Special Theory of Relativity in Absolute Space and the Symmetric Twin Paradox

(On the Possibility of Absolute Motion)

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Abstract. Departing from the traditional case where one twin stays put while the other rockets into space, we consider the case of identically accelerated twins. Both twins depart at uniform relativistic speeds in opposite directions for a round trip from the Earth on their 21^{th} birthday destined into space to some distant constellation that is a distance L_0 in the rest frame of the Earth. A "proper" application of the Special Theory *of* Relativity (STR) tells us that the Earth bound observers will conclude that on the day of reunion, both twins must both have aged the same albeit their clocks (which where initially synchronized with that of the Earth bound observers) will have registered a duration less than that registered by the Earth bound observers. In the traditional twin paradox, it is argued that the stay at home twin will have aged more than the traveling twin and the asymmetry is attributed to the fact that the travelling twin's frame of reference is not an inertial reference frame during the periods of acceleration and deceleration making it illegal for the travelling twin to use the STR in their frame, thus "resolving" the paradox. This same argument does not hold in the case considered here as both twins will undergo identical experiences where each twin sees the other as the one that is in motion. This means, each twin must conclude that the other twin is the one that is younger. They will conclude that their ages must be numerically different, thus disagreeing with the Earth bound observers that their ages are the same. This leads us to a true paradox whose resolution is found in the deduction that motion must be absolute. We provide a thought-experiment on how to measure absolute motion. Through this thought-experiment, we extend the second postulate of the STR to include the direction of propagation of light, namely that not only is the speed of light the same for all observers, but the direction of propagation as-well. Succinctly, the speed of light along its direction of motion in the absolute frame of reference is the same for all observers in the Universe. In an effort to try and resolve the symmetric twin paradox, we set-forth a relativistic aether model, which at best can be described as the Special Theory *of* Relativity in Absolute Space. By recalibrating several experiments performed by other researchers in the past, we find that the Earth's speed through the aether is in the range $240 \pm 80\,\mathrm{kms}^{-1}$.

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"There is no absolute space, and we only conceive of relative motion; and yet in most cases mechanical facts are enunciated as if there is an absolute space to which they can be referred."

– **Jules Henri Poincaré** (1854-1912)

I. INTRODUCTION

BEFORE we begin, perhaps we must persuade our reader to go through this reading with an open mind because the phenomenological (empirical) success of the Special Theory *of* Relativity (STR) has turned a very many number if not a plethora of physicists to both turn a blind eye and as-well give a deaf ear to any criticism that has and can be levelled against the philosophical foundations of the STR. This attitude is redolent of the attitude Einstein is wrongly accused of with regard to his position on the Interpretation *of* Quantum Mechanics. He has been accused of falling out of mainstream physics because he refused to accept the non-objective World that Bohr and his followers were advocating. Ironically, Einstein created mainstreams yet he was never a mainstreamer, he fearsomely and fearlessly stood aside from the streams that he created, he was a lone-ranger, a free and fearless independent thinker ready to defend his position even if it went against prevailing dogma for as long as his intuition informed him that he was on the right path of discovery – his only arbiter to which he would surrender was experience. Famously, this is what he had to say when he was accused of falling out of favour with the mainstream that he was not part of to begin with:

> *"I am generally regarded as a sort of petrified object, rendered deaf and blind by the years ... I must seem like an ostrich who forever buries its head in the relativistic sand in order not to face the evil quanta."*

A great many physicists are unable to face the "evil aether" even in the face of hard evidence [see *e.g.* the work by

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Cahill (2002); Cahill *&* Kitto (2002, 2003) and Demjanov (2010*a*, *b*, *c*)]. They would rather defend an allying dogma created by a man that accepted hard and ponderable facts, especially facts that have been measured against the wisdom of experience.

Vis the theories of *Nature* discovered by man, the STR stands – threefold; *neat*, *bold*, and *tall* as one of *Nature*'s most sacrosanct touch-and-go grails. Verily, we say unto our reader; while we are certain that what we present herein is not wrong, on the same footing, we feign not that what we present here-in is correct, but merely believe it is an attempt that is worthwhile. May you the reader be your own judge. Ours is nothing but an inexorable quest for nothing but the truth.

That said, let us begin by saying that, the philosophy derived from the Principle o*f* Relativity, according to which the Laws o*f* physical phenomenon must be the same for a "stationary" inertial observer as for one that is in uniform relative motion with the "stationary" inertial observer; has been understood to mean that there exists no means by which any inertial observer can determine whether or not they are in motion. This is the Philosophy *of* Relativity and is largely due to Einstein. This Philosophy *of* Relativity, introduces some uncomfortable inconsistencies that have made some vehement critics of the STR to spend a considerable amount of their time arguing that these inconsistencies render the STR obsolete. One such prominent critic is Professor Herbert Dingle (1890 – 1978), who spent about thirty years arguing against the STR (see *e.g.* McCausland 2008). While most of Professor Herbert Dingle's criticism was ruthlessly thwarted, on his last leg, he rejected the reciprocal nature of the Lorentz transformations as physically and mathematically inconsistent and illogical.

Empirically, the STR has never failed any experimental test to which it has been subjected and this has lead to the mainstream scientific community to ignore any such criticism. Without destroying or trying to render the STR obsolete – but building on the Principle *of* Relativity, this reading seeks to rail against this belief that all motion is relative and there exists no such thing as absolute motion. Absolute motion is motion relative to the immovable, non-ponderable absolute space. Herein, we rail-road against the Philosophy *of* Relativity and not its empirical foundations, we have no quarrel with these founded foundations of the STR.

The empirical basis and foundations of the non-existence of absolute motion rests its entire weight on the experiment by Albert Abraham Michelson (1852 – 1931) and Edward Williams Morley (1838 – 1923) which is now famously known as the Michelson-Morley Experiment (MME) (Michelson 1881; Michelson *&* Morley 1887). The MME is an experiment that was designed to measure the speed of the Earth in the hypothetical luminiferous aether medium. This luminiferous aether was thought to/or expected to exist since James Clerk Maxwell (1831 – 1879) had shown that light was a wave and this light wave travelled at a constant speed denoted by the symbol $c = 2.99792458 \times 10^8\ \mathrm{ms}^{-1}$. Since typical waves need a medium which to travel in – from a logic stand-point; it was reasoned that the luminiferous aether must fill all of space so as to act as a medium through which light travelled and hence thus it should be possible to measure the speed of ponderable material objects in this medium.

The above reasoning lead to the design and execution of the MME. Much to the surprise of the scientific community of the day, the experiment showed no proof of the existence (or lack thereof) the aether. Without the knowledge of the MME, Einstein reasoned that it was not necessary to invoke this hypothetical medium. Further, he reasoned that naturally the Laws *of* Physics must be the same for all inertial observers; if this where true, and concurrently the speed of light where an absolute constant as predicted by Maxwell's theory – then the speed of light ought to be a universal and absolute constant. This must be true for every observer every-when and anywhere in the Universe.

From this simple kind of reasoning, Einstein – with a rare mastery stroke of brilliance; overturned Newtonian Physics forever thus replacing it with his newly discovered STR which was derived from the universal constancy of the speed of light and the Principle *of* Relativity. Because of the experimental success of Einstein's theory, it phenomenology can never wrong. Its philosophy can be replaced while upholding its phenomenology. This is the attempt that we make in the present. Whether this attempt is successful or not, we leave this to the reader and the experimenters of prosperity.

Reiterating, this reading re-examines closely the long held underlying Philosophy *of* Relativity that is supposedly a direct descendent of the Principle *of* Relativity. First we give an exposition of the well known twin paradox where-after a modified version of it is given. The modified version is – unlike the original version; symmetric. The symmetric nature of the new version, brings about an inconsistency that the STR is unable to resolve even if the General Theory *of* Relativity (GTR) where to be brought to the rescue, as is the case in the symmetric version. This inconsistency, appears to us, insoluble unless we revise the underpinning philosophy supposedly emanating from the Principle o*f* Relativity.

Interestingly we argue (well) within the provinces of the STR without invoking the GTR, that the travelling twin is the one that ages and not the stay at home twin, *ipso facto*, this directly points to the fact that motion must according the STR, be absolute and not relative. This surely calls for a Lazarus moment, *i.e.* the resurrection of the idea that there must exist an absolute frame of reference. This may seen far fetched but recently, a significant number of researchers have began to rethink how to reintroduce the concept of an absolute frame of reference see *e.g.* Demjanov (2010*a*, *b*, *c*); Dmitriyev (2010); Niayesh (2010); Jacobson (2008); Cahill *&* Kitto (2002, 2003).

We are of the (very strong) view that Einstein's thinking that motion is only motion when measured relative to ponderable material bodies has mislead us to rule-out absolute motion as superfluous. If one where to ponder on this, deeper than meets the eye, it amounts to Bohr's philosophy of a non-objective World. This is a philosophy which Einstein consistently and unwaveringly rejected throughout his life. It is ironic that he embraced his Philosophy *of* Relativity and rejected Bohr's philosophy of a non-objective World, where the

moon exists only because you are looking at it and when not looking at it, it is superfluous to talk of its existence because this, according to Bohr's quantum mechanical philosophy, is meaningless.

Our revision of Einstein's philosophy of relative motion shall lead us directly to construct a relativistic aether model which allows observers to be able to measure their own state of motion – this is in fragment and complete disagreement with the underpinning philosophy championed by Einstein at the instalment of his STR. However, our new proposal leaves the phenomenology of the STR intact but its philosophy overturned.

We shall use the famous twin paradox to expose the flaws of Einstein's Philosophy *of* Relativity. Once these are exposed, it shall become clear that Einstein's own STR points to the existence of something absolute in *Nature*. We seize upon this, whereby we set into motion our own version of Special Relativity in which the immoveable, rigid absolute space takes centre stage – lets call this the Special Theory *of* Relativity in Absolute Space (STR-AS)

II. TWIN PARADOXES

In the present section, we shall give an exposition of the famous twin paradox and thereafter give a counter version *i.e.*, the symmetric twin paradox. This version exposes the subtle illogical contradictions of Einstein's Philosophy *of* Relativity that many critics have tried in vain to expose. The secret to unearthing these illogical contradictions lays in the unmasking of accelerations and decelerations of the travelling twin. It is with these accelerations and decelerations that any arguments about the twin paradox can successfully be thwarted. In a truly symmetric scenario, the accelerations and decelerations are unmasked, and the illogical contradictions lay bear in the full light of the day for all to see. To further expose Einstein's Philosophy *of* Relativity, we shall give another version of the twin paradox, this time of the twin that never returns.

A. Twin Paradox (Asymmetric)

It is safe and fair to say the twin paradox can be confusing. Before going into its details, we would like to give a brief background of its origins. This paradox was first pointed out by Einstein himself, not as a paradox but as a straight forward logical deduction from his STR. In its original form, Einstein stated:

> *"If we placed a living organism in a box ... one could arrange that the organism, after any arbitrary lengthy flight, could be returned to its original spot in a scarcely altered condition, while corresponding organisms which had remained in their original positions had already long since given way to new generations. For the moving organism the lengthy time of the journey was a mere instant, provided the motion took place with approximately the speed of light."*

It was the French physicist Paul Langevin (1872−946) in 1911 that rephrased this into what we now know as the twin paradox by replacing the organisms with the twins. Since then, the twin paradox has been the subject of analysis in philosophy, physics, biology, chemistry and other esoteric fields of human endeavour.

A natural source of this confusion for those encountering the STR for the first in their endeavour to comprehend the time-dilation effect and this is where the fascination and confusion comes from when one is dealing with the twin paradox. The real confusion lays in fathoming who is moving and who is not.

For instructive purposes, what we shall do is to state the twin paradox as it is popularly known and thereafter give the textbook solution. The textbook solution calls the General Theory of Relativity (GTR) to its rescue in-order for it to deliver a solution. Thereafter, we shall give a new solution to the twin paradox from within the provinces of the STR without the need for invoking the GTR. This solution points to the fact that the STR points to the existence of absolute space and motion. We shall thereafter argue that it must be possible to measure absolute motion. Because of these findings, the STR is modified so that it is in resonance and conformity with these facts.

Twin Paradox as Popularly Known

Suppose we have a set of twins – instead of Alice and Bob, lets call them Takunda and Tadiwa. Tadiwa decides to celebrate his 21^{th} birthday in style by rocketing at a constant relativistic speed (*i.e.* speeds comparable to the speed of light, for which the effects predicted by the STR become important and significant) to the nearest star to planet Earth – which is α-Centauri. Takunda and Tadiwa are recent *kum laud* physics graduates who understand very well Professor Albert Einstein's 1905 STR. Tadiwa makes a round-trip, *i.e.*, he travels to α-Centauri at a constant relativistic speed and upon arrival, he immediately makes an about-turn and returns back to planet Earth. The other twin Takunda decides to stay at home and not join his adventurous twin brother.

According to the Einstein's Philosophy *of* Relativity, Takunda sees Tadiwa moving away from the Earth and at the sametime, Tadiwa has equal claim in his own frame of reference that he is not moving but Takunda is moving away from him at the same speed as that Takunda sees him move albeit in the opposite direction. The paradox arises because according to the STR, the one that is "moving" will experience time dilation, so the question is; since each sees the other as "moving", who then amongst the two of them is the one that has experienced this time dilation? and thus seems younger to the other upon reunion?

Textbook Solution

All textbooks that we have had the opportunity to look at rightly state that the twin paradox is not a paradox and the solution they offer is as follows: they [the textbooks] correctly state that the apparent paradox arises from an incorrect appli-

cation of the Principle o*f* Relativity to the description of the story from the travelling twin's point of view.

From his [the travelling twin Tadiwa] point of view, the argument goes; his non-adventurous stay-at-home brother is the one who travels backward on a receding Earth, and then returns as the Earth approaches the spaceship again; while in the frame of reference fixed to the spaceship, the astronaut twin is not moving at all. It would then seem that the twin on Earth is the one whose biological clock should tick more slowly and not the one on the spaceship. Also, from Takunda's point of view, it is Tadiwa that is moving and thus must be younger on his return thus raising the apparent paradoxical situation – who really is younger on reunion?

The textbooks state that the flaw in the reasoning is that the Principle o*f* Relativity only applies to frames that are in motion at constant velocity relative to one another. This is correct, the question is, does this really solve the problem? The astronaut twin's frame of reference, is a non-inertial system because his spaceship must accelerate when it leaves until it reaches its desired speed, decelerate when it reaches its destination before turning back for the return journey, and then repeat the whole process (acceleration-deceleration) again on the way back home. Their experiences are not equivalent, because the astronaut twin feels accelerations and decelerations thus leading to the conclusion that the travelling twin will be younger when they are reunited.

The GTR must be used during the accelerations and decelerations. These accelerations and decelerations bring about asymmetric and it is this asymmetric that solves that twin paradox according to the textbooks. While these textbooks say the GTR solves the problem non that we have had the opportunity do make the GTR calculation to verify their claim. We have even surveyed GTR books, and again, non make this calculation. One can find a calculation on Wikipedia which only mathematically proves that the travelling twin is really the one that is younger on reunion. To what extent do the accelerations and decelerations affect the ageing process? no answers can be found on this. Off cause, because of accelerations and decelerations, adventurous twin is the one that really is moving. During the period when the adventurous twin is not experiencing any accelerations and decelerations, whose clock is tricking slower? Once again, one finds no answers to these questions in the textbooks or on Wikipedia.

It is clear from the above that the "real trick" lays in the accelerations and decelerations experienced by the travelling twin; these bring about the asymmetry which leads to Tadiwa being the one that experiences the time dilation. Despite the fact these accelerations and decelerations experienced by the travelling twin are accepted as a resolution of the paradox, we hold a view to the contrary namely that these accelerations are not key to the resolution of the problem. We believe there is a deep underlying asymmetry that solves this problem within the confines of the STR and this asymmetry, as shall be argued, invariably and intimately connects the STR to motion and to the existence of a fixed, immovable, all-pervading and permuting cosmic background.

New Solution from within the Provinces of the STR

From a purely idealized standpoint, we can neglect these accelerations and decelerations. If we did this, we will be lead to a scenario that appears at face value symmetric and this would certainly lead to irretrievable contradictions? With the accelerations and decelerations neglected, the scenario is actually asymmetric and this conclusion we draw from the fact the twin's succinct description of their experience reveal a deep underlying asymmetry.

If two persons where to give a succinct description of their experiences and these experiences where truly symmetric, one would not be able to differentiate the difference in their statements, because their experiences would appear exactly the same (equivalent) if we swapped or interchanged some *keywords* in their statements. This is not the case with the present scenario as will be clarified soon. A succinct description of the twins experiences is as follows:

According to Takunda (Earth bound twin): He is stationery and Tadiwa is moving toward α-Centauri and α-Centauri is not moving.

According to Tadiwa (travelling twin): He is stationery while both Takunda and α-Centauri are moving as a whole unit like a rigid body.

(**NB:** According to Tadiwa, Takunda and α-Centauri move as a rigid body because they are stationery relative to each other – this is where the asymmetric lays and this asymmetric solves the twin paradox but rises a question about absolute motion. α-Centauri is a third fixed reference point and it is this point that resolves the paradox from within the confines of the STR without need to invoke the asymmetries that come in with the accelerations and decelerations. According to Einstein's philosophy of relative motion, two reference points are sufficient for the complete description of motion *i.e.* the "stationery observer" and the "moving observer". The third point α-Centauri is a stationery fixed point relative to the "stationery observer".)

If the reader agrees with us so far, then lets proceed. Clearly, the description of events by the Takunda and Tadiwa are not equivalent hence not symmetric. For example, Tadiwa sees Takunda and α-Centauri moving as a whole unit like a rigid body, while Takunda sees himself and α-Centauri at relative rest. In order to better understand what we mean by "the description of events by each of the observers must be the same (equivalent) or symmetric" and as-well what we mean by:

> *"If their experiences where symmetric, then, the description of their experiences would appear exactly the same if we swapped (or interchanged) some keywords in their succinct statements."*

the reader may have to wait until the penultimate of the subsequent section.

The asymmetry seen in the description of events here is all one needs in order to come to the conclusion that the Tadiwa is older at the moment of reunion. We show this in the subsequent paragraphs.

According to Takunda (Earth bound twin): He is stationery and Tadiwa is moving toward α-Centauri and α-Centauri is not moving. Takunda, knowing that the distance from the Earth to α-Centauri in his rest frame is L_0; and that Tadiwa is moving at a speed v relative to him and given that Takunda is an astute physics graduate; it follows that he knows that the time lapse for a round trip for Takunda will be $t_1 = 2L_0/v$ (the accelerations and decelerations have been neglected here). Hence thus, Takunda will boldly conclude that Tadiwa's age is $t_1 = 2L_0/v$.

According to Tadiwa (travelling twin): He is stationery while both Takunda and α-Centauri are moving as a whole unit like a rigid body. Takunda and α-Centauri are stationery relative to each other hence they behave like a rigid body just like a rod. In Tadiwa's rest frame, this rigid body will have a length L. But this rigid body is not stationery in Tadiwa's frame but is moving at a speed v past his "stationery" frame of reference. Since Tadiwa is also an astute physics graduate, he knows very well that the rod will "appear" to him to have a length $L = L_0\sqrt{1 - v^2/c^2}$ and since this rod is moving at a speed v, it means that the time it takes this rod to move back and forth will be $t_2 = \left(2L_0\sqrt{1 - v^2/c^2}\right)/v$. It follows that:

$$t_2 = \frac{t_1}{\sqrt{1 - v^2/c^2}}, \tag{1}$$

hence thus Tadiwa will boldly conclude that Takunda's age is as given above.

Once again, if the reader agrees with us, then lets proceed. Now, from (1) we will have $t_2 > t_1$ since $v < c$. From this – clearly; it follows that the twins must have no quarrel whatsoever in finding out their ages. The travelling twin is the one that ages, and his ageing is real and not apparent and accepting this leads us to a "problem", namely that the twin that ages more is really the one that experiences motion in the true sense. The solution has come from the very fact that in Tadiwa's frame of reference, Takunda and α-Centauri move as a rigid body because they are stationery relative to each other and Takunda can never say that about Tadiwa and α-Centauri. This asymmetric, as just demonstrated, is the solution that solves the twin paradox. While it solves the twin paradox from with the provinces of the STR, it rises a question about absolute motion.

That is, while the travelling twin will see, the stay at home twin as being in motion and he being stationery, this motion is not real but apparent and only the motion seen by the Earth bound observer is what is real and the rest is nothing but an illusion since in the true sense it is the travelling twin that really ages and we need not the accelerations and decelerations to justify this. To cast more light on this, notice that t_1 is the age of the travelling twin as measured in the rest frame of the Earth bound observer and t_2 is the age of the stay at home twin as measured by the travelling twin in his own rest frame.

We should say that we have never encountered this kind of solution to the problem of the twin paradox in the literature. We believe this may be the first time such a solution appears. Because we have no better way to express ourself, we strongly believe the reader should go through this again to really convince themselves that solution lays in the asymmetry stated above.

B. Twin Paradox (Symmetric)

Now, we shall set-forth what we believe is a new version of the twin paradox. This paradox is a paradox in the true sense of a paradox because it is truly symmetric and this symmetric nature, leads to a situation where each of the travelling twins see the other as the younger one. Thereafter, we shall provide what we believe is a plausible solution and this solutions leads us to conclude that it must be possible to measure absolute motion *via* electromagnetic means.

Suppose, Takunda – unlike in the previous version, decided to be adventurous too. He decides to rocket into space and travels not with his twin brother but all by himself and instead of rocketing to α-Centauri he travels at the same constant relativistic speed as Tadiwa to an imaginary constellation (call it Constellation α-Christina) which is equidistant and directly opposite to α-Centauri along the line of site joining the Earth and α-Centauri [see figure (8)].

On their day of departure, their family and friends bid them farewell and wish them safe travels. They travel the same distance to and from at the same speed v (the speed is measured relative to the Earth bound observers). Without much say, on the day of reunion, the family and friends [who – like Takunda and Tadiwa; (all) have studied physics at university and understand very well Einstein's STR] will have no doubt that they will all have aged the same.

The big question is, will the twins agree with their family and friends that they have aged the same? If one accepts Einstein's Philosophy *of* Relativity, which amongsts others states that it is impossible for an inertial observer to measure their state of motion, *verily*, the "truth" according to this philosophy, each of the twins will see the other as having aged less than they, so they would not agree with their family and friends that they must be the same age. Actually, the twins will see the other as having aged less. Herein we have a paradox! We shall explain this more clearly.

If v is the speed with which the Earth bound observers (family and friends) see the twins travel at, then, according to the twins in their own respective frames of references, the Earth is receding at a speed v and the other twin is receding from them at a speed $V = 2v/(1 + v^2/c^2)$ (relativistic velocity addition). This scenario is perfectly symmetric and each of the twins has every right under the Sun and more so according to Einstein's Philosophy *of* Relativity, to say the other twin is the one that is younger and they will not agree that their ages are equal upon reuniting. Here, we can no longer seek

refuge in the GTR by making use of the accelerations and decelerations because both twins undergo identical accelerations and decelerations, actually, their motion is exactly identical in every respect except that they move in opposite directions.

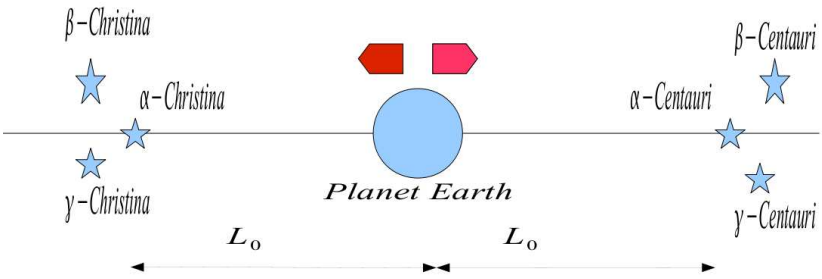

FIG. (1): The pictorial view of the symmetric twin paradox. Tadiwa rockets to α-Centauri at speed v relative to the Earth bound observers and Tadiwa rockets to the imaginary constellation α-Christina which is a replica of α-Centauri (but on the opposite end), at speed v relative to the Earth bound observers. According to the STR, the twins will each see the other move at a speed $V = 2v/(1 + v^2/c^2)$.

We are here presented with a true paradox which the STR is unable to provide an answer because both twins undergo similar experiences which see them see the other as the one that is younger. Logically, this is unacceptable especially given that ageing is a physical process. To shade some light, suppose the twins move at a speed that sees each twin see themselves age 1 yr and the other 60 yrs (given the distance to α-Centauri, it means $v \simeq 0.99981c$), clearly, on reunion the older twin will be seen by the wrinkles on their face and there will not be such an absurd statement from the twins as:

"From an Einsteinian relativistic point of view, it is you and not me that has wrinkles."

Their "Einsteinian and Relativity" pilgrimage is over, now they must face and dance to the music of physical and natural reality where something "is" or "is not".

We shall stress once again that the situation of the twins is symmetric and this symmetry is what brings about the true paradox. Can the STR solve this? Even when the GTR is brought to the rescue, is there a solution? *i.e.*: will the adventurous set of twins agree with their family and friends that they are the same age on reunion? Who between the two of them has wrinkles? Really? May the reader – here; be their own Judge.

Now moving on to other matters, we shall explain what we mean by this and in the process clear ourself on what we meant in the previous section by "The description of events by both observers must be the same if their experience are symmetric". A succinct description of the twins experiences goes as follows:

According to Takunda (α-Centauri bound twin): He is stationery and Tadiwa is receding from him at a speed V and the Earth is receding from him at a speed v. α-Centauri is receding at a speed v while α-Christina is approaching him at a speed v.

According to Tadiwa (α-Christina bound twin): He is stationery and Takunda is receding from him at a speed V and the Earth is receding from him at a speed v. α-Christina is receding at a speed v while α-Centauri is approaching him at a speed v.

The above descriptions are congruent. We just have to swap the α-Christina with α-Centauri and Takunda with Tadiwa, that is, where there is α-Centauri $\longrightarrow$ α-Christina and where there is α-Christina we make the replacement α-Christina $\longrightarrow$ α-Centauri and where there is Takunda $\longrightarrow$ Tadiwa. It is not possible to do the same in the case of the asymmetric twin paradox of the previous section. This is what we meant when we said the traditional twin paradox is asymmetric even if we did neglect the accelerations and decelerations because the:

description of events is and can never be symmetric in the sense envisaged above.

We would like to emphasis that unlike the asymmetric twin paradox where one can seek refuge by invoking the GTR to deal with the accelerations and decelerations of one of the twins, here, this clearly won't work since both twins will all undergo the same experience. Their ages will be less than that recorded by the Earth observers and these observers will measure these ages (of the twins) to be exactly the same but according to the twins, their ages can not be the same, hence a dilemma arises! How do we solve this? We offer in the next section (NB: not subsection but section) what we believe is a plausible solution.

C. Paradox of the non-Returing Twin

We shall set-fort yet another paradox that throws the STR into the abysmal depths of irretrievable contradictions – *i.e.*, the paradox of the non-returning twin. To do this, we shall as before, remove that veil behind which the STR seems able to escape its subtle labyrinth of contractions, that is, we eliminate the accelerations and decelerations.

To make matters simple, as before, we shall consider the one dimensional case along the x-axis. We shall assume the conventional x-axis, where the left-side of the origin $x = 0$ is the negative x-axis and the right-side of the origin $x = 0$ is the positive x-axis. Let the Earth be situated at $x = 0$. Further let the travelling twin start their journey somewhere at some appropriate point $x = x_{start} < 0$, such that they have ample time and space to accelerate and decelerate in such a way that they are able to travel up-till the point $x = 0$ such that when they are at that point $x = 0$, they have attained their desired constant relativistic speed ($v = 0.99981c$). An illustration of the set-up of the non-returning twin paradox is shown in figure (2).

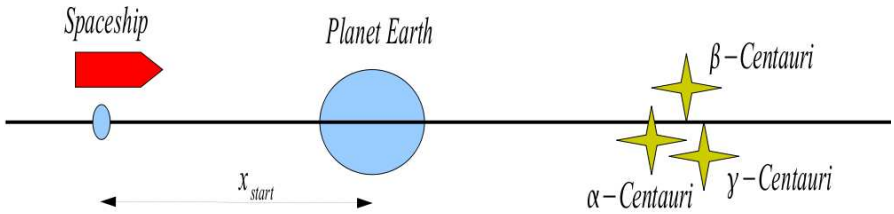

FIG. (2): The adventurous twin relocates themselves to position $x = x_{start}$ as shown in the illustration above. From there he begins his journey toward α-Centauri and beyond. When they pass the Earth, they have attained their desirable constant relativistic speed which they maintains till the time they self-terminate and leave the spaceship to itself without any conscious being to attend to it.

When the travelling twin starts their journey at the point $x = x_{start}$, they will move in the direction of the positive x-axis, that is, they approaches the Earth, reaches it and proceeds further to Alpha Centauri, passes it and continues their journey at a constant relativistic journey in a straight line along the x-axis into the unknown depths of space – against the desideratum, sadly, they is never to return!

For the adventurous twin to reach the point $x = x_{start}$, he must first accelerate before he decelerates and reaches the point $x = x_{start}$. When he now starts his journey to Alpha Centauri, he must accelerate, then decelerate and reach his desired constant relativistic speed ($v = 0.99981c$), the speed with which he shall fly past the Earth. From this, it appears we still have the problem of the accelerations and decelerations. Yes, it is present but we can eliminate it at the stroke.

This is how we are going to do this. When both twins are at the point $x = 0$ (remember that at this point and beyond, both are in inertial frames of reference), their clocks are synchronised such that they both register a time $t' = t = 0$ and in-conjunction with this, they make a deal – a deal that both are to religiously commit to.

The deal is that when their on-board clocks register 60 yrs they will send a light signal to the other and thereafter self-terminate (in the same style as Arnold Schwarzenegger in the movie Terminator), *i.e.* they commit suicide. The question is, according to the STR in its bare form as we understand it, who amongst the twins is going to self-terminate first? We shall leave this to the reader to find their own answer, to ourself, we find that once again, the proposed scenario throws the STR into the abysmal depths of irretrievable contradictions.

III. SOLUTION

We believe the solution to the symmetric twin paradox (and as-well that of the non-returning twin) will require us to rethink the very nimbus of the STR's central philosophy, namely that it is impossible for an inertial observer to detect their state of motion; otherwise, these paradoxes throw the STR into tatters marring it with insoluble contradictions. This solution that we offer, will not alter the mathematical formalism and phenomenology of the STR but, bring us back to the long rejected idea of the existence of the all pervading and permeating medium that is at absolute rest, namely the luminiferous aether.

Suppose we have an inertial observer O stationed at point O in a closed rectangular vacuum-cabin OABCDE as shown in figure (3). The axis X and Y are orthogonal and the corners of the vacuum-cabin $\perp$ ABC, $\perp$ BCD, $\perp$ DEO and $\perp$ EOA are right angles. At point A, observer O places a photon emitter

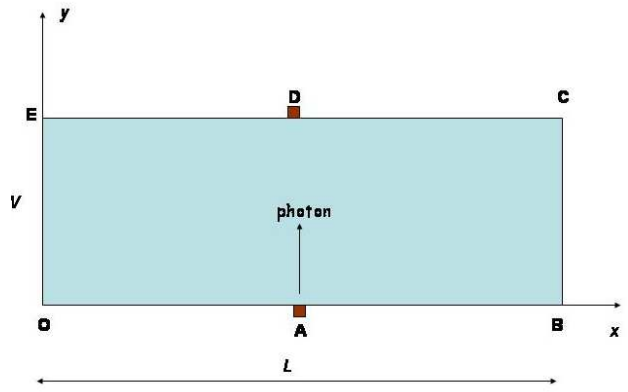

FIG. (3): The closed rectangular vacuum-cabin OABCDE is an inertial reference frame in which observer O is stationed at point O. Observer O has no knowledge of what is happening outside her/his vacuum-cabin. S/he sends a photon vertically upwards from point A. Since light travels in straight lines, this photon is expected to reach the detector at point D.

that emits a single photon at a time in the vertical direction parallel to EO and BC. Point D is vertically and directly above point A. Since the point D is directly above point A and the vacuum-cabin OABCDE is an inertial system; according to our current understanding of inertial systems, it goes without saying that the photon emitted in the vertical direction at point A will reach point D since light travels in straight lines. At this point D, observer O places a photon detector that is linked to the photon emitter at point A such that observer O is able to determine the time taken by this photon to travel from point A to point D. If OE=BC $= W$, the time of travel (Δt) according to observer O of the photon will be $\Delta t = W/c$ where c is the speed of light. So far so good and no problem. Lets proceed!

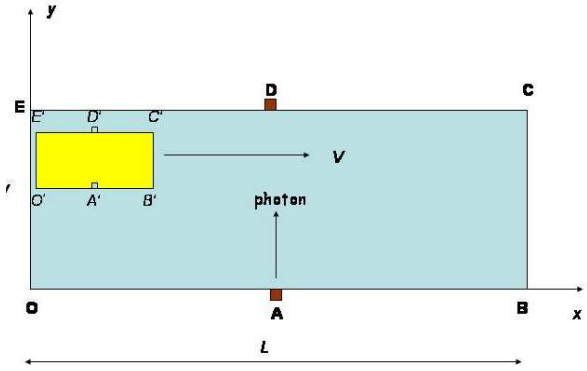

FIG. (4): Now, inside the closed rectangular vacuum-cabin OABCDE which is an inertial reference frame, we have another rectangular vacuum-cabin O′A′B′C′DE′ which off cause is smaller in size compared to OABCDE. The floors and roofs of these are parallel to one another. In this vacuum-cabin, we have observer O′ stationed at point O′. The vacuum-cabin O′A′B′C′DE′ moves as seen by observer O at speed v in the direction of the positive $x-axis$. the speed v is such that when observer O releases the photon from point A, this photon will reach the basement of observer O′ at point A′.

Let us introduce another inertial observer O′ stationed at point O′ in a closed rectangular vacuum-cabin O′A′B′C′D′E′ as shown in figure (4). As is the case with the X, Y axis, the axis X' and Y' are orthogonal and the corners of the vacuum-cabin $\perp$ A′B′C′, $\perp$ BCD, $\perp$ D′E′O′ and $\perp$ E′O′A′ are right angles. At point A′, observer O′ bores a large enough hole so much that for a photon entering *via* this hole, diffraction effects can be neglected and the photon can be treated as a particle. Point D′ is vertically and directly above point A′. The roof of the vacuum-cabin C′D′E′ is photo-sensitive. Let this vacuum-cabin move along the positive $x-axis$ at speed v such that when the lines A′D′ and AD are coincident, the photon realized at point A by observer O will be at the opening of the vacuum-cabin O′A′B′C′D′E′ at point A′. So far everything looks good, lets proceed.

We have agreed that the photon can be treated here as a particle because the opening at point A′ is large enough for us to neglect completely any diffraction effects. As illustrated in figure (5), this photon entering at this opening will have its direction of motion being parallel to the walls, OE & DC and O′E′ & D′C′ of the both vacuum-cabins OABCDE and O′A′B′C′D′E′ respectively. Now our trouble begins!

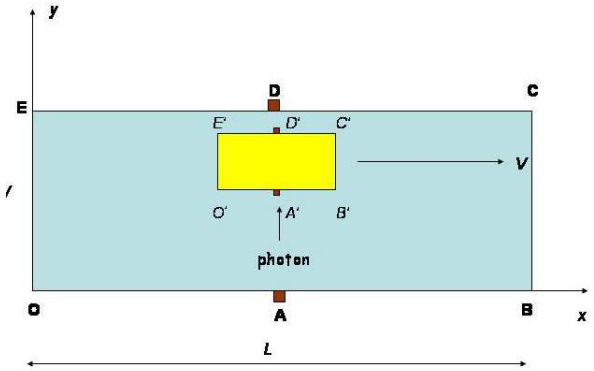

FIG. (5): Just at the time when point A′ is directly above point A, the photon released by observer O at point A reaches the opening at point A′ thus enters the vacuum-cabin of observer O′. Since light travels in a straight line, will this photon continue to travel along the same path as in figure (4)?

Since O′ is an inertial observer and s/he has knowledge that the particle that just entered is a photon and the direction of motion of this photon is as afore-described. The question is; Will s/he see the photon continue to travel parallel to the walls of her/his vacuum-cabin? If it does, then, s/he will expect at some finite time in the future that this photon will be detected at point D′. If it so happens that at this point D′, we have an opening, the photon will travel outside the vacuum-cabin of observer O′ upon arriving at point D′ and this photon will be detected on the roof of observer O's vacuum-cabin albeit off-set from point D (to the right-side of – to be specific). The reason the photon will be detected off-set the point D is because at the time of exit of the photon at point D′, this point is no-longer directly above point D because this vacuum-cabin is moving relative to the vacuum-cabin of observer O and the photon will have to continue its journey in a straight line parallel to wall of both vacuum-cabins.

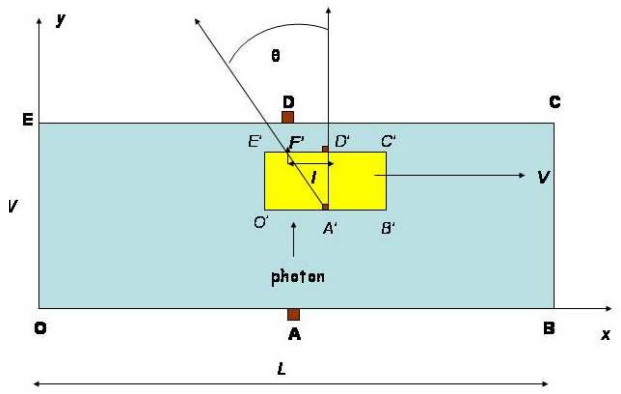

FIG. (6): If the photon travels the same path as that in figure (3), then, according to observer O′, its path will be inclined at an angle θ to her/his walls and this photon will traverse path A′F′ and not A′D′ as would expected for a photon travelling in the vertical direction from point A′ in the vacuum-cabin O′A′B′C′DE′. If the photon traversed along a straight path according O′ as much as in the case figure (3), then the photon will have to exit the vacuum-cabin O′A′B′C′DE′ at point D′ which will be offset thus the photon will have to be detect by observer O off-set from the point D to the right-side. If this is the case, observer O is forced to draw the conclusion that the vacuum-cabin O′A′B′C′DE′ at point D′ affected the motion of the photon.

Let us re-state or rephrase what we have just said in the previous paragraph. If the photon travels the same path as that in figure (3), then as shown in figure (6), according to observer O′, its path will be inclined at an angle θ to her/his walls and this photon will traverse the path A′F′ and not A′D′ as would be expected for a photon travelling in the vertical direction from point A′ in the vacuum-cabin O′A′B′C′DE′. This angle θ is such that:

$$v = c\tan\theta. \tag{2}$$

If the photon traversed along a straight path according O′ just as in the case figure (3), then the photon will have to exit the vacuum-cabin O′A′B′C′DE′ at point D′ which is offset thus the photon will have to be detected by observer O off-set from the point D, that is, to the right-side of point D. If this is the case, observer O is forced to draw the conclusion that the vacuum-cabin O′A′B′C′DE′ affected the motion of the photon by dragging it along its direction of motion. Naturally, we do not expect this dragging to take place. What we expect is that the path of the photon as seen by O must be the same as that seen by O′ and if this is what happens, it means that equation (2) must give the speed of observer O′'s vacuum-cabin. *If* the path or the direction of the photon is the same for all observers in the Universe, the speed (2) is the speed of O′ relative to some absolute and universal frame of reference that can only be at absolute rest!

Now the solution to the symmetric twin-paradox is clear. Takunda and Tadiwa can determine their state of motion by measuring their velocity using the afore-described. This velocity that they measure is their velocity relative to some absolute and universal medium that is at absolute rest and this medium clearly must be the one in which light has this constant speed c. If the Laws *of* Nature are to be the same everywhere in space and time, then, it follows that this medium must fill all of space at all times in-order that observers anywhere any time can determine their state of motion. We are thus brought back to the old ideas that now "safely" belongs to the Science Museum *of* Great *but* Failed Ideas.

IV. VELOCITY OF LIGHT

If the arguments presented in the previous section are correct – as we believe they are; then, not only is the speed of light in vacuum the same for all inertial observers, but the direction of motion of as-well. The direction of motion will have to be measured in the same frame of reference in which the speed of light is invariant to all observers. This frame of reference is the non-ponderable luminiferous aether. This would mean we will have to re-write the second postulate of the STR which in most popular physics textbooks reads (see *e.g.* Cutnell & Johnson 2003; Halliday & Resnick Walker 1997):

1st Postulate *of* Relativity: The speed of light in vacuum has the same value $c = 2.99792458 \times 10^8\,\mathrm{ms}^{-1}$ in ***all directions*** and in all inertial reference frames.

to read:

Extended 1st Postulate *of* Relativity: In all inertial frames of reference, the speed of light in vacuum has the same value $c = 2.99792458 \times 10^8\,\mathrm{ms}^{-1}$ ***along its direction of motion as defined by the ponying vector in the absolute frame of reference i.e., the aether frame***.

What this means in a nutshell is that all inertial observers will measure the same velocity (*i.e.*, magnitude and direction) of light in vacuum. On the direction of propagation, the STR says "*the speed of light in* ***all directions***"; we ask, which direction? There can only be one direction, which is the direction of propagation as defined by the ponying vector in vacuum. It is this subtle modification to the second postulate of the STR that enables an inertial observer to determine their state of motion as suggested in figures (3) to (6). We see in figures (3) to (6), that, the photon will not change its direction of motion relative to observer O thus the meaning of which will be that, O′ will see the photon traverse at an inclined angle θ to her/his walls. We have already argued, this angle is enough to deduce the speed of the vacuum-cabin. We know from the GTR, that gravitation will cause light to be deflected and its path appear curved. The deflection of light here is very different from the GTR-bending-of-light, we hope this is clearly evident.

The shift Δl measured by observer O′ in his/her vacuum-cabin as shown in figure (6) is given:

$$\Delta l = \left(\frac{v}{c}\right) W', \tag{3}$$

where W' is the height of the vacuum-cabin. This can be gen-

eralized to any given inertial observer. Thus if one is in an inertial frame of reference and they projected a light beam vertically up-wards and this light beam strikes the roof not on a point directly above the point where the beam of light was released, the conclusion they have to make is that their frame of reference is in motion and the shift is related to the speed of their frame of reference. We ask once more time; relative to what is this speed being measured? and we reiterate that we believe that this motion is motion relative to some absolute, immovable, permeable and non-ponderable medium. We shall advance our thoughts on this in the next section. Before leaving this section – we ask; is it feasible to measure this deflection?

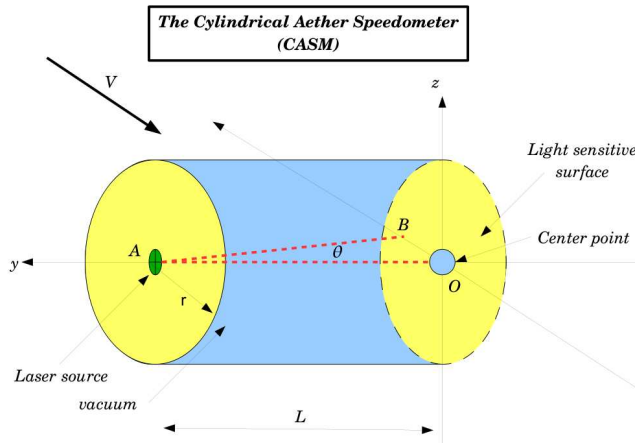

FIG. (7): The schematic diagram of the proposed aether speedometer. A monochromatic light beam is emitted parallel to the y-axis from the point A to the photo sensitive surface on toward the point O. In vacuum, this light is deflected by an angle θ to some-point B on the photosensitive surface that is capable of measuring the the deflection OB and this deflect is a measure of the speed of the CASM in the aether medium. In the absence of a vacuum, the emitted monochromatic light beam is expected to be detected at point O.

Given that the gravitational pull between the Earth and Sun causes the Earth to orbit the Sun at a speed of about $30\,\mathrm{kms}^{-1}$, this would mean a laboratory that is say 10 m in height, one would expect to register a shift [in accordance with (3)], of about 0.10 cm. Further, knowing that the solar system is in a motion relative to the galactic center and it speed is about $200\,\mathrm{kms}^{-1}$. This sets a minimum speed of about $230\,\mathrm{kms}^{-1}$ and for the same laboratory that is 10 m in height, we would expect a shift [in accordance with (3)], of about 0.77 cm (which is a shift of 0.04°).

Given modern day precision, it should be possible to detect such a shift. We thus propose that an experiment built on this idea of a shift of the light beam as suggested herein, be carried out. A schematic diagram of the kind of instrument we have in mind is shown in self explanatory diagram in figure (7). An illustration of the experiment is given in figure (7). Should the results provide a negative result, the present ideas are immediately rendered null and void and this would mean (against all expectations) that light acquires a component of motion from its source. If the experiments prove this shift, then, nothing of the mathematical structure of the STR will change, expect its philosophy (*viz* the physical time dilation and FitzGerald-Lorentz length contraction) will pretty much as that championed by the Irish philosopher, George Francis FitzGerald (1851 – 1901) and the great Dutch physicist, Hendrik Antoon Lorentz (1853 – 1928), in their great works (Lorentz 1892, 1904; FitzGerald 1889).

V. INERTIA

By asking a simple question, we come to the question and possible answer to the problem of inertia. Our question is:

> *"Suppose, instead of the photon in figures (3) to (6), we projected a ponderable material object such as a neutron and at D we placed a neutron detector instead. The question is: will observer O see the neutron take the same path as the photon?"*

Our answer to this question is ***no***, the neutron will take a different path! Observer O will see the neutron being deflected along the direction of motion of the vacuum-cabin and will reach the roof of the vacuum-cabin a distance Δl to the right side of point D′. The reason is that when the neutron is fired from the bottom of the vacuum-cabin, it already has a component of velocity of the vacuum-cabin along the direction of motion of the vacuum-cabin hence it will move along with the vacuum-cabin in its direction of motion as it makes it journey to the roof of the vacuum-cabin. Thus what differentiates light from ponderable material is that in a vacuum, the motion (both speed and direction of propagation – in summary, the velocity) of light is independent of the source. This means when the photon is fired from the bottom of vacuum-cabin, it does not acquire a component of velocity of the vacuum-cabin along the direction of motion, hence it will not move along with the vacuum-cabin but remain behind as it makes its journey to the roof of the vacuum-cabin and as a result it will appear (to O′) deflected!

We believe that, the reason why light and the neutron will take these different paths is because a photon has no inertia properties while a neutron has inertia properties. From Newton's second law of motion ($\vec{\mathbf{F}} = m\vec{\mathbf{a}}$), a material object without any inertia property ($m = 0$), will not experience any mechanical forces thus light, having no inertial mass it will not experience the mechanical forces that the neutron experiences which leads to it to acquiring a component of the motion of the cabin. From this simple analysis, one must be able to measure if a given material object has inertia or not. This brings us to one of the most sort for answers to the question:

> *"Do neutrinos have mass?"*

It is currently an unsettled hotly contested topic in modern physics *i.e.*, whether or not neutrinos do have inertia mass. From the foregoing, it is clear to us – that, this question could possibly be settled by measuring the path of light and that of neutrinos as in figures (3)-(6). If they traverse the same path, then neutrinos have no mass just as photons and if the

result is otherwise, then, neutrinos have mass. Obviously, the success (or failure) of this will hinge on the correctness (incorrectness) of the ideas propagated herein. We affirm our doubtless belief in the logical correctness of the ideas presented herein and at the same time we feign from taking these ideas as outright correct until they have been subjected to the rigid test of physical experience.

Now, in the next section, we shall set-forth our model of the aether which we believe is relativistic. This model, explains, *in our modest view*, the null result of the MME and at the same-time, it explains why gas-mode MMEs do observe a shift in the fringe pattern – a signal that absolute motion must exist.

VI. RELATIVISTIC AETHER MODEL

As already stated in the genesis, the idea of a universal all-pervading and permeating medium, is a superseded idea that is now thought to safely belong to the dustbin of the History *of* Science's great but failed ideas. Perusing through university textbooks, one will agree that the picture portrayed there is one where Einstein's 1905 STR is said to have delivered the lethal blow that sent this idea to its eternal rest where it will never raise again. However, in recent times some notable researchers claim to have detected absolute motion (as much as $300\,\mathrm{kms}^{-1}$) in gas-mode Michelson interferometers. Are we at a Lazarus moment? If the claim by these researchers is correct, then, the very Foundations *of* Physics will – at the very least; need a serious philosophical revision because so deeply entrenched is the philosophy that there exists no such thing as absolute motion.

Given the experimental success of the STR and GTR, it is clear that whatever revision that may come along, this revision can not render the STR and GTR obsolete. This revision ought and must build on the already present success in such a manner that in the limiting case, the new theory must reduce to the what we already know in much the same manner as the STR built [while at the same-time radically modifying Newtonian mechanics] on Newtonian mechanics and only tending to it [Newtonian mechanics] in the limiting case. If we are to modify the STR in such a way that we preserve its phenomenology, then we do not alter its experimental success but only its philosophical underpinnings. This is the approach we employ here as we seek to introduce absolute motion into the STR. Perhaps, instead of calling this the Relativistic Aether Model, we must call it the Special Theory *of* Relativity in Absolute Space (STR-AS).

If we are to build such a theory of the aether, then, this aether must be relativistic, the meaning of which is that it must uphold the Principle *of* Relativity and as well the universal invariance of the velocity of light in vacuum (NB, not just the speed of the photon/light but also the direction of of propagation of the photon/light as suggested previously herein).

From a physical point of view, the STR concerns itself with measurements of space and time between two inertial observers – call them, O and O′ where O′ is seen by O as moving along the positive x-axis with a relative velocity V_{rel},

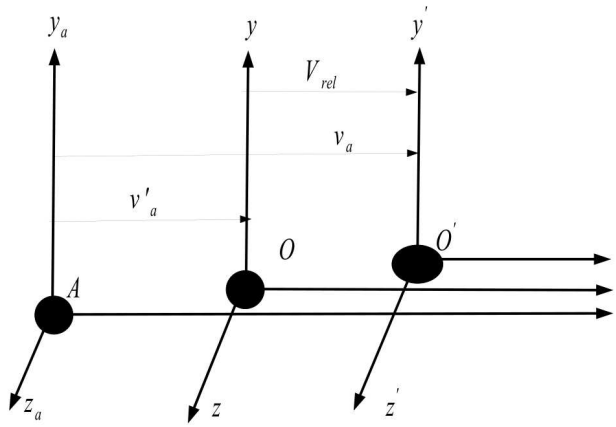

FIG. (8): The pictorial view of the symmetric twin paradox. Tadiwa rockets to α-Centauri at speed v relative to the Earth bound observers and Tadiwa rockets to the imaginary constellation α-Christina which is a replica of α-Centauri, at speed v relative to the Earth bound observers. According to the STR, the twins will each see the other move at a speed $V = 2v/(1+v^2/c^2)$.

that is:

$$\begin{pmatrix} \Delta x' \\ \Delta y' \\ \Delta z' \\ ic\Delta t' \end{pmatrix} = \begin{pmatrix} \Gamma & 0 & 0 & iV_{rel}\Gamma/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -iV_{rel}\Gamma/c & 0 & 0 & \Gamma \end{pmatrix} \begin{pmatrix} \Delta x \\ \Delta y \\ \Delta z \\ ic\Delta t \end{pmatrix} \tag{4}$$

where $\Gamma = 1/\sqrt{1-V_{rel}^2/c^2}$ and $\Delta x, \Delta y, \Delta z, \Delta t$ and $\Delta x', \Delta y', \Delta z', \Delta t'$ are the space and time intervals as measured by the two observers O and O′ respectively. The transformations (4) are the Einstein-Lorentz Transformations (ELTs).

Our addition (alteration to be more specific) to the STR, *vis* the introduction of absolute motion (which is a removal of non-absolute relative motion), is to in-cooperate a **common observer** $\mathcal{A}$ between any two observers O and O′ anywhere in spacetime. The role of this observer will be defined in a short while.

The measurements $\Delta x'$ and $\Delta t'$ of observer O′ are related to those of observer $\mathcal{A}$ (*i.e.* $\Delta x'_a$ and $\Delta t'_a$), just as in the STR by the ELTs:

$$\begin{pmatrix} \Delta x' \\ \Delta y' \\ \Delta z' \\ ic\Delta t' \end{pmatrix} = \begin{pmatrix} \Gamma'_a & 0 & 0 & iv'_a\Gamma'_a/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -iv'_a\Gamma'_a/c & 0 & 0 & \Gamma'_a \end{pmatrix} \begin{pmatrix} \Delta x'_a \\ \Delta y'_a \\ \Delta z'_a \\ ic\Delta t'_a \end{pmatrix} \tag{5}$$

where $\Gamma'_a = \left(1 - v'^2_a/c^2\right)^{-\frac{1}{2}}$ and v_a is the speed of O relative to $\mathcal{A}$. The speed v'_a is not the relative speed but the relative absolute speed as given by (2), *i.e.*, it is the speed which this observer can measure in their own frame of reference as described in the previous section *i.e.* they can use the aether speedometer to measure their absolute speed. In a similar fashion, the measurements Δx and Δt of observer O are related (as in previous case) to those of observer $\mathcal{A}$, Δx_a and Δt_a by:

$$\begin{pmatrix} \Delta x \\ \Delta y \\ \Delta z \\ ic\Delta t \end{pmatrix} = \begin{pmatrix} \Gamma_a & 0 & 0 & iv_a\Gamma_a/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -iv_a\Gamma_a/c & 0 & 0 & \Gamma_a \end{pmatrix} \begin{pmatrix} \Delta x_a \\ \Delta y_a \\ \Delta z_a \\ ic\Delta t_a \end{pmatrix}, \tag{6}$$

and likewise $\Gamma_a = \left(1 - v_a^2/c^2\right)^{-\frac{1}{2}}$ and v_a' is the speed of O′ relative to $\mathcal{A}$ and v_a is the relative absolute speed, it is the speed which the observer O′ can measure in their own frame of reference using the method suggested in the previous section.

Now, we shall formally introduce the properties of the absolute observer. According to the STR, in general $(\Delta x_a', \Delta t_a') \neq (\Delta x_a, \Delta t_a)$. Contrary to this, we propose that $(\Delta x_a', \Delta t_a') = (\Delta x_a, \Delta t_a)$. What this means is that the two observers O and O′ will completely agree with $\mathcal{A}$ on the numerical values of whatever measurements this observer may make. This observer's measurements are not affected at all by the motion of either O or O′, the observer $\mathcal{A}$ is eternally in a state of absolute rest. Since this observer must everywhere every-when, it follows that this observer must be non-ponderable, al-pervading and permuting. This is in contrary to Einstein's conception which lead to the formulation of the STR; as he gathered support to convince the scientific community to lay to rest the notion of the aether, Einstein once said:

"*It conflicts with ones scientific understanding to conceive of a thing [as] which acts but cannot be acted upon*".

Now that we have defined the absolute observer, it is time to eliminate them from the equations but before we do so, we clear some air here. The scenario just presented can lead one to think this scenario is a double Lorentz boost scenario encountered in the STR, no! it is not the same. The scenarios are similar but radically different in their philosophy.

To see this, if observer $\mathcal{A}$ measures the length of a rode in his/her rest frame to be L_a^*, in-accordance with Einstein's STR, observer O will measure this stick to be $L = L_a/\Gamma_a$ where L_a is what this observer will define as the rest length of the rode. On the other hand, observer O′ will measure this rode to be $L' = L_a'/\Gamma_a'$ where likewise L_a' is what this observer will define as the rest length of the rode. Under a normal Lorentz boost scenario, observers O and O′ will agree that, $L_a = L_a' = L_a^*$. In the new scenario $L = L' = L_a^*$, and this is where the subtle difference lays! The length L_a^* is the true physical size of the rode, and both observers O and O′ will agree on this, but they will disagree on the apparent size of the rode that they will each measure in their respective moving frames.

Now, we shall proceed from where we left just before the previous paragraph. Since the observer $\mathcal{A}$ is common to both and the measurements of observer $\mathcal{A}$ are the absolute true physical measurements, we can delete/eliminate this observer from the equations. To do this we make the column vector in (5) and (6) the subject of the formula and knowing that $(\Delta x_a', \Delta t_a') = (\Delta x_a, \Delta t_a)$, we simple equate the two. So doing, one arrives at:

$$\begin{pmatrix} \Delta x_a \\ \Delta y_a \\ \Delta z_a \\ ic\Delta t_a \end{pmatrix} = \begin{pmatrix} \Gamma_a' & 0 & 0 & iv_a'\Gamma_a'/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -iv_a'\Gamma_a'/c & 0 & 0 & \Gamma_a' \end{pmatrix} \begin{pmatrix} \Delta x' \\ \Delta y' \\ \Delta z' \\ ic\Delta t' \end{pmatrix} = \begin{pmatrix} \Gamma_a & 0 & 0 & iv_a\Gamma_a/ic \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -iv_a\Gamma_a/ic & 0 & 0 & \Gamma_a \end{pmatrix} \begin{pmatrix} \Delta x \\ \Delta y \\ \Delta z \\ ic\Delta t \end{pmatrix}. \tag{7}$$

Written in terms of O′ and O without the absolute observer, one will have:

$$\begin{pmatrix} \Delta x' \\ \Delta y' \\ \Delta z' \\ ic\Delta t' \end{pmatrix} = \begin{pmatrix} \Gamma_a' & 0 & 0 & -iv_a'\Gamma_a'/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ iv_a'\Gamma_a'/c & 0 & 0 & \Gamma_a' \end{pmatrix} \begin{pmatrix} \Gamma_a & 0 & 0 & iv_a\Gamma_a/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ iv_a\Gamma_a/c & 0 & 0 & \Gamma_a \end{pmatrix} \begin{pmatrix} \Delta x \\ \Delta y \\ \Delta z \\ ic\Delta t \end{pmatrix}. \tag{8}$$

It should not be difficult to deduce from (7) that the invariant line element is:

$$\Delta s^2 = \Delta x_a^\mu \Delta x_{a\mu} = \Delta x'^\mu \Delta x_\mu' = \Delta x^\mu \Delta x_\mu. \tag{9}$$

From the above invariant line element, the ELT's of the STR which are:

$$\begin{aligned} \Delta x' &= \Gamma\left(\Delta x - V_{rel}\Delta t\right) \\ \Delta y' &= \Delta y \\ \Delta z' &= \Delta z \\ ic\Delta t' &= i\Gamma\left(c\Delta t - V_{rel}\Delta x/c\right) \end{aligned} \tag{10}$$

will in the new STR-AS transform and become:

$$\begin{aligned} \Gamma_a'\left(\Delta x' - v_a'\Delta t'\right) &= \Gamma_a\left(\Delta x - v_a\Delta t\right) \\ \Delta y' &= \Delta y \\ \Delta z' &= \Delta z \\ i\Gamma_a'\left(c\Delta t' - v_a'\Delta x'/c\right) &= i\Gamma_a\left(c\Delta t - v_a\Delta x/c\right) \end{aligned} \tag{11}$$

(**NB:** The reader should take note of the fact that the insertion of the complex factor $i = \sqrt{-1}$ as we have done leads to a Lorentz matrix that, prima facie, may appear to be wrong, no, this Lorentz matrix is not wrong. In the convention used here,

it is the right way to right it. The reader must check this to their satisfaction.)

These new Lorentz transformations serve the same purpose in the STR-AS as the normal Lorentz transformations serve in Einstein's STR. All that can be derived in the STR-AS will have to be derived from these transformations just as all that is known in the STR is derived from the normal Lorentz transformations. We are sure these new Lorentz transformations would have made Professor Herbert Dingle happy because they solve – in our modest opinion; the confusing reciprocal nature of the Lorentz transformations. We are very sure and certain, that these new transformations, if applied correctly and properly, with the understanding with which they have been derived herein, there are no paradoxes that can arise as in the case with the STR.

Now, if we are to preserve the mathematical formalism of the STR (this preserves its [STR] phenomenology), then, (8) must be identical to (4) thus we must compare these; so doing, one obtains:

$$\begin{pmatrix} \Gamma & 0 & 0 & iV_{rel}\Gamma/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -iV_{rel}\Gamma/c & 0 & 0 & \Gamma \end{pmatrix} \equiv \begin{pmatrix} \Gamma'_a & 0 & 0 & -iv'_a\Gamma'_a/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ iv'_a\Gamma'_a/c & 0 & 0 & \Gamma'_a \end{pmatrix} \begin{pmatrix} \Gamma_a & 0 & 0 & iv_a\Gamma_a/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -iv_a\Gamma_a/c & 0 & 0 & \Gamma_a \end{pmatrix} = \begin{pmatrix} \Gamma'_a\Gamma_a(1 - v'_a v/c^2) & 0 & 0 & i(v_a - v'_a)\Gamma'_a\Gamma_a/c \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -i(v_a - v'_a)\Gamma'_a\Gamma_a/c & 0 & 0 & \Gamma'_a\Gamma_a(1 - v'_a v/c^2) \end{pmatrix}, \tag{12}$$

and from this, we easily deduce the relationships:

$$\Gamma = \Gamma_a\Gamma'_a\left(1 - \frac{v_a v'_a}{c^2}\right), \tag{13}$$

$$V_{rel} = \frac{v'_a - v_a}{1 - v'_a v_a/c^2}. \tag{14}$$

From (13) and (14), we see that the gamma factor now is in-terms of the (absolute) velocities of both observers while the relative velocity between the two observers is exactly as is in the STR. This completes our task of introduction absoluteness into the STR. *Vis* the STR, the absolute speeds v_a and v'_a, now make sense again, otherwise in the bare STR, this would leave the unanswerable question: relative to what are these speeds (v_a and v'_a) being measured? Now, we can safely say these speeds are measured relative to absolute and immovable space.

Now, according to (14), if an (any) observer knows their absolute speed – which they can measure using *e.g.* the aether speedometer; and as-well the relative speed between them and another observer moving relative to them at a speed V_{rel}, then, they can deduce from (14) the absolute speed of this other observer that is motioning relative to them at the speed V_{rel}. So, this means knowing v' and V_{rel}, one will know Γ_a and Γ'_a.

In-passing, in the light of the new STR-AS, let us look at the time dilation and length contraction phenomenon. If observers O′ and O are to make any length measurements for comparison purposes, they have to take the readings off the end points of the rode simultaneously in their respective frames, this means $\Delta t' = \Delta t = 0$. From (11), it follows that:

$$\Delta x' = \left(\frac{\Gamma_a}{\Gamma'_a}\right)\Delta x = \gamma\Delta x. \tag{15}$$

Likewise, if observers O′ and O are to make any time measurements for comparison purposes, they have to take the readings from a clock that is stationed at the same place in their respective frames, this means $\Delta x' = \Delta x = 0$. From (11), it follows that:

$$\Delta t' = \left(\frac{\Gamma_a}{\Gamma'_a}\right)\Delta t = \gamma\Delta t. \tag{16}$$

From these relationships *i.e.* (15) and (16), there is no real nor apparent twin and or length paradox. Everything is as is, all measurements here are absolute! The length and time contractions are real in the sense first envisaged by Lorentz (1892, 1904) and FitzGerald (1889).

VII. RE-INTERPRETATION OF THE MME RESULT

As already stated, with James Clerk Maxwell having shown (theoretical) in 1864 that light was a wave and that this light wave should travel at a constant speed and coupled with the knowledge that typical waves (or all known waves then) needed a medium which to travel in, it was reasoned that there must exist a medium through which these light waves travel and this medium – coined the aether, had to fill all of space so that light can travel in the cosmos. The MME was designed to measure the Earth's putative motion in this aether medium and the underlying calibrations they used was the Galilean calibration *i.e.*, their interpretation was based:

> *On the (clearly wrong) assumption that spacetime and the Laws of Nature obeyed Galilean invariance and also (if it the aether exists, on the correct assumption) that the aether was immovable (at absolute rest), permeable, all-pervading and non-ponderable; its was the carrier of light waves, a medium which light assumed its universal speed c.*

Shown in figure (9) is the setup of the MME. It consists of two perpendicular arms through which light waves would race

and in the process – along the race, the light rays in the different arms take different times to complete their journey before being detected. The time difference in the two rays results in the merged beams to exhibit a phase shift that causes the emergence of an interference pattern which is suppose to shift as the apparatus is rotated. Let the length of arm parallel to the direction of motion of the interferometer be $L_{\parallel}$ and like the transverse arm is of length $L_{\perp}$. In the first trip for the beam travelling parallel to the aether wind, we will have $ct^{+} = L_{\parallel} + vt^{+}$, and for the return trip, we will have $ct^{-} = L_{\parallel} - vt^{-}$, and from this, it follows that the total time of travel ($t_{\parallel} = t^{+} + t^{-}$) in the parallel arm is:

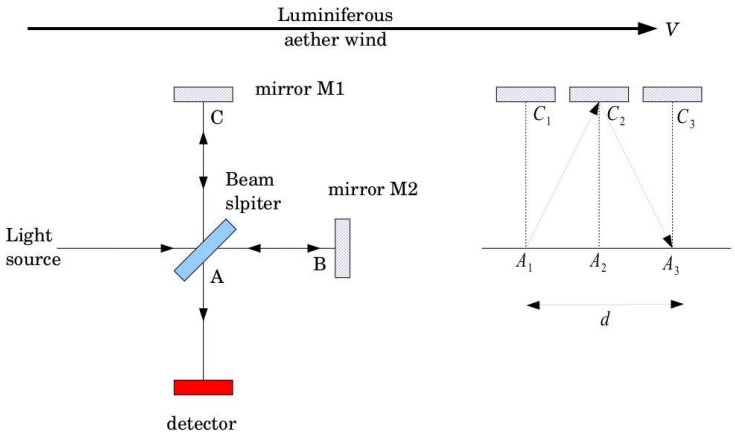

FIG. (9): A schematic diagram of the set-up of the Michelson-Morley Experiment. The apparatus is moving in the aether wind at speed V. Light travels from the source to the beam splits which splits the light beam into, one of the beams travels to mirror M_1 and the other to M_2 before returning to and reuniting at the point A where after the reunited beam travels to the detector. A rotation of the whole apparatus should manifest itself as shift in the fringes if the luminiferous aether exits. Opposite is a schematic diagrams showing the path of the light beam taken by the beam travelling to M_2.

$$t_{\parallel} = \frac{L_{\parallel}}{c-v} + \frac{L_{\parallel}}{c+v} = \frac{2L_{\parallel}}{c}\left(1 - \frac{v^2}{c^2}\right)^{-1}. \tag{17}$$

For the transverse arm, we will have $(ct_{\perp}/2)^2 = L_{\perp}^2 + (vt_{\perp}/2)^2$, and after some elementary algebraic manipulations, one arrives at:

$$t_{\perp} = \frac{2L_{\perp}}{c}\left(1 - \frac{v^2}{c^2}\right)^{-1/2}. \tag{18}$$

The time difference ($\Delta t = t_{\perp} - t_{\parallel}$) in the two racing light beams upon reunion is:

$$\Delta t = \frac{2}{c}\left[L_{\perp}\left(1 - \frac{v^2}{c^2}\right)^{-1} - L_{\parallel}\left(1 - \frac{v^2}{c^2}\right)^{-1/2}\right]. \tag{19}$$

To first order approximation in terms of v^2/c^2, Δt is:

$$\Delta t = \frac{2}{c}\left(L_{\perp} - L_{\parallel} + \frac{L_{\perp}v^2}{c^2} - \frac{L_{\parallel}v^2}{2c^2} + ...+\right). \tag{20}$$

This time lag between the two light rays is what causes the fringe pattern. Since the interferometer is of equal arms, *i.e.* $L_{\perp} = L_{\parallel} = L$, the above reduces to:

$$\Delta t = \frac{L}{c}\frac{v^2}{c^2}. \tag{21}$$

Now, in order to measure this time difference, the whole apparatus must be rotated through 90° so that arm parallel arm becomes transverse arm and vise-versa. The time difference between the two racing beams becomes:

$$\Delta t' = -\frac{L}{c}\frac{v^2}{c^2}. \tag{22}$$

So that the total time difference ($\Delta\tau = \Delta t - \Delta t'$) in the two set-ups is:

$$\Delta\tau = \frac{2L}{c}\frac{v^2}{c^2}. \tag{23}$$

This 90° rotation will cause a shift in the fringe pattern. The fringe shift ΔA_m to be expected from this is given, $\Delta A_m = 2c\Delta t/\lambda$. From (23), it follows that:

$$\Delta A_m = \frac{2L}{\lambda}\frac{v^2}{c^2}. \qquad (24)$$

In anticipation, Michelson reasoned that because the Earth is moving at a speed of $\sim 30\,\mathrm{kms}^{-1}$ in its orbit about the Sun, he could calculate a minimum expected fringe shift. Alas! not only is the Earth moving about the Sun but the Solar system as a whole is orbiting the centre of the Milkyway Galaxy at about $220\,\mathrm{kms}^{-1}$, thus a minimum value to be considered for the motion of the Earth through the aether is $250\,\mathrm{kms}^{-1}$. In their calculation of the expected fringe shift, Michelson appears to have been unaware of the motion of the Solar system about the galactic centre. In this first experiment, Michelson used yellow light with $\lambda = 5.75 \times 10^{-7}\,\mathrm{m}$ and the arms of the interferometer were 2.4 m, thus the expected fringe shift calculated by him was $\Delta A_m^{ex} = 0.04$.

When he made the actual measurements, he found no indications of the shift of interference fringe (*i.e.*, he obtained A_m which was compatible with zero). He repeated the experiment this time, with his colleague, Edward E. Morley. They used interferometric arms that where almost 10 times the previous, *i.e.* $L = 22\,\mathrm{m}$. Their expected fringe shift this time was $\Delta A_m^{ex} = 0.4$, and they obtained $\Delta A_m^{ex} = 0.03$ and from there, they announced their now World famous result that the aether does not exist.

Einstein readily endorsed this result as it was a most welcome present and finish to this philosophy of relativity. Given Einstein's public stature that grew as a result of the public's attempt to fathom his great and esoteric works that shock and replaced the foundation of physics, any challenge to the MME result were naturally thwarted. In vain, the World would look up to Einstein to lay another relativistic egg on the front-lines of the search for an al-encompassing unified theory. As Cahill (2005) said at the centenary celebrations of Einstein's STR, Einstein's influence on this matter of the aether has brought the progress of physics into stagnation, how do you get past Einstein without being ridiculed? Ask any physicist today, the majority consider the question of the aether as settled just as they consider the question of the twin paradox resolved.

Those working at the frontiers of quantum gravity and cosmology know very well that there is a dire need to have something like an aether into their models in-order for them to make sense and progress in physics. How to tackle this, without resurrecting the aether is the main problem. In another way, how do you clandestinely bring in the aether without upsetting Einstein or Einstein's philosophy of relativity? Many physicists think the introduction of the aether, *i.e.* the aether that the MME "failed" to detect, will upset the foundations of physics. We think not, we think this will cement its foundation and bring about order, harmony, tranquillity and great progress in physics. We think it will upset only the philosophical and not the phenomenological foundations of physics.

Given the consistent measurements that have been made so far, we are of the very strong and unwavering view that the phenomenological (empirical) foundations of physics can not be found wanting. The philosophical foundations of physics can be found in a wanting state – that's not a problem but a call for a revolution in thinking. During his tenure in the period 1589 – 1592 at Pisa as professor of mathematics, in one of the most beautiful experiments in science history, did not Galileo Galilee (1564 – 1642) demolish at an instant of time, Aristotle's more than 1700 yr dogma that heavier objects fall faster than lighter ones by famously dropping two cannon balls of different masses from the tower to demonstrate that their speed of descent was independent of their mass, whence ushering in and fathering a new age of thinking?

At that instant when Galileo performed his experiment (which some historians dispute he actually conducted the the experiment at the tower), it was the philosophical foundations of physics that were shaken and replaced by a new way of thinking that indeed, all objects in the absence of air resistance will fall at the same rate in a gravitational field. In our view, the efforts of Miller, Cahill, Demjanov are yet to be widely recognised; these researchers have done to science what Galileo Galilee did. The aether is measurable and physicists can no longer continue to pretend that the MME gave a null result.

Actually, reading through Michelson and Morley's classic 1887 paper, one finds – as stated above; that these two experimenters did detect a fringe shift in their experiment and because it was far less (*i.e.* forty times less) than what they had expected, they decided that their result was a null result. This is what they said on pages 340 – 341:

> *"Considering the motion of the earth in its orbit only, this displacement should be* $2Dv^2/V^2 = 2D\times10^{-6}$. *The distance D was about eleven meters, or* 2×10^7 *wavelengths of yellow light; hence the displacement to be expected was 0.4 fringe. The actual displacement was certainly less than the twentieth part of this, and probably less than the fortieth part. But since the displacement is proportional to the square of the velocity, the relative velocity of the earth and the ether is probably less than one sixth of the earth's velocity, and certainly less than one-forth."*

In the above quote, V is the speed of light, v the speed of the earth in its orbit about the Sun and D the length of the arms of the MM interferometer. It is clear from the above quote that Michelson and Morley suppressed their experimental result because it did not yield to the desideratum of their expectations. It is thus very correct to confidently say the MME did detect absolute motion, it simply was not believable to the experimenters. They desired $A_m^{ex} \geq 0.4$, but they obtained $A_m = 0.03$.

It (*i.e.* the speed of the earth in the aether medium that was deduced by Michelson and Morley: they found $\sim 8\,\mathrm{kms}^{-1}$) being unbelievably small (compared to the speed of the earth in its orbit about the Sun of $\sim 30\,\mathrm{kms}^{-1}$) has a lot to do with the calibration of the experiment itself. Cahill (2002) and Cahill & Kitto (2003) have convincingly demonstrated this fact that using gas-mode MMEs absolute motion is detectable. Further Demjanov (2010a, b, c) have conducted what appears to be convincing evidence of absolute motion.

Michelson and Morley used Galilean relativity to calibrate their experiment. Given the phenomenological success of the

STR, Michelson and Morley's Galilean relativity calibration of their experiment is obviously not correct. At best, Michelson and Morley under Galilean calibration of the MME, can be interpreted to mean that Galilean relativity is strictly speaking not an exact Law *of* Nature. It has its domain of applicability that does not extend across the entire spectrum of motion. With hindsight, perhaps Michelson and Morley should have simple published the result $A_m = 0.03$ and let the physics audience decide the meaning of this very important *non-null* result. If they had done so, Michelson most probably may not have won the 1907 Nobel Prize in Physics for:

> *"for his optical precision instruments and the spectroscopic and metrological investigations carried out with their aid".*

A major part of the investigations mentioned in the 1907 Noble Prize award most certainly should be the famous "demonstration of the non-existence" of the luminiferous aether.

Cahill (2002) and Cahill & Kitto (2003)'s result is in good agreement with the COBE measurement of the Earth's motion through the cosmic microwave background radiation field. They find $359 \pm 54\,\mathrm{kms}^{-1}$ while COBE finds $365 \pm 18\,\mathrm{kms}^{-1}$ (Smooth *et al.* 1991). The Cosmic Microwave Background Radiation (CMBR) is a diffuse and almost isotropic microwave radiation that apparently fills all of space and this radiation is generally thought to be a relic of the so-called Big Bang. The CMBR measurement by Smooth *et al.* (1991) indicate a unique local inertial frame near the Earth in which its dipole moment is zero; this frame moves at a speed of $465 \pm 18\,\mathrm{kms}^{-1}$ relative to the Sun. This can be interpreted as measure of motion of the Earth through the CMBR field. The agreement of the COBE result with Cahill's result is very striking, so striking that the issue of the aether can no longer be ignored.

In-passing, according to the relativistic velocity addition, if v_a^e is the speed of the Earth relative to the Sun and v_a^s is the speed of the Sun relative to the galactic center and v_a^g speed of the galactic center to the center of the Universe (if there is such a thing to being with, we believe there is a center of the Universe), that the velocity of the Earth ($V_a^\oplus$) relative to the center of the Universe would be:

$$V_a^\oplus = \frac{v_a^e + v_a^s + v_a^g}{1 + (v_a^e v_a^s + v_a^e v_a^g + v_a^g v_a^s)/c^2}. \tag{25}$$

The low speed $v_a^s = 220\,\mathrm{kms}^{-1}$ and $v_a^e = 30\,\mathrm{kms}^{-1}$ can be added algebraically in the Galilean sense to give a speed of $250\,\mathrm{kms}^{-1}$ of the Earth relative to the Galactic centre. Any excess above this can be interpreted as the motion of the galaxy relative to the centre of the Universe.

A. Vacuum MME in the Relativistic Aether

In accordance with the modified second postulate of the STR *i.e.*, according to the second postulate of the STR-AS, the velocity of light in vacuum is the same for all observers, thus, for the trip along the arm parallel to the direction of motion of the Earth, the arm in with length contraction will take place, light will travel at speed c, and for the return trip the total time is:

$$ct_\parallel^+ = L_\parallel \sqrt{(1 - v^2/c^2)} + vt_\parallel^+ \tag{26}$$

and for the return trip, we will have:

$$ct_\parallel^- = L_\parallel \sqrt{(1 - v^2/c^2)} - vt_\parallel^- \tag{27}$$

and the total time in the arm #1 is:

$$\Delta t_\parallel = t_\parallel^+ + t_\parallel^- = \frac{(L_\parallel/c)\sqrt{(1 - v^2/c^2)}}{1 - v/c} + \frac{(L_\parallel/c)\sqrt{(1 - v^2/c^2)}}{1 + v/c} \tag{28}$$

and this reduces to:

$$\Delta t_\parallel = \frac{2L_\parallel \sqrt{(1 - v^2/c^2)}}{c^2\,(1 - v^2/c)} = \frac{2L_\parallel}{c}\left(1 - \frac{v^2}{c^2}\right)^{-1/2} \tag{29}$$

and the other arm, the total time of travel is $\Delta t_\perp = 2L_\perp/c$ thus the time difference in the two times of travel is:

$$\Delta t = \frac{2L_\perp}{c} - \frac{2L_\parallel}{c}\left(1 - \frac{v^2}{c^2}\right)^{-1/2}. \tag{30}$$

To first order approximation for the case $L_\perp = L_\parallel = L$, the above reduces to:

$$\Delta t = \frac{2L}{c}\frac{v^2}{c^2}, \tag{31}$$

and hence the expected fringe shift is given by:

$$\Delta A_m = \frac{2L}{\lambda}\frac{v^2}{c^2}. \tag{32}$$

This result is the same as the Michelson-Morley result, the meaning of which is that a fringe shift ought to be observed for vacuum MMEs. With this, how does one explain the Brillet-Hall (1979) experiment performed in vacuum and detected absolutely no aether wind to an unprecedented accuracy of three parts in 10^{15}? A closer inspection reveals that (32) can not be correct because the derivation of this formula assumes that after their after their round trip in the respective arms of the interferometer, the light beams will converge at the same point in space. This is not the case.

Because the velocity (not just the speed but the direction of propagation as-well) of light in vacuum is the same for *all* observers, the interferometer will not drag the light beam with. According to the illustration in figure (10), if the interferometer did drag the light beam with, the light beam will take the

path $A_1C_2A_3$. But – because of no drag, the light beam will take the path A_1C_1, and upon the completion of the round trip and on its way to the detector, it will be a distance $d = v\Delta t_\perp$ (this assumes $\Delta t_\perp \geq \Delta t_\parallel$) apart from the beam coming from the parallel arm. The fringe pattern, will not be due to the phase difference of the two waves, but the path difference.

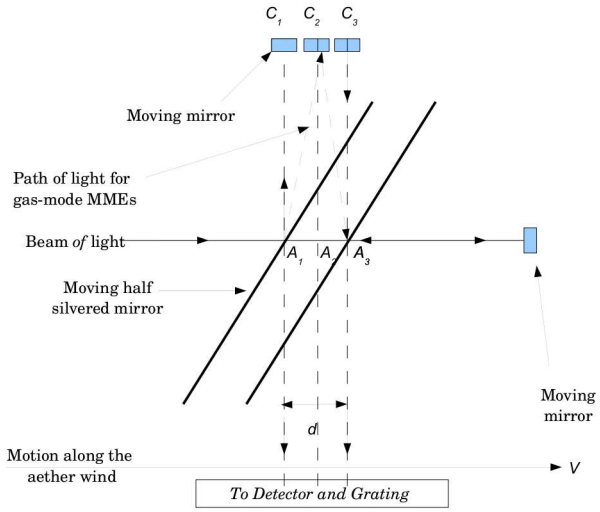

FIG. (10): In the vacuum mode MME, light is not dragged by the apparatus, so it travels the path AC_1A. When it returns to the half silvered mirror, it is a distance d apart from the the light ray that travelled long the parallel arm. This separation d is what causes the interface pattern and using Young's double slit technique, one must be able to deduce the speed of the Earth through its passage in the lumiferous aether. In the gas-mode MME, the light will be dragged by the apparatus and thus will traverse the path AC_2B.

Because the reuniting light rays in the vacuum MME are going to be separated by a distance $d = v\Delta t_\perp = 2Lv/c$ and their fringe pattern is due to this spatial separation, then we have to use Young's double technique to due the v. Using Young's double slit experimental result that the fringe separating Δf, is related to the wavelength of the monochromatic beam of light λ, the separation of the grating and the screen D, and the grating spacing d, by:

$$\Delta f = \frac{\lambda D}{d}, \tag{33}$$

it follows that the speed of the Earth in the aether frame according to the vacuum MME, will be:

$$v = \left(\frac{\lambda D}{2L\Delta f}\right)c. \tag{34}$$

In the case of the vacuum MME, the distance of separation of the light beams takes the place of the grating spacing d in the actual Young's double split experiment.

In-order to have any fringe shift, the distance d must be changed. The usual 90° rotation does not change this at all, hence there will be no expected fringe shift according to the STR-AS. A rotation through angle θ, will give:

$$\Delta t_\perp(\theta) = \frac{2L}{c}\left(1 - \frac{v^2\sin^2\theta}{c^2}\right)^{-1/2} \tag{35}$$

therefore $d(\theta) = v\Delta t_\perp(\theta) = d(0)(1 - v^2\sin^2\theta/c^2)^{1/2}$ where $d(\theta)$ the separation distance of the beams at reunion after an rotation of angle θ, hence:

$$\Delta A_m(\theta) = \frac{\Delta f(0) - \Delta f(\theta)}{\Delta f(0)} = \left(1 - \frac{d(\theta)}{d(0)}\right) \simeq \frac{v^2\sin^2\theta}{2c^2}, \tag{36}$$

given that the aether must be moving at a speed $230\,\mathrm{kms}^{-1}$, the expected fringe shift must be of the order of 10^{-7}. As to why the 1979 Brillet-Hall experiment is said not to have detected absolute motion, this depends large on the calibration that these author used, certainly they used the Galilean calibration which would have prejudiced them to concluded that they had not detected absolute motion.

B. Gas-mode MME in the Relativistic Aether

Now, we consider the case where the interferometer is immersed in a medium of refractive index $n > 1$. In this medium, light no longer has its usual speed c but $\tilde{c} = c/n$. According to the Extended Second Postulate of Relativity, only light in a vacuum is not going to be dragged by a moving frame, this mean for light in a gas-mode, it will be dragged by the medium in the same manner as we have argued that a neutron will be dragged by a moving frame if released from it because it acquires a component of the motion of the body from which it was released. In-passing, it appears, in this case, the photon must somehow possess inertial properties for it to be dragged by this medium. For us to quantify the motion of light in this gas, we must must now use the Relativistic velocity addition law:

$$V = \frac{v' + v}{1 + vv'/c^2}. \tag{37}$$

From this formula, what we seek is the Fresnel-drag formula. With the advent of Einstein's STR, Fresnel's equation which explains very well the motion of light in a moving medium of refractive index greater than one, it was shown from (37) by Max Theodor Felix von Laue (1879 – 1960) in 1907 to be just an approximation, valid for v much smaller than c, for the relativistic formula to add the co-linear velocities v (medium) and $v' = c/n$ (rest frame) and for the speed of light $c \longmapsto c/n$, from this we have:

TABLE (I): Column (1), lists the index of the experiment as it appears in the present table; Column (2), lists the names of the experimenter(s); column (3), the year in which the experimenter(s) performed the experiment; column (4), the type of experiment they conducted; column (5), the calibration these experimenters used; column (6), the length of the arm of the Michelson interferometer; column (7, 9), give the expected fringe shift from the Galilean calibration (gc) and the and the Absolute Relativistic Calibration (alc) assuming the Earth moves through the aether at $30\,\mathrm{kms}^{-1}$, respectively; column (8, 10), give the expected fringe shift from the Galilean calibration and the Absolute Relativistic Calibration assuming the Earth moves through the aether at $250\,\mathrm{kms}^{-1}$, respectively; column (11), gives the experimentally measured fringe shift, and lastly; column (12, 13), gives the measured speed of the Earth in the luminiferous aether from the Galilean calibration and the Absolute Relativistic Calibration method respectively. This table is reworked from the table of Stankland *et al.* (1955). We assume $\lambda = 5.75 \times 10^{-7}$ m.

No	Experimenter(s)	Year(s)	Type of Exp.	L m	$\Delta A_m^{gc}(30)$	$A_m^{arc}(30)$	$\Delta A_m^{gc}(250)$	$A_m^{arc}(250)$	A_m^{Exp}	V_a^{gc} kms^{-1}	V_a^{arc} kms^{-1}
1	Michelson	1881	air-mode	1.2	0.04	0.000023	2.78	0.0016	0.0200	4.63	192
2	Michelson & Morley	1887	air-mode	11.0	0.40	0.000232	27.8	0.0162	0.0100	4.83	201
3	Morley & Miller	1902 – 1904	air-mode	32.2	1.13	0.000655	78.5	0.0457	0.0150	3.26	144
4	Miller	1921	air-mode	32.0	1.12	0.000649	77.8	0.0452	0.0800	8.02	333
5	Miller	1923 – 1924	air-mode	32.0	1.12	0.000649	77.8	0.0452	0.0800	8.02	333
6	Miller	1925 – 1926	air-mode	32.0	1.12	0.000649	77.8	0.0452	0.0880	8.41	349
7	Kennedy	1926	air-mode	2.0	0.07	0.000041	4.86	0.0028	0.0020	5.07	211
8	Illingworth	1927	helium-mode	2.0	0.07	0.000005	4.86	0.0004	0.0004	2.27	267
9	Piccard & Stahel	1927	air-mode	2.8	0.13	0.000075	9.03	0.0053	0.0060	7.42	308
10	Michelson *et al.*	1929	air-mode	25.9	0.90	0.000522	62.5	0.0364	0.0100	3.15	131
11	Joos	1930	helium-mode	21.0	0.75	0.000054	52.1	0.0038	0.0020	1.56	184
mean										5.00	240
stdev										3.00	80

$$\tilde{c}_a = \frac{\tilde{c}+v}{1+v\tilde{c}/\tilde{c}^2} \simeq \frac{c}{n} + \left(1-\frac{1}{n^2}\right)v. \tag{38}$$

In our calculation, we shall neglect Fresnel dragging on the assumption that for the scenario under consideration, its effect is negligibly small, so we will have $\tilde{c}_a = c/n$. Now, for the transverse arm, we have:

$$\left(\frac{\tilde{c}_a \Delta t_\perp}{2}\right)^2 = L_\perp^2 + \left(\frac{v\Delta t_\perp}{2}\right)^2, \tag{39}$$

which upon re-arranging to make $\Delta t_\perp$ the subject to the formula, one obtains:

$$\Delta t_\perp = \frac{2L_\perp}{\tilde{c}_a}\left(1-\frac{v^2}{\tilde{c}_a^2}\right)^{-1/2}. \tag{40}$$

Notice something here; the above derivation assumes that the interferometer carries with it the light beam *i.e.*, it drags is along with. According to the extended second postulate, or the second postulate if the STR-AS, this is correct, because it is only in the vacuum mode that the interferometer will not drag the light beam. This is something that differentiates Cahill's re-calibration from ours and this can and must be used as a tool to find out if Cahill's Process Physics and the STR-AS are perhaps one and the same thing. If they make the same predication, then, it would be interesting phenomenon, they may just be different ways of looking at the same thing like Schrödinger's wave mechanics and Heisenberg's matrix mechanics.

Now, for the parallel arm, we will have for the first part of the trip of the light beam to the mirror:

$$\tilde{c}_a t_\parallel^+ = L_\parallel\sqrt{(1-v^2/c^2)} + vt_\parallel^+, \tag{41}$$

and for the return trip, we will have:

$$\tilde{c}_a t_\parallel^- = L_\parallel\sqrt{(1-v^2/c^2)} - vt_\parallel^-, \tag{42}$$

and the total time in the arm #1 is:

$$\Delta t_\parallel = t_\parallel^+ + t_\parallel^- = \frac{(L_\parallel/\tilde{c}_a)\sqrt{(1-v^2/c^2)}}{1-v/\tilde{c}_a} + \frac{(L_\parallel/\tilde{c}_a)\sqrt{(1-v^2/c^2)}}{1+v/\tilde{c}_a}, \tag{43}$$

and this reduces to:

$$\Delta t_\parallel = \frac{2L_\parallel\sqrt{(1-v^2/c^2)}}{\tilde{c}_a(1-v^2/\tilde{c}_a^2)} = \frac{2L_\parallel}{\tilde{c}_a}\left(1-\frac{v^2}{c^2}\right)^{-1/2}\left(1-\frac{v^2}{\tilde{c}_a^2}\right)^{-1}. \tag{44}$$

The time difference in the two times of travel is:

$$\Delta t = \frac{2L_\perp}{\tilde{c}_a}\left(1-\frac{v^2}{\tilde{c}_a^2}\right)^{-1/2} - \frac{2L_\parallel}{\tilde{c}_a}\left(1-\frac{v^2}{c^2}\right)^{-1/2}\left(1-\frac{v^2}{\tilde{c}_a^2}\right)^{-1}, \quad (45)$$

and if $L_\parallel = L_\perp = L$, then:

$$\Delta t = \frac{2L}{\tilde{c}_a}\left(1-\frac{v^2}{\tilde{c}_a^2}\right)^{-1/2}\left[1-\sqrt{\left(1-\frac{v^2}{c^2}\right)\left(1-\frac{v^2}{\tilde{c}_a^2}\right)}\right], \quad (46)$$

and taking only terms up to first order approximation in terms of v^2/c^2, one will arrive at:

$$\Delta t = \frac{2n\left(n^2-1\right)L}{c}\frac{v^2}{c^2}, \quad (47)$$

and as in the original MME, a 90° rotation will result in the fringe shift:

$$\Delta A_m = \frac{2n\left(n^2-1\right)L}{\lambda}\frac{v^2}{c^2} \quad \text{for} \quad n>1. \quad (48)$$

One hundred and twenty one years after the MME, from a Process Physics vantage point, it is Cahill (2002) who was the first to arrive at the above result (48). Using this result, Cahill has interpreted the 1979 Brillet-Hall which was performed in vacuum and is said to have detected no absolute motion, to mean the supposed *null* result is because for the vacuum $n \equiv 1$. Clearly, if $n \equiv 1$, from (48), it follows that ΔA_m appears not yield results pointing to absolute motion. For the vacuum mode MME, the two beams do not recombine but are spatially separated and the fringe pattern is as a result of this separation of the two beams and th ebest way to deduce absolute motion is by measuring the fringe separation and using the Young's slit technique to deduce the speed of the Earth via the luminiferous aether.

Table (I) is a demonstration of (48) at work. On average, the Galilean calibration detects absolute motion of a speed $5.00 \pm 3.00\,\mathrm{kms}^{-1}$ while the calibration done using (48) (lets call this calibration the absolute relativistic calibration), give an average absolute motion of $240 \pm 80\,\mathrm{kms}^{-1}$. It is clear from this table that the expected fringe shift from the absolute relativistic calibration considering the motion of the Earth about the Sun and the Sun about the galactic centre are comparable to the detected fringe shift. It is seen again from this table that the Helium-mode MMEs produce absolute motion that us comparable to that obtained from Air-mode MMEs.

From all what has been presented in this section, it is therefore clear that using the Galilean calibration as done by Michelson and Morley, prima facie, one arrives at the conclusion that absolute motion does not exist because the from resulting fringe shift, what one expects is far too large in comparison to what one actually measures but with he correct calibration, the conclusion is clear, absolute motion exists.

VIII. DISCUSSION AND CONCLUSIONS

One hundred and twenty nine years latter, it strongly appears that the 1881 and 1887 result of Michelson and Michelson & Morley which appeared to have found a safe, unshakable, and permanent place in physics textbooks is under serious scrutiny, the jury is all out, this time with greater determination to overturn the tables and thereafter delivering what appears to be an "everlasting and eternal judgement", the aether may "not be dead after all". It strongly appears that Maxwell, Lorentz and other early proponents of the luminiferous aether stand to be vindicated, while Einstein and the legion of anti-aether advocates may find themselves under the pile and weight of the sands of Einstein's Philosophy *of* Relativity. A new understanding has dawned and experience is pointing in the direction of an overhaul of the more than century old dogma that absolute space and absolute motion are superfluous. It is interesting to see how physics will develop in the 21^{st} century.

With the new re-calibration methods, the first ten years have seen the clandestine resurgence of the aether which for most of the past century, has been kept tightly under the lid. A popular resurgence of the aether strongly appears eminent. Cahill (2002)'s re-calibration of the Michelson interferometer appears to be the key to finally fathom the fringe shift of the MMEs. With this re-calibration of the MME, the stirring agreement of the results thereof with the COBE measurements is most certainly reassuring. Smooth *et al.* (1991)'s result are not interferometric in nature, hence it is completely independent in nature, just as Torr & Kolen (1984)'s results of the detection of absolute motion are independent confirmation of absolute motion..

To really have the greatest confidence that Cahill's re-calibration is the key, there is need to perform MMEs in mediums of much higher refractive index ($n > 1.1$) such as glass and water. In such mediums, we could expect significantly higher fringe shifts and more than just these fringe shifts, they must yield to results in an acceptable range of resonance with those of the low refractive index mediums ($1 < n \lll 1.1$). If these experiments produce measurements that are comparable to the air-mode MME results, then, physics will have but very two options *i.e.*, to accept the aether exists or to accept that the more than century old philosophy "that the aether is superfluous" is not correct. Simple, it would mean the aether is here, and here to stay.

As how to look at the STR in the advent of the aether, after a ponderous introspection of the supposedly resolved twin paradox, we have provided – in our modest view; a way to do so *via* the new Lorentz transformations in (11). These transformations are built on the idea that, relative to the absolute frame of reference – *i.e.* the luminiferous aether frame; the velocity of light (*i.e.* its speed plus its direction) is the same for all inertial observers. Because of this, all observers can determine their state of motion relative to the absolute space. Phenomenologically and empirically, the resultant theory is the same as Einstein's STR – less the philosophy that absolute space and motion are superfluous; it is the STR in absolute space where absolute motion is real and measurable.

With the proposed STR with absolute space and motion, the null-result of the vacuum mode MMEs is understandable. Cahil understands this null result as being due to the fact that the refractive index of the vacuum is unity, and from his re-calibration, the null result follows. We hold a different view here. The null result is due the the the reuniting light beams in the MME being spatially separated. This spatial separation leads to a new calibration, that absolute motions for vacuum mode MMEs can be deduced by using the Young's double split technique to measure the speed of the Earth in the luminiferous aether. This provides an independent test since the calibrations form the vacuum mode and the gas mode MMEe will here be very different. Obtaining compatible results from different calibrations will be the clearest indication yet, that sure, the aether is real, it is here to stay. Also, we have provided the idea of the aether speedometer. This is yet another method for an independent verification. Thus we have three methods (with independent calibrations) to measure absolute motion and all these must be employed.

Cahill derives his re-calibration from a new kind of quantum physics that he calls Process Physics; he is the discoverer of this (see http://www.mountainman.com.au/process_physics/). We should admit our ignorance here. We have not any clue what this Process Physics is all about, besides that it does give a plausible re-calibration of the MME. On that footing, we should also state that Cahill's re-calibration emerges as natural consequence of the proposed STR-AS. If Cahill's physics is different from the physics that is to emerge in our proposed STR-AS, then, the prediction from the STR-AS that the fringe separation of the vacuum mode MME – *via* the Young Double's Slit Technique; are a measure of absolute motion, is a prediction that may separate Process Physics and the STR-AS. It is interesting question to ask: "With respect to the measurement of absolute motion, what meaning does Process Physics give to the fringe separation for the vacuum mode MME?"

To different researchers, the aether has different meanings and names. The quantum field theorists calls it the fixed Minkowski background of spacetime. Some cosmologists (*e.g.* Niayesh 2008) trying to fathom the supposed acceleration expansion of the Universe call it the the gravitational aether (*e.g.* Xiao-Mei & Yi 2009; Zlosnik *et al.* 2007) or dark-energy. Some quantum theorists prefare the term the invisible Dirac sea. The aether is called by the many different names. Perhaps it is time for physicists to converge – as they did at the Slovary conference in 1927; and give serious thought to the seemingly undeniable hard experimental results that the aether exists in the true sence of the word exist, it is measurable.

On the same footing but different trajectory, we note that together with its accompanying philosophy, Einstein's STR has received the greatest accolades in the popular media; and in most if not all modern textbooks of physics, these theories are presented as a touch-and-go works, as being so sacrosanct; behind the scenes as demonstrated herein, there is an ever growing chorus that philosophy of relativity has caused a more than 100-year stagnation in physics (Cahill 2005) because any attempt in the mainstream journals to suggest ideas that go contrary to Einstein receives not just a stonewall but a double if not triple rock-wall defense so much that many physicists feel frustrated and it appears physics may well have landed into a crisis (see *e.g.* Hu 2010; Castro *et al.* 2008; Rabounski 2006; Smolin 2006; Woit 2006).

One would understand the rejection of ideas that challenge central tenets of physics, especially if they have no experimental basis, but, to reject and conceal experimental results simple because they go against a physics dogma is not science but something else other than science. Science concerns itself with measurable results and thus; no matter our feelings, no matter our influence in this World, experimental results are verdicative and final, experimental results have the last word. Faced with the ruthless wrath of experimental evidence, we but have just two choices, to accept the results or to accept the results – *for* nothing can go against results that have been measured – the experiment has spoken. Cahill (2005) had this to say:

> *"The Einstein postulates were first formulated in 1905 and have played a fundamental role in limiting the form of subsequent physical theories, and in also defining our comprehension of reality. They lead to the concept of spacetime, and that a curved spacetime explained gravity. They also lead physicists to reject any evidence that was revealing that the postulates were in disagreement with experimental data. In physics they have become a vigorously defended belief system, and any discussion of the numerous experiments that indicate their failure is banned."*

In closing, allows us to say this: that, in the present moments in humankind's quest for understanding of *Natur*e, real progress in fundamental physics appears to be stalled. We believe the twin pillars of this stagnation are due to Einstein's all-sweeping dismissal of absolute space and hence absolute motion as mere superfluous, and again the great Danish physicist Niels Bohr's all-sweeping dismissal of the existence of an objective reality. Undoubtedly, the philosophies of Einstein and Bohr have had enormous influence in physics over the past 90 years or so. We believe that once the physicist has overcome these twin pillars of stagnation, real progress in fundamental physics will begin to take place. The unification of quantum mechanics with Einstein's GTR, the apparent acceleration of the Universe, the rotation curves of galaxies – but to mention a few; are all calling for Lazarus to raise from the dead. Shall the coming-back to life of the dead destroy the present? We believe not. We believe our philosophical interpretation of facts is what is set to change. For example, having something like: Special Theory *of* Relativity in Absolute Space and a Probabilistic Quantum Mechanics with an Objective Reality.

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