The Dynamics of Moving Bodies without Lorentz's Invariance

Part I: time and distance transformations

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Abstract

The present article proposes a theory of relativity which disentangles Einstein's relativistic approach from Lorentz's invariance principle, the latter being basically an Ether theory. This modification, termed Complete Relativity (CR) is justified both theoretically and experimentally. On the theoretical side it is argued, as done half a century ago by Herbert Dingle, that the inconsistency in Special Relativity theory (SR) is a result of Einstein's attempt to reconcile the theory with the Lorentz's electrodynamics. On the empirical side, questioning the adequacy of the Lorentz invariance principle is supported by numerous experimental results, attesting to symmetry-breaking at high enough energy, and by Quantum Gravity and other theories which allow for such breaking.

In part I of the theory, presented here, I focus is on relativistic time and space under conditions of uniform motion. Relaxing the constraint of SR's second axiom yields time and distance transformations in which the *direction of relative movement* with respect to an observer has dramatic effects. The derived time and distance expressions are tested using three different types of experiments: The seminal Michelson-Morley null experiment, the famous Frisch and Smith muon decay experiment, and recent quasi-luminal neutrino experiments. Tests of the theory, using the above mentioned experiments, shows that it succeeds in predicting *all* the reported results. In comparison, SR, which is known to predict the results of the first two types of experiments, fails completely in predicting the results of the quasi-luminal neutrino experiments. Because in the quasi-luminal neutrino experiment the neutrinos *depart* from a source laboratory and *approach* a detector laboratory, their results qualify as a crucial test for comparison between SR and CR.

Keywords: Relativity. Lorentz Invariance, time dilation, Michelson-Morley, muon decay, quasi-luminal neutrino

1. Introduction

The publication in 1905 of Einstein's most famous work on Special Relativity [2] is without doubt one of the most important theoretical contributions in physics in all times. Like quantum mechanics, it sprung a fundamental shift in our understanding of the physical world we live in, from the Galilean model in which time is universal, to a fundamentally different model in which the measures of time, distance, and all other physical entities are "frame-dependent". The time dilation effect, predicted by Special Relativity Theory, has been confirmed experimentally and is implemented in technology of communications, including in the global GPS system [3-6]. Nonetheless, since its publication the theory has been the focus of strong criticism by many. The most serious criticism, in my evaluation, is

Herbert Dingle's critique of the conceptual and theoretical foundations of SR, which lead him to the conclusion that SR suffers from a fundamental inconsistency which justifies its rejection on mere theoretical grounds. In a paper published in *Nature* [7], Dingle argued that SR, though mathematically self-consistent, could not correctly describe the facts of nature since it imposed contradictory requirements on the measuring instruments. He summarized his argument by stating that: "Einstein deduced, from the basic ideas of his theory that a moving clock works slower than a stationary one. By a similar line of reasoning I deduced from the same basic ideas that the same moving clock works faster than the same stationary one. Hence the theory, since it entails with equal validity two incompatible conclusions, must be false". ([1], p. 41).

Dingle's view aroused considerable rejection [e.g. 8-12], to which he replied in papers published in *Nature* and other journals [e.g., 1, 13] and later in a book which he devoted to this issue [14]. According to Dingle: "Einstein, in 1905, proposed an amendment of mechanics, the effects of which, however, would be perceptible only at velocities far beyond practical realization. If the amendment were justified it would succeed in making the electromagnetic equations, like those of mechanics, relativistic, and so remove the incompatibility; but, clearly, the only possible test of such a theory was a mechanical one. It was framed in order to justify electromagnetic theory, so that to use electromagnetic theory to justify it would be to argue in a circle" ([1], p. 49). Dingle concludes that "The alternative, that the laws of electromagnetism need reformulation, thus appears almost inescapable, and indeed, quantum phenomena have long been telling us this—though, in view of the apparent justification of the Maxwell-Lorentz theory by special relativity, attempts have naturally been concentrated (without success) on the attempt to reconcile it with such phenomena instead of on the formulation of fundamentally new laws. We must now, however, face the fact that new laws are necessary" ([1], p. 59).

The theory advanced in this paper might be considered as a follow-up on Dingle's critique, although the author was not aware of Dingle's work prior to writing it. The theory presents a relativity model without the Lorentz transformation. Justification for the approach taken here is found in the fact that Lorentz's electrodynamics theory presupposes fixed, universal ether; a hypothetical entity that Michelson & Morley's experiments, which furnished the ground for Special Relativity, have demonstrated that it does not exist. It is also justified by a growing number of cosmological and experimental findings attesting to the possibility of Lorentz invariance breaking at high energies [15-21], and by some theories in which Lorentz violation appears [22-24].

The remainder of the article is organized as follows: Section 2 presents the postulates of the theory postulates. Section 3 details the derivation of time and distance transformations for the case of two frames of reference moving with respect to each other with *constant velocity*. Section 4 tests the theory predictions on three types of experiments, and Section 5 concludes. Part II of this article deals with the transformations of mass density and energy and with the implications of the derived transformations for a new relativistic cosmology. The two parts could have been written as one paper. The decision to separate them into two papers was due to size limitation and readability. For simplicity the theory treats the case of linear motion.

2. Postulates

Because in its essence, a relativistic approach involves measurements conducted in two or more frames of reference moving with respect to each other, a true physical approach to relativity requires that the measurement devices, and the ways in which information is carried from one from one frame of reference to another, should be clearly specified. In this respect, the proposed model takes the approach of quantum mechanics in asserting that our perception of reality is based on our measurements' techniques and their outcomes [25-26]. It is worth noting that the proposed model does not go as far as quantum mechanics which posits that a "local realism" does not exist. Instead, it is proposed that even if such reality does exist, our representations of such reality are completely a construct of our observations, which in turn depend on the methods and instruments through which this reality is perceived. In other words, "reality" is "in the eyes of the beholder" and his or her telescope and microscope, etc.

The postulates of the new relativity theory, hereby called Complete Relativity Theory (CR), could be stated as follows:

1. The laws of physics are the same in all inertial frames of reference.
2. All translations of information from one frame of reference to another are carried by light or electromagnetic waves of equal velocity.

The difference between the second axiom of CR and SR is obvious. SR postulates that the velocity of light has a unique property, manifest in its independence on the motion of the light source relative to the observer. This axiom is essential for SR in order to reconcile the laws governing the mechanics of moving objects with Lorentz's electrodynamics. In a theory that alienates itself from the Lorentz invariance principle, no such constraint is needed, which also means that in principle, the theory allows for velocities that exceed c = 299792458 m/s., the velocity of light at our time and place. The justification of the present theory's second axiom comes from the necessity to specify the medium by which information is translated from one frame of reference to another. For the theory to stay intact, it is immaterial what kind of medium one chooses. One can derive the same laws of physics, as proposition 1 implies, using monochromatic sound waves. However, applying the theory to the mechanics of high velocities and energies, and its relevance to how *real* measurements are conducted in cosmology and high energy physics, makes the velocity of light is the only reasonable choice.

3. Relative motion with constant velocity

3a. Relativistic Time

Consider the two frames of reference F and F'shown in Figure 3. Assume that at $t_1 = t_1' = 0,$ F and F' start departing from each other with relative constant velocity v. Also assume that simultaneously, an event starts at time t_1' in F' and terminates at t_1', and that two observers in F and F' are informed about the termination of the event by means of light, or another signal with equal velocity.

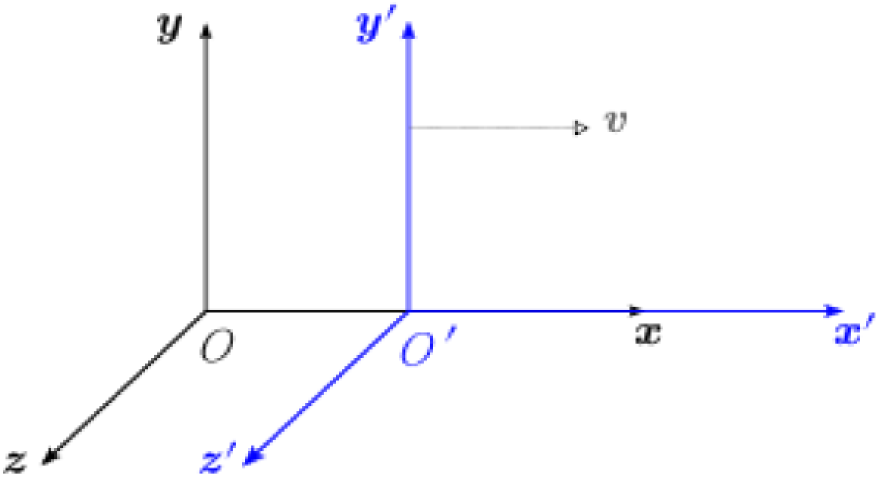


Figure 1. Observers in two reference frames moving with velocity *v* with respect to each other

The termination time t, measured in F, equals the termination time t' measured in F' plus the time δt which it takes the light beam, signaling the termination of the event, to arrive at F, or: $t = t' + \delta t$. But $\delta t = \frac{x}{c}$, where x is the distance (measured in F) that is traveled by F' relative to F, and c is the velocity of light measured in $\boldsymbol{F}$. But $x = v\,t$, thus we can write:

$$t = t' + \frac{x}{c} = t' + \frac{v\,t}{c} = t' + \frac{v}{c}\,t \qquad \text{...... (1)}$$

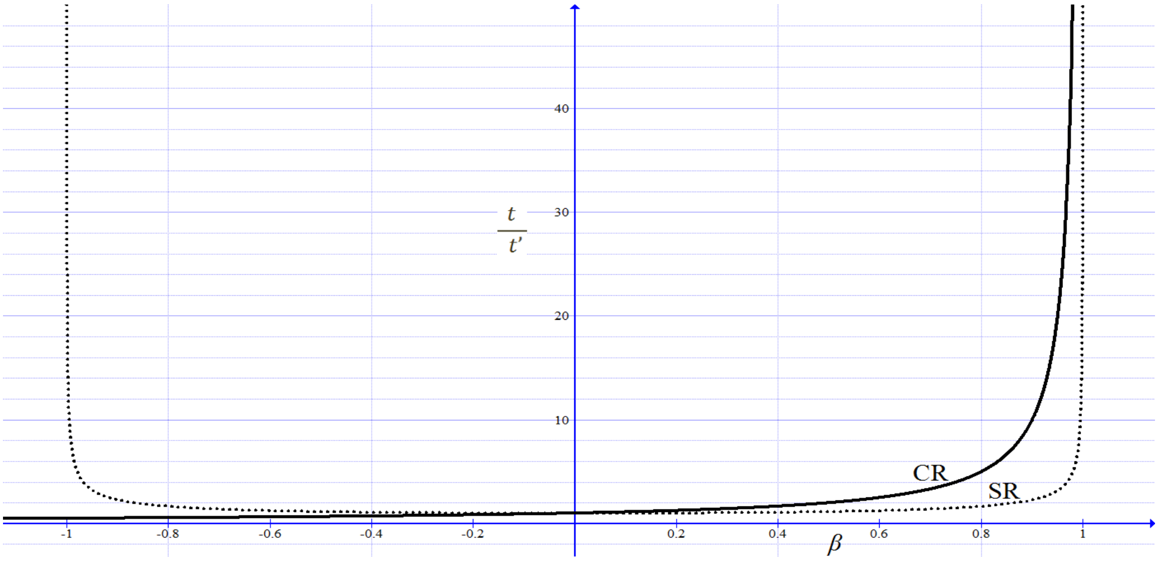
Or:

$$\frac{t}{t'} = \frac{1}{1-\beta} \qquad \text{...... (2)}$$

Where $\beta = \frac{v}{c}$

Note that Eq. (1) is similar to the Doppler Formula, except that the Doppler Effect describes red- and blue-shifts of waves propagating from a departing or approaching wave source, whereas the result above describes the time transformation of moving objects. Also note that $\frac{1}{1-\beta}$ is *positive* if F and F' *depart* from each other, and *negative* if they *approach* each other. Figure 2 depicts the relative time $\frac{t}{t'}$ as a function of β for the one-way trip. The dashed line depicts the corresponding predictions of SR.

Note that for the one-way trip and a *departing* F' at velocity β (0 ≤β≤ 1), Complete Relativity (*CR*) and Special Relativity (*SR*) yield similar predictions, although the time dilation predicted by *CR* is larger than that predicted by SR. Conversely, for an *approaching* F' (β< 0), CR predicts that the internal time measured at F will be *shorter* than that measured at F'.



Figures 2. Time transformations for the one-way trip. The dashed line depicts the corresponding prediction of SR

3b. Relativistic Distance

Consider again the two frames of reference in Figure 1. Assume that a body moving in the +x direction arrives at time t_1 in F (t_1' in F') to the point x_1 in F (x_1' in F') and continues to point x_2 in F (x_2' in F') at which it arrives at time t_2 in F (t_2' in F'). Assume further that the body's arrival at each point is signaled by a light pulse sent in the –x direction to two observers, one stationed at the point $x = 0$ in F and another stationed at point $x' = 0$ in F', and that the light signals travel with velocity c relative to F. The signal indicating the body's arrival at x_1' reaches the observer stationed at $x' = 0$ at time t_1' which equals:

$$t_1' = \frac{x_1'}{c+v} \qquad \text{……(3)}$$

Where v is the velocity of F' relative to F, and c is the velocity of light as measured in F.

Similarly, the time t_2' indicating the body's arrival at x_2' is given by:

$$t_2' = \frac{x_2'}{c+v} \qquad \text{...... (4)}$$

The time arrivals in F at x_1 and $x_2$are given, respectively, by: $t_1 = \frac{x_1}{c}$ and $t_2 = \frac{x_2}{c}$. Thus, we can write:

$$t_2 - t_1 = \frac{x_2 - x_1}{c} \qquad \text{...... (5)}$$

And:

$$t_2' - t_1' = \frac{x_2' - x_1'}{c+v} \qquad \text{...... (6)}$$

From Eq. 5 and 6 we have:

$$\frac{x_2 - x_1}{x_2' - x_1'} = \frac{c+v}{c}\,\frac{t_2 - t_1}{t_2' - t_1'} = (1+\beta)\,\frac{t_2 - t_1}{t_2' - t_1'} \qquad \text{...... (7)}$$

Substituting the time transformation from Eq. 2 in Eq. 7 and defining x = $x_2 - x_1$ and $x' = x_2' - x_1'$, the distance transformation could be written as:

$$\frac{x}{x'} = \frac{(1+\beta)}{(1-\beta)} \qquad \text{...... (8)}$$

The relative distance $\frac{x}{x'}$ as a function of β, together with the respective relative distance according to *SR* (in dashed black), are shown in Fig 3. While *SR* prescribes that irrespective of direction, objects moving relative to an internal frame will contract, *CR predicts that a moving object will contract or expand, depending on whether it approaches the internal frame or departs from it.*

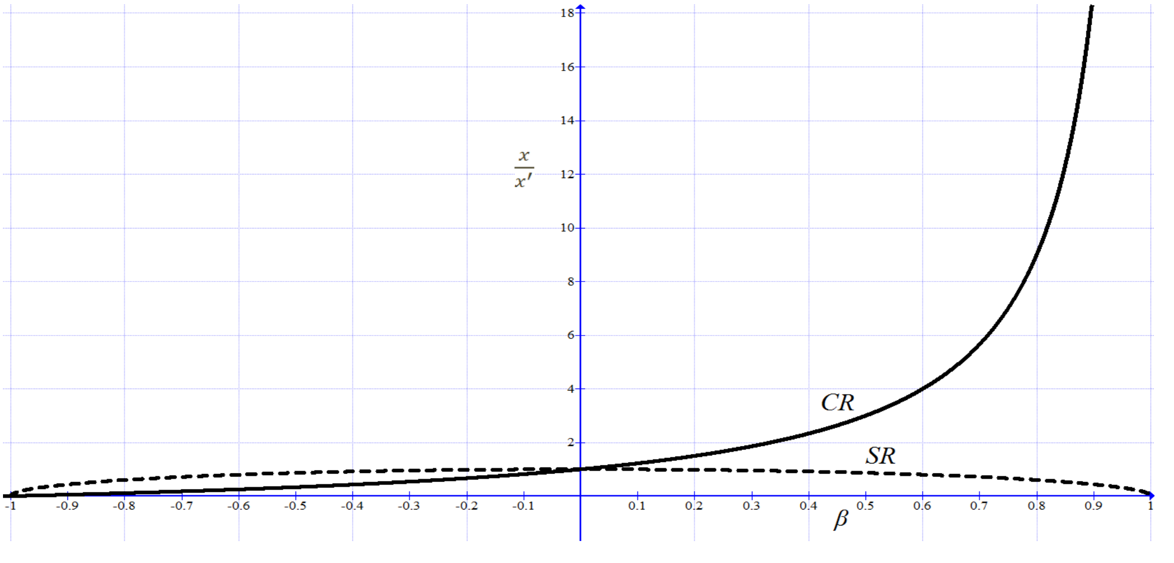


Figure 3. Distance transformation for the one-way trip. The dashed line depicts the corresponding prediction of SR

3c. Time and Distance in the Round-Trip

For the *round trip* from *F* and back, synchronization of the start time is not required. For this case, using Eq. (2), the total relative time is given by:

$$t = \vec{t} + \overleftarrow{t} = \left(\frac{1}{(1-\beta)} + \frac{1}{(1+\beta)}\right)t' = \left(\frac{2}{1-\beta^2}\right) t' \qquad \text{……(7)}$$

Or,

$$\frac{t}{t'} = \frac{2}{1-\beta^2} \qquad \text{…… (8)}$$

Similarly, using Eq. (6), the distance transformation for the round trip is given by:

$$x = \left(\frac{(1+\beta)}{(1-\beta)} + \frac{(1-\beta)}{(1+\beta)}\right) x' = \frac{2\,\beta}{1-\beta^2}\; x' \qquad \text{…… (9)}$$

Or:

$$\frac{x}{x'} = \frac{2\,\beta}{1-\beta^2} \qquad \text{…… (10)}$$

The relative time and distance as functions of β in the round trip are depicted in figures 5 and 6, respectively. The dashed lines depict the corresponding predictions of SR. Note that for the round trip the results of CR and SR are qualitatively similar, except that the time dilation predicted by CR is larger than that predicted by SR. For small β values, the two theories yield almost identical results. Conversely, while SR predicts distance *contraction*, CR predicts distance *expansion*.

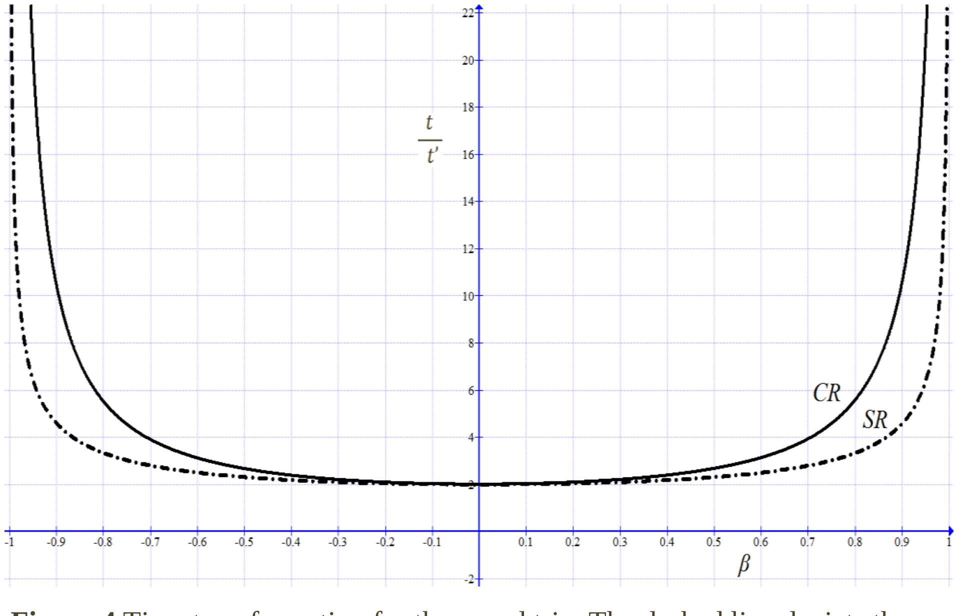


Figure 4. Time transformation for the round trip. The dashed line depicts the corresponding prediction of SR

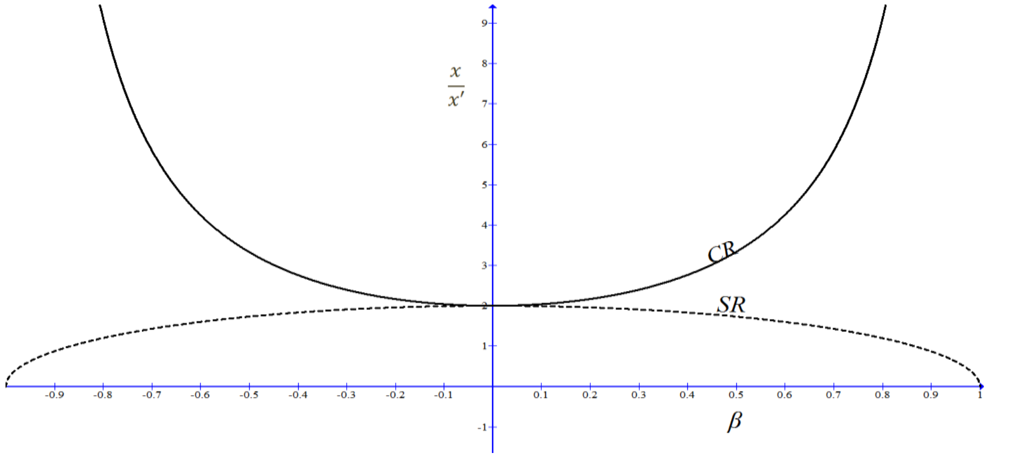


Figure 5: Distance transformation for the round trip. The dashed line depicts the corresponding prediction of SR

4. Empirical validation

Predictions of the theory were tested using sets of data from three different experiments: 1. the famous Michelson-Morley's experiment [27] together with several similar "null" experiments [28-33]. 2. The muon decay experiment [34, 35]. 3. Three recent quasi-luminal neutrino experiments conducted at CERN [36, 37] and FermiLab [38]. Of special importance is the last set of experiments, because the setup of these experiments is modeled differently by CR than by SR. Viewed from the perspective of SR, the source of the neutrino laboratory (e.g., at CERN) and the detector laboratory (e.g., at Gran Sasso) are placed in the same frame of reference. In contrast, from the perspective of CR, despite the fact that the two laboratories are stationary with respect to each other, they are treated as stationed in different frames of reference. This is because while an observer at the neutrino source observes that the neutrinos are *departing* from his laboratory with velocity v_n, an observer at the neutrino detector observes that the same neutrinos are approaching his laboratory with an equal velocity. This fundamental difference creates an ideal setup for a crucial test between the two theories, and as will be demonstrated in section 5c, for all three tested experiments SR fails completely, whereas CR succeeds in providing accurate predictions of the observed $\frac{v_n - c}{c}$ values.

4a. The Michelson-Morley experiment

In their seminal paper, Michelson and Morley [27] analyzed the motion of the parallel and perpendicular waves (with respect to Earth's motion) and concluded (incorrectly) that the displacement of the interference fringes is given by: $2\ D_0(\frac{v}{c})^2 = 2\ D_0\beta^2$, where D_0 is the interferometer arm length at rest. To account for the relativistic effects on the distance traveled by light in the round trip, I replace $2D_0$ by $D_1 + D_2$, where D_1 and D_2 are the departure and arrival distances, respectively. Using Eq. (7) we get:

$$\text{Fringe Shift} = (D_1 + D_2)\,\beta^2 = D_0 \left(\frac{1+\beta}{1-\beta} + \frac{1-\beta}{1+\beta}\right) = D_0 \frac{1+\beta^2}{1-\beta^2}\,\beta^2 \qquad \text{….. (11)}$$

Where $\beta = \frac{v}{c}$, c ≈ 299792.458 $km/_s$ and v is the velocity of Earth around the ($v \approx 29.78$ $km/_s$).

Substituting $\beta = \frac{29.78\ km/_s}{299792.458\ km/_s} \approx 9.9340 \text{ x } 10^{-5}$ and D_0 =11m (M&M's interferometer's arm length) in Eq. (11), we obtain a predicted fringe shift of approximately 1.09 x 10^{-7}, which is five orders of magnitude smaller than the reported experimental resolution (of ≤ 0.02). Table 1 summarizes similar calculations performed for several Michelson-Morley type experiments. As could be seen in the table, the predictions of *CR* for all listed experiments are three orders of magnitudes less than the highest reported sensitivity.

Table 1
Experimental and Theoretical Fringe-Shifts for several Michelson-Morley experiments

Experiment	**Arm length (meters)**	**Expected Fringe shift**	**Measured Fringe shift**	**Experimental Resolution**	**CR Prediction**
Michelson and Morley [27]	11.0	0.4	< 0.02 or ≤ 0,01	0,01	≈ 4.34 x 10^{-7}
Miller [28]	32.0	1.12	≤ 0.03	0.03	≈ 1.27 x 10^{-6}
Tomaschek [29] (star light)	8.6	0.3	≤ 0.02	0.02	≈ 3.40 x 10^{-7}
Illingworth [30]	2.0	0.07	≤ 0.0004	0.0004	≈ 7.89 x 10^{-8}
Piccard & Stahel [31]	2.8	0.13	≤ 0.0003	0.0007	≈ 1.11 x 10^{-7}
Michelson et al. [32]	25.9	0.9	≤ 0.01	0.01	≈ 1.02 x 10^{-6}
Joos [33]	21.0	0.75	≤ 0.002	0.002	≈ 8.30 x 10^{-7}

4.b Muon Decay

A famous experiment, usually brought as a conclusive evidence for SR's time dilation is the muon decay experiment. Muons are generated when cosmic rays strike the upper levels of the Earth's atmosphere. They are unstable, with a life time of τ = 2.2 μs. Using counters which count muons traveling with velocity of 0.99450***c*** to 0.9954***c***, comparison of their flux density at both the top and bottom of a mountain gives the rate of their decay. In the most famous muon decay experiment [34], assuming a velocity of muons in air of 0.992c, it was found that the percentage of the surviving muons, descending from the top of Mt. Washington to the sea level ($d \approx$ 1907 m.), was (72.2 ± 2.1) %, considerably higher than 36.79%, the expected percentage resulting from non-relativistic calculation.

To calculate the relativistic muon decay, denote the times at Earth and at a muon's frame by t and t', respectively. Without loss of generality, assume that at the mountain's level $t = t' = 0$. For any time t' $(0 \leq t' \leq t'_B)$, where t'_B is the 's muon's time arrival at the bottom, the flux density N(t') could be expressed as:

$$N(t') = N(0)\ e^{-\frac{t'}{\tau}} \qquad \text{..... (12)}$$

Where $N(0)$ is the count at the mountain's level. Substituting the value of t' from Eq. (2) we get:

$$N(t)_{CR} = N(0)\, e^{-\frac{(1-\beta)t}{\tau}} \qquad \text{..... (13)}$$

A similar analysis based on SR yields:

$$N(t)_{SR} = N(0)\, e^{-\frac{\sqrt{1-\beta^2}\ t}{\tau}} \qquad \text{..... (14)}$$

For β =0.992, Figure 7 depicts the rates of decay predicted by CR, SR and a nonrelativistic calculation. For an ascending time of $\delta t = \frac{d}{v} = \frac{1907\ m.}{2.998\text{x}\ 10^8} \approx 6.36\ \mu s.$, the predictions of CR and SR are, respectively: $\frac{\mathrm{N}(t=6.36)_{CR}}{\mathrm{N}(0)}$ x 100= $e^{-\frac{(1-0.992)x\ 6.36}{2.2}}$ x 100 ≈ 97.7% and $\frac{\mathrm{N}(t=6.36)_{SR}}{\mathrm{N}(0)}$ x 100= $e^{-\frac{\sqrt{1-0.992^2}\ x\ 6.36}{2.2}}$ x 100 ≈ 69.42%. In comparison, the expected percentage of surviving muons according to nonrelativistic considerations is only: $\frac{\mathrm{N}(t=6.36)_{NR}}{\mathrm{N}(0)}$ x 100= $e^{-\frac{6.36}{2.2}}$ x 100 ≈ 5.55%. Comparison with the observed percentage of 72.2% gives strong indication that a classical analysis fails to account for the observed phenomenon, while the two relativistic approaches accomplish that quite impressively. It is worth noting that the predicted values of both theories are not precise, given the fact that in the theoretical calculations several factors affecting the flight of descending particles are ignored [39].

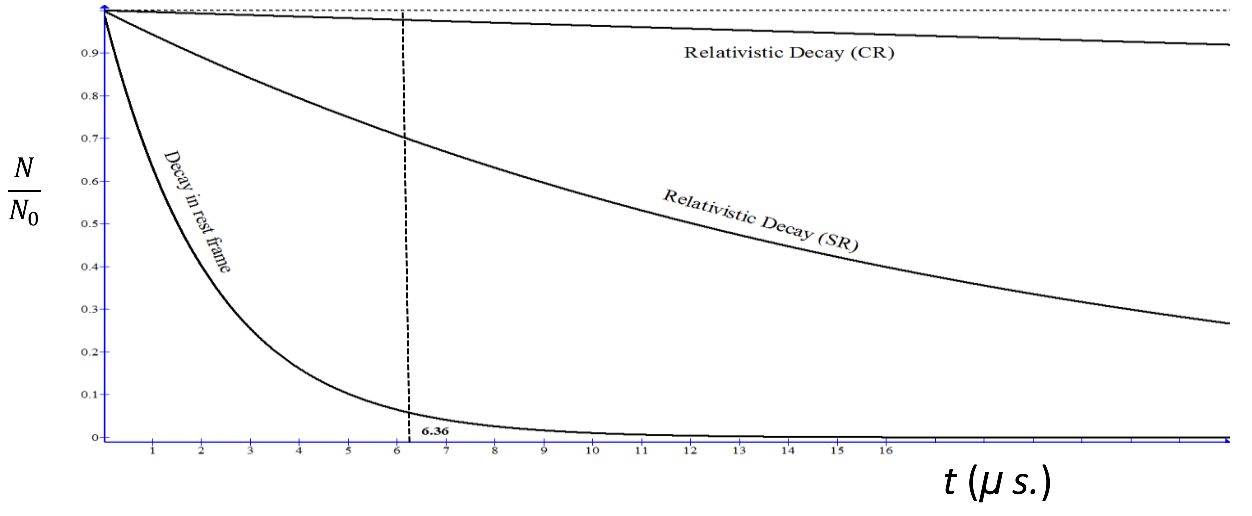


Figure 7: Three predictions of the rate of muon decay

4c. Quasi-luminal Neutrinos

In general, all neutrino-velocity experiments utilized the same technology. Thus, for the sake of convenience and without loss of generality, I analyze the one implemented by OPERA shown schematically in Fig. 8. Contrary to the perspective of SR, in which the start and end laboratories F' and F'' are in the same frame of reference, in CR they constitute different frames of reference. Thus the analysis takes into account *three* frames of reference: F'at CERN, F'' at Gran Sasso, and F, the neutrino rest frame. F is *departing* from F' with velocity v_n and *approaching* F'' with the same velocity. F' and F'' are at rest relative to each other. Analysis of the setup described in Fig. 8, derailed in [45] yields:

$$\frac{v_n - c}{c} = \left(\frac{2}{1-\frac{c\,\delta t}{D}} - 1\right)^{\frac{1}{2}} - 1 \qquad \text{..... (15)}$$

Where D is the distance between F' (CERN) and F'' (Gran Sasso), and δt is the neutrino early arrival time (with respect to light).

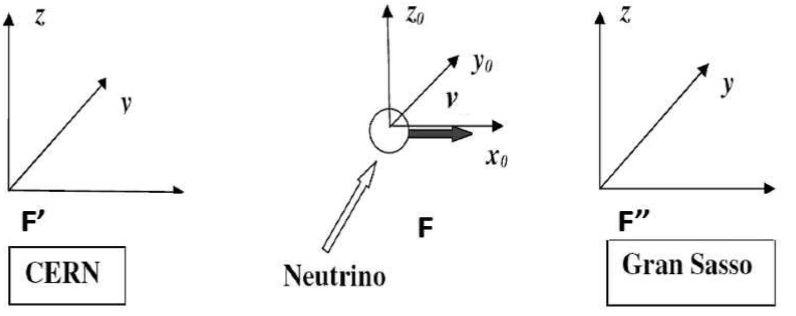


Figure 8. The OPERA setup

Equation 15 was used to calculate theoretical predictions for the results reported by OPERA [36], ICARUS [37] and MINOS [38]. The results are summarized in Table 2, which depicts all three experimental results against the corresponding theoretical predictions.

Table 2

Experimental results and theoretical predictions for three superluminal neutrino experiments

Experiment	Neutrino Anticipation Time (δt)	Experimental $\frac{v_n - c}{c}$	Theoretical $\frac{v_n - c}{c}$
MINOS $D = 734298.6\,\text{m}$	$\left(126 \pm 32\,(\text{stat.}) \pm 6\,(\text{sys.})\right)\text{ns}$	$(5.1 \pm 2.9)\,(\text{stat}) \times 10^{-5}$	$\mathbf{5.14 \times 10^{-5}}$
OPERA 2012 (corrected result) $D = 730085\,\text{m}$	$\left(6.5 \pm 7.4\,(\text{stat.}) \begin{array}{c} +9.2 \\ -6.8 \end{array} (\text{sys.})\right)\text{ns}$	$\left(2.7 \pm 3.1\,(\text{stat.}) \begin{array}{c} +3.8 \\ -2.8 \end{array} (\text{sys.})\right) \times 10^{-6}$	$\mathbf{2.67 \times 10^{-6}}$
ICARUS 2012 $D = 730478.56\,\text{m}$	$\left(0.10 \pm 0.67\,(\text{stat.}) \pm 2.39\,(\text{sys.})\right)\text{ns}$	$\left(0.4 \pm 2.8\,(\text{stat.}) \pm 9.8\,(\text{sys.})\right) \times 10^{-7}$	$\mathbf{0.41 \times 10^{-7}}$

As could be seen in the table, for all three experiments *CR* yields accurate predictions. A similar analysis based on SR (see details in [40]) yields grossly incorrect results.

6. Summary and concluding remarks

This article is one of two parts of a paper in which I present a new relativity theory without Lorentz's transformation. This variation implies that the *direction* of the relative motion between a "stationary" and a "moving" frame of reference matters. As a result the emerging mechanics with regard to all physical measurements are dramatic. In this paper I focused only on the time and distance transformations. The implications to the relativity of mass density and energy are discussed in part II of the article.

The main disparities between the results presented here and those derived from SR are the following:

(1) While SR predicts time dilation regardless of the direction of relative motion, the results of CR for the case of uniform velocity indicate that in the one-way travel, *time dilation* occurs only if the two frames of reference are *departing* from each other. In contrast, if the two frames are *approaching* each other, then an observer in the internal frame will measure a *contracted* time, relative to the time measured by an observer in the "moving: frame.
(2) For the round trip both theories predict time dilation.
(3) While SR predicts distance contraction regardless of the direction of the relative motion, for the case of a one-way uniform motion, CR predicts distance *contraction* relative to the internal distance measured by an observer in an *approaching* frame, and distance *expansion* relative to an observer in a departing frame. For the round trip CR predicts distance expansion.

Application of CR to a class of Michelson-Morley type experiments reveals that like SR, CR predicts the experimental null results. CR, like SR is also successful in predicting the experimental results obtained in the tested muon decay experiment. The reason behind the similarity in the above mentioned predictions, despite the fundamental differences between the two theories, is attributed to the specific designs and velocity range utilized in these experiments. The similarity between the two theories' predictions of the M&M results is the product of the round-trip nature of these experiments, under which both theories yield qualitatively similar predictions, This is particularly true given the relatively low velocity of the Earth around the sun ($\beta \approx 9.9340 \text{ x } 10^{-5}$), for which the two theories are expected to yield almost identical results (see Fig. 5).
With regard to muon decay experiments, both theories treat the setup as a one-way travel under which time dilation is predicted to occur. Although the two theories make quantitatively different predictions, with dilation factors of $\frac{1}{1-\beta}$ and $\frac{1}{\sqrt{1-\beta^2}}$ for CR and SR, respectively, for a range of high velocities the predictions of the two theories are of the same or order of magnitude. For β = 0.995 and $\frac{t}{\tau} = \frac{6.36\ \mu s}{2.2\ \mu s} \approx$ 2.89, the ratio between the prediction of CR and SR equals: $e^{-2.89\ ((1-0.995)+\sqrt[2]{(1-0.995^2})}\ \approx 1.33$.
The case of the fast neutrino experiments is different. The design of these experiments is modeled differently by CR than by SR. Viewed from the perspective of SR, the source of the neutrino laboratory (e.g., at CERN) and the detector laboratory (e.g., at Gran Sasso) are placed in the same frame of reference. In contrast, from the perspective of CR, despite the fact that the two laboratories are stationary with respect to each other, they are treated as stationed in different frames of reference.

This is because while an observer at the neutrino source observes that the neutrinos are *departing* from his/her laboratory with velocity v_n, an observer at the neutrino detector observes that the same neutrinos are *approaching* his/her laboratory with an equal velocity. This fundamental difference creates an ideal setup for a crucial test between the two theories, and as I have demonstrated in section 5c., for all three tested experiments SR fails completely, whereas CR succeeds in providing accurate predictions of the observed $\frac{v_n-c}{c}$ values.

Finally, the proposed theory does not grant light a mysterious standing, as done by Special Relativity theory. The velocity of light's special standing derives from mere *instrumental* reasons, being the medium by which information is sent from one frame of reference to another. Thus, the resulting singularities of time and distance at velocities equaling the velocity of light (see Equations, 2, 4 and 8) does not result from "forbidding" matter, other than light photons, to travel at the speed of light. They are the product of a *measurement constraint*, resulting from the fact that light, or other electromagnetic waves, do not enable us to measure times and distances of objects traveling with velocities equal or larger than the velocity of the information carrier.

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