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Time Contraction: The Possibility of Faster Than Light without Violation of Lorentz Transformation or Causality and the Vacuum Energy Dependent

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Abstract— Faster than light is impossible according to the special relativity theory of Einstein SRT. In this paper I'll propose a new concept in physics called "time contraction". This concept will solve many problems in physics related to faster than light without violation Lorentz transformation or causality. According to this concept, it is possible measuring the speed of an electromagnetic wave or a particle which owns rest mass greater than zero to be faster than the speed of light in vacuum without violation of Lorentz transformation or causality. Time contraction is proposed by a new understanding to the Lorentz transformation equations depending on the concepts of quantum theory (Copenhagen School). It is a new formulation to the time dilation and the length contraction and the speed of light which are vacuum energy dependent. By this new formulation, I could rescue the special relativity from the Twin paradox, Ehrenfest paradox, Ladder paradox and Bell's spaceship paradox. Furthermore, I could reconcile and interpret the experimental results of quantum tunneling and entanglement (spooky action), —Casimir effect, Hartman effect— with the SRT in this paper.

Index Terms— Special relativity, Lorentz transformation equations, faster than light, wormholes. Pioneer anomaly.

1 INTRODUCTION

MY paper (The modified special relativity theory MSRT) [23] is considered as a new understanding to Lorentz transformation equations depending on the concepts of quantum theory (Copenhagen School). It is a new formulation to the time dilation, length contraction and the speed of light which are vacuum energy dependent. What I proposed in my paper is agreed and interpreting the experimental results of quantum tunneling (Gunter Nimtz experiments) and quantum entanglement. Recently, there are some voices in physics asking for the variability of the speed of light, one of them the Portuguese cosmologist and professor in Theoretical Physics at Imperial College London João Magueijo. In 1998, Magueijo teamed with Andreas Albrecht to work on the varying speed of light (VSL) theory of cosmology, which proposes that the speed of light was much higher in the early universe, of 60 orders of magnitude faster than its present value. This would explain the horizon problem (since distant regions of the expanding universe would have had time to interact and homogenize their properties), and is presented as an alternative to the more mainstream theory of cosmic inflation [37]. My paper reconciles and interprets the variability of the speed of light in SRT which is vacuum energy dependent. Also recently, two published papers in European Physical Journal D challenge established wisdom about the nature of vacuum. In one paper, Marcel Urban from the University of Paris-Sud, located in Orsay, France and his colleagues identified a quantum level mechanism for interpreting vacuum as being filled with pairs of virtual particles with fluctuating energy values. As a result, the inherent characteristics of vacuum, like the speed of light, may not be a constant after all, but fluctuate [38]. Meanwhile, in another study, Gerd Leuchs and Luis L. Sánchez-Soto, from the Max Planck Institute for the Physics of Light in Erlangen, Germany, suggest that physical constants, such as the speed of light and the so-called impedance of free space, are indications of the total number of elementary particles in nature [39]. Also, two separate research groups, one of which is from MIT, have presented evidence that wormholes — tunnels that may allow us to travel through time and space — are "powered" by quantum entanglement. Furthermore, one of the research groups also postulates the reverse — that quantum entangled particles are connected by miniature wormholes. These ideas are agreed and predicted in my paper [40,41].

The dependency of the speed of light on the vacuum energy is adopted in my paper, which is the lost key of unifying between quantum theory and relativity (special and general).

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2 The Theory

In my Modified Special relativity (MSRT)[23], I found, when the train is moving with constant speed V, its vacuum energy is increased compared to the vacuum energy of the earth surface. And when the light beam is passing through the vacuum of the train, it is equivalent to passing through a medium of refractive index greater than 1. In this case I proposed in my MSRT, the time required for the light beam to pass the length of the moving train for the earth observer is independent of the direction of the velocity of the train compared to the direction of transmitting the light beam (Robertson [33]). Thus, if the light beam is sent inside the moving train from the end to the front –at the direction of the velocity- in this case for the earth observer according to his clock the required time separation for the light beam to pass the length of the moving train is Δt where

$$\Delta t = \frac{L}{\sqrt{c^2 - v^2}} \qquad (1)$$

Also if the light beam is sent from the front of the moving train to the end at the opposite direction of the direction of the velocity of the train, then the measured time separation for the light beam to pass the length of the moving train for the earth observer according to his earth clock is also given according to (1). From (1), the measured speed of light inside the moving train for the stationary earth observer according to his earth clock is c' where

$$c' = \sqrt{c^2 - v^2} \qquad (2)$$

Where c' does not depend on the direction of transmitting the light beam compared to the direction of the velocity of the train. It depends only on the absolute value of the velocity of the train. This proposed solution - the independency of the measured speed of light inside the moving frame with the direction of the velocity of the moving frame – explains the negative result of the Michelson-Morley experiment [34] as we shall see later.

In my MSRT I proposed also, the length of the moving train L is the same if the train was stationary for the stationary earth observer, where I refute the length contraction in the special relativity of Einstein that the length of the moving frame will be contracted in the direction of the velocity for the earth observer. From that we get, when the train is stationary, and a light beam is sent along its length, we get

$$L = c\Delta t_0 \qquad (3)$$

Where c is the light speed in vacuum, and Δt_0 is the time required for the light beam to pass the length of the stationary train for the stationary earth observer according to his clock. Now, if we substitute the value of L in (3) to (1), we get

$$\Delta t = \frac{c\Delta t_0}{\sqrt{c^2 - v^2}} = \frac{\Delta t_0}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad (4)$$

Equation (4) indicates us that, for the stationary earth observer according to his earth clock, the time separation required for the light beam to pass the length of the moving train is greater than if the train is stationary by the factor of $\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$. Thus, (4) indicates us also if the stationary earth observer registered by his clock a time separation for an event occurred inside the stationary train to be $\Delta t = \Delta t_0$, then if this train is moving with constant speed v, then the earth observer will register by his clock a time separation Δt for the same event to be occurred inside the moving train, where $\Delta t = \frac{\Delta t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$. Thus events are occurring inside the moving train in a slower rate than if the train was stationary for the stationary earth observer according to his earth clock according to (4).

Now suppose both the earth observer and the rider of the moving train are agreed to perform this thought experiment. The rider of the moving train sent a ray of light along his moving train length, and both the earth observer and the rider will measure the time required for the light beam to pass the length of the moving train, each one uses his clock. According to the MSRT [23], both the earth observer and the rider of the moving train will be agreed at the moment of transmitting the ray of light from the end of the moving train and then they will be agreed at the moment of reaching the ray of light at the front of the moving train. We have seen previously, relative to the earth observer the direction of transmitting the light beam is independent on the direction of the velocity of the moving train. Also, both of them will be agreed at the measured length of the moving train to be L. Thus for the earth observer the time separation of this event according to his clock is given according to (4). Where, the earth observer will measure a time separation for the light beam to pass the length of the moving train to be greater than if the train is stationary. Now for the rider of the moving train, since the motion of his clock inside the moving train is considered as events occurring inside the train, thus its motion will be slower when the train is moving than when it is at rest. And, since both the rider of the moving train and the stationary earth observer are agreed at the measured length of the moving train to be L, and also they are agreed at starting of transmitting the light beam from the end of the train and then agreed at the moment of reaching the light beam to the front of the moving train. Thus, by these conditions, when the stationary earth observer computed the time Δt for the light beam to pass the length of the moving train L, at this moment the rider of the moving train will measure the time separation $\Delta t'$ according to his clock, where

$$\Delta t' = \sqrt{1 - \frac{v^2}{c^2}}\Delta t$$

And from (4) we get

$$\Delta t' = \Delta t_0 \quad (5)$$

Thus, (5) indicates us, the rider of the moving train will measure a time separation for the light beam to pass his moving train length to be the same time separation if the train at rest. From that the measured speed of light inside the moving train for the rider according to his clock is equal to the speed of light in vacuum, same as the stationary earth observer when he measures the speed of light on the earth surface; he will get it equals to the speed of light in vacuum. From that we get the main principle of the modified special relativity which illustrates the consistency of the speed of light locally.

* The speed of light is locally constant and equals to the speed of light in vacuum c for any inertial frame of reference.

From (5), we can write (4) as

$$\Delta t = \frac{\Delta t'}{\sqrt{1-\frac{v^2}{c^2}}} \quad (6)$$

Equation (6) represents the equation of time dilation in Einstein's SRT.

3 The Lorentz Transformation Equations and The MSRT

How can we understand the Lorentz transformation equations according to the MSRT in order to keep the laws of physics are the same for all inertial frames of reference?

We have seen in the previous section, when the light beam is passing through the moving train, then the time separation for passing the light beam the length of the moving train is independent on the direction of transmitting the light beam compared to the direction of the velocity of the moving train (Robertson [33]).

Both the stationary earth observer and the rider of the moving train are agreed at the length of the moving train to be L, same as if the train is stationary. Also, both the stationary earth observer and the rider of the moving train are agreed at the moment of transmitting the light beam from the back of the moving train and also will be agreed at reaching the light beam at the front of the train, and vice versa if the light beam sent from the front to the end of the moving train.

From these postulates we derived (6) which represents the equation of Einstein of the time dilation in the SRT.

Now suppose we have a tube full of water of length L. we have seen in optics, when a light beam is incident inside this tube, then the time separation for the light beam to pass the length of the tube is greater than if the tube is empty according to our lab clock. If the tube is empty and we measured the time separation Δt_0 by our clock for the light beam to pass the length of the tube, then when the tube is full of water we shall measure the time separation Δt where

$$\Delta t = n\Delta t_0 \quad (7)$$

Where n is the refractive index of water. According to postulate (*) and (4), we get an equivalence when the light beam is passing through the moving train or passing through a medium of refractive index n. Suppose we have a meter stick of length Δx_0 in free space. If we put this meter stick inside the tube of water, we shall see the length of this meter stick is longer than in the free space, by the factor of n, the refractive index of water, where

$$\Delta x = n\Delta x_0 \quad (8)$$

Where Δx is the length of the meter stick inside the water for an observer in free space.

Thus from our equivalence principle, and from (8), if we determined two points of length separation Δx_0 inside the train when it is stationary, then, when the train is moving with constant velocity v, the measured length of Δx_0 for the stationary earth observer will be Δx given according to (8) as

$$\Delta x = \frac{\Delta x_0}{\sqrt{1-\frac{v^2}{c^2}}} \quad (9)$$

For the rider of the moving train the measured space time lengths inside his moving train will be equal as it is stationary, where from (5) we have $\Delta t' = \Delta t_0$, and thus we get also

$$\Delta x' = \Delta x_0 \quad (10)$$

Thus from (10), we can write (9) as

$$\Delta x = \frac{\Delta x'}{\sqrt{1-\frac{v^2}{c^2}}} \quad (11)$$

Equations (6) and (11) represent the measured space-time inside the moving train comparing to the measured space-time locally on the earth surface for the earth observer. For a free particle moving on the earth surface, the particle is defined by the space-time length of Δx and Δt for the earth observer. But when this particle is incident inside the moving train, it will be defined locally by the space-time length of $\Delta x'$ and $\Delta t'$ of the stationary rider of the moving train. In this case Δx is related to $\Delta x'$ by (11), and Δt is related to $\Delta t'$ by (6). Now suppose a light beam is incident inside the moving train. According to the two points separated by a distance $\Delta x'$ inside the moving train, for the rider of the moving train, the measured speed of light will be given as

$$c' = \frac{\Delta x'}{\Delta t'} = \frac{\Delta x_0}{\Delta t_0} = c \qquad (12)$$

$\Delta t'$ is the time separation of the event for the rider according to his clock. Thus the rider will measure the light speed inside his moving train to be the light speed in vacuum.

For the stationary earth observer, within the same two points inside the moving train separated by a distance $\Delta x'$ for the rider of the moving train, the measured speed of light will be given as

$$c'' = \frac{\Delta x}{\Delta t} = \frac{\sqrt{1-\frac{v^2}{c^2}}\Delta x'}{\sqrt{1-\frac{v^2}{c^2}}\Delta t'} = \frac{\Delta x_0}{\Delta t_0} = c \qquad (13)$$

Equation (13) indicates us; the measured speed of light inside the moving train for the earth observer will be equal to the speed of light in vacuum also! At the first time the reader will think (13) is contradicted with (2), but there is no contradiction. Since (2) is predicting the light speed by measuring the time separation for the light beam to pass the length of the moving train according to the clock of the stationary earth observer. And since the length of the train is determined locally by the space on the earth surface and this length of the train is not changed if the train is moving or stationary. This is equivalent to the tube of length L full of water. Suppose the length of the tube is 1 meter. Now if we have two meter sticks of length 1 meter. Now if we put one meter stick inside, along the water tube length and we put the other outside along the length of the tube. What shall we observe? We shall observe the meter stick inside the water will be appeared to be longer than the meter stick outside. And since the meter stick outside will give us the length of the tube locally. The meter stick inside will give us the length of the tube according to the space inside the tube. Thus, by using (7)&(8) to determine the speed of light according to the space-time inside the water tube, we get

$$c'' = \frac{\Delta x}{\Delta t} = \frac{n\Delta x_0}{n\Delta t_0} = c \qquad (14)$$

Equation (14) represents the measured speed of light inside the water tube according to the space-time coordinates inside the tube which is related to our coordinates according to (7)&(8). Where, according to (14), the measured speed of light is equal to the speed of light in vacuum. Equation (14) represents another interpretation why the light beam is taking longer time separation when it is passing though a medium of refractive index greater than 1. According to the meter stick located outside along the length of the tube, the light speed will be decreased, and because of that it takes longer time separation according to our clocks. But according to the meter stick inside the medium, the light speed is the same light speed in vacuum, because the distance is longer inside the medium of refractive index greater than 1 according to (8), so it takes longer time separation according to our clocks. Einstein in his special relativity adopted the second interpretation, the consistency of the speed of light and then the difference of measuring the time and space by the two observers who are moving in a relative velocity. But, what we have discovered in our MSRT that the two interpretations are equivalent to each others as we shall see in the following.

In order to understand how my theory works, let's start studying the thought experiment which was adopted by Einstein's SRT which illustrating his interpretation of the Lorentz transformation and the simultaneity. Suppose both the earth observer and the observer of the moving train will perform this thought experiment. As in fig. 1, at pylon A the train started to move with constant speed v, and at this moment the observer stationary on the moving train sent a ray of light from back to front the train, and also at this time the observer on the ground sent a ray of light from pylon A to pylon B. The two rays of light are sent along the direction of the velocity of the train.
Relative to the observer stationary on the moving train, the distance between the back and the front is fixed, where the length of his moving train is the same length as if the train is stationary. For the observer on the ground, while he sees the ray of light moves toward the front of the moving train, he will see also at the same time the front of the moving train is going far from the light beam, that is because the train moves with constant speed v at the same direction of the light beam. In this case and according to the concept of the classical relativity, the observer stationary on the train will see the light beam arrives the front of his moving train before the observer stationary on the ground. Let's propose this condition- according to the classical relativity- if at the moment that the observer stationary on the moving train sees the light beam reaches to the front of the train, at this moment the train arrives to the second pylon B on the ground. According to the concept of the objective existence of the phenomenon of the classical physics, both the observer on the ground and the observer stationary on the moving train will see the train arrives pylon B, but according to the classical relativity, the observer stationary on the moving train will see the light beam arrives to the front of his train and also at this time the front of his train arrives to pylon B. But at this moment for the observer stationary on the ground, he sees the train arrives to pylon B, but the light beam is still approaching to pylon B.

The negative result of the Michelson-Morely experiment [43] illustrated the speed of the light beam will not be affected by the relative velocity and thus both the observer stationary on the ground and the observer stationary on the moving train must see the light beam arrives the front of the moving train and the front must arrive to pylon B at the same moment according to the concepts of the classical physics at that time.

And thus in order to solve the negative result of the Michelson-Morely experiment FitzGerald [43-45] Proposed the concept of the length contraction in the direction of the velocity, where according to this concept the length of the moving train must be contracted along the direction of the moving train relative to the observer on the ground, and thus according to this concept both the observer on the ground and the observer on the moving train will see the light beam arrives the front of the train, and also the front of the moving train arrives pylon B. After that, Lorentz [46-48] proposed his transformation in order to keep on the constancy of the speed of light and then the invariance of Maxwell's equations and the laws of physics. Einstein interpreted the Lorentz transformation equations according to the concept of the relative velocity and the simultaneity by his special relativity SRT. According to the SRT of Einstein, both the observer on ground and the observer on the moving train see the light beam arrives to the front of the moving train and the front of the train arrives to pylon (B) as well, but in a different time separation and space separation. Where according to the reciprocity principle of the SRT of Einstein and under the postulate of the constancy of the speed of light, he defined the Lorentz contraction, where the measured length of the moving train for the observer on the ground is L′ where

$L'=\sqrt{1-\frac{v^2}{c^2}}L$, where L is the proper length of the moving train for the observer stationary on the moving train, where L is equal to the length of the train if it was stationary. Thus from that and according to the SRT of Einstein's interpretation of the Lorentz contraction, both the observer on the ground and the observer on the moving train will agree that the light beam arrives to the front of the train and also the front of the train arrives to pylon B. Now, relative to the light beam that was sent from pylon A, according to the classical relativity, for the observer stationary on the moving train, pylon A is moving with velocity –v relative to him, and thus the light beam is going far from the front of his train. Thus, at the moment that the stationary observer on the train sees the front of his train arrives at pylon B, he will see the light beam that was sent from pylon A is not arrived to pylon B according to classical relativity. According to classical relativity the observer stationary on the moving train will see the light beam is still approaching to pylon B, while at this moment, the observer on the ground sees the light beam which was sent from pylon A is arrived to pylon B, and he agrees also with the observer stationary on the moving train that the front of the train arrives to pylon B. According to Einstein's SRT interpretation of the Lorentz contraction, both the observer on the ground and the observer stationary on the moving train will agree that the light beam which was sent from A reaches to pylon B but they will be different in the time separation of the event and the space separation between the two pylons, where the observer stationary on the moving train will measure the distance between the two pylons to be contracted.

According to Einstein interpretation to the Lorentz transformation in his SRT, it is impossible measuring a particle or electromagnetic waves to move faster than light. Where, that leading to violation the Lorentz invariance and causality. In this paper I'll introduce a new interpretation to the Lorentz transformation depending on a new understanding to the Lorentz transformation equations. And this interpretation is leading to the possibility of measuring faster than light without violation of the Lorentz invariant or causality and at the same time keeping on the constancy of the speed of light to be c the speed of light in vacuum locally.

In our new interpretation to the Lorentz transformation equations in the previous thought experiment, we propose that at the moment that the observer on the ground sees the front of the moving train arrives to pylon B, he sees the light beam that sent from the back does not arrive to the front of the train as in point (h) in fig. 1, where if the train length is L, then the observer on the ground sees the light beam that sent from the back is still at distance L′ where

$L'=\sqrt{1-\frac{v^2}{c^2}}L$ from the back or the light beam is still at distance $\Delta x'$ from pylon A where $\Delta x'=\sqrt{1-\frac{v^2}{c^2}}\Delta x$. At this moment also, when the observer on the ground sees the front of the train arrives pylon B, he sees the light beam which sent from pylon A reaches to pylon B. Where, relative to the observer on the ground the light beam which sent from the back of the moving train requires more time separation than the light beam which sent from pylon A in order to reach the front of the moving train, and at this time separation during the motion, the train would pass a distance more than the distance between the two pylons, where if the distance between the two pylons Δx, then when the observer sees the light beam which sent from the back of the train reaches to the front of the train, then the front of the moving train must pass pylon B, and the front of the moving train is at distance $\Delta x'$ from pylon A where $\Delta x'=\frac{\Delta x}{\sqrt{1-\frac{v^2}{c^2}}}$. From this principle we lead to eqs 1&2.

Now relative to the observer stationary on the moving train, at the moment that the stationary observer on the ground sees the front of the moving train arrives pylon B, at this moment, the observer stationary on the moving train sees his train front does not arrive to pylon B, but it is still approaching to it. Where at this moment if the distance between the two pylons is Δx for the observer stationary on the ground, at this moment the observer stationary on the moving train will see the front of the train is at distance $\Delta x'$ where

$\Delta x'=\sqrt{1-\frac{v^2}{c^2}}\Delta x$ from pylon A, and this distance was passed

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in a time separation $\Delta t'$ according to his clock stationary on the moving train, where $\Delta t' = \sqrt{1-\frac{v^2}{c^2}}\Delta t$, where Δt is the measured time separation for the event when the train front arrives to pylon B for the observer on the ground according to his clock. Also at this moment the observer on the moving train sees the light beam which was sent from back is still approaching to the front of his train, where if the length of the train is L, then he sees the light beam is at a distance L′ from the back, where $L' = \sqrt{1-\frac{v^2}{c^2}}L$ (point (i) in fig. 1), and thus, the light beam is still at a distance $\Delta x''$ from pylon A as in fig. (1). Relative to the light beam that was sent from pylon A, for the observer stationary on the moving train, at the moment that the observer on the ground sees the light beam arrives to pylon B at point (f). At this moment the observer stationary on the moving train sees his train front is at a distance $\Delta x'$ from pylon A and also at this moment he sees the light beam is still approaching to pylon B. He sees the light beam which sent from pylon A is at point (g) at a distance $\Delta x''$ from pylon A in a time separation $\Delta t' = \sqrt{1-\frac{v^2}{c^2}}\Delta t$ for the event according to his clock on the moving train. The observer on the moving train sees the light beam which sent from back to front moves at the same time with the light beam which sent from pylon A to pylon B. Thus the measured speed of light that sent from the back of the train is equal to the measured speed of light that sent from pylon A is equal to c the speed of light in vacuum for the observer stationary on the moving train according to his measured time and space separation. Also, for the observer on the ground, he will see the light beam which was sent from pylon A arrives pylon B at the same time when the front of the train arrives pylon B, but the light beam which sent from back did not reach the front at this time, but it is still approaching to the front.

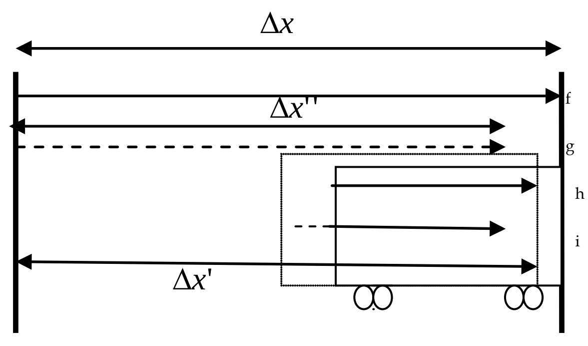

Fig. 1: the observer stationary on the moving train sent a light beam from back of the train to the front in the direction of the velocity. At the same time the observer on the ground sent a light beam from pylon A to Pylon B.

According to the MSRT, at the moment that the stationary observer on the ground sees the front of the train arrives pylon B, he sees the light beam which sent from pylon A arrives pylon B at point f , and at this moment he sees also the light beam which sent from the back of the moving train does not arrive to the front, it is at distance $\Delta x'$ from pylon A at point h. At this moment also the observer stationary on the moving train sees the light beam is still approaching to the front of the train as in point (i) where, the light beam is at a distance $\Delta x''$ from pylon A, and the front of the train does not arrive pylon B, where the front is still at distance $\Delta x'$ from pylon A. The dotted picture of the train illustrates the location of the train from pylon B for the observer on the train at the moment the observer on the ground sees the front of the moving train arrives pylon B. At this moment also, the observer on the train sees the light which was sent from pylon A is at point (g) at distance $\Delta x''$ from pylon A, at the moment the observer on the ground sees the light beam is at point (f).

In our preposition we adopt the principle of quantum theory (Copenhagen school) that the observer has the main formation of the phenomenon. And we refuse in our preposition the principle of the objective existence of the phenomenon that is exited in Einstein's SRT and then his interpretation to Lorentz transformation equations. In our preposition both the observer on the ground and the observer on the moving train will agree at the measured length of the moving train to be L same if the train was stationary and then the measured distance between the two pylons. According to our preposition in my modified relativity we predict also the observer on the moving train will see the clock of the observer on the ground is moving in a similar rate of his clock motion, that means the observer on the moving train sees the events on the ground in his present are considered as past relative to the observer on the ground.

Now let's propose another thought experiment. Suppose the train moves from pylon A to pylon B and the ray of light is sent from pylon B to pylon A in opposite direction of the velocity, and at the same time a ray of light is sent inside the moving train from front to back as in figure 2. According to our MSRT interpretation to the Lorentz transformation, and according to fig. 2, when the train front arrives to pylon B relative to the observer stationary on the ground, at this time he sees the light beam does not arrive to the back of the train, where if length of the train is L, then light beam is at distance L′ from the front where $L' = \sqrt{1-\frac{v^2}{c^2}}L$, and also at this time he sees the light beam which sent from pylon B arrives to pylon A. But, for the observer on the moving train at this moment he sees the train front does not arrive to pylon B but it is still approaching to pylon B. Where, the measured passed distance is $\Delta x' = \sqrt{1-\frac{v^2}{c^2}}\Delta x$ from pylon A to the back of the train in a time separation $\Delta t' = \sqrt{1-\frac{v^2}{c^2}}\Delta t$ according to his

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clock. Where, when the observer stationary on the ground sees the train arrives to pylon B, his measured distance from pylon A to the back of the train is Δx in a time separation Δt according to his clock on the ground. At this moment the observer on the moving train sees the light beam which sent from front to back of his train is still approaching to the back of his moving train, where if the length of the train is L, at this moment the light beam is at distance $L' = \sqrt{1-\frac{v^2}{c^2}}L$ from the front for the observer on the train, at the same time he sees the light beam which was sent from pylon B does not arrive to pylon A but it is still approaching to it. When the observer stationary on the moving train sees the train front arrives to pylon B and then at this moment he sees the light beam which sent from the front arrives to the back of the train, he will see also at this moment the light beam which was sent from pylon B arrives to pylon A. But at this moment the observer on the ground sees the light beam which was sent from the front arrives the back of the moving train, but the front of the train passed pylon B, where the front of the train is at distance $\Delta x'$ from pylon A, where $\Delta x' = \frac{\Delta x}{\sqrt{1-\frac{v^2}{c^2}}}$. From that, relative to the observer on the ground the time separation for the light beam to pass length of the moving is independent on the direction of transmitting the light comparing to the direction of the velocity as we proposed previously.

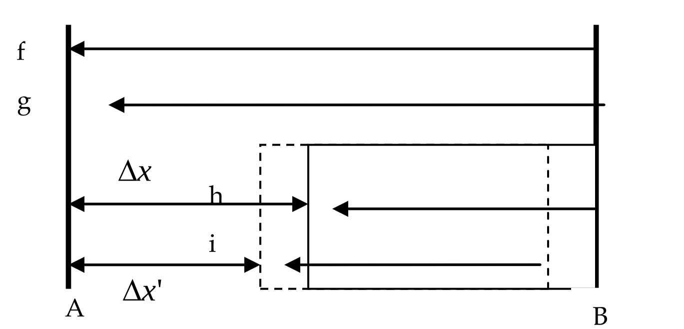

Fig. 2: The observer stationary on the moving train sent a ray of light from the front to the back of his moving train in the opposite direction of the velocity. At this time the observer on the ground sent a ray of light from pylon B to pylon A. The dotted picture of the train represents the location of the train for the observer of the moving train at the moment the observer of the ground sees the train arrives to pylon B.

In this case during the motion, the observer on the moving train will measure the speed of light inside his moving train when it is sent from front to back to be c the speed of light in vacuum, and also he will measure the speed of light which sent from pylon B to pylon A to be the speed of light in vacuum also. And when we define light beam inside the moving train which is defined by S′(x′,t′) according to the coordinates system of the observer stationary on the moving train, then the light beam is defined according to the coordinates system S(x,t) of the observer on the ground as

$$\Delta x = \frac{\Delta x'}{\sqrt{1-\frac{v^2}{c^2}}} + \frac{v\Delta t'}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$\Delta t = \frac{\Delta t'}{\sqrt{1-\frac{v^2}{c^2}}} + \frac{vx/c^2}{\sqrt{1-\frac{v^2}{c^2}}}$$

But the new modified thing in the Lorentz transformation equations which is predicted by our MSRT is existed in the case of the space axis y and z, where the transformation will be according to our MSRT as

$$\Delta y = \frac{\Delta y'}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$\Delta z = \frac{\Delta z'}{\sqrt{1-\frac{v^2}{c^2}}}$$

In the literature of relativity, space-time coordinates and the energy/momentum of a particle are often expressed in four-vector form. They are defined so that the length of a four-vector is invariant under a coordinate transformation. This invariance is associated with physical ideas. The invariance of the space-time four-vector is associated with the fact that the speed of light is a constant. The invariance of the energy-momentum four-vector is associated with the fact that the rest mass of a particle is invariant under coordinate transformations. In our previous thought experiments we proposed a null vector or lightlike. In our previous examples, the null vector for the observer stationary on the moving train according to his coordinates system $c^2\Delta t'^2 - \Delta x'^2 = 0$, and then by the Lorentz transformation equations we have also relative to the observer on the ground $c\Delta t^2 - \Delta x^2 = 0$. We have seen previously, Lorentz transformation is applied during the motion, and as we have seen in our previous examples, when the observer on the ground sees the front of the moving train arrives to pylon B, at this moment it is impossible that the observer on the moving train sees the front of the moving train arrives pylon B, both of them are not agreed that the front of the moving train arrives to pylon B, and this is the main difference between my MSRT and the SRT of Einstein. According to my MSRT when the observer on the moving train looks at the clock stationary on the ground, he will see the clock on the ground is moving in a similar rate of his clock motion, and since his clock is considered stationary on the moving train, then he will confirm that the clock on ground is stationary also same as his clock on the moving train. From that also he will agree with the observer on the ground on the measured rest mass of the clock. When the clock on the ground moves with speed v on the ground, in this case both the observer on the ground and the observer on the moving train are agreed at measured speed of the moving clock and then the relative measured mass, and the kinetic energy and the momentum, and the clock is moving slower than their clocks and they will agree at the slowing rate. Furthermore according to my MSRT, I could rescue the special relativity from the Twin paradox, Ehrenfest paradox, Ladder paradox and Bell's spaceship paradox as we have seen previously.

4 The Length Contraction According to MSRT

To understand the concept of the length contraction according to the MSRT [23], let's assume Sally is driving a train with constant velocity 0.87c between the two pylons A&B, and the distance between the two pylons is 100 m. let's assume also at the moment of reaching the train at pylon B, Sara who was stationary on the earth could stop the train instantaneously by a remote control. In this case we neglect the deceleration because this case is equivalent to some cases in quantum as we shall see in following sections. Thus, in this case we consider the velocity of the train is changed from 0.87c to zero in a zero time separation at the moment of reaching to Pylon B. Thus, by this condition we have

$$v = 0 \text{ at } L = 0$$
$$v = 0.87c \text{ at } 0<L\leq 100 \text{ m}$$
$$v = 0 \text{ at } L = 100 \text{ m}$$

The concept of the length contraction which is adopted by the MSRT [23], [24], [28] is agreed with the concepts, principles and laws of quantum theory (Copenhagen School) [10], [17]-[22].

Subsequently, according to MSRT [23] during the motion, when Sara sees the train reached to pylon B, at this moment Sally will not see the train reached at the second pylon B, it is still in the middle of her trip at 50 m from pylon A, and thus it is still approaching to the second pylon B. Subsequently, according to this interpretation, when Sara sees the moving train at a distance Δx, at this moment Sally will see her moving train is at the distance $\Delta x' = \sqrt{1-\frac{v^2}{c^2}}\Delta x$. This interpretation is agreed with the concept of Heisenberg to the wave function, where the observer has the main formation of the phenomenon. And by this interpretation Sally and Sara create their own pictures about the location of the moving train. Now, for Sara, the measured velocity of the moving train is given as $v = \frac{\Delta x}{\Delta t} = 0.87c$ which is equal to the equivalent velocity of the kinetic energy owned by the moving train. For Sally (who is the driver of the train) there are two states that the train existed instantaneously, the first one is the state of motion, and the measured velocity of the train at this state for Sally is given as

$$v' = \frac{\Delta x'}{\Delta t'} = \frac{\sqrt{1-\frac{v^2}{c^2}}\Delta x}{\sqrt{1-\frac{v^2}{c^2}}\Delta t} = v = 0.87c$$

And this measured velocity is equal to the measured velocity equivalent to the kinetic energy owned by the moving train. The other state is the state of stationary, and the predicted velocity of the train for Sally at this state is given as

$$v' = \frac{\Delta L'}{\Delta t'} = \frac{\Delta L}{\sqrt{1-\frac{v^2}{c^2}}\Delta t} = \frac{v}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{0.87c}{\sqrt{1-(0.87)^2}} = 1.74c$$

Those two states of the train are separated by a distance equals to 50m, where Sally will think her train passed this distance in a zero time separation as seen in fig. 3, and then Sally will think the distance of 100m was passed by her train with velocity equals to 1.74c which is greater than the speed of light in vacuum. This measured velocity is not real, as we have seen the train hasn't moved with speed greater than the speed of light in vacuum locally for Sara, but because of the time dilation, and as we have seen in (4)&(6), events are occurring in the frame of the moving train in a slower rate than on the earth surface, and then the clock of the moving train will compute a time separation of the event less than the earth clock. The difference of time between what is computed by the train clock of Sally at the state of stationary, and what is computed by the earth clock of Sara for the train to pass the distance 100m, we find this difference is negative, and this difference led Sally to think her train passed the distance 100m between the two pylons with speed greater than the speed of light in vacuum. From fig. 3, Sally would confirm that the distance between the interval 50<x'<100m was not passed by her train. Her train was transformed from 50m to 100m in a zero time separation. For Sally time is contracted!

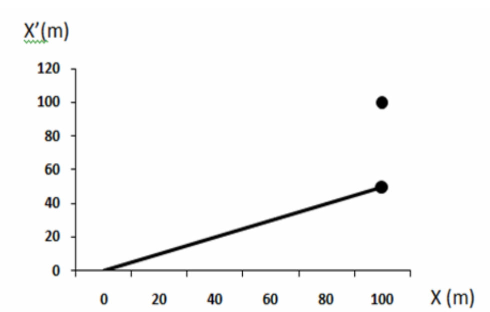

Fig. 3 illustrates the relationship between x and x′

There is another consequence that produced by adopting this interpretation of the length contraction by MSRT. It is; how does Sally see the motion of Sara's earth clock comparing to her clock during the motion. According to MSRT [23], Sally will see the motion of the earth clock of Sara is moving similar to her moving train clock, and by adopting this principle let's study the following thought experiment.

Suppose Sally during the motion of her train is looking at the stationary earth clock of Sara by applying this condition

$$v = 0 \text{ at } \Delta t_{Sara} = 0$$

$$v = 0.87c \text{ at } 0 < \Delta t_{Sara} \leq 4 \text{ years.}$$

$$v = 0 \text{ at } \Delta t_{Sara} > 4 \text{ years}$$

Where Δt_{Sara} is the reading of Sara from her clock. We can draw Δt_{Sara} versus Δt_{Sally} as in fig. 4, where Δt_{Sally} is the reading of Sally from the clock of Sara. From fig. 4, we find two straight lines; the first one is for $0 < \Delta t_{Sara} \leq 4 years$ and its slope is equal to 0.5. The second line is for $\Delta t_{Sara} > 4$ years, and its slope is equal to 1. We find from fig.4, the years between $2 < \Delta t_{Sara} \leq 4$ years would not be determined by Sally, where her train was stopped at $\Delta t_{Sara} > 4$ years, and thus she would find that Sara is living the years at $\Delta t_{Sara} > 4$ years, while her last reading was equal to 2 years. That means the events were lived by Sara between $2 < \Delta t_{Sara} \leq 4$ years were not be received by Sally during her motion.

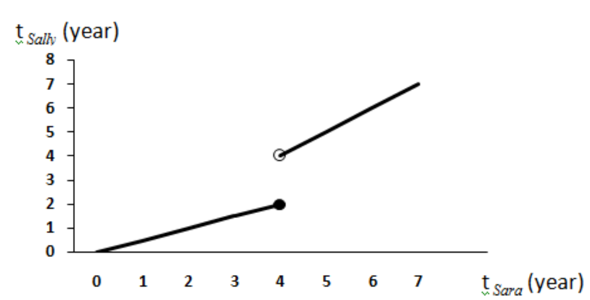

Fig. 4 t (Sara) versus t (Sally).

From the fig. 4 we get, the observer is the main participant in formulation of the phenomenon, where each one creates his own clock picture during the motion although they used the same clock. That is in contrast with the objective existence of the phenomenon.

5 The Vacuum Energy and the Equivalence Principle of the MSRT

Suppose Sally is living on a planet of mass M. and Sara is stationary very far from the planet in space. Now according to the general relativity theory of Einstein, if Sara is looking at the clock of Sally, she will find the clock of Sally is moving in a slower rate than her clock according to the equation

$$\Delta t' = \sqrt{1 - \frac{2GM}{c^2 R}} \Delta t$$

Where, $\Delta t'$ is the time separation measured by Sara from the clock of Sally, Δt is the time separation measured by the clock of Sara for Sara, G is the gravitational constant, and R is the radius of the planet. Thus from the equation above $\frac{2GM}{R}$ is equivalent to v^2, that means it is equivalent that Sally is riding a train moving with constant speed v. Thus according to the previous discussion, if Sally is looking at the clock of Sara, then Sally will see the clock of Sara is moving at the same rate that her clock is moving, and what is Sally seeing now about Sara is done for Sara in the past. Now suppose both Sally and Sara are in the Lab. They cooled an empty tube to $-237^o C$. In this case the vacuum energy of the tube is less than the vacuum energy of the lab. That is equivalent; both of Sara and Sally are moving with velocity v relative to the tube, and then the events inside the lab are occurring in a slower rate than if the same events are occurring inside the tube for an observer located inside the tube. What is the consequence of that according to what we discussed previously is what we shall discuss in the next section.

6 Quantum Tunneling and Quantum Entanglement

Quantum tunneling experiments have shown that 1) the tunneling process is non-local, 2) the signal velocity is faster than light, i.e. superluminal, 3) the tunneling signal is not observable, since photonic tunneling is described by virtual photons, and 4) according to the experimental results, the signal velocity is infinite inside the barriers, implying that tunneling instantaneously acts at a distance. We think these properties are not compatible with the claims of many textbooks on Special Relativity [1-9, 16]. The results produced by our modified special relativity theory MSRT [23] are in agreement with the results produced by quantum tunneling experiments as noted above, and thus it explains theoretically

what occurs in quantum tunneling. It proves the events inside the tunneling barrier should occur at a faster rate than the usual situation in the laboratory. It provides a new concept of time contraction which is not existed in the SRT. The concept of time contraction in our theory is proven by many experiments where some enzymes operate kinetically, much faster than predicted by the classical $\Delta G^{\ddagger}$. In "through the barrier" models, a proton or an electron can tunnel through activation barriers [11, 12]. Quantum tunneling for protons has been observed in tryptamine oxidation by aromatic amine dehydrogenase [13]. Also British scientists have found that enzymes cheat time and space by quantum tunneling - a much faster way of traveling than the classical way - but whether or not perplexing quantum theories can be applied to the biological world is still hotly debated. Until now, no one knew just how the enzymes speed up the reactions, which in some cases are up to a staggering million times faster [14]. Seed Magazine published a fascinating article about a group of researchers who discovered a bit more about how enzymes use quantum tunneling to speed up chemical reactions [15].
In order to understand what is occurring by quantum tunneling, let's study this thought experiment depending on the concepts and principles what we proposed previously.

Suppose Sara and Sally in the lab, they made a tube of length L. the vacuum energy inside the tube is negative compared to the vacuum energy of the lab. That means the vacuum energy of the tube is less than the vacuum energy of the lab. Now suppose the amount of the negativity comparing to the vacuum energy of the lab is equivalent that the observer in the lab are moving with speed equals to v. In quantum, the negativity of the vacuum energy inside the tube is depending on the difference of temperature, pressure and the effective density.

Now, suppose Sara entered inside the tube and Sally remained in the lab. After that, Sally sent a ray of light through the length of the tube. Now, since the vacuum energy is less inside the tube than outside in lab, which means the events inside the tube, will occur in a faster rate for Sara than Sally. That means the rate of occurring the information which define the location and time for the light beam inside the tube is faster for Sara inside the tube than Sally in lab. Thus, if Sara determined the light passed the distance Δx inside the tube, at this moment Sally will determine the location of the light beam at $\Delta x'$ inside the tube, where $\Delta x' = \sqrt{1-\frac{v^2}{c^2}}\Delta x$, also for Sara the distance Δx was passed by the light beam in a time separation Δt according to her clock. Also, for Sally the distance $\Delta x'$ was passed by the light beam inside the tube in a time separation $\Delta t'$ according to her lab clock. From that the measured speed of the light beam for Sara is $v = \frac{\Delta x}{\Delta t} = c$, which is the speed of light in vacuum, and for Sally is $v' = \frac{\Delta x'}{\Delta t'} = \frac{\sqrt{1-\frac{v^2}{c^2}}\Delta x}{\sqrt{1-\frac{v^2}{c^2}}\Delta t} = c$. Thus, both Sally and Sara will agree at the measured speed of the light beam inside the tube. But, when Sara sees the light beam reached to the end of the tube and passed the distance L the length of the tube, at this moment for Sally, the light beam have not reached to the end of the tube, it is still at $\Delta x' = \sqrt{1-\frac{v^2}{c^2}}L$. After that the light beam will exit the tube, and will be seen for Sally at the distance $\Delta x' > L$. In this case, for Sally, the light beam is transformed from the point $\Delta x' = \sqrt{1-\frac{v^2}{c^2}}L$ to the point $\Delta x' > L$ in a zero time separation. Thus Sally will see the light beam is existed in two places or states at the same time. Now, when Sally sees the light beam at $\Delta x' > L$ and she tries to compute the speed of the light beam when passed the distance L of the tube, she will find that the light beam passed this distance by a speed $c' = \frac{L}{\Delta t'} = \frac{L}{\sqrt{1-\frac{v^2}{c^2}}\Delta t} = \frac{c}{\sqrt{1-\frac{v^2}{c^2}}}$, where for Sara inside the tube, the light beam passed the length of the tube with speed $c = \frac{L}{\Delta t}$ which equals to the speed of light in vacuum. Thus for Sally in the lab, she will think the light beam passed the length of the tube in a speed greater than the light speed in vacuum, but this measured speed is not real. In this case, although, Sally measured the light beam passing the length of the tube faster-than-light speed in vacuum, But according to that there is no violation for Lorentz transformation or causality. Where, according to Sara inside the tube, the light beam passing all the length of the tube with speed equals to the speed of light in vacuum.

Suppose now, Sally sent instead of a light beam, she sent a particle of kinetic energy E inside the tube, which is equivalent the particle to move with speed v(E), as seen in fig. 5.

According to fig. 5, when Sara who is living inside the tube sees the particle reached at the end of the tube and passed the distance L of the tube in a time separation Δt according to her clock, at this moment for Sally who is in the lab, will see the particle location at $\Delta x' = \sqrt{1-\frac{v^2}{c^2}}L$, and this distance was passed at a time separation $\Delta t' = \sqrt{1-\frac{v^2}{c^2}}\Delta t$ according to Sally's lab clock. At this moment, the predicted velocity of the

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particle for Sara is $v=\frac{L}{\Delta t}=v_p(E)$ and for Sally is $v'=\frac{\Delta x'}{\Delta t'}=\frac{\sqrt{1-\frac{v^2}{c^2}}L}{\sqrt{1-\frac{v^2}{c^2}}\Delta t}=v_p(E)$. At this moment the particle will exit the tube and will be seen for Sally out of the tube. Sally will think the particle is transformed from the point $\Delta x'=\sqrt{1-\frac{v^2}{c^2}}L$ to the point $\Delta x'$ >L at a zero time separation, and then the particle will be seen at two places or states at the same time for Sally. Sally will think the particle passed the length of the tube with velocity equals to $v'=\frac{L}{\sqrt{1-\frac{v^2}{c^2}}\Delta t}=\frac{v_p(E)}{\sqrt{1-\frac{v^2}{c^2}}}$, and if $v_p(E)$ is very close to c, in this case it is possible the predicted speed will be greater than the speed of light in vacuum for Sally depending on the negativity of the vacuum energy of the tube.

Fig. 5 (A) Sara who is living inside the tube will see the particle is passing all the length of the tube, and exit it with kinetic energy v(E). (B) Sally who is in the lab will see the particle existed in two places at the same time, one place is at $\Delta x'=\sqrt{1-\frac{v^2}{c^2}}L$, and the other place is at $\Delta x'$ >L. Sally will think the particle is transformed from $\Delta x'=\sqrt{1-\frac{v^2}{c^2}}L$ to $\Delta x'$ >L at a zero time separation. When Sally measures the kinetic energy of the particle at $\Delta x'$ >L , she will find it is equal to the kinetic energy at the moment of sending the particle inside the tube

And in order to understand what a quantum entanglement is, let's study this thought experiment. Suppose Sally sent an electron inside the tube. The negativity of the vacuum energy of the tube is equivalent that Sally who is staying in the lab, moving with speed equals to v. Also, suppose Sally applied a magnetic field on the tube at a distance equals to $\Delta x'=\sqrt{1-\frac{v^2}{c^2}}L$ as seen in fig. 5. Now for Sara inside the tube, she will see the electron passes through the magnetic field before Sally, and then it will be affected on the magnetic field. Now when the electron reaches to the end of the tube and passes the distance L the length of the tube. At this moment Sally will see the electron is at $\Delta x'=\sqrt{1-\frac{v^2}{c^2}}L$, and at this moment she will see the electron is affected on the magnetic field. Also at this moment, Sally will see other picture for the electron at $\Delta x'$ >L, and this picture of the electron at $\Delta x'$ >L was affected by magnetic field as seen by Sara. And since the two pictures of the electron are seen by Sally in the lab at the same time. Sally will think at the moment of applying the magnetic field on the electron at $\Delta x'=\sqrt{1-\frac{v^2}{c^2}}L$, this effect was transformed instantaneously to the electron at $\Delta x'$ >L.

Existing an object in two states at the same time for an observer outside the system was verified experimentally by a team of scientists that has succeeded in putting an object large enough to be visible to the naked eye into a mixed quantum state of moving and not moving [25]. Furthermore there are many other experiments where done proving that quantum laws can be applied on macro objects, and that implies the macro and micro world are governed by the same laws [29]-[31]. This is supporting the main goal of the MSRT which unifying quantum theory (Copenhagen school) and relativity theory (special & general) with the same concepts, principles and laws.

7 The Cherenkov Radiation

While electrodynamics holds that the speed of light in a vacuum is a universal constant c, the speed at which light propagates in a material may be significantly less than c. For example, the speed of the propagation of light in water is only 0.75c. Matter can be accelerated beyond this speed (although still to less than c) during nuclear reactions and in particle accelerators. Cherenkov radiation results when a charged particle, most commonly an electron, travels through a dielectric (electrically polarizable) medium with a speed greater than that at which light would otherwise propagate in the same medium. Cohen and Glashow [32] pointed out that these analogs to Cherenkov radiation must appear at superluminal speeds. According to the SRT of Einstein, in order a particle to move with speed equals to the speed of light c in vacuum, it is required the particle to be owned by a kinetic energy equals to infinity. Thus, what about if this particle moved with speed faster than the speed of light in vacuum? Faster-than-light speed in vacuum can't be interpreted and reconciled according to the SRT principles and equations, and thus Cherenkov radiation principle can't be interpreted and reconciled with the principles and equations of the SRT.

Cherenkov radiation principle can be interpreted and reconciled according to the MSRT. For example, suppose the tube that is existed in fig. 5 of length L. The negativity of the vacuum energy of the tube compared the vacuum energy of the lab is equivalent that the observer stationary on the lab are moving with speed 0.87c relative to the tube. Now, if a neutrino is sent inside the tube of kinetic energy E_k. As we have seen previously, when the neutrino reached to the end of the tube and passed the distance L for an observer stationary inside the tube, then at this moment, for the observer of the lab, the neutrino is located at the distance $L' = \sqrt{1-\frac{v^2}{c^2}}L = \frac{L}{2}$. Now, if there is a detector at the end of the tube, that means, the neutrino is not passing through the space of the lab, in this case, for the observer on the lab, according to his clock, the neutrino passed the distance of the tube in a less time separation than it is required according to its kinetic energy. Now if the kinetic energy inside the tube of the neutrino is equivalent to move in a velocity $\sqrt{1-\frac{v^2}{c^2}}c$ $< v_{neutrino} <$ c, which is according to our examples, 0.5c $< v_{neutrino} <$ c, in this case when the neutrino is detected by the detector for the observer of the lab, he will think, the neutrino was moving with speed equals to $v'_{neutrino} = \frac{v_{neutrino}}{\sqrt{1-\frac{v^2}{c^2}}}$, and in the case 0.5c $< v_{neutrino} <$ c, then the measured speed of the neutrino for the lab observer according to his clock is greater than c, the speed of light in vacuum, where, $v'_{neutrino} >$ c. But, when the neutrino is detected by the detector without passing through the space of the lab, then, the neutrino will register an energy spectrum fully corresponding with what it should be for particles traveling at the speed of light and no more. The neutrino inside the tube will not exceed the light speed in vacuum locally. But if the lab observer removed the detector, and after that the neutrino passed through the space of the lab, in this case the neutrino would radiate an energy equivalent to the Cherenkov radiation. That is because the vacuum energy of the lab is greater than the vacuum energy of the tube, which is equivalent that the refractive index of the vacuum of the lab is greater than 1 comparing to the vacuum of the tube. The Cherenkov radiation is emitted when a particle travels in medium with speed v_p such that c/n< v_p <c, where n is the refractive index of the medium.

8 The Modified General Relativity and the Exact Solution of the Pioneer Anomaly

Is light bending by gravity or refracted? According to special relativity, light speed is constant and equals to light speed in vacuum for all inertial frames of reference. General relativity was formulated according to the concepts and principles of SR. Thus, according to GR, light speed must be constant, and thus to keep the constancy of the speed of light, Einstein proposed in his GR that, for an observer located far away from the gravitation field, this observer will see the light beam will be bended toward the big mass when passing through the gravitational field of the big mass. Einstein explained this bending of the light beam through the gravitational field because when the light beam is passing through the gravitational field, then for an observer located far away from the gravitational field will see this light beam is moving in a geodesic path, and that means the light beam will passing longer distance through the gravitational field than if there is no gravitational field, and thus registering longer time separation for the event according to the clock of the observer far away from the gravitational field. Thus, according to that, the geodesic path is referring to the strength of gravitational field depending on the distance from the center of mass. According to our MSRT, we have seen how we keep on the consistency of the speed of light according our derivation to the Lorentz transformation equations and the equivalence of the Lorentz factor to the refractive index in optics which is related to the vacuum energy. From that, at the same time of keeping the consistency of the speed of light, in our MSRT, we keeping on the variability of the speed of light as existed in the concept of the refractive index in optics which depending on the vacuum energy. Thus by applying this concept on GR, taking into account the dependency of the strength of the gravitational field on the distance from the center of mass, and thus the dependency of the equivalent refractive index of the gravitation field on the distance from the center of mass. Thus, according to the modified general theory MGRT according to MSRT, I could reach to the exact solution to the Pioneer anomaly [35]. According to MGRT, if a particle or light beam passing through the gravitational field, then the measured speed of the particle or the light beam will be decreased for an observer far away from this gravitation field. Hubble's law can be interpreted according to this principle [35]. My solution to the Pioneer anomaly is more accurate than the proposed solution of the thermal origin of the Pioneer anomaly [36].

9 The Wormholes and the Faster-than-Light Travel

The impossibility of faster-than-light relative speed only applies locally. Wormholes allow superluminal (faster-than-light) travel by ensuring that the speed of light is not exceeded locally at any time. While traveling through a wormhole, subluminal (slower-than-light) speeds are used. According to GR, if two points are connected by a wormhole, the time taken to traverse it would be less than the time it would take a light beam to make the journey if it took a path through the space outside the wormhole. However, a light beam traveling through the wormhole would always beat the traveler. As an analogy, running around to the opposite side of a mountain at maximum speed may take longer than walking through a tunnel crossing it. In GR, the interpretation of faster-than-light is different from our interpretation although we accept that the impossibility of faster-than-light locally. According to our MGRT depending on our MSRT, both the local observer on the mountain and the observer located far away from the mountain will agree at the length of the distance passed, and the particle will move through the same path on the mountain for both observers. The particle will not walking through a tunnel crossing it. According to our MGRT depending on the MSRT, the particle will reach the opposite side of the mountain for the local observer before the observer far away seeing it on the opposite side. And if the observer sees the particle on the opposite side of the mountain in a less time separation than the local observer, in this case there must be a distance was not seen by the observer far away that the particle passed it on the mountain. For that observer the particle transformed from point A to point B separated by a distance D on the mountain in a zero time separation. In my MSRT and MGRT, wormholes are an analogy of quantum tunneling and entanglement as illustrated in the previous sections which are depending on the negativity of the vacuum energy.

As we have seen in the case of faster-than-light in MGRT and MSRT there is no violation for the Lorentz transformation or causality, and our interpretation is solving the contradiction between quantum theory and relativity (general and special).

10 THE SPEED OF LIGHT ACCORDING TO THE MSRT

According to the SRT of Einstein, the speed of light in vacuum c is constant for all inertial frames of reference, and thus the inertial frames of reference are different in measuring space and time. There is no particle which owns rest mass greater than zero can reach or exceed the speed of light in vacuum. Einstein -in his SRT- refusing an absolute inertial frame of reference to exist. According to the MSRT, we have found that it is possible to measure the speed of a particle which owns rest mass greater than zero to move with a speed faster than light c. We have kept in the constancy of the speed of light c locally, and at the same time we illustrated how the variability of the speed of speed light. In the MSRT, the information is transmitting to us in the speed of light c, and the observer has the main formation of the phenomenon as adopted in quantum theory (the Copenhagen school). The main question that the MSRT answers is the question of Einstein that “how shall I see the universe if I’m riding a ray of light? But! The MSRT is modifying the question to be as “How shall I see the universe if I’m a ray of light?” For example, suppose a ray of light is transformed from point A to point B separated by a distance x. For an observer located in the earth surface, he will see the ray of light at point A first, and then he will see it at point B. And if the observer divided the distance x over the time separation of the trip t according to his clock, he will get the speed of light in vacuum c. But for the ray of light for itself, it will be at point A and B at the same time, and if we divided the distance x at infinity number of points, then for the ray of light for itself will exist at all the points of the distance x at the same time. That means for the ray of light for itself when it exists at B, it exists at A at the same time and it exists at any point between A and B at the same time. Thus, from that we get, for the ray of light for itself there is no past or future, but there is present only. For the ray of light for itself we can consider as if the space is zero because it can exist at two points A and B separated by a distance equals to infinity at the same time. At the same time also we can consider the speed of light for the ray of light for itself to be infinity, because it exists at two points A and B separated by a distance equals to infinity at the same time. The two definitions are equivalent to each other. But in the material world of the mass, the speed of light c which is locally constant is related to the rest mass of the system which is greater than zero. By creating the mass, it is created the space and time, and it is created the speed of light c to be 299,792,458 meters per second for the system of mass, and then it is created what are called the past and the future for the mass system. The information is transmitted to the mass system by the present. The present of the mass system is defined by the collapse of the quantum wave function [24], [28]. Collapsing the quantum wave function leading the information to be transformed to past. According to the equivalence of mass and energy equation in the SRT, when all of my mass is transformed to energy or photons or ray of light, then how can I see the universe? According to the MSRT, I’ll see all my life history without past or future. I’ll live all my life history as a present without past or future. I live –at the same time as a present- each event that I lived in my mass world or what I would live in the future. I see myself while I was baby, child, youth and old at the same time at the present without past or future [24], [28]. In this case I can’t determine who is before or after if I was baby, child, youth or old. Or who came first I or my father or my grandfather. All of us are existed at the same time or present. And thus! I can confirm now the chicken and the egg are existed at the same time or present!

11 TACHYON IS NOT EXIST ACCORDING TO THE MSRT

A tachyon or tachyonic particle is a hypothetical particle that always moves faster than light. Most physicists think that faster-than-light particles cannot exist because they are not consistent with the known laws of physics [26][27]. If such particles did exist, they could be used to build a tachyonic antitelephone and send signals faster than light, which -according to SRT- would lead to violations of causality [27]. Potentially consistent theories that allow faster-than-light particles include those that break Lorentz invariance, the symmetry underlying special relativity, so that the speed of light is not a barrier. In the MSRT I confirm that tachyons are not exist, but the possibility of faster than light measurement is exist without violation of Lorentz transformation or causality. To understand that, let's study this thought experiment according to the MSRT. Suppose Sally and Sara again! Sally is staying in the Lab, and Sara is a pregnant at the first day of pregnancy. Sara incident inside a tube of negative vacuum energy. The negativity of the vacuum energy of the tube is equivalent to Sally as moving with constant speed 0.87c. According to the MSRT, Sally observes the clock of Sara inside the tube is moving similar to her lab clock motion. But Sara inside the tube observes Sally lab clock is moving slower than her clock. Thus, when Sara computes 9 months according to her clock inside the tube, at this moment Sally computes 4.5 months according to her lab clock or according to Sara's clock inside the tube. At this moments Sally observes Sara when she was at 4.5 month of pregnancy, while relative to Sara she is at 9 months of pregnancy, and after that Sara puts her baby and decided to leave the tube to the lab. When Sally observes Sara with a baby outside the tube in the lab, she will be surprised how Sara got the baby in 4.5 months. Sally has already observed Sara at 4.5 month of pregnancy. Sally has not observed Sara at $4.5<t\leq 9$ months of pregnancy. So, Sally who is an expert in physics and relativity will confirm that there is something unknown in the laws of physics. And to understand what happened according to the recent laws of physics in the case of Sara, she proposed that Sara is transformed to tachyons which are always moving faster than light, and then these tachyons passed the time period $4.5<t\leq 9$ months to decay after that to Sara with a baby. But the proposition of tachyon violates causality and Lorentz invariance according to the recent laws of physics.

But according to the MSRT, Sally will understand what happened with Sara and will understand there is no violation of causality or breaking Lorentz invariance in the case of Sara, and thus there is no particle known as tachyon!

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