Relativity Of Speed Of Light With Rate Of Universe Expansion

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ABSTRACT

Theory of 'Relativity of speed of light with rate of universe expansion' explains relation of speed of light with rate of universe expansion. This theory provides evidences that the time can not be relative as stated by 'Theory of Special Relativity' and 'Theory of General Relativity'. 'Theory of Special Relativity and 'Theory of General Relativity' are based on fundamental proposition of constancy of speed of light. However, postulates of these theories are not correct. Theory of 'Relativity of speed of light with Rate of Universe Expansion' answers fundamental proposition of constancy of speed of light in terms of rate of universe expansion. This theory also explains real reason behind $E = mc^2$.

Key Words: Speed of light, Rate of Universe Expansion, Speed of Gravitational wave, Theory of General Relativity, Theory of Special Relativity, Kinetic Energy, $E = mc^2$

1. INTRODUCTION

I used to wonder from where light photon which does not have even intrinsic mass gets energy to move at speed of 299,792 km /second. The other question which occurred to me was why speed of gravitational force which is based on mass of an object is same as speed of light. The other related question is, why when mass is released as energy, the energy released is related to speed of light (c) ($E = mc^2$).

What is the significance of speed of light in these cases? or is it that all these are related to one common source (universe expansion) and hence derive speed / energy from the same.

Let us study this in detail. We will also get explanations regarding

1. Speed of light remains constant irrespective of speed of observer.
2. Reason why speed of light does not depend on speed of source of light.
3. Reason behind Time Dilatation at higher speed and Gravitational Time Dilatation, and
4. Real reason behind $E = mc^2$

We will validate our analysis with Hubble's constant and other evidences. We will analyze two fundamental postulates of 'Theory of General Relativity' and 'Theory of Special Relative' i.e. (1) Nothing can travel faster than light and (2) Time is relative and depends on speed of object, and evidences suggesting that these postulates cannot be true.

2. EXPANSION OF UNIVERSE, LOCATION OF OUR GALAXY AND ITS IMPACT ON SPEED OF LIGHT

A. Understanding Expansion of Universe and location of our Galaxy in Universe

After big bang universe started expanding in all directions **[1].** We can think of this expansion as a sphere (like rubber ball) which is being stretched in all directions and thus expanding. The galaxies including galaxy in which we reside move away from the 'center of universe' (i.e. location of big bang) on account of universe expansion. The speed at which galaxy would be moving away from center of universe, is related to rate at which universe is expanding and position of galaxy with respect to 'center of universe' and 'outmost layer of universe'.

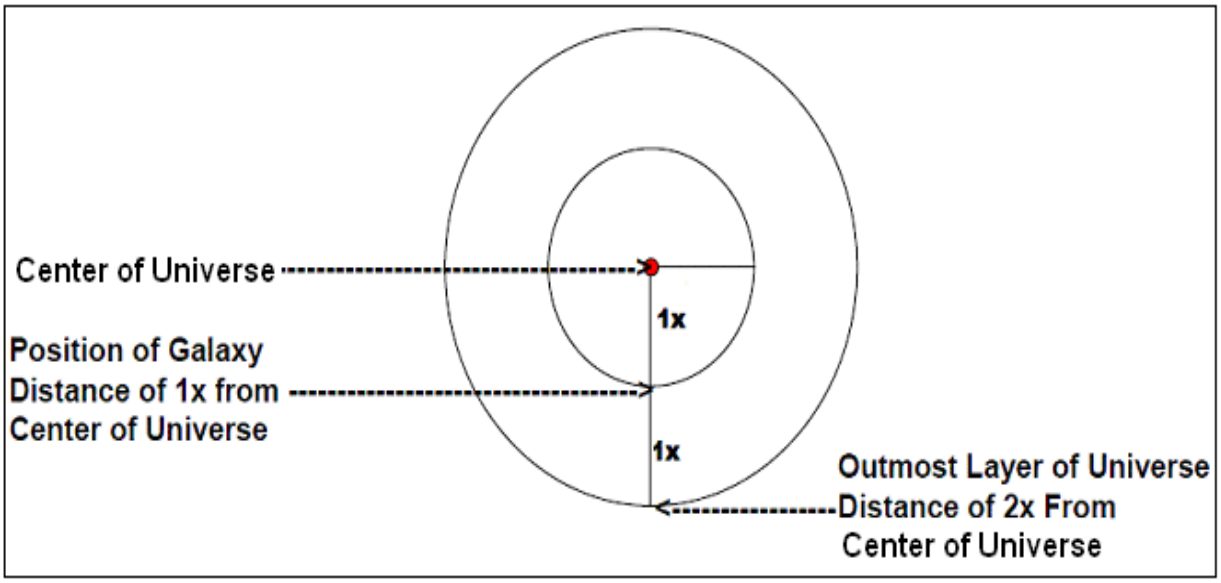
This can be explained with the help of following FIGUREs:

FIGURE A

UNIVERSE AT THE TIME OF BIG BANG

FIGURE A represents Universe at the time of big bang.

FIGURE B

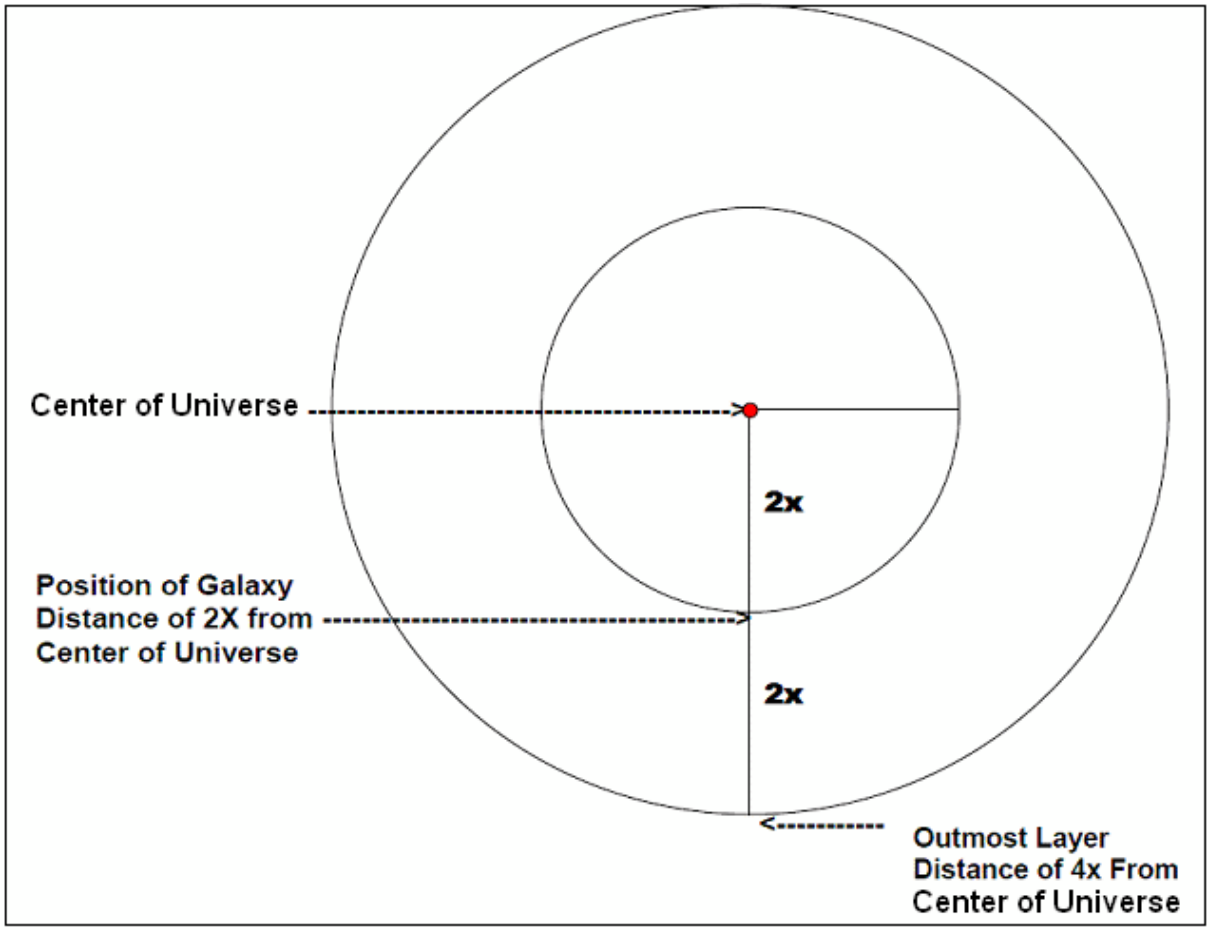


UNIVERSE AFTER LAPSE OF TIME T

FIGURE B represent Universe after lapse of time T where universe is expanding at the rate of 2x per time of T (at this point to keep things simple we will not assign value to x and T). Our galaxy which is lying at mid point of 'center of universe' and 'outmost layer of universe' would have moved x on account of expansion of universe by 2x.

Let us have FIGURE showing position at the time of 2T.

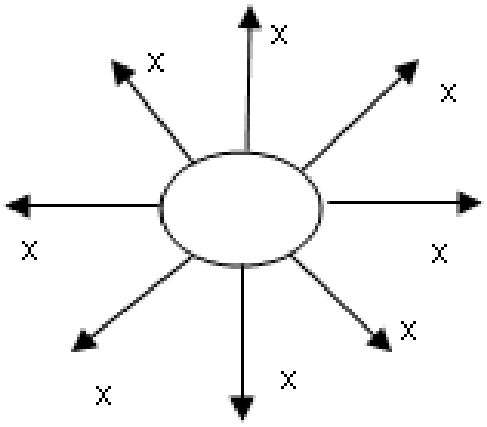
FIGURE C



UNIVERSE AFTER LAPSE OF TIME 2T

As shown in FIGURE 'C' universe would have been expanded to 4x and position of our galaxy would be at 2x. Thus universe is expanded ('stretched') at the rate of x per T on both sides of our galaxy i.e. side which is towards 'center of universe' as well as side which is towards 'outmost layer of universe'. When we apply this to sphere (like rubber ball) it can be analyzed that universe would have stretched at the rate of x in all directions with respect to galaxy as shown in FIGURE 'D'

FIGURE D



EXPANSION OF UNIVERSE WITH RESPECT TO GALAXY

B. Implication of Universe Expansion on Speed of Light and Speed of Gravitational Force

On account of this expansion (stretching), light photon which does not have any intrinsic mass moves along with universe expansion in all directions. Other objects including us, which have basic mass remain attached to galaxy on account of gravitational force and hence do not move along with universe expansion in the manner light photon moves.

As explained above, x is the speed at which universe is expanding in all directions with respect to galaxy, which we measure as speed of light, which is 299,792 km/s. As can be seen from above FIGUREs, location of our galaxy changed from x to 2x per T. Therefore our galaxy is also moving at the speed of x per T, which is approximately 299,792 km/s. As explained later in Section 4 B, gravitational force of our galaxy also moves with our galaxy at the same speed as speed of our galaxy. Thus we observe speed of light and speed of gravitational force as same.

3. EVIDENCES SUPPORTING SHAPE OF UNIVERSE EXPANSION AND LOCATION OF MILKY WAY GALAXY IN UNIVERSE

In the above section, we made following propositions regarding Shape of Universe Expansion, Location of our Galaxy and Speed of our galaxy:

1. Universe is expanding in shape of Sphere
2. Our Galaxy is located at mid-point of center of universe and outmost layer of universe
3. Our Galaxy is moving at speed of approximately 299,792 km/s on account of universe expansion.

In this section we will evaluate evidences supporting Shape of Universe expansion and location of our galaxy at mid-point of center of universe and outmost layer of universe. In the following section we will evaluate evidences supporting speed of our galaxy.

There are two strong evidences to suggest that universe is expanding in sphere (like rubber ball) and our galaxy is at mid point of center of universe and outmost layer of universe.

A. Hubble's constant

In the years following proof of existence of other galaxies, Hubble spent his time cataloging their distances and observing their spectra. At that time most people expected the galaxies to be moving around randomly, and so expected to find as many blue-shifted spectra as red-shifted ones. It was quite a surprise, therefore, to find that most of galaxies appeared red-shifted: nearly all were moving away from our galaxy! More surprising still was the finding that Hubble published in 1929: even the size of a galaxy's red shift is not random, but it is directly proportional to the galaxy's distance from our galaxy. Or, in other words, the farther a galaxy is, the faster is moving

away! **[2]**

Value of Hubble constant being directly proportional to the galaxy's distance from our galaxy reinforce our understanding that universe is expanding in sphere (like shape of rubber ball) and our galaxy is at mid point of 'center of universe' and 'outmost layer of universe' otherwise value of Hubble's constant could not have been constant (i.e uniform). This is only possible in structure like sphere where our galaxy is at midpoint of 'center of sphere' and 'outmost layer of sphere'. Refer FIGURE B (Universe after lapse of time T) and FIGURE C (Universe after lapse of time 2T) shown above, speed at which any point (galaxy) is moving away from our galaxy is directly proportional to the distance of that point (galaxy) to our galaxy.

Refer FIGURES B and C. Distance between our Galaxy and Galaxies which are located near center of universe / outmost layer of universe is x as per figure B. The distance increased to 2x in figure C i.e. Those Galaxies moved away from our galaxy at the rate of x per t. Distance between our Galaxy and Galaxies which were at half distance compared to above is ½ x as per figure B. The distance increased to x in figure C. Thus, those galaxies moved away from our galaxy at the rate of ½ x per t compared to increase in distance of x per t in previous case. Thus, as noted by Hubble and stated in first paragraph Galaxy's red-shift is directly proportional to the galaxy's distance from our galaxy.

B. Cosmic Microwave Background Radiation (CMBR)

Cosmic background radiation is well explained as radiation left over from an early stage in the development of the universe, and its discovery is considered a landmark test of the Big Bang model of the universe. With a traditional optical telescope, the space between stars and galaxies (the background) is completely dark. However, a sufficiently sensitive radio telescope shows a faint background glow, almost exactly the same in all directions, that is not associated with any star, galaxy, or other object. **[3]** The CMB temperature on the sky is remarkably uniform. At the level of 1 part in 1000, the CMB temperature varies.

Both Hubble's constant and CMBR strongly support that universe is expanding in sphere (like rubber ball) and our galaxy is at mid point of center of sphere (universe) and outmost layer of universe. If universe was not expanding like sphere and our galaxy would not have been at mid-point of center of sphere (universe) and outmost layer of universe, these would not have been possible.

4. EVIDENCES SUPPORTING SPEED OF OUR GALAXY

As stated above our Galaxy is moving away from center of universe at the speed of approximately 299,792 km/s. Let us study evidences we have supporting speed of our galaxy.

A. Measuring speed of our Galaxy through Hubble's constant

Hubble's constant gives us rate at which other galaxies are receding from our galaxy. We can use this data point to calculate rate at which center of universe is receding from our galaxy i.e. speed of our galaxy in universe.

Presently Hubble's constant value is estimated to be about 70 kms-1 Mpc-1 **[4].** It is stated that distance of our galaxy from center of universe is equal to 1.40 x 1010 light years or about fourteen thousand million light years. Therefore velocity of recession (i.e. speed of our galaxy) from center of universe is given by

Velocity of recession (v) = Hubble constant (H) x distance (r) **[5]**

$$v = \frac{70\ km/s}{1\ Mpc} * 1.4 * 10^{10}\ light\ years$$

We are aware that 1Mpc = 3,260,000 light-years **[6]**

Replacing value of 1 Mpc in above equation we get

$$v - \frac{70\ km/s}{3{,}260{,}000\ light\ years} * 1.4 * 10^{10}\ light\ years$$

v = 70 km /s * 4294.48

v = 300,613.6 km/s

This shows that velocity of recession of our galaxy (i.e speed of our Galaxy) from center of universe is 300,613.6 km/s. This is approximately the same speed as we stated speed of our galaxy above. **(Refer Section 2 B)**. It may be noted that Hubble's constant is approximate number and hence it may

not give exact number.

B. Speed of gravitational force

As stated by 'Theory of General Relativity' the speed of gravitational waves is equal to the speed of light in vacuum **[7].** Gravity is curvature in space. Speed of this curvature should be related to the speed of object ('galaxy') which is causing this curvature. Imagine a heavy ball rolling on rubber mattress. Curvature caused by this ball on rubber mattress is similar to gravity. Speed of the curvature caused by this ball is exactly equal to speed of ball. If ball moves at the speed of 1 km/s then curvature also will move alongwith ball at the same speed. Similarly speed of gravitational waves is equal to speed of our galaxy.

As stated above, Milky Way galaxy moves at speed of approximately 299,792 km/s on account of universe expansion. Curvature caused by Milk Way also moves at the same speed alongwith Milky Way Galaxy.

To analyze this further let us have a case where a particular galaxy is moving at speed of 100,000 km/s then speed of curvature ('gravity') caused by that Galaxy would be 100,000 km/s. If speed of gravitational wave is not 100,000 km/s but is equal to speed of light i.e. 299,792 km/s then it may lead to situation where galaxy is at one location in universe while curvature caused by that galaxy (gravity) is at different location in Universe which can not be possible. Speed of Gravitational force of our Galaxy which equal to speed of light gives us strong evidence that our galaxy is moving at speed of approximately 299,792 km/s in universe.

C. Energy generated by stars of Milky Way galaxy

In later part (Refer Section 7) we will analyse how c in equation $E = mc^2$, refers to the speed of object ('stars') and energy released is in line with kinetic energy formula where energy is related mass of object(M) and velocity of object(v) $E = Mv^2$.

5. REVIEW OF EXISTING THEORIES (THEORY OF SPECIAL RELATIVITY AND THEORY OF GENERAL RELATIVITY) AND EVIDENCES SUGGESTING WHY THESE THEORIES DO NOT REFLECT CORRECT PICTURE

Two fundamental postulates of Theory of Special Relativity and Theory of General Relativity are

1. Nothing can travel faster than light
2. Time is relative and depends on speed of object

Following evidences/ analysis suggest that these do not reflect correct picture.

A. Time which is measured based independent source will remain universal for all observers irrespective of speed of observers:

To understand this let us have a case of three observers, A, B and C. A – who is staying in New York city and not moving i.e. speed of zero. B – who is traveling in a train which is moving around New York city at 10% of speed of light and C – who is traveling in a space rocket with a speed of 10% of speed of light i.e. same speed as speed of B. Day/ year for A and B, who both are in New York city will be same, Earth's orbital speed will not change for B even if B is traveling at 10% of speed of light. Earth will complete one Day/ Year in same time for A and B. Thus planetary time will run universally for A and B.

Now let us analyze what will happen to C. If time depends upon speed of observer than time will be same for B and C as both B and C are traveling at the same speed that is 10% of speed of light. As explained above, planetary time for B is same as planetary time for A, which means planetary time for A and C is also same. Thus time which is measured based on independent source is universal for all observers irrespective of speed of observers.

To understand this further let us have one more analysis. We know that since ancient time, time is measured based on movement with respect to SUN. Let us have a case of two observers A and B who assemble at centre of New York City. It is obvious that both observers will see SUN at same angle. Post that A decides to sit at that location i.e. speed of zero while B takes train which is rotating that place at speed of 10% of speed of light. Once SUN is exactly overhead at that location B stops and sits besides A. Now at that point both A and B will observe SUN at same location even though B in the interim period has traveled at the speed of 10% of speed of light. If both A and B observe SUN at same location at the time of start of experiment and at the end of experiment despite A not moving while B moving in the interim period at 10% of speed of light, can we say that time is relative and depends on speed of observer? Answer is obviously no. Planetary time runs universally for all observers irrespective of speed of observers.

B. Gravitational Time Dilation argument in support of theory of General Relativity

Following argument is given in support of Theory of General

Relativity 'There are identical atomic clocks at the Royal Observatory in Greenwich England and the National Bureau of standards in Boulder Colorado. The one in Greenwich England ticks 5 microseconds / year slower than the one in Boulder Colorado which is predicted by General Relativity given their one mile difference in altitude. The clocks are accurate to 1 microsecond / year so the difference cannot be a result of error.' **[8]**

However, since years duration of day / year remains same at both locations. If this is the case, can we say that time runs differently at both locations? or time runs slower near high gravitational field? The answer as explained in Section 6 D is when gravitational mass increases speed of clock slows down on account of increase in mass. However, it may be noted that the slower movement would be applicable for that clock only. This will not have any impact on time which is measured based on independent source.

C. OPERA Experiment which later confirmed that neutrinos did not travel at speed exceeding speed of light

Although this argument is given in support of 'Theory of Special Relativity', if we carefully analyze above experiment we can make out that fundamental postulates of Theory of General Relativity and Theory of Special Relativity cannot be true. Let us understand this in detail.

We are aware that speed of light is 299,792 km/s. Imagine a particular object (object O) is moving at 99% of speed of light. Therefore speed of object O would be 299,792 km/s * 99% which is 296,794 km/s. If object O starts its journey from point P1 at speed of 296,794 km/s, after one second object O would be at distance of 296,794 kms from point P1, we will refer this as point P2.

If time is relative and depends on speed of object as stated by 'Theory of Special Relativity' then clock which is at rest (speed of zero) will measure different time. We will denote such clock as clock (at rest). Let us calculate time which would be measured by clock (at rest) when Object O traveled from point P1 to point P2 i.e. distance of 296,764 km.

Formula for time dilation as per 'Theory of Special Relativity' is given by

$t = t_0 / (1-v2/c2)\ 1/2$ [9]

where: t = time observed in the other reference frame

t_0 = time in observers own frame of reference

v = the speed of the moving object

c = the speed of light in a vacuum

In our example, v = 0.99c, t_0 = 1 second

We will solve this for t which will give us time observed by clock (at rest)

$t = 1/(1- (0.99c)2/c2)1/2$

$t = 1/(1- 0.992)1/2$

$t = 1/ .141067$

t = 7 seconds (approximately)

Therefore, as per clock (at rest) object O travelled distance of 296,764 kms in 7 seconds i.e. at a speed of 42,399 km /s (296,794 kms / 7 seconds).

Thus, as per 'Theory of Special Relativity' different observers who are travelling at different speed will measure different speed. In above case, clock (at rest) will measure speed of 42,399 km/s as speed of object which is travelling at speed of 296,794 km/s (i.e. 99% of speed of light). In other words if clock (at rest) measures speed of more than 42,399 km/s then actually the object is travelling more than 99% of speed of light.

In OPERA experiment clock (at rest) measured that neutrinos travelled at the speed of light i.e. at speed of 299,792 km/s. Clock measuring neutrino's speed were not moving (clock at rest). If clock (at rest) measured speed of neutrino same as speed of light then neutrino's clock should have measured lower time since neutrinos were travelling at high speed. In the above experiment clock (at rest) measured that neutrinos traveled distance of 731.278 kms in 0.00243928457 seconds i.e. speed of 299,792 km/s [10].

Let us compute in this case how much time which would have been measured as per neutrinos' clock.

$t = t_0 / (1-v2/c2)\ 1/2$

$0.00243928457 = t_0 / (1- (0.9999c)2/c2)\ 1/2$(note 1)

$0.00243928457 = t_0 /(1- .99992)1/2$

$0.00243928457 = t_0 / 0.01414$

$t_0 = 0.00003449$

Thus, as per neutrino's clock neutrino traveled distance of 731.278 km in 0.00003449 seconds, i.e speed of 21,202,609.45 km /s which is far exceeding speed of light, if time is relative as stated by 'Theory of Special Relativity'.

(note 1) It is assumed that neutrinos travelled at speed of 99.99% of speed of light and not at 100% of speed of light, else as per postulates of theory of special relativity time would be zero and speed would be infinite which can not be true in any case.

Let us analysis two fundamental postulates of Theory of Special / General Relativity

1. Nothing can travel faster than light
2. Time is relative and depends on speed of object

In above case, if time is relative and depend on speed of object then actually neutrinos travelled at speed of 21,202,609.45 km /s which is far exceeding speed of light which cannot be true since as per Theory of Relativity nothing can travel faster than light. Thus, it can be analyzed that either of postulate is not true.

It can be argued that relativity of time and hence speed should be applicable for light also and hence if measured from light's clock, light also would have travelled at very high speed, however, Theory of Relativity mentions that speed of light remains uniform for all observers irrespective of speed of observer. In fact, this is one of the basic proposition on which Theory of Special Relativity and Theory of General Relativity are based.

D. Analysis suggesting time is not relative in Universe

If time is relative as stated by Theory of Relativity then speed also becomes relative since speed is nothing but distance travelled / time.

As a consequence of universe expansion all galaxies are moving away from center of universe (i.e. location of big bang). Say if particular galaxy is moving at speed of 99.99% of speed of light and if time is related to speed of object then time for object (galaxy) moving at such high speed should slow down. One of the consequences of time, on account of universe expansion is, galaxy should move away from the 'center of universe' with elapse of time, but if time is relative, time should slow down at such high speed and hence galaxy should move away from 'center of universe' at slow speed. Both these i.e. time getting slower on account of high speed of galaxy and simultaneously galaxy moving at slow speed on account of time running relatively slower are contradictory.

To understand this further let us have case of Galaxy G which is moving away from center of universe at speed of 299,792 km / second (i.e. same speed as speed of light) and observer C who is at center of universe. After one second Galaxy should be at distance of 299,792 kms from center of universe. As per Theory of Relativity time should stop for galaxy which is travelling at speed of light. Therefore, Galaxy G should be at the same location since even one second has not been elapsed for Galaxy G. Observer C after lapse of one second should see Galaxy G at same location since time has stopped for Galaxy G. Hence according to observer C speed of Galaxy is actually zero since even after one second for Observer C, Galaxy G has remained at the same location. Both these i.e. time getting slower on account of high speed of galaxy and simultaneously galaxy moving at slow speed on account of time running relatively slower are contradictory and cannot be true.

It is observed that some galaxies are moving away from our galaxy at speed of light. If these galaxies are moving away from our galaxy at speed of light there is no reason to believe that some of these galaxies might have been moving away from center of universe at speed of light or higher than speed of light. As explained above, if time is relative then time should stop when speed of galaxy equals speed of light. Consequently, galaxy should stay at the same location, but if Galaxy remains at the same location then speed slows down to zero since speed is nothing but distance travelled / time. Both these i.e. time getting slower on account of high speed of galaxy and simultaneously galaxy moving at slow speed on account of time running relatively slower are contradictory and can not be true.

The above analysis / evidences suggests postulates of Theory of Special Relativity / Theory of General Relativity are not correct.

6. UNDERSTANDING FUNDAMENTAL PROPOSTIONS

Following propositions have always posed challenges and couple of theories (including Theory of Special Relativity and Theory of General Relativity) were developed explaining these propositions. Let us understand each of these propositions:

A. Speed of light remains constant irrespective of speed of observer

As explained above, presently universe is expanding approximately at the rate of 2x (599,584kms) per T (second).

Milky Way galaxy on account of universe expansion moves approximately at the rate of 299,792 km/s. Further universe around our galaxy expands at the rate of 299,792 km/s in all directions. As a result, light moves in all directions at the speed of 299,792 km/s. Speed of universe expansion with respect to galaxy would be same irrespective of speed of observer therefore speed of light remains constant irrespective of speed of observer.

To understand this, let us have an experiment where speed of light is measured as light travels from point A to point B. As explained above, on account of universe expansion (stretching), space between points A to B is being stretched at the rate of 299,792 km/s. All objects including us, which have basic mass remain attached to galaxy on account of gravitational force and hence do not move along with universe expansion. However, light photons which do not have intrinsic mass moves along with this expansion(stretching) at the same rate. As a result, rate of universe expansion with respect to galaxy would be measured as speed of light irrespective of speed of point A and / or point B.

B. Speed of light does not depend on speed of source of light

We are aware speed of light in vacuum is 299,792 km/s. If any object is moving at speed of say 100 km/s then speed of light emitting from object remains at 299,792 km/s and does not increase or decrease depending on direction to 299,892 km/s or 299,692 km/s respectively. Let us understand reason for the same.

When we say that an object is moving, actually mass of that object is moving. Light photon does not have intrinsic mass. A particle which is not having intrinsic mass will not carry attributes (such as speed) of object which are related to mass. To understand this, say if mass object is wet, light photon emitting from that object will not be wet. If mass has a particular odor, massless particle (light photon) will not carry that odor (odor is spread through air which has mass and not through light photon). In case of color also there is contrast in attribute between object and light photon emitting from the object. Wavelength of color which is not absorbed by object ('mass') is seen as color of the object. In the same manner, massless light photons do not carry speed attribute of mass. In fact none of the attribute of mass like (shape, taste, vibration, color, odor, etc) would be carried by massless light photon. Accordingly speed of light does not depend on speed of source of light.

C. Dual Characteristics of Light Photons

A mystery surrounding light in nineteenth century was whether light is particle or wave. Now it is settled that light has dual characteristics i.e both particle and wave. Let us understand why dual characteristics. Light is made up of large number of photons. A I-watt night light emits a billion billion each seconds. These photons move alongwith universe expansion in all directions. This explains dual character of light which are particle and move as wave alongwith universe expansion in all directions.

D. Reason behind Time Dilatation at higher speed and Gravitational Time Dilatation

With increase in speed of clock, gravitational mass of clock increases, resulting in relatively slower movements of clock. However, it may be noted that the slower movement would be applicable for that clock only. This will not have any impact on time which is measured based on independent source.

The phenomenon is same as with increase in weight more energy is required to achieve same speed. However, if energy is kept constant than speed slows down. This can be explained with the help of following example. Say if two motors – motor A and motor B are running at speed of 50 kms per hour. If weight of motor A is increased while keeping other factors constant, speed of motor A slows down compared to speed of motor B. Similarly, in case of two clocks, clock A and clock B, when mass of clock A is increased, speed of clock A slows down.

To analyse this further let us have a case where we are measuring time based on a traditional clock which has minute arm and hour arm. Mechanics of clock is built such that at set interval particular energy moves minute arm and hour arm. If mass of clock is increased then obviously energy falls short and accordingly speed of clock slows down. Similarly in atomic clock due to increase in mass speed of oscillation slows down. However, it cannot be construed as time slows down.

The same effect is also observed near high gravitational field where on account of increase in gravitational mass, speed of clock slows down; however, as explained in Section 5A this will not have any impact on time which is measured based on independent source. Therefore, time at the top of mountain will be same as at bottom of mountain even though speed of clock may slow down at bottom of mountain on account of increase in gravitational mass. If we measure time at both locations based on solar clock, time will exactly be the same. Day / Year would be same at both locations and will not differ even by fraction of second although speed of clock at

respective location may differ on account of change in gravitational mass.

7. UNDERSTANDING E = mc^2 AND EVALUATING WHETHER ENERGY GENERATED IS ON ACCOUNT OF E = Mv^2 OR ON ACCOUNT OF E = mc^2

A. Implication of Universe Expansion on Energy Generation

As explained in Section 2B, our galaxy is moving on account of universe expansion at the rate of approximately 299,792 km /s (v). Kinetic Energy is related to mass (M) and velocity of mass (v). Mass requires energy to attain velocity. Therefore when mass is released as energy, energy generated is related to mass (M) and velocity of mass (v). This is in line with law of conservation of energy which states that the total amount of energy in an isolated system remains constant over time. If energy generated is not related to velocity of mass (v) but to speed of light (c), then the above law can not be complied with. Thus above equation needs to be changed to E = Mv^2 where v is velocity of mass. It may be noted that result would be same since as explained above masses (our galaxy) on account of universe expansion are moving at speed of approximately 299,792 km/s.

If we read carefully the way E = mc^2 is derived we can make out E refers to Energy of light photon and m refer to mass of light and not mass of object in E = mc^2. Therefore E = mc^2 is nothing but E = Mv^2 this is explained further in **Section 7 B**.

B. E = mc^2 is nothing but kinetic energy formula

(i) Deriving Kinetic energy formula

Let us derive formula for kinetic energy

We know that Force = Mass * Acceleration [11] (Newton's Second Law)

$$F = M * A$$

Where F represents net force, M = Mass of object and
A = Acceleration which is Velocity (v) / time (t) i.e. A = v / t

We know that, Distance (D) is velocity (v) * time (t) i.e. D = v * t

Kinetic Energy is force multiplied by distance, therefore,

$$\text{Kinetic Energy (E)} = F * D$$

E = M *A * D (since F = M * A as stated above)

Therefore, **UNDERSTANDING E =**

E = M * v / t * vt (replacing value of a and d stated above)

$$E = M * v^2$$

(ii) Why E = Mv^2 and not ½ Mv^2

A question may arise that formula for kinetic energy is ½ Mv^2 and not Mv^2. Let us understand why in this case Mv^2 and not ½ Mv^2. Kinetic energy formula of ½ Mv^2 is arrived based on average velocity, that is, velocity starting with zero and velocity reaching its peak and thus average velocity is ½. Thus value of D in such case is ½ * v * t. However in this case, velocity of our galaxy continues to be same i.e. approximately 299,792 km/s and hence average velocity is also v and not ½ v. Hence in this case kinetic energy equation would be Mv^2.

(iii) Test for E = Mv^2 and not E = mc^2

Energy generated by star is related to E = Mv2 where v is speed of object ('galaxy'). As explained above speed ('velocity') of galaxy is related to rate at which universe is expanding and position of galaxy with respect to 'center of universe' and 'outmost layer of universe'. Velocity of stars located near center of universe should be low since their position is near the center (Refer Figure B and Figure C as shown above), conversely, velocity of stars which are located near outmost layer of universe should be high in fact it would be approximately 599,584 km/s (i.e. 2x as explained in Section 2) and hence energy generated in such case also should be higher.

However, presently we do not have much data point by which we can conclude the proposition that energy generated is different for different galaxies based on velocity of galaxy. May be in future when we have data pertaining to rate of energy generated by stars from different galaxies we will actually be able to confirm that actually energy generated is on account of E = Mv^2 and not on account of E = mc^2.

C. Analyzing how E = mc^2 was derived

If we read carefully the way $E = mc^2$ is derived we can make out that E refers to Energy of light photon and m refers to mass of light and not mass of object in $E = mc^2$. Therefore,

E (Energy of light photon) = m (mass of light) * c^2 (where c is speed of light)

Now replacing light with an object in above equation we have

E (Energy of object) = M (mass of object) * v^2 (where v is speed of object)

Thus, $E = mc^2$ is nothing but equation of kinetic energy which is

E (Energy of object) = M (mass of object) * v^2 (where v is velocity of object)

I am listing below in *italics* derivation of $E = mc^2$ as given by Einstein based on stationary box example (Reference http://www.adamauton.com/warp/emc2.html) [12]

'First, imagine a stationary box floating in deep space. Inside the box, a photon is emitted and travels from the left towards the right. Since the momentum of the system must be conserved, the box must recoils to the left as the photon is emitted. At some later time, the photon collides with the other side of the box, transferring all of its momentum to the box. The total momentum of the system is conserved, so the impact causes the box to stop moving.

Unfortunately, there is a problem. Since no external forces are acting on this system, the centre of mass must stay in the same location. However, the box has moved. How can the movement of the box be reconciled with the centre of mass of the system remaining fixed?

There must be a 'mass equivalent' to the energy of the photon. In other words, the energy of the photon must be equivalent to a mass moving from left to right in the box. Furthermore, the mass must be large enough so that the system centre of mass remains stationary.

For the momentum of photon, we will use Maxwell's expression for the momentum of an electromagnetic wave having a given energy. If the energy of the photon is E and the speed of light is c, then the momentum of the photon is given by:

$$p_{photon} = \frac{E}{c} \qquad (1.1)$$

The box, of mass M, will recoil slowly in the opposite direction to the photon with speed v. The momentum of the box is:

$$p_{box} = Mv \qquad (1.2)$$

The photon will take a short time, Δt, to reach the other side of the box. In this time, the box will have moved a small distance, Δx. The speed of the box is therefore given by

$$v = \frac{\Delta x}{\Delta t} \qquad (1.3)$$

By the conservation of momentum, we have

$$M\frac{\Delta x}{\Delta t} = \frac{E}{c} \qquad (1.4)$$

If the box is of length L, then the time it takes for the photon to reach the other side of the box is given by:

$$\Delta t = \frac{L}{c} \qquad (1.5)$$

Substituting into the conservation of momentum equation (1.4) and rearranging:

$$M\Delta x = \frac{EL}{c^2} \qquad (1.6)$$

Now suppose for the time being that the photon has some mass, which we denote by m. In this case the centre of mass of the whole system can be calculated. If the box has position x1 and the photon has position x2, then the centre of mass for the whole system is:

$$\overline{x} = \frac{Mx_1 + mx_2}{M + m} \qquad (1.7)$$

We require that the centre of mass of the whole system does not change. Therefore, the centre of mass at the start of the experiment must be the same as the end of the experiment. Mathematically:

$$\frac{Mx_1 + mx_2}{M + m} = \frac{M\left(x_1 - \Delta x\right) + mL}{M + m} \qquad (1.8)$$

The photon starts at the left of the box, i.e. x2 = 0. So, by rearranging and simplifying the above equation, we get:

$$mL = M\Delta x \quad (1.9)$$

Substituting (1.4) into (1.9) gives:

$$mL = \frac{EL}{c^2} \quad (1.10)$$

Rearranging gives the final equation:

$$E = mc^2$$

Now see the two lines highlighted above in BOLD 'If the energy of photon is E' and 'now suppose for the time being that the photon has some mass, which we denote by m'.

Thus E refers to Energy of light photon and m denotes mass of light in $E = mc^2$. Therefore equation can be explained as below:

E (Energy of light) = m (mass of light) * c^2 (where c is speed of light)

Now replacing light with an object in above equation we have

E (Energy of object) = M (mass of object) * v^2 (where v is speed of object)

Thus, $E = mc^2$ is nothing but equation of kinetic energy which is

Energy of object = M (mass of object) * v^2 (where v is velocity of object)

D. Analysing components of $E = mc^2$

i. Analysing m in $E = mc^2$

As explained above m in $E = mc^2$ refers to mass of light and not mass of object. To analyse further let us have a case where we have two objects M1 (large mass) and M2 (small mass) if energy generated is related to mass of light and not mass of object then when mass is released as energy, energy generated by M1 and M2 should be equal since m in $E = mc^2$ refers to mass of light and not mass of object. However, it is known fact that when large mass is released as energy, energy generated is higher compared to small mass.

ii. Analysing c in $E = mc^2$

To analyse c in $E = mc^2$ let us have case of two objects, object A (with velocity of 10% of speed of light and object B with velocity zero. If energy generated is as per $E = mc^2$ then in both cases energy generated should be equal since $E = mc^2$ states that energy generated is related to mass of light and speed of light, irrespective of velocity of object. If energy generated for object A and object B is same despite velocity of object A being higher then where does extra energy on account of velocity of 10% of speed of light go to? In this case it may be argued that with increase in velocity gravitational mass increases and hence actually object A would generate higher energy, however, in above para we analysed that m in $E = mc^2$ does not refer to mass of object but actually it refers to mass of light.

The above analysis suggests that actually energy released is on account of $E = Mv^2$ and on account of velocity of our galaxy and not on account of speed of light.

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