The Modified Special Relativity Theory and the Meaning of Time

The Interpretation of Quantum Tunneling, Quantum Entanglement, OPERA, ICARUS, and SN 1987a

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Abstract

Through the meaning of time in the Modified Special Relativity Theory MSRT [23], we introduce an interpretation to the most problems in physics related to quantum tunneling [1-9,16], quantum entanglement [29-31], OPERA [26], ICARUS [27], and Sn 1987a [28].

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Time! What does time mean? From time events are created, and by time it is defined what are called past, present and future. Events are arranged on time, and all the physical quantities are formed from time. Mass, length and time are the fundamental quantities; from them we can derive all the other quantities in physics. Space is measuring by length. In our material world it is defined by three dimensions, x, y, and z. Before Einstein formulated his special relativity theory, time was considered as universal, clocks are ticking at the same rate at any place in the universe. When Einstein formulated his special relativity theory, he discovered time is not universal, in some situation it is dilated. What is universal in special relativity theory is the speed of light. The speed of light is constant for all inertial frames of reference, which it is the speed of light in vacuum [20-22]. What is speed…!? As we taught in physics, speed is a derived quantity; it is derived from space and time. For example, if a car is in motion that means it is not existed in a same point in space while a clock is ticking. It is transformed from point to point in space while a clock is ticking. The rate of change in space in the unit of time is called speed. If this rate of change is constant in the unit of time, then we say this car is in motion with constant speed or velocity. If the car is existed at the same point while a clock is ticking, then we say this car is stationary. Energy! Energy is the source of motion. If a particle owns enough energy, then it will be in motion, which means it will transform from point to point in space while clock is ticking. There is no motion without enough energy let the particle to move. The amount of energy that leads the particle to be in motion is called kinetic energy. As we can derive the speed from distance (space) and time, we can derive the speed from the kinetic energy. In order to keep the physical laws working right, the speed which is derived from the kinetic energy must be equal to the speed which is derived from the distance (space) and time, if not! There is something wrong in our understanding to the laws of nature, and then the conservation law will be violated.

Nature does not make a mistake. The mistakes are always existed in our equations while we are trying to discover the natural laws. In OPERA experiment, scientists claimed they broke the speed of light. The neutrinos passed the distance 732km in a time separation less than the time separation of the light beam to pass this distance by 60ns [26]. According to special relativity theory, the speed of light is the highest speed in the universe, there is no material particle can reach or exceed this speed. Thus in order to the neutrino -which owns mass greater than zero- to move with speed equals to the speed of light in vacuum, we must give this neutrino an amount of kinetic energy equals to infinity. The energy which owned by the neutrino in OPERA was finite, and the OPERA team determined the speed of the neutrino depending on the passed distance by the neutrino divided by the measured time separation of the event, the measured speed was greater than the speed of light. This is violating the concept of the conservation law. The measured speed depending on the rate of change of distance in a unit of time is not equal to the speed equivalent to kinetic energy which owned by the neutrino. Thus! Is there something error in the experiment? Lately, the OPERA team discovered the error is existed in the measured time separation of the trip of the neutrino. This error led the measured time separation to be contracted by 60ns. But the question here; is this error instrumental, or there is something wrong in our understanding to time. This will return us to the first question; what is time? If we could answer this question, we can answer what happened in the OPERA experiment, and then we can understand; what is the meaning of breaking the speed of light?

1- What is time?

I hate traveling, because I hate leaving my children. I used to travel alone. I remember the moment of the farewell of my children while the taxi was waiting to take me to the border. I always wished that the time could be stopped at the moment of hugging my children; I wished the feeling of that hug remains with me forever, and the taste of kissing remains with me forever. But all of that were thrown to past very fast. That feeling led me to ask myself how I can catch the present to keep living the happily moments forever. While I was riding the taxi to the border, I used to turn on my video camera reviewing the recorded tape of my children while they were playing and laughing. At that time I used to stop moving the tape at some fascinating pictures. I was saying to myself, this picture was picked up from the present; it was once a time a present that I lived with my children, but! I could stop it here on the screen of the camera, and I couldn’t stop it in my life. At that time I understood that all my life events are like the negative of the tape in the camera, and the screen of the camera is like me. The present that I’m living now is like a picture in the negative of the tape which is displayed now on the screen. My life is ongoing for me like the pictures of the negative of tape are ongoing on the screen. So! I can’t catch my present because I can’t stop the motion of the tape of my life.

At that time I understood time is not existed in the ticking of clocks. If we stop ticking the clock, the time does not stop. It is in motion and continuing in motion. My age will not stop if we stop ticking all the clocks in the universe. Ticking of clocks is something forming from time.

2- Present and time

I always used to looking at the clocks observing their motion, in order to understand what is time? What I'm seeing now around me is drawn by the present. Time (the motion of the clock) is moving because present is moving on now. If I recorded a video clip for a clock, and after that I looked at the negative of this video, I'll find the motion of the clock is composed from a collection of pictures; each picture is taken from the present and forms a part of the motion of the clock. When I display these pictures on the screen, I'll find the clock is moving. The motion of our present is like the motion of the pictures on the screen. In order to develop this concept into physics, let's agree about some definitions**. The information element** is equivalent to that picture which is displayed now on the screen [24]. **The thought unit of an observer** is equivalent to that screen [24]. Suppose an observer observing a stationary train on the earth surface. According to our definition, the observer is observing this train because there is a collection of information elements that are transmitting into the thought unit of the observer keep the observer observing the stationary train. Each information element is transmitting into the thought unit of the observer through his present. From that the present of any observer is defined as the moment of elapsing the information element into the thought unit of the observer. The form of observing the stationary train for the observer is given according to figure 1. According to fig. (1). the small circle represents the present of the observer, and the small line represents the information element. Thus from the figure, the present is existed now between the thought unit of the observer and the information element no.1 I1, after elapsing I1 into the thought unit of the observer, the observer lives I1 in his material world. At this moment the present of the observer is existed between the thought unit of the observer and I2, after elapsing I2 into the thought of the observer, the observer lives I2, and at this moment the present of the observer is existed between the thought unit of the observer and I3, ….and so on for I4,….In. This definition illustrates for us why I can't catch the present, because the moment of living the information element in my material world is that moment of elapsing the information element into my thought unit, where at this moment the information element is thrown into the past and my present at this moment is existed between my thought unit and the other information element. This motion of the information elements into my thought unit is equivalent to how the wave function which described by Heisenberg is working [10,21].

What is the wave function? Heisenberg defined it as "it is a mixture between two things, the first is the reality, and the second is our knowledge to this reality [10]." As we have seen previously, I'm living my life in my material world because there is an information element that is transmitting into my thought unit through my present leading to translating this information element from a thought to be real in my material world by living it. From that the wave function and the present are the same thing, and the meaning of the **collapse of the wave function** is same meaning of transmitting the information into my thought unit and then living it in my material world. The wave function is not material, and its motion can't be described by our time and space, that is because I see the time and space drawn around me, and then the motion of things around me through the motion of the wave function (present). Same thing, the motion of the tape on the screen leading me to see the train is moving on the screen, the motion of the wave function (present) leads me to eat, drink, sitting down and moving through the space and time.

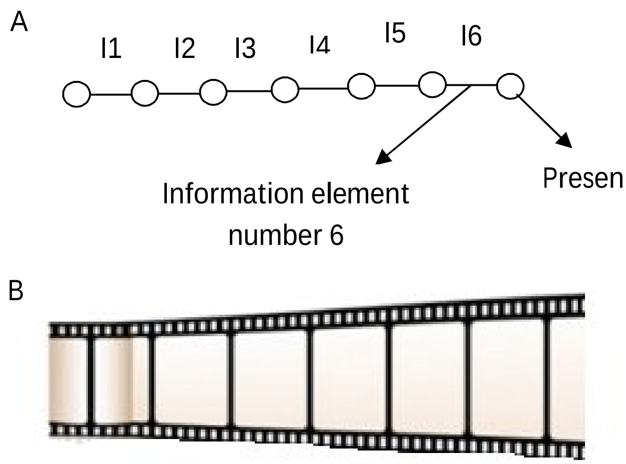

Fig 1*: (A) represents the form of an event in my life. The small line represents the information element that is transmitting into my thought unit through my present. The small circle represents my present. My present separates between the information elements of the event.*

(B) A negative of a movie tape, each picture in the negative is equivalent to the information element in my life which I live through my present. The pictures in the negative are separated from each other same as the information elements of my life are separated by my present.

3- **What is motion?**

Motion is transforming an object from point to point in space. Suppose you have a video camera and recorded a video clip for a moving train with a timer on the screen. Now if we review the negative of the video tape, we shall find a collection of pictures of the train, each picture represents the train location at a different point in the space and different time. Now if we turn on the video, we shall see the train is moving with moving the timer on the screen. If we speed up the tape motion, that means speeding up the rate of displaying the pictures on the screen. Then we shall see the motion of the train is increasing, and at the same time the motion of the timer is increasing. If we slowing down the speed of the tape, that means slowing down displaying the pictures on the screen, and then we shall see the motion of the train is slowing down and the motion of the timer is slowing down also.

Now if I want to make an experiment in order to measure the speed of the moving train between the two pylons with distance Δx, in this case I compute the required time separation Δt for the train to pass this distance by my clock. In this case I conclude that, the train is moving with speed equals to $\Delta x / \Delta t$. This measured speed depending on the distance and time will be equal to the speed derived by the kinetic energy of the train. Speed or velocity is a derived quantity from length and time, and I see the train is moving now, because each information element that is transmitting through my present into my though unit is informing me the location of the train is at a different point from previous information element I received before. The continuity of transmitting the information elements into my thought unit about the train let me seeing the train is in motion in the space. Same as the continuity of transmitting the information elements into my thought unit about the clock let me seeing the clock is in motion. The rate of transmitting the information elements into my thought unit through my present is constant, and in my present it is transmitted only, or I live one information element. In this example I find the conservation law is not violated because the rate of transmitting the information elements -which describe the motion of the train- into my thought unit through my present, is equal to the rate of transmitting the information elements about the motion of the clock.

4- Time Dilation and Twins Paradox in Special Relativity

Sally and Sara are twins of old 20 years. Sally traveled by his spacecraft for space trip. The speed of the spacecraft was constant and equals to 0.87c. Sally returned to earth after 2 years according to her clock time. Now, according to the special relativity theory SRT, when Sally returned to earth, her old would be 22, while she would find Sara's old 24 years. Sara would be older than Sally by 2 years, although they are twins. According to SRT, time in the moving frame of Sally will move slower than Sara's frame on the earth surface. And since Sara and Sally are computing their old using the motion of their clocks, thus, the motion of the clock of Sally will move in a slower rate than Sara's clock. As we have seen previously, the motion of the clock is considered as information elements which are transmitting through the present of Sally or Sara into their thought units. Thus, from that the rate of transmitting the information elements (which are describing the motion of the clock of Sally) through the present of Sally into her thought unit is slower than the rate of transmitting the information elements (which are describing the motion of the clock of Sara) through the present of Sara into her thought unit. Suppose that both of Sally and Sara are agreed to record their events of life within the range of the trip, each one uses her own video camera. And when Sally returned to earth, she reviewed with Sara here video tape which was recorded by her camera inside the spacecraft during her trip. Also Sara reviewed with Sally her video tape which was recorded by her camera on the earth within the range of the trip of Sally.

Now, when both reviewed their videos with each other, what would they see? They would see Sally's video tape recorded a period of time of 2 years, while Sara's video recorded a period of time of 4 years. That means the number of pictures that form Sara's video tape is double the number of pictures that form Sally's video tape. That means the number of information elements that were transmitted into Sara's thought unit through her present was double the number of the information elements were transmitted into Sally's thought unit through her present. That means the rate of transmitting the information elements into the thought unit of Sara was higher than the rate of transmitting the information elements into the thought unit of Sally. Although of the that, when both of them reviewed their video tape on the TV screen, they would find the rate of displaying the pictures on the TV screen are the same, where the pictures of Sally's video tape will be displayed on the TV screen at the Same rate of the Sara's Video tape. That means, Sally was feeling on elapsing the time in her spacecraft during the motion same as Sara who was stationary on the earth surface. This is illustrating why the speed of light is constant in all inertial frames of reference, as Einstein proposed in his SRT. Sally will measure the speed of light inside her moving spacecraft to be equal to the speed of light in vacuum, same as Sara on the earth surface. And thus the feeling of Sally relative to elapsing the time moments inside her moving spacecraft is the same feeling if the spacecraft was stationary on the earth surface. But, what is different, if Sara who is stationary on the earth tried to measure the speed of light in the moving frame of the spacecraft, she will find it equals to $c' = \sqrt{c^2 - v^2}$ as in the MSRT [23]. The decreasing of the speed of light in the moving frame relative to Sara, leading Sara to see the clock of Sally in the moving spacecraft to move slower than her earth clock.

5- Time contraction

We have found in the previous example, when Sally returned to earth, her old increased 2 years, while Sara's old increased 4 years, that means for Sally, she had known what is the form of Sara after 4 years on the earth from the moment of the leaving the earth in a time separation of 2 years according to Sally's time. Thus from that for Sally to Sara time is contracted. Suppose both of Sally and Sara are agreed to perform a chemical reaction, each one will do the same reaction in her reference frame at the moment of Sally leaving the earth. This reaction required a time separation 4 years to be performed. Now when Sally returned to earth after 2 years according to her time, the reaction would not be performed in her spacecraft, it is required other 2 years to be performed. But the reaction was performed on the earth, because the time passed on the earth was 4 years. Sally would know the result of the reaction which required a time separation 4 years to be performed in a time separation 2 years.

6- The Length Contraction

According to the thought experiment of Einstein in SRT, suppose Sally is a train driver, and Sara is stationary on the earth. Both of them will measure the distance between two pylons A&B on the earth.

They situated the train at pylon A, and then the train at A started to move with constant velocity V. The distance between the two pylons on the earth is well known for Sara, it is Δx , but! what is the measured distance for Sally during her train motion? According to Einstein's SRT, since the laws of physics are the same for all inertial frames of reference, thus, from this principle, both of

Sara and Sally will be agreed at the measured relative velocity v. This measured relative velocity must be equal to the velocity derived from the kinetic energy which owned by the moving train and also must be equal to the rate of change of the distance passed in the unit of time. From that the distance passed by the train for Sara is Δx given as

$$\Delta x = v\Delta t$$

Where Δt is the time separation of the event for Sara according to her clock.

Relative to Sally, who is driving the train the measured passed distance $\Delta x'$ by the train is given as

$$\Delta x' = v\Delta t'$$

Where $\Delta t'$ is the time separation of the event for Sally according to her clock in the moving train. Thus, from the two previous equations we get

$$\frac{\Delta L}{\Delta L'} = \frac{\Delta t}{\Delta t'}$$

And since $\Delta t' = \sqrt{1-\frac{v^2}{c^2}}\Delta t$, where the clock of Sally is moving slower than Sara's earth clock, from that we get

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

According to the previous equation, Sally will measure the distance between the two pylons A&B to be less than the real length as measured by Sara according to the factor $\sqrt{1-\frac{v^2}{c^2}}$. Einstein believed in the objective existence of the phenomenon as in the classical physics concepts, and according to this concept both of Sara and Sally will be agreed at the location of the train at pylon A, and then they will be agreed when the train reached at pylon B. Thus according to Einstein the distance between the two pylons will be contracted for Sally during her train motion. And according to the reciprocity principle in SRT, Sara will see the length of the moving train to be contracted in the direction of the velocity according to the previous equation.

To understand the concept of the length contraction more accurately, let's assume the train of Sally was moving with constant velocity 0.87c, 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 for simplicity, and 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

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

There are two interpretations to understand the length contraction according to the previous proposed condition. One of them is the interpretation depending on what is interpreted by Einstein depending on the objective existence of the phenomenon, and the second one which is depending on what adopted on the concepts and principles of quantum theory, specially the definition of the wave function of Heisenberg.

From that and according to SRT-during the motion- when Sally reaches to the second pylon B she will measure the distance between the two pylons 50 m, not 100 m. that means if we consider Pylon A is located at L=0, then pylon B is located at a distance 50 m from pylon A for Sally. But for Sara who is stationary on the earth, Pylon B is located at a distance 100 m from pylon A. Now, at this moment, the train of Sally is stopped, and when Sally left her train and measured the distance between pylons A&B, she would find it is 100m not 50m. That means the location of pylon B is transformed from 50 m to 100 m at a zero time separation for Sally (because the velocity of the train changed from 0.87c to 0 at a zero time separation) according to this condition. Also according to Sally's clock, this distance between the two pylons 100 m was passed by her train in a time separation $\Delta t'$ where

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

Δt is the measured time separation for the train to pass the distance between the two pylons for Sara according to her earth clock. And as we have seen in section 4, the clock of Sally is moving in a slower rate than Sara's earth clock. Thus Sally will predict (when her train stopped), that her train was passed the distance between the two pylons with velocity v'

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

Thus Sally will predict that her train was moving with speed greater than the speed of light in vacuum. This is not violating the conservation law. According to Sara the measured velocity for the train is $v = \frac{\Delta L}{\Delta t} = 0.87c$ which is equal also to the velocity equivalent to the kinetic energy owned by the train. For Sally, there are two states that the train existed in at the same time, the first one is the state of motion and the second one is the state of stationary. In the case of the state of motion the measured velocity of the train for Sally is $v' = \frac{\Delta L'}{\Delta t'} = \frac{\sqrt{1-\frac{v^2}{c^2}}\Delta L}{\sqrt{1-\frac{v^2}{c^2}}\Delta t} = v = 0.87c$, which is equal to the velocity measured by Sara, and equal to the velocity equivalent to the kinetic energy owned by the train.

In the case of the stationary state $v'=\dfrac{\Delta L'}{\Delta t'}=\dfrac{\Delta L}{\sqrt{1-\dfrac{v^2}{c^2}}\Delta t}=\dfrac{v}{\sqrt{1-\dfrac{v^2}{c^2}}}=\dfrac{0.87c}{\sqrt{1-(0.87)^2}}=1.74c$

The other interpretation of the length contraction which is depending on the concepts, principles and laws of quantum theory, and the definition of Heisenberg to the wavefunction, where, Heisenberg defined the wave function as "it is a mixture between two things, the first is the reality and the second is our understanding to this reality. From that we can interpret eq. (1) as given in fig. (1). Fig. (1) illustrates the relationship between x and x', where x' is the distance passed by the moving train as seen by Sally, and x is the distance passed by train as seen by Sara. From fig. (1), we find that the relationship between *x* and *x'* is a straight line. Its slope is $\sqrt{1-\dfrac{v^2}{c^2}}$ and we find, when Sara confirms that the train passed the distance 100*m*, at this moment Sally will confirm (during the motion) that her train passed only50*m*. When the train is at rest at *x* = 100*m*, and Sally leaves her train, she will be surprised that the passed distance is 100*m*, not 50*m*. Subsequently she will avow that her train transformed from 50*m* to *100m* at zero time separation, and the distance in the interval 50<x <100 was not passed by her train.

The difference between this interpretation and the first one which is adopted by Einstein in the SRT that; according to Einstein, when Sara sees the train reached to pylon B, where the distance separation between pylon A&B is 100m as seen by Sara. At this moment Sally also -during the motion- will see her train reached to pylon B, but the location of pylon B is at a distance separation 50m from pylon A, that is because Einstein was believing in the objective existence of the phenomenon. But according to the second interpretation, 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 his trip at 50 m and thus it is still approaching to the second pylon B. Thus, according to this interpretation, when Sara sees the moving train at distance x, at this moment Sally will see her moving train at the distance $\Delta x'=\sqrt{1-\dfrac{v^2}{c^2}}\Delta x$. 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 creates their own pictures about the location of the moving train. Now, for Sara, the measured velocity of the moving train is given as $v=\dfrac{\Delta x}{\Delta t}=0.87c$ 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 in 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

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

These 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. (1), 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, but because of the time dilation, and as we have seen in section 4, events (transmitting the information elements) 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.

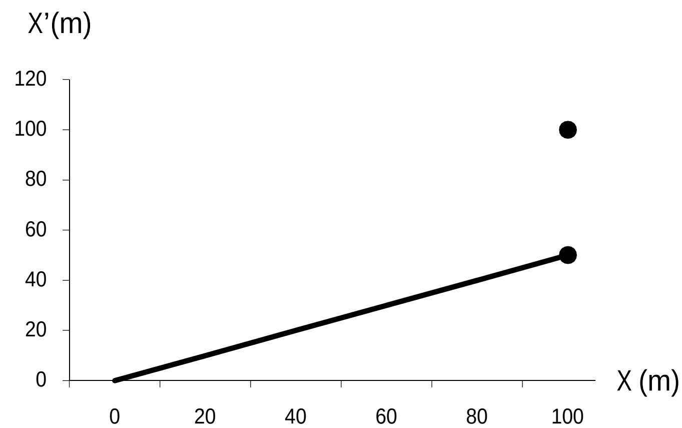

Fig. (1): illustrates the relationship between x and x' .

There is another consequence that produed by adopting the second interpretation of the length contraction. It is; how does Sally seeing the motion of Sara's earth clock comparing to her clock during the motion. According to Einstein SRT, and according to the reciprocity principle, Sally will see the clock motion of Sara is slower than her train clock. For Sally the train is at rest and the earth clock is moving with constant speed equals to the speed of the train. But what I predicted in my paper the "Modified Special Relativity Theory" [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

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

Where Δt_{Sara} is the reading of Sara from her clock. We can draw Δt_{Sara} versus Δt_{Sally} as in figure (2), where Δt_{Sally} is the reading of Sally from the clock of Sara. From fig. (2), we find two straight lines; the first for $0 < \Delta t_{Sara} \le 4 years$ 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 the figure, the years between $2 < \Delta t_{Sara} \le 4 years$ would not be determined by Sally where the train of Sally stopped at $\Delta t_{Sara} > 4$ years. Thus she would find that Sara was 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 $2 < \Delta t_{Sara} \le 4 years$ were not be received by Sally in the moving train.

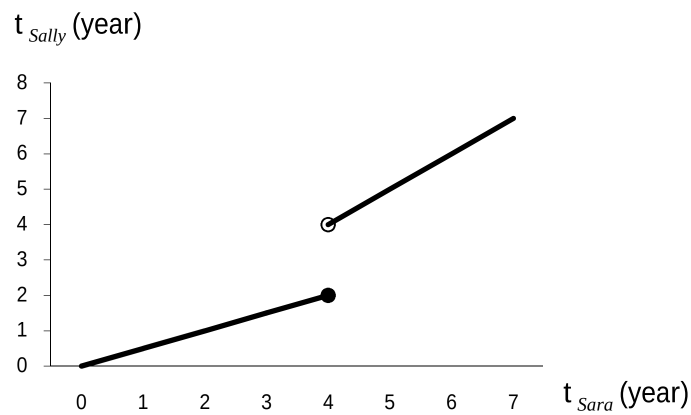

Fig. (2): t (Sara) versus t (Sally).

From the figure 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 same clock. That is in contrast with the objective existence of the phenomenon.

If we reviewing the thought experiment in section 4, we have seen, when Sally returned to earth from her space trip, she was younger than Sara by two years, and we have seen also when both of Sara and Sally reviewed their video tapes together, the tape of Sally was recorded 2 years, and the tape of Sara was recorded 4 years. Also according to figure 2 we concluded, if Sally was looking at Sara on the earth during the motion, she would see Sara is growing at the same rate that she is growing. And when Sally returned to earth, she was thinking Sara's old is 22 years same as her old, because before she stopped her spacecraft she was seeing Sara's old at 22 years. And when she stopped her spacecraft she saw Sara's old 24 years not 22 years. The events that were done by Sara between the interval $2 < \Delta t_{Sara} \le 4$ years were not seen by Sally. Sally was living in her present the events were done by Sara in the past relative to Sara.

7- The Vacuum Energy and The Equivalence Principle

Suppose Sally is living in 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 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 in the lab are occurring in a slower rate than if the same event are occurring inside the tube. What is the consequence of that according to what we discussed previously is what we shall discuss in the next section.

8- 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 [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 special relativity theory. 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 causing 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 glass 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 as moving with speed equals to v as seen in section 7.

Now, suppose Sara entered inside the tube, and 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 faster rate for Sara than Sally. That means the rate of transmitting the information elements which define the location and time for the light beam inside the tube is higher for Sara inside the tube than Sally in lab. Thus, if Sara determined the light is 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 $v = \frac{\Delta x}{\Delta t} = c$, 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 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 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 at the same time. Now, when Sally sees the light beam at $\Delta x' >$L and tries to compute the speed that light beam passed the distance L of the tube, she will find 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.

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 figure (3).

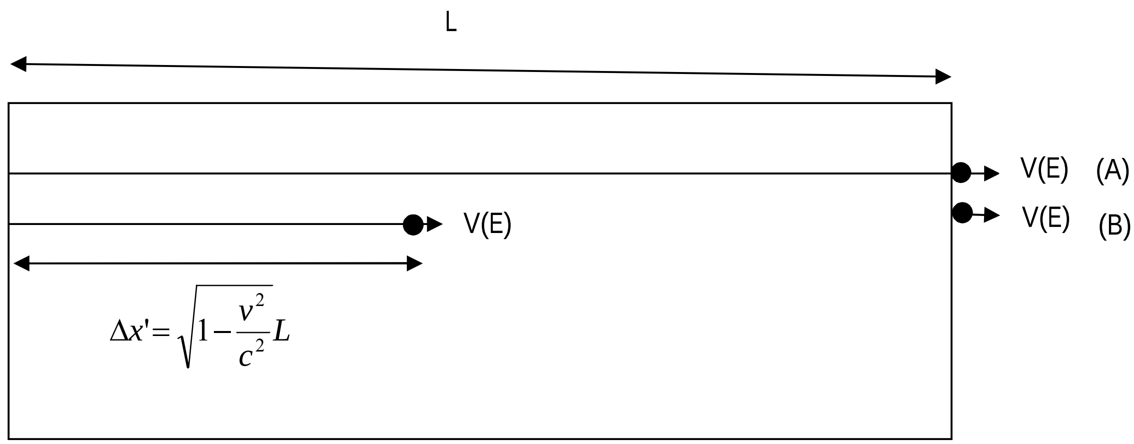

Fig. (3): (A) Sara who is living inside the tube will see the particle is passing all the length of the tube, and exit it with kinetic energy v(E). (B) Sally who is in the lab will see the particle existed in two places at the same time, one place is at $\Delta x'=\sqrt{1-\frac{v^2}{c^2}}L$*, and the 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.*

According to fig. (3), when Sara who is living inside the tube seeing 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 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 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 depending on the negativity of the tube, same as what happened in the OPERA experiment, where the OPERA team measured the speed of the neutrino greater than the speed of light in vacuum. The OPERA team found the error in their experiment was in the measured time separation of the trip of neutrino. And as we have seen this error is not instrumental, it is produced -as we have seen previously- similar as; Sally's clock in lab measured a time separation for the event to be less than Sara's clock inside the tube.

In their paper, the ICARUS team says their findings "refute a superluminal (faster than light) interpretation of the OPERA result." They argue, on the basis of the published studies by two top U.S. physicists, that the neutrinos pumped down from CERN, near Geneva, should have lost most of their energy if they had travelled at even a tiny fraction faster than light. But in fact, the ICARUS scientists say, the neutrinos beam as tested in their equipment registered an energy spectrum fully corresponding with what it should be for particles traveling at the speed of light and no more. The result produced by the ICARUS team is agreed with what predicted previously. The actual measured speed of the neutrino is measured according to a clock inside the tube. We have seen Sara inside the tube will measure the speed of the neutrino to be equal or less than the speed of light in vacuum, and this speed is equal to the equivalent speed of the kinetic energy owned by the neutrino.

Neutrinos scarcely interact with matter, which means they escape an exploding star more quickly than photons, something the SN 1987A measurements confirmed. But SN 1987A is 170,000 light years away. If neutrinos moved slightly faster than the speed of light, they would have arrived at the Earth years - not hours - before the detected photons from the supernova.
If the OPERA team instead of sending neutrinos, they sent a ray of light in their equipment, we have predicted previously that both the light ray and the neutrinos will reach at the end of the tube at the same time separation (if the actual speed of the neutrinos is equal to c) according to the OPERA team clock, and then they will predict that the ray of light is moving with speed greater than the light speed in vacuum, same as the neutrino. Both the neutrino and the light ray

will reach the detector at the same time approximately). This interpretation illustrates why the neutrinos of the SN 1987A arrived at the Earth- hours not years- before the detected photons from the supernova.

Now let's study this thought experiment in order to understand how quantum tunneling is speeding up time. Suppose both Sara and Sally in the lab. Sara is in the first day of pregnancy. Now if they created the tube of a negative vacuum energy equivalent to Sally in the lab is moving with constant velocity 0.87c. Now if Sara who is in the first day of pregnancy entered inside this tube, and lived inside it for 9 months according to her time clock inside the tube. Now for Sally who is staying in the lab, when she is looking at Sara in the tube, she will find the clock of Sara is moving at the same rate of her clock. But Sally's clock is moving in a slower rate than Sara's clock for Sara. Thus when Sara computes 9 months according to her clock, at this time Sally will compute according to her clock the time $\Delta t' = \sqrt{1-\frac{v^2}{c^2}}\Delta t = 4.5 months$. So at this time - 9 month- Sara will put her baby, and after that she will leave the tube out to the lab. Sally will see Sara with her baby after leaving Sara the tube to the lab, and she will be surprised how Sara got her baby in 4.5 months, where before Sara leaving the tube, Sally was seeing her pregnancy at 4.5 month, where Sally was living in her present in the past of Sara for Sara. When Sara left the tube, the moments which were lived by Sara at $4.5 < \Delta t < 9$ months were not received by Sally.

And in order to understand what a quantum entanglement is, let's study this thought experiment. Suppose Sally sent a beam of electrons 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. (3). 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 effected 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 a particle in two states at the same time or in two places at same time is confirmed in March 2010. Researchers at UC Santa Barbara have provided the first clear demonstration that the theory of quantum mechanics applies to the mechanical motion of an object large enough to be seen by the naked eye. In a related experiment, they placed the mechanical resonator in a quantum superposition, a state in which it simultaneously had zero and one quantum of excitation. This is the energetic equivalent of an object being in two places at the same time [25].

The researchers showed that the resonator again behaved as expected by quantum theory. This experiment is a good confirmation to what I proposed in the MSRT. The theory that governs the micro and macro world is the same. Thus, what is applied on the moving is same as what is applied to the electron.

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