2] W. Voigt, *Über das Dopplersche Prinzip Nachr*, Ges. Wiss.Goettingen, 1887.

[3] J.J. Larmor, *Aether and Matter*, Cambridge, 1900.

[4] A.H. Lorentz, *Electromagnetic Phenomena in a System Moving with any Velocity less than that of Light*, 1904.

[5] A.Einstein, *Zur Elektrodynamik bewegter Körper* (On the Electrodynamics of the Moving Bodies), Annalen der Physik, 1905, p. 891- 921.

[6] A. Einstein, *Über die spezielle und die allgemeine Relativitätstheorie* (On the Special and General Relativity Theory) 1916; A.Einstein, *Vier Vorlesunge über Relativitätstheorie* (The Meaning of Relativity), Friedrich Vieweg & Sohn, Braunschweig, 1922.

[7] A. Einstein, *Über die spezielle und die allgemeine Relativitätstheorie,* 1916; (Relativity / The Special and General Theory), New York, H. Holt, 1920.

[8] A. Einstein, *Vier Vorlesunge über Relativitätstheorie*, Friedrich Vieweg & Sohn - Braunschweig, 1922; (The Meaning of Relativity), Princeton University Press, 1945.

[9] Hafele J.C., Keating R.E, Nature 227 (1970), p. 270 (Proposal); *Around the World Atomic Clocks: Observed Relativistic Time Gains,* Science Vol. 177 p. 166 -170 (1972).

[10] A.G. Kelly, *Hafele & Keating Tests; Did They Prove Anything?*

[11] Rossi and Hall, *Physical Review* 59, p. 223 (1941).

[12] J. Bailey, *Measurements of relativistic time dilatation for positive and negative muons in a circular orbit,* (Nature 268, July 28, 1977) p. 301; Nuclear Physics B 150 p.1-79, 1979).

[13] Michelson, Pease, Pearson, *Repetition of the Michelson-Morley Experiment* (1929); G.Joos, Ann.Phys.7385(1930); K.K.Illingworth,Phys.Rev.30(1927), p.692; R.J.Kennedy, E.M.Thorndike, *Experimental Establishment of the Relativity of Time,* Phys.Rev. 42, ı400-418 (1932).

[14] D. Miller, *The Ether-Drift Experiments and the Determination of the Absolute Motion of the Earth,* Reviews of Modern Physics 5, 203-242 (1933).

[15] Michelson and Gale, *Nature* 115 (1925), p. 566; *Astrophys. J.* 61 (1925), p. 137.

[16] Saburi et al., *IEEE Trans*. IM25, 473-7, 1976.

[17] Sadeh et al., *Science* 162, p. 897-8, 1968.

[18] F.T.Trouton and H. R. Noble, *The forces acting on a charged condenser moving through space*, Proceedings of the Royal Society, Vol. 72, p. 132, (1903).

[19] Michel Janssen, *The Trouton Experiment and* $E = mc^2$, University of Minnesota.MAAPT, Augsburg College, St.Paul, MN.October 25, 2003.

[20] C.T. Chase, *A repetition of the Trouton-Noble ether drift experiment*, Phys. Review, Vol. 28, p.378, (1926).

[21] H.C.Hayden, *High sensitivity Trouton-Noble experiment,* Review Scientific Instruments, Vol. 65, N° 4, p.788, (1994).

[22] P.Cornille, J.L. Naudin and A.D.Szames, *Way back to the future: why did the Trouton-Noble experiment fail and how to make it succeed,* p. 81, Physical Interpretations of Relativity Theory VI (Eds. M. C. Duffy), Imperial College, London.

Appendix I: Time alterations in the propagation of sound

On May 15, 2005, I carried out an acoustic test consisting in the recording, from a station at rest, of a sound sample diffused by a wave source moving at a velocity comparable to that of sound. The aim of this experiment was to detect not only the well known alterations in the frequency of the sample, but also in its duration, as predicted by my WPAE relativistic model valid for both light and sound propagation.
As a reference sample I used a short 3.97 s cut of music and voice, diffused by a horn speaker from a car moving along a straight line at about 1/18 the sound speed.

Two kinds of takes were made: A) for approaching motion, and B) for separating motion. According to our relation $\Delta t = \Delta t_o \left(1 \pm v/c\right)$ (equations (1b) and (3b) of section 8, (*c* here being the sound speed in the air, and *v* the speed of a sound source relative to the air), for a source speed of ≈66.5 km/h and a ≈1253 km/h sound speed (with a temperature of 28° Celsius), our sound sample should had been time dilated to ≈4.18 s when diffused from a moving away source, and time compressed to ≈3.76 s when diffused from an approaching source, corresponding to ≈ ±½ musical tone.

Experiment results

Takes A and B were analyzed by means of a sound editor capable of visualizing wave forms and measuring samples with a one millisecond accurateness, and then compared to the original sample. Obviously, Doppler frequency alterations, here corresponding to a ±5.3% increase/decrease, were fully confirmed. But our takes also exhibited time alterations by the same percentage, the “approaching” sample being compressed to ≈ 3.76 seconds, and the “moving away” sample dilated to ≈ 4.17 seconds (see fig.1), as predicted by our relation. (The effect “observed” resulted qualitatively identical to that obtainable by increasing/decreasing the tape speed in an analog recorder).

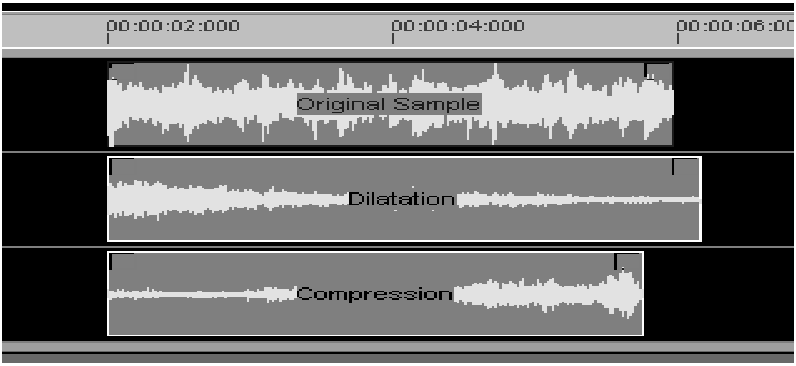

Fig.1 Sound editor view of the original sample and of the two altered recordings - length of segments representing their duration. Time dilatation and compression in the second and third segment starting from top are clearly visible.

Conclusions

The detection of an apparent time dilatation and compression in sound propagation demonstrates the validity of our relativistic WPAE model derived from the classical Doppler effect. Objection that light and sound are different phenomena is not acceptable in this context, since they consist in the thesis itself of SRT, and therefore are merely tautological.* Concluding, I am greatly indebted to Giorgio Russo and Domenico Menzio for their patient aid in the taking of these recordings.

* We do not question here the different nature of electromagnetic and sound waves, but simply hold that their motion in a medium obeys the same causal logic.