

WHAT IS TIME AND WHAT CAUSES TIME?

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**More powerful than the armies of the world
Is an idea whose time has come.**
.....Victor Hugo

INTRODUCTION

In the next few pages you will understand “**time**” from a totally new perspective and discover the real cause of time. This will bring to light the reason behind many predictions of Special and General Relativity. By knowing what is time and what is its cause you will discover why time slows with motion and in gravity? You will understand the cause of gravity and why it is only attractive? Why space is curved by gravitational fields? Why objects gain mass when accelerated by a force but do not gain mass when falling in gravity? What is the cause of inertia and length contraction? I am presenting here a clear solution to the enigma of time. The concepts are simple so that anyone with knowledge of high school physics and math should be able to follow.

MANY FACETS OF TIME

Time presents to us in many different ways. We measure time, keep time, meet and greet in time and our daily lives are completely wrapped around the onward rush of time. We perceive time as past present and future. In physics time plays a major role in the measurement of motion and forces. Time also gives us a place like feeling to it suggesting that time is a dimension. This has sprung a whole culture around the concept of time travel leading to numerous science fiction stories, and movies. The many facets of time suggest that time is an emergent phenomenon that is arising from some underlying process that we need to identify.

The greatest breakthrough in understanding of time occurred about a hundred years ago with Einstein's theories of Special and General relativity which introduced the concept of slowing of time with motion and in gravity. Einstein also showed that large masses curve space and there is increase in mass with acceleration by application of a force. **These discoveries of Einstein provide the necessary clues to solving the riddle of time.**

MEASURING TIME: WHAT ARE WE MEASURING?



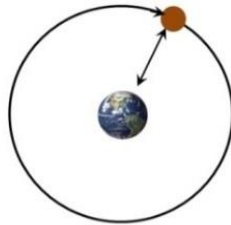
One of the earliest devices to measure time was the sundials; which used the sun's motion as a standard of measurement for time. The use of units like seconds and minutes which are radial angle measurements in geometry may be pointing toward the original connection of time measurements to radial motion of astronomical objects across the sky. Once we started using precise time keeping devices like digital clocks and time based on atomic oscillations the time's celestial connection was lost. Now the whole world's time can be synchronized by atomic clocks and time has developed a life of its own.

When we measure the speed of a car, we seem to be measuring speed with something abstract called time; we are actually just comparing a known motion (of the sun) with an unknown motion of the car. Time is a way to compare or describe different kinds of motions like speed of light, how fast heart beats or how frequently earth spins around its axis. But these processes can be compared directly without making any reference to time. **Time may have no independent existence, it may just be a common unit of motion** making the world that is constantly changing easier to describe.

TIME CHANGE MOTION AND FORCES

Time is a real phenomenon a continuous change through which we live. Time becomes evident through motion; sunrise sunsets, night and day, the changing seasons, the movement of the celestial bodies all is indicative of continuous change. The aging process is a reminder that **molecular motion and interactions are also at work and are a part of time**. Other important aspect of time is presence of motion of particles like photon, the motion at the atomic level and subatomic level. An often overlooked but very important aspect of time is that **forces also act in time**.

MOTION AND FORCES ARE PART OF TIME



Imagine two objects one moving in orbit around the other in space. Now suppose from our distant observation point of a fixed time we observe time to get slower in the area where these two objects are moving. We expect to see slower motion? We also should observe proportionally weaker gravitational force; otherwise the objects will get pulled together. If we observed faster time, we expect to see faster motion and stronger gravity to keep the objects from flying apart. While with zero time motion will freeze and gravity will become zero. As this thought experiment also can be extended to particles held together by electromagnetic forces **we can say that time involves both motion and forces**.

PERCEPTION OF TIME: THE PAST THE PRESENT AND THE FUTURE

We feel the passage of time in the present, our interaction with the world in the present creates our memories which are then relegated to the past as we venture into the unknown future. The present gives us the most real feeling of time however almost all of what we perceive as now is already past. The present is a fleeting moment; whatever is happening now (present) is confined to an infinitesimally narrow point on the time line which is being encroached upon by the past and the future.

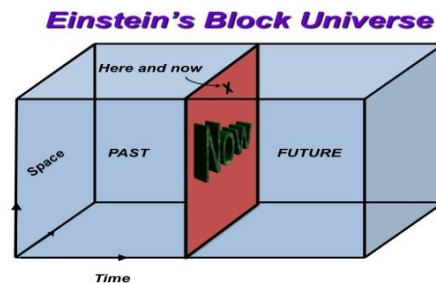


Present resembles the sharp point of a recording laser or needle; it may be the mental awareness of recording of memory as it is being perceived and inscribed into our neurons. Unlike the present we see past and future as measurable durations of time. Past historical events, a meeting, or a wedding reception are all measurable durations or extensions in time, just like a recorded material on tape. This similarity suggests that past is more like a recorded memory, while future can be compared to an unrecorded tape. Another interesting observation pointed out by philosopher Mc Taggart was that historical events also have the same time characteristic as stories that are just creations of the human imagination. Both stories and historical events contain the time concepts of earlier, the later, the past the present and the future suggesting that past is nothing more than memory of events.

Future appears to be a projection created by our past experiences stored in our memory. The fact that the present which gives us the most real feel of time cannot be measured while the inaccessible past and future can be measured as durations **suggests that the way we perceive time is an illusion.**

IS THE BLOCK UNIVERSE DESCRIPTION OF TIME CORRECT?

"People like us who believe in physics know that the distinction between the past, the present and the future is only a stubbornly persistent illusion": Albert Einstein



Every past or possible future event also has a place like feeling to it. Time-scape feels like it is a place where it may be possible to go. This dimension like view of time has spawned numerous science fiction stories and movies on time travel. This view of time suggests that dinosaurs are still alive and roaming the earth in some other time dimensions; it also suggest that there are multiple copies of us and the whole universe smeared across multiple dimensions of time.

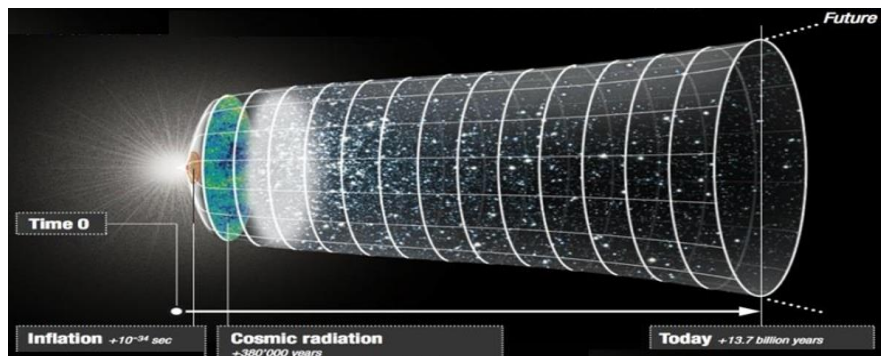
In Special Relativity (SR) the block universe view of time arises from an interpretation of the Lorentz transformation equation known as the Rietdijk–Putnam argument (or the Andromeda paradox.) By this innovation of SR just walking on the earth toward or away from the Andromeda galaxy which is 2.5 million light years away we can shift our line of simultaneity so that our time can be in sync with either past or future of beings living in Andromeda. This interpretation of SR suggests that past and future exists as part of the block universe. Lorentz transformation is interesting but has not been proven experimentally and this interpretation of SR cannot be verified. All of other SR's predictions of slowing of time, length contraction and gain in mass with motion can be derived without Lorentz transformation and are experimentally verifiable.

In the block universe time is laid out as a time-scape similar to landscape and it is obvious that there cannot be a free will. This has led to some innovations or variations in the theme of the block universe in which the future is changeable. If time-scape is already laid out then what causes our conscious experience to move through this time-scape and why we cannot willfully move our consciousness anywhere anytime?

The time of the block universe leads to some interesting conclusions. The universe in its time dimensions should have numerous future civilizations millions or billions of years more technologically advanced than us. At least some of these civilizations should be capable of travelling through the block universe and we should have seen some evidence for that, unless there is some law of the universe which prohibits time travel. Block universe also leads to the possibility of time travel paradoxes like the grandfather paradox in which a person travels to the past and kills his grandfather thereby changing the future so that the time traveler would not exist and thus not travel to the past to kill his grandfather.

THE INSTANTANEOUS BIG BANG ORIGIN OF THE BLOCK UNIVERSE

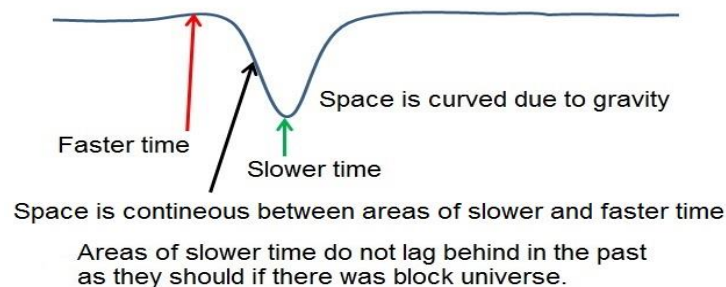
If the universe with its past present and future exists as a part of time-scape in the block universe then all of the time-scape from the big bang to the infinite future should have begun at the instant of the Big Bang.



The universe is thought to have originated in an event called the Big Bang about 13 billion years ago. We live in an expanding universe and the galaxies are receding from each other as a part of the universal expansion. Microwave back ground radiation which is a relic from the Big Bang has been studied by many NASA and European satellites. There is no doubt in the minds of physicists and astronomers that Big Bang occurred.

Similarly the concept of time being a block universe is considered a natural outcome of the Lorentz transformation. However we seem to have overlooked that the concept of a block universe in which **past, present and all of the future** is laid out as a time-scape maybe at odds with the origin of the universe in the Big Bang. In the block universe view of time everything, every event exists simultaneously. If the universe from its beginning to its distant infinite future exists as a part of time-scape of the block universe then all of the time-scape from big bang to infinite future should have begun in the Big Bang. This basically means that all of the history was created in an instant at the time of big bang. There is no escape form this unless we discard the block universe view of time or the origin of the universe in Big Bang. These two concepts appear to be mutually exclusive.

SLOWING OF TIME IN A BLOCK UNIVERSE



Next time you look at a tall building or a mountain try to visualize that time is running more slowly even slightly so near the bottom of these structures then at the top. The stability of these structures depends on the fact that space-time is continuous; being

slow in time does not lead to lagging behind and disappearing into the past. Imagine if the bottom of a mountain or a building vanished into the past.

Theory of relativity predicts slowing of time with motion and gravity. These predictions have been confirmed in particle accelerators as well as gravity experiments. If there is a block universe why particles and masses with slower time do not disappear into the past? In gravitational fields space is clearly continuous between areas of slower and faster time.

Black holes with their intense gravity that bring time to a screeching halt do not disappear from our present into the past. We need to have clarity in our minds as to what slowing of time means in a block universe. Does passage of time mean our consciousness is moving across time dimensions? **Slowing of time without sliding into the past or the future suggests that time is a process and not a dimension.** This may be a significant point against the block universe view of time when taken together with other aspects of time described above.

MOTION FORCES AND ARROW OF TIME

Arrow requires two points in time that can exist only in the block universe. The time-scape in the block universe is already laid out and our conscious experience of time is only toward the future. The question therefore remains why arrow of time does not point toward the past? If future and past already exist (as in the block universe) why we only remember the past and not the future?

Unrestricted by the block universe view of time we are free to consider time as a process so that every event is occurring in the present where it is being perceived. If as shown earlier time is the presence of motion as well as forces then forces provide the necessary gradient for the direction of time. There is also a statistical touch to this argument; smashing a glass with a hammer means application of force at one point while to assemble it back in reverse would require coordinated application of multiple tiny forces in a reverse and continuous manner which is statistically unlikely. Similarly throwing a stone

into a pond creates ripples which then travel to the edge of the pond. To reverse this process it would require simultaneous application of multiple tiny forces at the edge of the pond to produce multiple synchronized waves moving backward to the area of splash where the stone pushed up by the ground at the bottom of the pond will be waiting to be thrown out into the hand of the thrower.... a statistical impossibility.

Direction of time in a block universe is difficult to explain as times-scape is already laid out and our conscious experience could have run in any direction. Without the burden of the block universe arrow of time is no enigma, it is just a process a natural outcome of cause, effect and probability.

Following are a number of observations, conjectures and a definition of time on which this article is based:

1. Time is the presence of motion and forces and it is caused by the expansion of space. The perception of time is an emergent phenomenon that is why it is perceived in so many different ways. Present is our perception of the process of time as it records into our memory while past is a record and future does not exist.
2. The accelerated expansion of the universe which we are seeing is another indication that our time is caused by expansion of space and time is slowing down causing us to mistakenly think that expansion is accelerating. This is happening as we try to measure distant and past motion of galaxies and supernova by our present local slowing time.¹⁶
3. Time is not a dimension although space is curved in a higher dimension where time is slow.
4. The amount of motion and forces imparted by expanding space to a mass is a constant and equal to $\frac{1}{2}mc^2$. This is time dependent potential energy and it includes motion and forces at the atomic level.

5. When an object is pushed it interacts with expanding space. Expansion slows in front of the object slowing time and increases behind the object making time faster. The object moves in time differential from faster to slower time. This happens at the level of the atoms and is the cause of inertia.

6. The total kinetic plus potential energy imparted by the expanding space to a mass is a constant ($\frac{1}{2}mc^2$) and cannot be increased therefore when a mass is accelerated by application of a force it can only become more massive and its energy is $\frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} - mc^2$. This happens as the energy of the force goes into increasing the mass and not into increasing the velocity. The increase in kinetic energy due to velocity is accompanied by decrease in potential energy just as in a falling mass; the sum of both these is from expanding space and remains constant ($\frac{1}{2}mc^2$).

7. For a mass falling in time differential of gravity where there is no accelerating force (just weightlessness) the gain in kinetic energy $\frac{1}{2}mv^2$ is accompanied by decrease in potential energy and there is no increase in mass. Again the total of kinetic plus potential energy remains constant and equal to $\frac{1}{2}mc^2$.

8. The expansion of space causes matter to radiate gravitons (and other force bearing particles). Gravitons are double spin particles which interact with space causing it to expand slowly and produce negative curvature around large masses like earth, sun, moon, and stars. The slower expansion leads to slower time.

9. Gravity is just time differential, masses move from faster to slower time converting the circular atomic motion to linear motion of fall. There is no force just a time differential.

EXPANSION OF SPACE IS THE CAUSE OF TIME?

I have defined time as presence of motion and forces which is caused by the expansion of space, so to prove that time is caused by expansion of space I will need to show that all motion is caused by the expansion of space; even the motion that is apparently produced by application of a force.

The amount of motion and forces in the form of potential and kinetic energy (that is imparted to a mass by the expanding space) is a constant. Therefore when objects are falling in a gravitational field and no force is felt there is no increase in mass with increase in velocity. The potential energy is being converted into kinetic energy of fall.

Besides motion caused by gravitational fields we do need to apply force to move objects like cars trains and cannon balls. I will show that even in this case (motion through application of force) the potential energy is being converted to kinetic energy and total remains constant while the force that is applied to produce acceleration only goes to increase the mass.

It is easy enough to see that time is slow where expansion of space is expected to be slow as around large masses suggesting that time is caused by the expansion of space. The negative space curvature predicted by Einstein can also be explained as an area of slower expansion of space. Motion of free fall in gravity can be seen as occurring due to time differential so that the objects are moving spontaneously without application of force from faster to slower time. It will also become obvious that length contraction is necessary for motion to exist and this will demonstrate the cause of inertia.

THE CAUSE OF TIME DILATION IN MOTION

Time dilation seen with motion was initially thought to be due to acceleration as this was the only real difference between the moving twin and the stay home twin. However now we know through experiments in particle accelerators that acceleration plays no part in time dilation which can be calculated precisely with velocity only.

We do not need particle accelerators to arrive at the same conclusion as acceleration of the travelling twin can be made brief so that he or she differs from the stay home twin only by time spent moving at high velocity showing clearly that slowing of time is caused by motion.

By our definition time is the presence of motion and forces and is caused by the expansion of space also the amount of motion and forces in form of potential and kinetic energy imparted by expanding space is constant so when a mass is accelerated as the linear velocity of the mass increases the circular orbital motion of the atoms slows as part of the slowing of time.

TIME DILATION IN GRAVITY

Because of initial wrong assumption that time dilation is caused by acceleration the same concept crept into **explaining time dilation of gravity**. Even now some physicists think that gravitational acceleration is causing the time dilation in gravity. Time dilation in gravity can be derived by inserting escape velocity into the original time dilation equation as shown below:

$$t_1 = t \sqrt{1 - \frac{v^2}{c^2}} \dots \dots \dots \text{I}$$

$$\frac{1}{2}mv^2 = \frac{GMm}{r} \text{ (The magnitude of gain in kinetic energy is equal to loss in potential energy)}$$

Escape velocity is $v = \sqrt{\frac{2GM}{r}}$ and $v^2 = \frac{2GM}{r}$ Inserting $v^2 = \frac{2GM}{r}$ in equation I

We get $t_1 = t \sqrt{1 - \frac{2GM}{rc^2}} \dots \dots \dots \text{III.}$ This is the time dilation in gravity

From above we can conclude that **time dilation in gravity is unrelated to acceleration but depends on escape velocity at a given point in gravity**. The cause of time dilation in gravity however is slowing of expansion of space which will be discussed later.

SPEED OF LIGHT IN GRAVITATIONAL FIELDS

Slowing of time can be demonstrated in gravitational fields. According to GR and also precisely measured by atomic clocks time is slower at the foot of a mountain than at its peak. If a faster clock at the top of a mountain is used to measure the speed of light at the bottom of a mountain the speed should appear to be slow. Similarly a slower clock at the bottom of a mountain will measure speed of light to be faster at the top of the mountain. This thought experiment shows us that **speed of light is constant only when measured in a local reference frame in local space and by local time**. This would also maintain the integrity of permeability and permittivity constants in the local space. Following equations show the effect of slowing of time in gravity and its effect on the speed of light:

$$t_1 = t \sqrt{1 - \frac{2GM}{rc^2}} \text{-----II} \quad c_1 = c \sqrt{1 - \frac{2GM}{rc^2}} \text{-----IV}$$

HALF OF ENERGY IN A MASS IS TIME DEPENDENT POTENTIAL ENERGY

Let us consider the following scenario: If a mass falls an arbitrary large distance toward a black hole then at event horizon it should approach the velocity of light and its Kinetic Energy should approach $\frac{1}{2}mc^2$. As the kinetic energy was derived from the original time dependent potential energy stored within the mass it shows us that in an area of space with maximal rate of expansion at great distance from a gravitational field the time dependent potential energy is equal to $\frac{1}{2}mc^2$, while near a black hole where the expansion of space is expected be minimal the time dependent potential energy is expected to approach zero. **This links expansion of space to time dependent potential energy within a mass in this way linking time to expansion of space**. Following is the mathematical outcome of this concept.

In gravity $t_1 = t \sqrt{1 - \frac{2GM}{rc^2}} \text{-----II}$ and as part of slowing of time $c_1 = c \sqrt{1 - \frac{2GM}{rc^2}} \text{-----IV}$

In free fall part of time dependent potential energy $\frac{1}{2}mc^2$ gets converted to $KE = \frac{1}{2}mv^2$ as shown below:

$$\text{As } c_1 = c \sqrt{1 - \frac{2GM}{rc^2}} \quad \text{and} \quad c_1^2 = c^2 \left(1 - \frac{2GM}{rc^2}\right)$$

$$\text{Multiplying both sides by } \frac{1}{2}m \text{ we get: } \frac{1}{2}mc_1^2 = \frac{1}{2}mc^2 \left(1 - \frac{2GM}{rc^2}\right)$$

$$\text{And } \frac{1}{2}mc_1^2 = \frac{1}{2}mc^2 - \frac{GmM}{r}$$

With time dilation in gravity the time dependent potential energy $\frac{1}{2}mc^2$ is being reduced to $\frac{1}{2}mc_1^2$ by $\frac{GmM}{r}$ which we know is equal to the gain in kinetic energy of fall $\frac{1}{2}mv^2$.

Thus $\frac{1}{2}mc_1^2$ represents the remaining time dependent potential energy when a mass is placed in gravity. While $\frac{GmM}{r}$ represents reduction in potential energy of a mass in gravity.

When there is no time dilation of gravity $\frac{GmM}{r} = 0$ and $\frac{1}{2}mc_1^2 = \frac{1}{2}mc^2$

TOTAL ENERGY OF A MASS FALLING IN GRAVITY

As a mass falls in gravity the total energy is:

$$mc^2 = \left(\frac{1}{2}mc^2 + \frac{1}{2}mc_1^2 (\text{time dependent potential energy})\right) + \left(-\frac{1}{2}mv^2 \text{ kinetic energy}\right)$$

(Negative sign for kinetic energy as the mass is falling toward earth).

$$\text{However as } c_1 = c \sqrt{1 - \frac{2GM}{rc^2}} \quad \text{and} \quad c_1^2 = c^2 \left(1 - \frac{2GM}{rc^2}\right) \quad \text{so} \quad \frac{1}{2}mc_1^2 = \frac{1}{2}mc^2 \left(1 - \frac{2GM}{rc^2}\right)$$

$$\text{Therefore in free fall: } mc^2 = \frac{1}{2}mc^2 + \frac{1}{2}mc^2 \left(1 - \frac{2GM}{rc^2}\right) - \frac{1}{2}mv^2$$

In free fall the time dependent potential energy reduces and the kinetic energy increases.

$$\text{Total energy} = mc^2 - \frac{GmM}{r} - \frac{1}{2}mv^2 \quad \text{However } -\frac{1}{2}mv^2 = \frac{GmM}{r}$$

The total energy of a mass falling in gravity = $mc^2 - \frac{GmM}{r} + \frac{GmM}{r} = mc^2$ is constant.

Gain in Kinetic energy during free fall is exactly balanced by reduction in potential energy due to slowing of time in gravity. There is no force felt by the accelerating mass and no gain in mass. The above results (Kinetic energy of fall) are well known, however the same results are obtained by using the following concepts:

1. That half of energy in a mass $\left(\frac{1}{2}mc_1^2\right)$ is time dependent potential energy which reduces when placed in a time differential (in gravity) and is converted into KE of fall.
2. That in gravity as part of slowing of time speed of light is slow $c_1 = c \sqrt{1 - \frac{2GM}{rc^2}}$.

GRAVITY

As time is caused by expansion of space it depends on how fast space is expanding. All masses like earth sun, moon, stars and black holes radiate gravitons which are double spin particles that interact with space slowing its expansion, in the process slowing time. Time is slowest where the concentration of the gravitons is highest which is near or within the mass. Objects are made of billions of particles moving at high orbital velocities (time dependent potential energy). When these masses are placed in a time differential the atomic motion is being converted into the kinetic energy of fall making the mass move from faster to slower time producing the effect of gravity.

Gravity has two components a deflective component which is due to curvature in space produced by slower expansion of space caused by interaction of gravitons with space. This is well described in GR. Meanwhile the attractive component is purely due to time differential (this can be called the Newtonian component).

Despite it being called force, gravity is more of a property of space. Being mediated by time differential which is very slight between two adjacent areas of space makes gravity one of the weakest forces although its affect due to differences in rate of expansion of space can be felt at great distances. Another reason gravity is so weak is that it is not directly mediated by gravitons but indirectly through the effect of gravitons on space and time differential. This is unlike other forces like magnetism which are mediated by the direct action of force carrying particles. Gravity is always attractive as it can only operate between faster and slower time that is mediated by differences in expansion of space making it one of the strangest forces.

DO BLACK HOLES HAVE SINGULARITY?

At the event horizon the intense concentration of gravitons brings expansion of space almost to a halt and time approaches zero, placing a limit on gravity. As gravity can only operate between areas of faster and slower time in a time differential gradient; with no increase in time differential beyond the event horizon there can be no further increase in gravity. This is a safety mechanism built into the universe which prevents massive objects developing infinite gravity or singularity and disappearing from the universe. Once the limit of the speed of light is reached at the event horizon and time approaches zero the black holes can only grow in diameter. Below the event horizon there can be no further increase in gravity and no time, or motion or forces can exist.

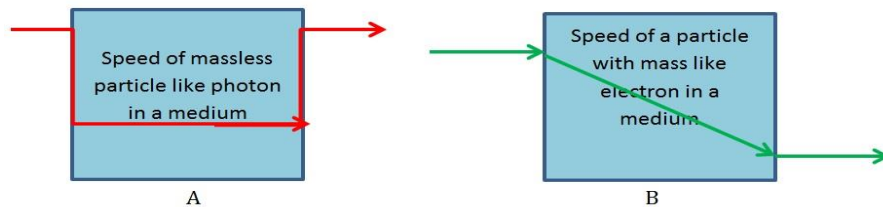
CONSTANCY OF THE SPEED OF LIGHT AND OTHER CONSTANTS

Speed of light is a constant and it seems to defy the common sense view of the world. My understanding of speed of light begins by stating that time, speed of light and length are all properties of space and **are constants in local reference frame**. The speed of light is related to the permeability and permittivity constants (in a local frame reference) by the following equation:

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$$

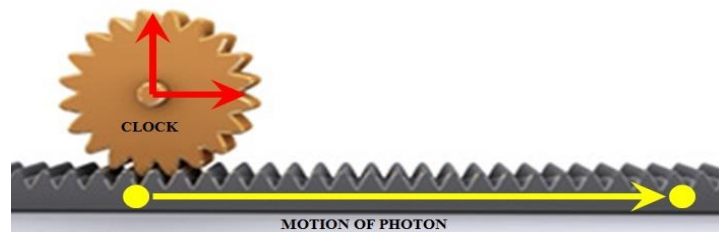
If speed of light varied from c it would lead to changes in the permeability and permittivity constants. This is an important point which should be kept in mind by those who think that speed of light can be violated. Speed of light obviously also depends on time. In relativity time is related to space therefore the speed of light as well as all motion also depends on space.

Another interesting way of looking at motion of photons (time dependent motion) is to consider how they move through denser medium such as glass or water as compared to the motion of a particle with mass like electron.



The picture on left (A) shows how a ray of light would behave as it passes through a denser medium like glass or water. On entering the medium the speed of light instantly drops to a lower but constant speed and as soon as it exits its speed goes back to its original speed although it has lost energy. Compare this to the speed of a particle like electron or a bullet going through denser medium (B). Its speed steadily declines and it exits at a slower speed at the right. This thought experiment suggests that the speed of light is the property of space itself. It is the space which propels massless particles at a constant speed.

UNDERSTANDING THE CONSTANCY OF SPEED OF LIGHT

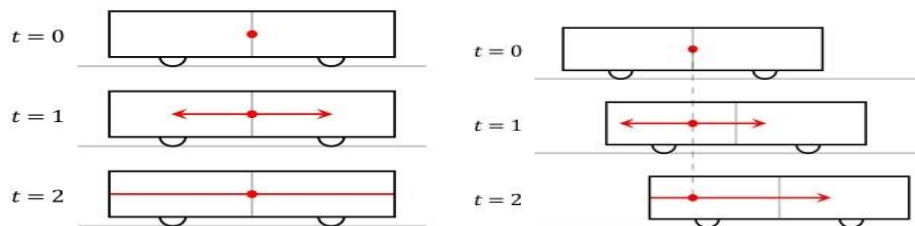


The oscillations of cesium atoms of the atomic clock and motion of the photon are both caused by the expansion of space, so these are fixed at a basic level making the **speed**

of light constant when measured locally. However this leaves open the possibility of measuring a different speed of the photon when measurements are made from a non-local space i.e. from a distance where time may be running at a different rate as the top of a mountain or measuring motion within a moving object by using a clock from a distance where time is different.

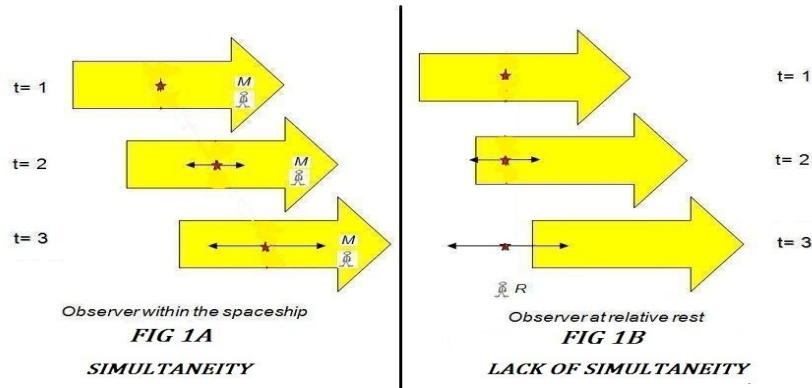
SIMULTANEITY OR LACK OF SIMULTANEITY

Einstein's postulate of constancy of the speed of light in all reference frames leads to the concept that simultaneity cannot be preserved so events appearing to be simultaneous in one reference frame may not be simultaneous in another. Following is a typical thought experiment that demonstrates lack of simultaneity that was taken from Wikipedia.



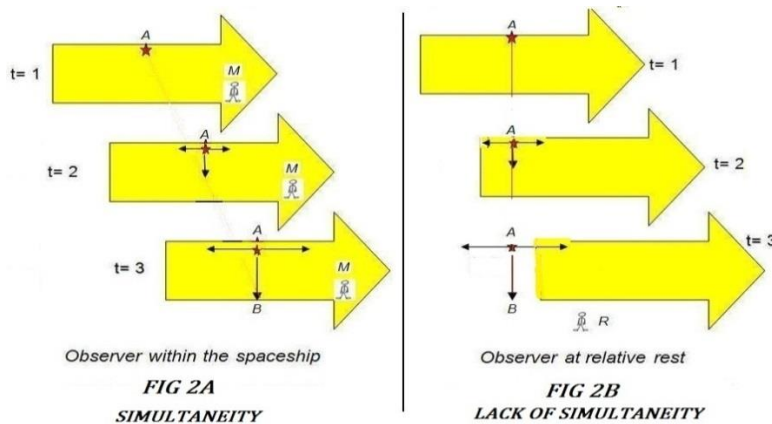
Similar thought experiments were used by Einstein and are given in popular relativity books as well as advanced level relativity books to show that simultaneity is not preserved. I will however show that the **most basic time dilation equation which has been experimentally shown to be correct is actually dependent on preservation of simultaneity.**

$$t_1 = t \sqrt{1 - \frac{v^2}{c^2}} \text{ .. eq\#1A} \quad \text{or} \quad t = \frac{t_1}{\sqrt{1 - \frac{v^2}{c^2}}} \text{ .. eq\#1B}$$



In figure 1, a spaceship is moving to the right at a constant velocity, an **observer M on the spaceship** (Figure 1A) will see rays of light emitted from the center reach the front and the backend of the spaceship **simultaneously as if the rays of light are being dragged along with the spaceship**. However according to relativity as the speed of light is c for all observers so **the observer R, at rest** (Figure 1B) will see the **light reach the back of the spaceship first and the front later on**. Thus what is simultaneous for an observer M on the spaceship is not simultaneous for the observer R, at rest.

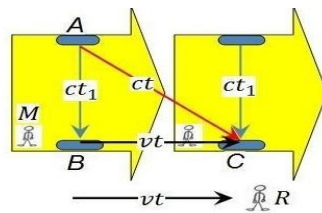
To illustrate how violation of the above concept of simultaneity is ignored in physics books¹ when it is convenient, we will repeat the thought experiment with an additional ray of light moving perpendicular to the direction of motion as shown in figure 2.



In Figure 2A a spaceship is moving to the right at a constant velocity and a ray of light is shown to move down perpendicular to the direction of motion from the center. An observer M on the spaceship will see this ray move straight down through the center of the ship. According to relativity an observer R, at rest (Figure 2B) should see this ray of light move straight down in his nonmoving reference frame independent of the motion of the spaceship.

In special relativity both the above scenarios are correct as the speed of light is constant and each observer has his own simultaneity. **The above concept is completely ignored in relativity books¹ when deriving Einstein's and Lorentz's famous time dilation eq#1.**

$$t_1 = t \sqrt{1 - \frac{v^2}{c^2}} \dots eq\#1A \quad \text{or} \quad t = \frac{t_1}{\sqrt{1 - \frac{v^2}{c^2}}} \dots eq\#1B$$



THE DERIVATION OF PRECISELY CORRECT
TIME DILATION EQUATION
FIG 3

Figure 3 shows a spaceship moving to the right. The vertical ray of light $AB = ct_1$ within the spaceship is seen by an observer 'R' at rest to move diagonally $AC = ct$ due to motion of the spaceship **as if the light is being dragged along the direction of motion. The difference here from FIG 1 and FIG 2 is that the point of view of the observer M in motion and the observer R, at rest coincide at every point, thus simultaneity is preserved.**

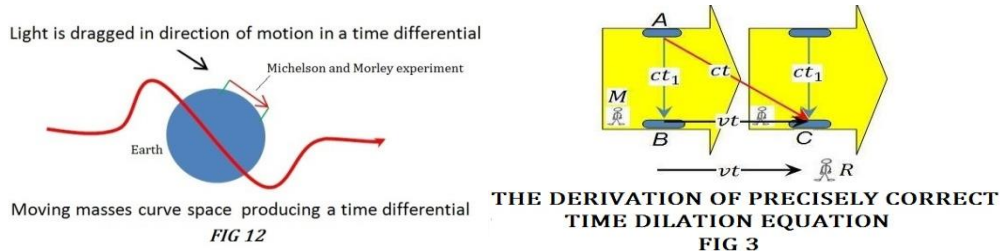
Using Pythagorean Theorem we can derive eq#1.

$$t_1 = t \sqrt{1 - \frac{v^2}{c^2}} \dots eq\#1A \quad \text{or} \quad t = \frac{t_1}{\sqrt{1 - \frac{v^2}{c^2}}} \dots eq\#1B$$

It should be stressed that **this equation cannot be derived unless the light beam is dragged in the direction of motion as seen by the observer at rest.** The turnaround points when light is reflected off the mirrors is the same for the observer M moving with the spaceship and observer R, at rest. These points coincide both in space and time. These points of reflection **are points of simultaneity** and the concept on which Einstein's and Lorentz's time dilation eq#1 is based is **consistent with preservation of simultaneity** and presence of a **dragging effect of moving objects on light.** This derivation directly contradicts Lorentz transformation (LT) equations which are based on lack of simultaneity and have never been experimentally verified⁸. Equation #1 is the gold standard predicted by SR. **All the experiments which demonstrate time dilation in motion are demonstrating the accuracy of this equation.**^{2,3}

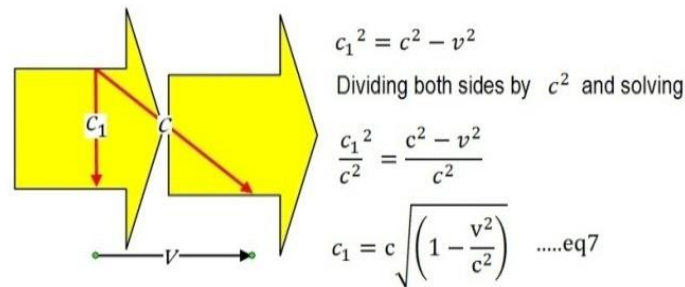
Another important consequence of preservation of simultaneity is that **Lorentz transformation (LT) equations cannot be correct.** Moreover all the important aspects of SR can be derived without LT. Invalidation of LT also invalidates block universe view of time and Minkowski's space-time diagrams which will also be discussed later in this article.

SPEED OF LIGHT WITHIN MOVING OBJECTS



Speed of light within a moving object can be calculated by using addition of vectors. We need to keep in mind three important points while calculating speed of light within moving objects.

1. Light is dragged in the direction of motion in or around moving objects.
2. As part of slowing of time light moves slowly within moving objects just as in gravitational fields.
3. Simultaneity is preserved.



Calculating speed of light within a moving object using addition of vectors

FIG 11

In the above picture (FIG 11) the yellow rocket is moving to the right with velocity v . A ray of light c_1 passes vertically in reference frame of observer moving with the rocket and this is seen to move diagonally in reference frame of a stationary observer. By using addition of velocities as vectors we can show that the vertical ray of light should be moving slowly from the point of view of non-moving observer who has faster time. As this observer also sees slower time in the moving rocket ship he should conclude that slowing of all motion within the moving rocket including the motion of the photon is part of slowing of time. This compares with the concept of slowing of speed of light at the base of mountain where time is slower when observed from the top of the mountain where time is faster.

So in reference frame of gravity or a moving object such as a rocket ship where time is slow when observed from outside that reference frame as from a distance, the speed of light may be measured to be slower without violating relativity or the law of constancy of speed of light or disturbing the permeability and permittivity constants. **However in a local reference frame speed of light is always constant.** In this way time and lengths when measured locally are also constant. However from a distance lengths can be seen to be shortened as in moving objects and time can be seen to run slowly. So it should not be a

surprise that speed which is related to lengths and time should appear changed if measured from a non-local distant space where clocks are running at a different rate.

The following equations are for time and speed of light within a moving object when observed from a distance (non-local reference frame):

$$t_1 = t \sqrt{1 - \frac{v^2}{c^2}} \dots \dots \dots \text{I} \qquad c_1 = c \sqrt{1 - \frac{v^2}{c^2}} \dots \dots \dots \text{II}$$

The above are similar to the following equations for time and speed of light in gravity when observed from a distance (non-local reference frame):

$$t_1 = t \sqrt{1 - \frac{2GM}{rc^2}} \dots \dots \dots \text{III} \qquad c_1 = c \sqrt{1 - \frac{2GM}{rc^2}} \dots \dots \dots \text{IV}$$

MICHELSON AND MORLEY EXPERIMENT

The velocity of light slows within moving objects as part of slowing of time and is a constant only within the local (or moving) reference frame. **Simultaneity is also preserved as light is dragged in the direction of motion** in the time differential that is created by moving objects as shown above. Length contraction is a local effect and cannot be measured locally as measuring rods will also contract. The dragging of photons in the direction of motion and slowing of velocity of light to match the slowing of time within the moving objects is the reason that the speed of light is a constant in reference frame of the moving masses like earth and the reason for the negative results of Michelson and Morley experiment. **This also shows that even one way speed of light experiments will fail to show any variation in c.**

WHAT IS THE CAUSE OF MASS GAIN WITH INCREASE IN VELOCITY?

As mentioned earlier in a free fall there is no gain in mass with increase in velocity as no force is acting on the mass and no acceleration is felt by the falling object. This important point appears to be missing from textbooks of physics and is ignored by physicists.

In contrast to above when increase in velocity is produced by acceleration with application of a force (Rocket ship) there is gain in mass. The accelerating force causes the mass to constantly feel the acceleration. **The energy of the force applied is being converted into mass.** Meanwhile it can be shown that the sum of time dependent potential and kinetic energy in this case also remains constant just as in free fall. It is well known that the Relativistic KE is not equal to Newtonian Kinetic energy.

$$\frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} - mc^2 \neq \frac{1}{2}mv^2$$

The usual text book explanation for this is that the Relativistic KE is more accurate and at lower velocities these two quantities are the same. This however contradicts the fact that in falling bodies there is only one kind of kinetic energy which is exactly equal to: $\frac{1}{2}mv^2$.

Keep in mind the equation: $c_1 = c\sqrt{1-\frac{v^2}{c^2}}$III. Which shows that as part of slowing of time within moving objects c is affected in the same proportion as time and all other motion.

When a mass is accelerated by application of a force the time dependent potential energy within the object reduces as part of slowing of time while the classical Kinetic energy increases and the sum of both remains constant:

$$mc^2 = \left(\frac{1}{2}mc^2 + \frac{1}{2}mc_1^2(\text{time dependent potential energy})\right) + \frac{1}{2}mv^2$$

$$\text{However as } c_1 = c\sqrt{1-\frac{v^2}{c^2}}\text{.....III and } c_1^2 = c^2\left(1-\frac{v^2}{c^2}\right)$$

$$mc^2 = \frac{1}{2}mc^2 + \frac{1}{2}mc^2\left(1-\frac{v^2}{c^2}\right) + \frac{1}{2}mv^2$$

$$mc^2 = \frac{1}{2}mc^2 + \frac{1}{2}mc^2 - \frac{1}{2}mv^2 + \frac{1}{2}mv^2 = mc^2\text{.....remains constant}$$

Application of force just shifts the balance between potential energy and kinetic energy so that there is less of potential energy and more of kinetic energy and sum of both remains constant. **The force cannot increase the total sum of potential and kinetic energy** (as it is caused by expansion of space) **therefore the energy of the force only goes into increasing the mass of the object and not into increasing its velocity.**

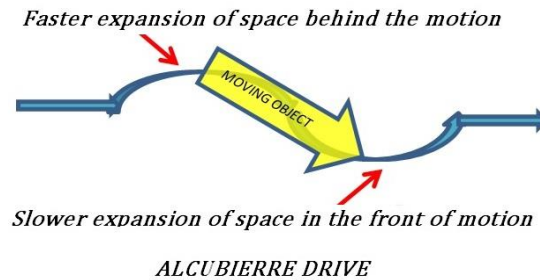
$$\text{That is why } KE = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} - mc^2 \neq \frac{1}{2}mv^2$$

RELEASE OF RELATIVISTIC KINETIC ENERGY ON IMPACT

If a mass is accelerated by application of force and is now moving at a certain velocity it has kinetic energy $\frac{1}{2}mv^2$ (which plays no part in the impact) and relativistic KE: $\frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} - mc^2$. When this mass is suddenly brought to a stop the time dilation of motion disappears. During deceleration the mass can absorb back the kinetic energy $\frac{1}{2}mv^2$ as potential energy as now the slowing of time is no longer present and the mass again has higher allowed potential energy capacity. This process is same as conversion of kinetic to potential energy in a pendulum as it rises to a higher point and enters a zone of space with higher allowable potential energy.

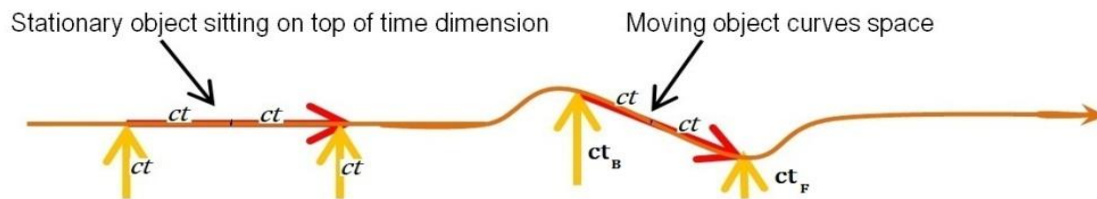
Meanwhile the energy acquired from application of force and stored as gain in mass $\frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} - mc^2$ which masquerades as the kinetic energy is released. These subtle differences that are present in the kinetic energy of fall and the kinetic energy produced by application of a force illustrate the point that all motion is part of time and is due to expansion of space. This is why acceleration by application of a force is accompanied by increase in mass and there is no mass gain in free fall.

LENGTH CONTRACTION, MOTION AND INERTIA



Miguel Alcubierre in 1994 suggested the above mechanism for a warp drive to move objects at high velocities by bending space. I proposed (in 1982) that this happens normally when objects are pushed as we live in an expanding space. This mechanism explains inertia motion as well as length contraction. The moving object interacts with space slowing the expansion of space in front of the object, slowing time (eq#2.) The space behind the object interacts with the object to expand faster causing faster time (eq#4), **this creates a time differential which then perpetuates motion.** The space resists motion however once motion begins with application of force and the curvature is produced then space perpetuates motion. This is the mechanism of inertia which likely works at the atomic level so as to explain rotational motion as well.

MOTION CAUSES SPACE TO CURVE



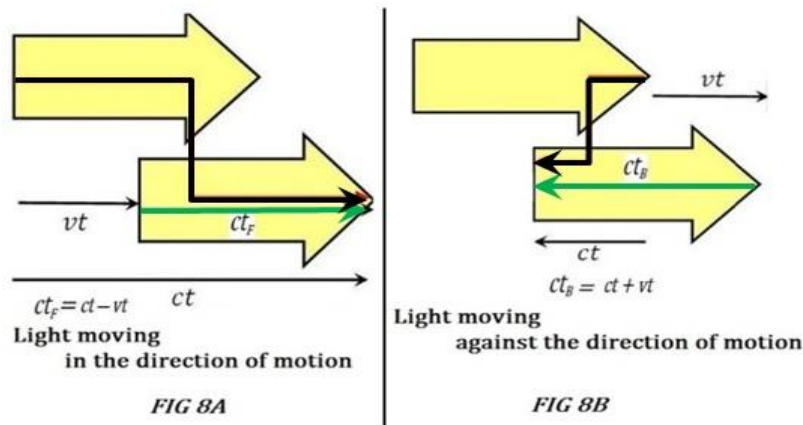
Three dimensions of space are represented by one dimension line.
Time is multiplied by speed of light to get distance in higher dimension

FIG 7

The distance "ct" is set as the distance in a higher dimension which is perpendicular to our three dimensional space. The non-moving object is sitting on the top of this dimension. This distance I propose is equal to half the length of the object because of the way we are making measurements. If the time that light takes to cross half the length of the

object is set as “t”, then this is the time which changes when an object is set into motion i.e. it becomes slower or faster.

The term **time dimension I mention does not refer to dimension of the block universe** but just higher or 4rth dimension in which the space curves in areas where time is slower or faster. Also **important point to keep in mind that the derivations given below are not in any way connected to Lorentz transformation equations.**



The object (Figure 8A and 8B) is moving to the right and light is reflected within the object in the direction of motion and then opposite to the direction of motion. The black lines represent the ray of light passing through the moving object as seen by an observer at rest. The green lines represent light path as observed from within the moving object. The object is split for clarity to separate the path of light seen by observer at rest and that seen by the observer in motion. The time t_F is assumed to be the time toward the front end of the object and t_B is the time assumed to be toward the back end of the object.

$$ct_F = ct - vt \quad \text{solving for } t_F = t \left(1 - \frac{v}{c}\right) \quad \text{eq\#2a slower time}$$

$$ct_B = ct + vt \quad \text{solving for } t_B = t \left(1 + \frac{v}{c}\right) \quad \text{eq\#4a faster time}$$

Pushing on an object would cause it to interact with the expanding space. The expansion of space slows in front of the moving object and becomes faster behind thus propelling the object in a time differential that is created. This phenomenon can happen

only in an expanding space. **Thus expansion of space (i.e. expansion of the universe) is essential for motion to exist.**

Fig 9 shows how the object rotates in curved space-time. The object moves in a time differential that is produced with motion.

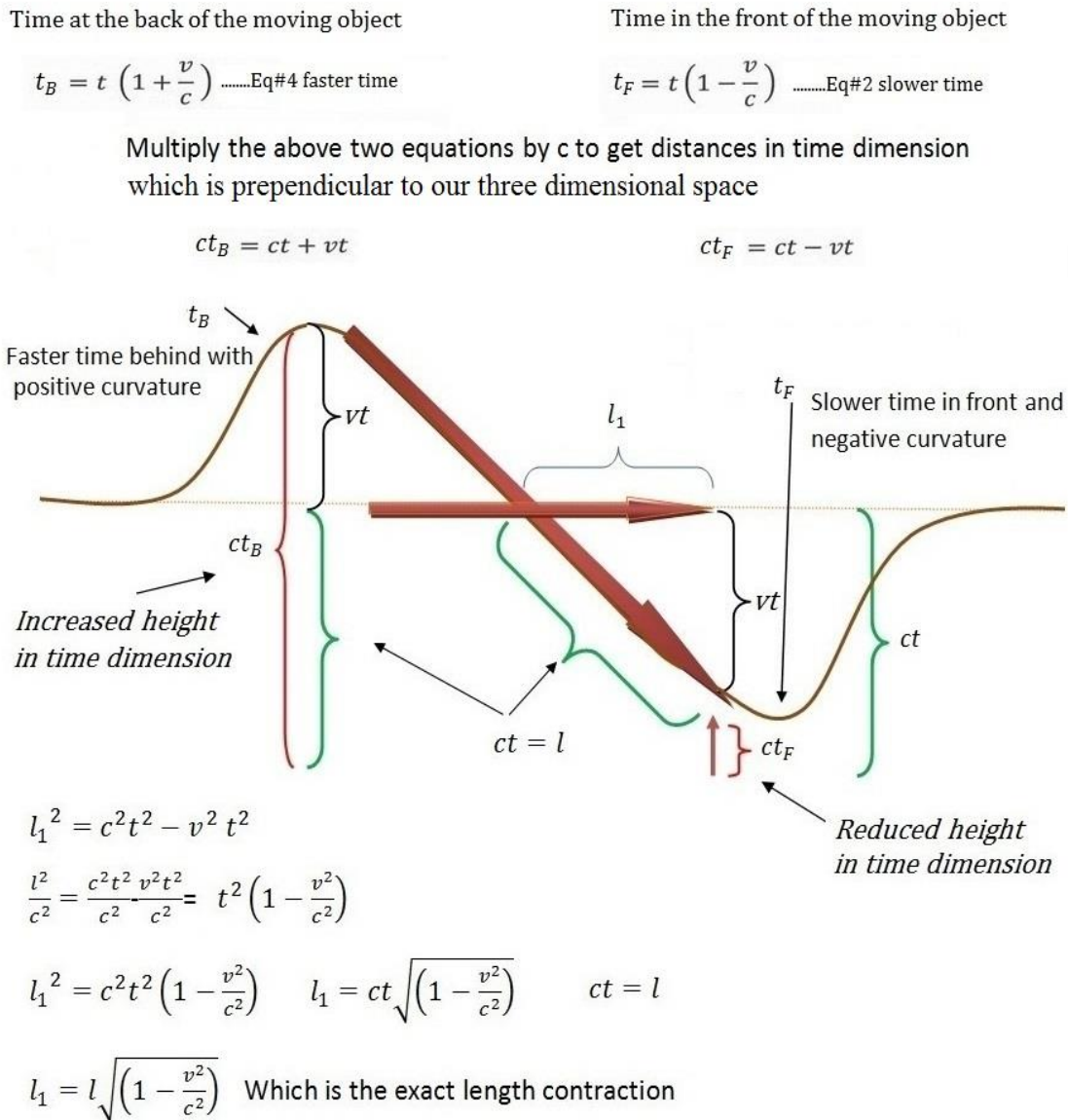
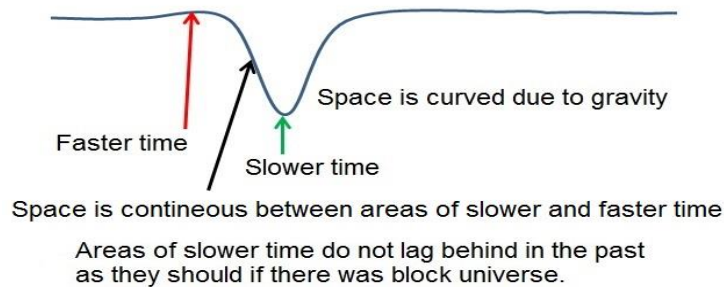


FIG 9 LENGTH CONTRACTION

The curving of space and rotation of the moving object in this curved space is the real cause of the length contraction.

BLOCK UNIVERSE AND MINKOWSKI'S SPACE TIME DIAGRAMS

As discussed earlier slowing of time is not compatible with block universe view of time. The following figure illustrates this concept by showing that areas of slower time are continuous with areas of faster time in gravitational fields. The areas with slower time do not get disconnected and do not left behind in the past dimensions despite staying in slower time for prolonged periods as in case of base of mountains.

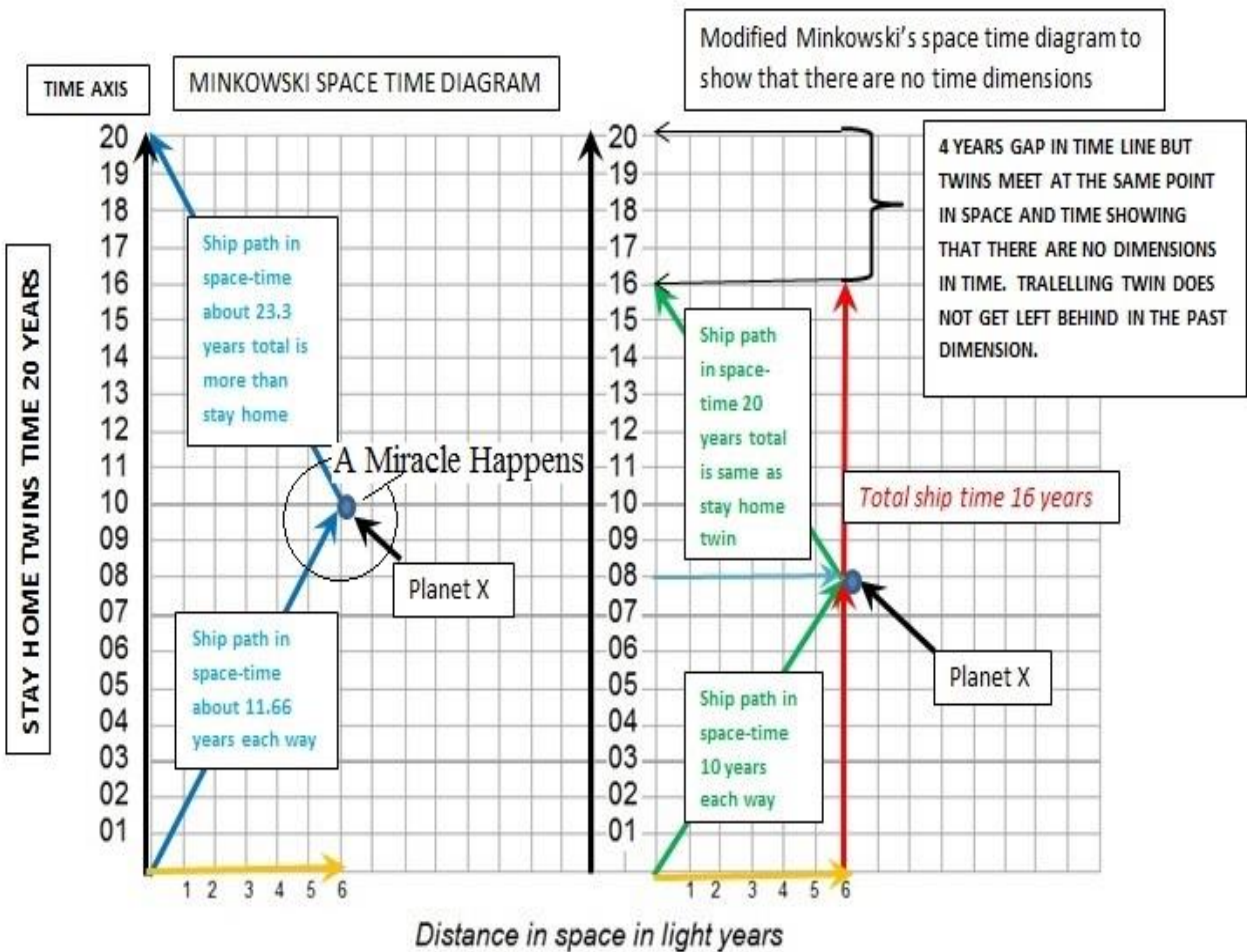


The LT equations that depend on the concept on lack of simultaneity and the Minkowski's space time diagram support the concept of block universe view of time. However it can be shown that Minkowski's space time diagram is just a diagrammatic representation of a concept which is not correct and it ignores the fact that the travelling twin despite his or her slower time does not lag behind in time dimension as should have if there was a block universe.

Below on left is the typical Minkowski's space-time diagram. You may note that the space time distance travelled by the travelling twin to planet X is actually even more than that of stay home twin's 20 years. In Minkowski's space time diagram **the slow time of travelling twin is already assumed**. Many physicists **claim that something special happens at the turn around point** i.e. so that there is some kind of explanation for twin paradox. Some educators mix the time dilation of the travelling twin with the Doppler shift to mislead their students into thinking that there is some kind of explanation. **This is pure intellectual dishonesty**. The space time diagrams are just graphic representations of motion through space and an **imaginary timeline** which has **no physical reality** but gives an **illusion of a time dimension**.

The **modified space time diagram** (below right) is much more revealing. The stay home twin's time line is on the left (black line.) Passage of time for the stay home is 20 years. The space-time axis (green) of the travelling twin leans in the direction of travel. However the time axis (red) of travelling twin is parallel to the original time axis. The travelling twin (theoretically) is **moving more in space and less in time**. The total travel in **space-time** (green) is the same (20 years) as the stay home twin. According to this modified **graphic representation** the total movement in **space-time** is constant for all objects for a given period of time either the movement is in time or space time. However when we separate the motion into space like (yellow line at bottom) and time like (the redline) we find that as the object moves more in space it moves less in time.

THE MINKOWSKI DIAGRAM COMPARED WITH MODIFIED SPACE TIME DIAGRAM



In the Modified diagram above right the travelling twin returns at the **16 years point in the original time axis**. While the stay home twin is at the 20 years point on the time axis. **The travelling twin however does not return into the past** of the stay home twin **although on time line he is 4 years earlier**. This lays bare a profound implication which is hidden in the Minkowski's space time diagram. **The black lines are actually only points**. We have **chosen to represent time as timeline** however there **is no space like distances in time**. **In other words** time is only a process (forces and motion) which reduces with motion and **there are no time dimensions**. More importantly rest and motion only appear relative but actually are not; this is what twin paradox and centrifugal force is trying to tell us. There is **no need to mix Doppler shift with time dilation** to confuse the issue **we just know that moving objects have slower time**.

WHY THERE IS NO TWIN PARADOX

All explanations of twin paradox fail miserably. Some of the notable ones are:

1. Acceleration argument.
2. Mixing Doppler shift to mislead in to some kind of explanation.
3. Turnaround argument.
4. Minkowski's space time diagram mixed with Doppler shift.

Twin paradox exists as SR denies existence of space structure as it is reminiscence of ether. Moreover if space has a structure then how huge masses can move through space unimpeded. SR cannot explain motion through a space structure. In GR space has many characteristics that resemble ether like curvature black holes etc. We seem to have changed name of ether to space without explaining why objects can move through it with zero resistance. However with the definition of time as presence of motion and forces which is caused by expansion of space and gravity being time differential we are in a position to solve this issue.

All motion and time are caused by expansion of space. So it is space that resists motion and then perpetuates it. Without expansion of space motion forces and time cannot

exist. Increasing external linear motion reduces internal motion of the atoms the total remaining constant. Objects when pushed develop time differential and move in a wave like fashion curving the space and causing length contraction. Objects move in a time differential from faster to slower time. Length contraction in expanding space is imperative for motion to exist. Moving twin has slower time as rest and motion are not the same, thus there is no need to explain twin paradox.

Have I offered any proof that expansion of space is the cause of time?

1. Time is slow where expansion of space is slow as around large masses.
2. The slowing of expansion and slowing of time is causing us to observe accelerated expansion of the universe when we look at distant galaxies and supernova and take measurements using our local time which is comparatively the slowest as looking into distance is equivalent to looking into the past.¹⁶
3. Slowing of time with motion when the total of kinetic and potential energy remains constant as it is coming from expanding space.
4. Increase in mass when an object is accelerated by force but no increase in mass for an object falling in gravity also suggests that total of kinetic plus potential energy is coming from space.
5. An explanation of length contraction and inertia suggests that motion can only exist in expanding space as part of time.

How can this concept be proved?

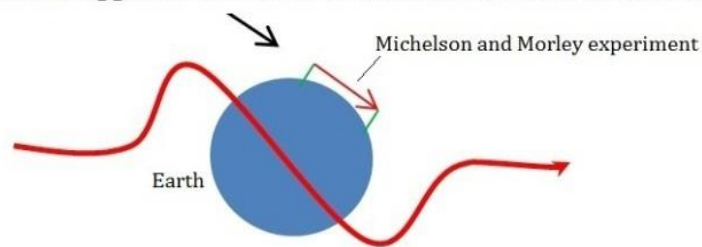
First of all we require considerable paradigm shift and acknowledgement that SR as well GR has significant problems. SR makes numerous predictions like slowing of time increase in mass and length contraction that have been experimentally proven but cannot give conceptual reason as to why these things happen.

I have shown some beautiful reasoning to all the predictions of SR and GR. I also show the following:

1. Light is dragged in the direction of motion within and near moving objects and simultaneity is preserved.
2. Light moves slowly within moving objects as part of slowing of time.
3. Length contraction is a real phenomenon for moving objects.
4. There is no mass increase with increase in velocity for objects falling in gravity.

All the above predict measurable experimental results that are different from SR.

Light is dragged in direction of motion in a time differential



Moving masses curve space producing a time differential

FIG 12

PHOTON ACCELERATION EXPERIMENT TO CONFIRM

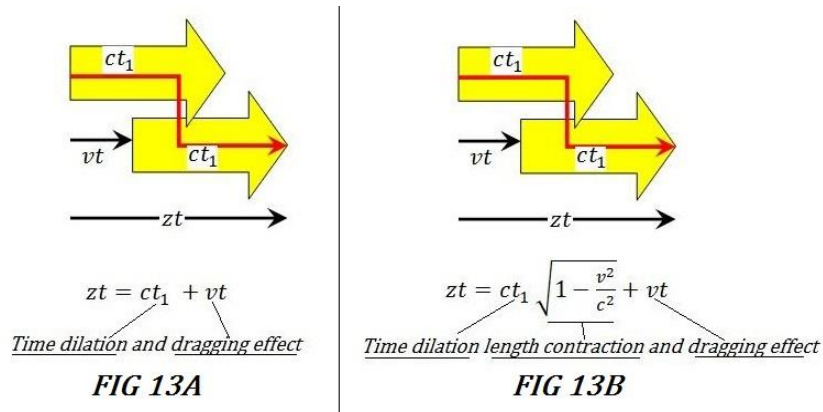
LENGTH CONTRACTION, LIGHT DRAGGING EFFECT, AND SIMULTANITY

Plasmas moving at high velocity can up-shift photon frequency¹⁰ thus leading to the term “Photon acceleration.” Photons passed through particle beams which have relativistic motion may be used to precisely test predictions of special relativity like length contraction, light dragging effect, preservation of simultaneity, Einstein’s velocity addition equation and Fresnel’s ether drag formula. This will be like performing Fizeau’s 1851 experiment using high velocity plasma instead of low velocity water or air.

In 1851 Hippolyte Fizeau¹¹ carried out an experiment to measure the drag effect on light passed through moving water. The speed of water was 7.059 meters per second and some effect was noticed. Air with almost zero refractive index was also used in another experiment at the speed of 25 meters per second with completely negative results. These velocities (7 to 25 meters per second) are a minute fraction (0.023 to 0.083 parts per

million) of the speed of light and the experiment may have missed any effect which may become apparent at higher velocities.

One of the explanations of photon acceleration in moving plasma is “space-time refraction⁷”. It is possible that photons when grazing the relativistic moving particles will be dragged in the direction of motion resulting in photon acceleration thus preserving simultaneity and showing measurable fringe changes. Both Fresnel’s ether drag formula and Einstein’s velocity addition formula do not take into account effect of time dilation or length contraction within or near moving masses and cannot explain photon acceleration. When these factors are considered in the equations, the graphs (Fig 14) shows that peak photon frequency up-shift occur at different points depending upon presence or absence of length contraction. We will now extend the above concept to a beam of light passed through an object in the direction of motion. We use an object in FIG 13 for clarity although in the suggested experiment light is supposed to be passed through a particle beam.



In figures 13A and 13B the yellow object is moving with velocity ‘v’ to the right in time t. During that time interval a ray of light passes through the object as it moves through the distance vt, as seen by observer R, at rest. The distance covered by light within the moving object is ct_1 (t_1 is the time measured by observer within the moving object.)

The apparent speed of light as seen by rest reference frame observer is set as an unknown factor z. This is done to keep in mind that light is possibly dragged in the direction of motion by the moving object covering the distance zt. The group velocity of

photons in this special case is then is not equal to c and this will manifest itself by upshift in photon frequency. The group velocity is set as z due to the dragging, the length contraction and time dilation effect surrounding the moving particles. Figure 13A shows the equation with only time dilation and dragging effect. Figure 13B shows the equation with time dilation, length contraction, as well as the dragging effect.

The photon frequency may be up-shifted by a dragging effect of the velocity 'v' of the particle beam. Moving particles may curve space and photons entering this curved space should be dragged in the time differential surrounding the moving particle. This would effectively show that simultaneity is preserved. Time dilation surrounding the moving particle would cause photon frequency to downshift by a factor of $\sqrt{1 - \frac{v^2}{c^2}}$ eq#1c

The combined effect of dragging, and time dilation but without length contraction is given by $z = ct_1 + vt$...eq#12. However as $t_1 = t\sqrt{1 - \frac{v^2}{c^2}}$ eq#1A

Therefore: $z = c\sqrt{1 - \frac{v^2}{c^2}} + v$ eq#13

This equation (eq#13 without length contraction factor) has a distinctive graph which peaks at particle beam velocity of 222132.034 km per sec derived as follows:

$$z = c\sqrt{1 - \frac{v^2}{c^2}} + v \text{eq#13} \quad \text{Derivative } z' = -\frac{v}{c\sqrt{1 - \frac{v^2}{c^2}}} + 1$$

$$\text{set } z' = 0, \text{ then } v = c\sqrt{1 - \frac{v^2}{c^2}} \text{ and } v = \frac{c}{\sqrt{2}} = 212132.034 \text{ km/sec}$$

Length contraction if present around the moving particle should cause the photon frequency to additionally downshift by a factor of: $\sqrt{1 - \frac{v^2}{c^2}}$ eq#1c

The combined effect of all three factors the dragging, time dilation, and length contraction which can change photon frequency would be seen in graph of:

$$z = \left(c \sqrt{1 - \frac{v^2}{c^2}} * \sqrt{1 - \frac{v^2}{c^2}} \right) + v \text{ or } z = \left(1 - \frac{v^2}{c^2} \right) + v \dots \text{eq\#14}$$

This equation has a distinctive graph which peaks at particle beam velocity of 150000 km/sec derived as follows:

$$z = c \left(1 - \frac{v^2}{c^2} \right) + v \dots \text{eq\#14} \quad \text{Derivative } z' = -2 \frac{v}{c} + 1,$$

set $z' = 0$, then $2 \frac{v}{c} = 1$ and $v = \frac{c}{2} = 150000 \text{ km/sec}$

Both Einstein's equation and Fresnel's formula with refractive index close to 1 predict flat curves with no photon frequency up shift. It should be noted that Fresnel's drag coefficient is based on concept of ether and Einstein's velocity addition formula does not take into account the length contraction or time dilation around the moving particles.

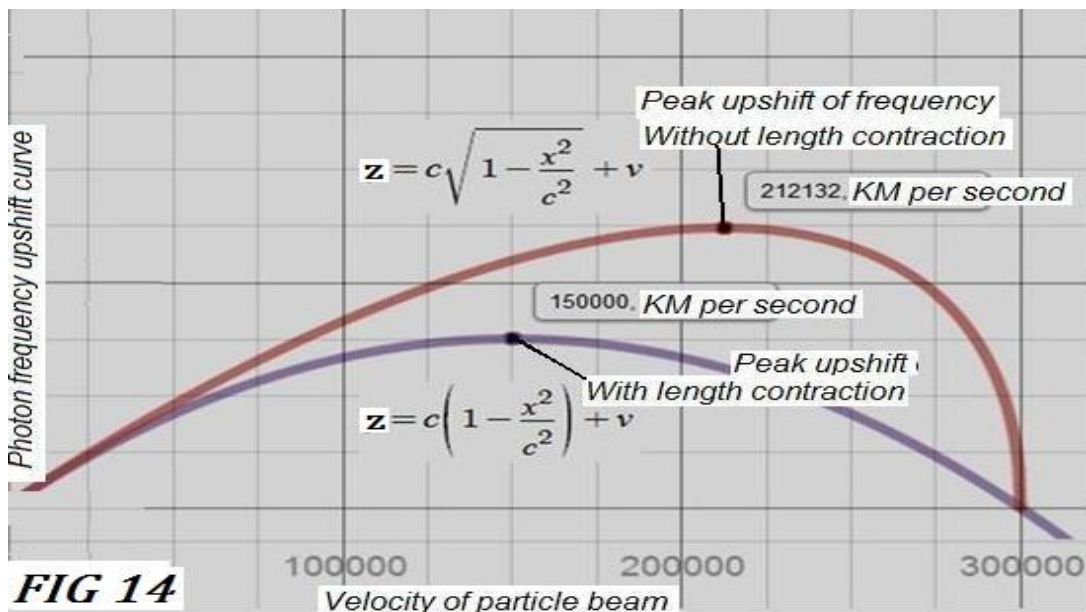
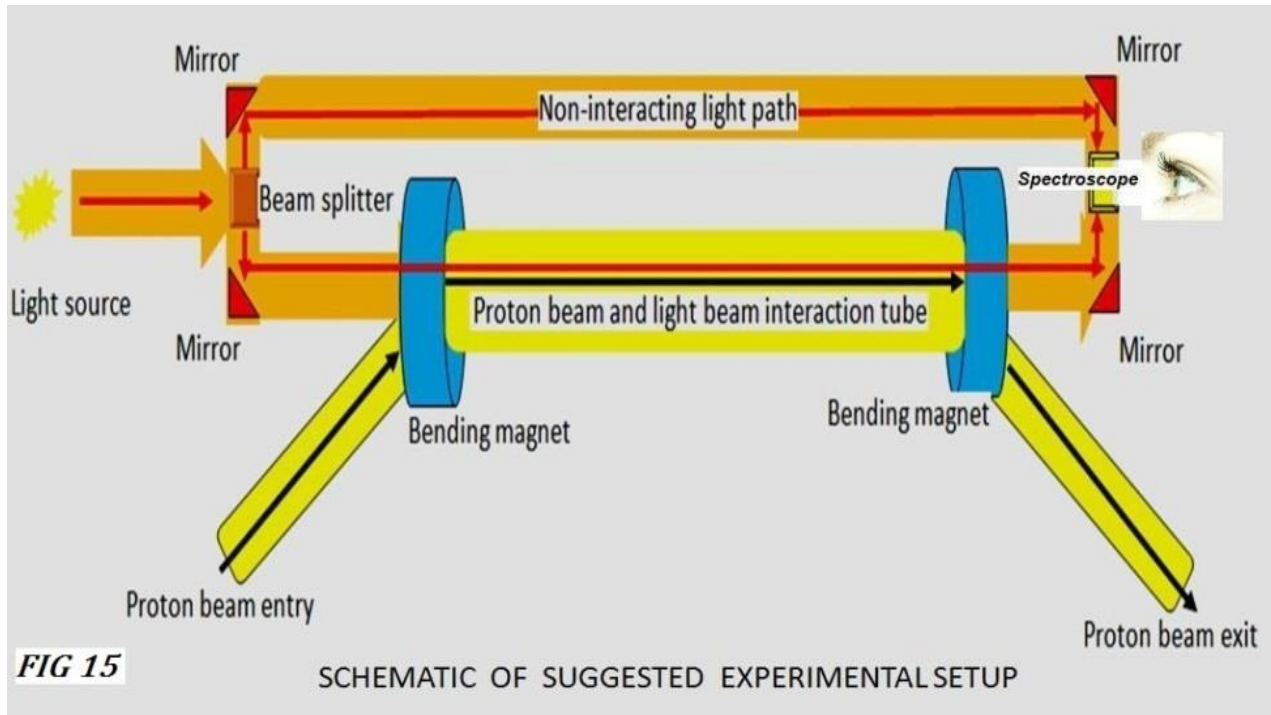


Figure 14 shows the graphs of the equations showing peak increase in group velocity of photons due to the drag effect, the length contraction, and the time dilation.

Above are the examples of effect of full dragging, time dilation and length contraction on the photons by the particle beam. However as the relative size of photon and distances between particles in the beam are relatively vast this much effect is not expected and this may be the reason no effect was seen in the original Fizeau's experiment using air as the photons will normally follow the much larger drag of the earth's gravitational field. Experimentalist should use dense particle beams to insure the effects will be seen. We are looking for peaks of interference pattern and they are expected to occur at particle beam velocity of 222132.034 km per sec if there is no length contraction but only time dilation and dragging effect and at particle beam velocity of 150000km per sec if there is length contraction time dilation as well as dragging effect. No effect is predicted by Einstein's velocity addition formula and Fizeau's ether drag formula

The suggested experimental setup is shown in fig 15. The photon beam from source is split into two. One goes through the interacting tube to interact with the high density particle (proton) beam and the other goes straight unimpeded to the spectrometer. The two photon beams are then united in the spectroscopy to see changes in the interference pattern through a spectrum of proton beam velocity from zero to near c. The graphs then can be compared to what is predicted by the equations so as to ascertain which equation is correct. **Light beam travelling in opposite direction (as done by Fizeau) should not be used as it destroys the peaks of the interference pattern.**



DISCUSSION

Einstein having successfully applied the concept of space curvature in General Relativity (GR) could have applied it to moving objects as well to explain time dilation in motion. Slowing of time in gravity and motion has a common denominator the expanding space providing a link between expansion of space and time. Many relativity books try to explain slowing of time in motion on acceleration¹ as it was felt that acceleration in gravity is the cause of slower time in gravity. Now we know from experiments using circular particle accelerators³ that time dilation can be precisely calculated using velocity only and acceleration has no effect on time. This calls into question the common wisdom that gravitational acceleration is responsible for time dilation in gravity. In actuality similar to velocity of a moving body which gives precise time dilation “escape velocity” and not acceleration is used to derive time dilation in gravity¹. The other concept used to explain time dilation of travelling twin and the twin paradox is the Lorentz transformation and its associated lack of simultaneity which further complicates the picture by creating yet another anomaly the Andromeda paradox¹⁴. Volumes have been written on LT in books and articles on the lack of simultaneity which has never been experimentally verified⁸. As

shown above the accurate and precisely verified^{2, 3} eq# 1 depends on preservation of simultaneity while LT describes lack of simultaneity.

The proposal that moving objects curve space hopes to bridge a gap in the understanding of many predictions of relativity and lead to the understanding of gravity, inertia, length contraction, time dilation, and the phenomenon of time. The curvature in space caused by motion creates a time differential. Length contraction is due to curving of space and rotation into a higher dimension. There is no twin paradox if moving objects curve space, so that there is a real difference between rest and motion.

Objects are composed of trillions of atoms with kinetic energy of electrons moving in tremendous orbital velocities. Imagine placing this mass in a time differential (which is gravity) and the internal kinetic motion of the electrons is converted to external linear motion. This is how I believe gravitational acceleration is produced.

The differences in time follow differential expansion of space around large masses linking expansion of space with time. This is reinforced by the concept that objects in gravity as well as motion move from a faster expanding space to a slower expanding space therefore from faster to a slower time. Gravity can only work between zero time and positive time excluding the possibility of negative gravity. The prime mover behind time and gravity is the expansion of space, once expansion of space in large masses is brought to zero as within the Schwartz radius, limit to time differential is reached and gravity cannot increase any further. This is why black holes do not collapse and disappear from the universe.

Time is the presence of motion and forces and is related to the expansion of space. That is why time is slower where expansion of space is slower as around large masses. The accelerated expansion of the universe which we are seeing is another indication that our time is caused by expansion of space and time is slowing down causing us to mistakenly think that expansion is accelerating. This is happening as we try to measure distant and past motion of galaxies and supernova by our present local slowing time.¹⁶

If the amount of motion and forces imparted by expanding space to a mass is a constant then we can see that when external motion or velocity of an object is increased the internal motion of atoms slows as part of slowing of time. Slower time where expansion of space is slow leads to negative curvature of space; however time is not a dimension in which we can travel. There is no past or future existing out there and only present is real. There is no block universe and that is why there are no time travelling visitors from an advanced futuristic civilization and there is no grandfather paradox.

SUMMARY

1. Moving objects curve space and rotate in a higher dimension to produce length contraction.
2. Space resists motion however once an object is pushed a curvature is produced in the expanding space and time differential is created perpetuating motion. This is the cause of inertia.
3. Motion is possible only in an expanding space as only in such a space expansion can be slower in the front of moving object and faster behind it creating time differential. Objects move in a time differential.
4. Light within moving objects is dragged in the direction of motion in the time differential.
5. Time as well as the speed of light slows within moving objects and this along with dragging in direction of motion explains the constancy of the speed of light as observed on earth.
6. Simultaneity is preserved as light is dragged in the direction of motion.
7. Amount of time (motion and forces) imparted by expanding space to a mass is a constant therefore when motion (velocity) of an object is increased internal motion of the atoms as well as forces reduce, which is then seen as slowing of time with motion
8. Gravitons radiated by masses interact with space slowing its expansion.

9. Slower time around large masses is due to slower expansion of space. Time is related to the expansion of space.
10. The accelerated expansion of the universe that is observed recently is another clear indication that expansion of space is the cause of time.¹⁶
11. Time differential around large masses is the cause of gravitational acceleration. There is no force of gravity only time differential.
12. Once expansion of space approaches zero as within the Schwartz radius of the black holes, time also approaches zero and there is no further increase in time differential or gravity. This concept rules out infinite gravity or singularity in the black holes.

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