We Always Travel at a Constant Speed – at the Speed of Light \( C \)

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Abstract. In 1915, Albert Einstein postulated the theory of general relativity which is the updated and modified version of the theory of Special Relativity (postulated in 1905) to incorporate the gravity. Although the theory of general relativity is one of the pioneering theory in the theoretical physics, but unfortunately it can only describe macrocosm of the Universe without any proper link to the microcosm of the Universe in regard of the properties of space-time. Although the great pioneering theory can measure the macroscopic universe reasonably with great accuracy, but the “true or real nature” of the space – time is still remarkably vague to till date. In this paper, I will show why space and time are mutually independent, why space and time both are constants and why we always travel at a constant speed – at the speed of light \( C \).

1. Introduction
Like many European physicist, Albert Einstein was actually a phenomenological physicist in his early career influenced by Austrian physicist and philosopher Ernst W.J.W. Mach [1]. From the phenomenological point of view, there is never an antithesis, it is because, there is no contraposition [2]. From the phenomenological point of view, it represents a reduced version of all – inclusive reality [3], like for example, a sphere can represent the whole universe, thus a sphere is the reduced version of reality of the Universe [4]. Natural phenomena can be visible or invisible [5]. Natural phenomena themselves create their own reality and natural phenomena interact with themselves mutually but we can never prove that phenomena that created the reality are not created by the universe itself [6]. No matter how much successful the theory of general relativity is, but it failed to reveal the in – detail phenomena of space – time [7]. Although the theory of general relativity has created the phenomenological model – ‘space – time’ but the true nature of ‘empty space’, relation of matter with gravity is still somewhat obscure to till date [8]. To counterattack the intrigues of the space – time, he introduced the so called “eather” concept to avoid the opinion that space – time is fabric or not [9].

2. The space – time
The space – time does not have any tangible structure [9]. The properties of space – time are actually depending on the phenomena of the space – time. The big questions are – does space – time have structure like fabric? Or can we expand space – time? The answers are really critical because, the space – time does not have any significant property on its own. Probably that is why, Einstein had frustrated admission that without any phenomena, the theory of relativity does not exist. The ‘space – time’ is at the bottom of reality because it is very hard to think about something which is more than just space and time individually. From observer point of view like human being, space is an abstract idea of an endless volume and time is an everlasting endless change of observable properties within
the endless volume. So, it is not just an abstract idea that space – time is way more than what the theory described.

3. The change and the time

Figure 1 shows an imaginary change of positions of a sphere from point \( A \) to point \( B \) for a distance \( d \). It is something surely we can observe and can detect. Without the transfer of the sphere, there are no other observable changes in the event only if space – time does not have any structure. But if the space – time has definite structure, we need to define the relation between the structure of space – time and the sphere. But if the structure itself transferred from point \( A \) to point \( B \), then there is no observable change occurred of the sphere. If we move two spheres in different directions at the same time, then there must be an internal change in the structure of space – time. It implies that the change in the internal structure of space – time must be at rest with respect to the transfer of sphere from point \( A \) to point \( B \). In 1905, Albert Einstein postulated the theory of special relativity where he proved that the speed of light is a constant \( c \) and it is independent of the movement of the source of light. This is only possible only if the electromagnetic waves are the creations of the underlying structure of the space – time. Because the structure is in rest with respect to the phenomena in the universe, thus, every change in the internal structure of the space – time must be at the speed of light \( c \). Thus, the speed of light is constant is the internal property of the underlying structure of the space – time. Now, any changes in the space – time we call it energy. According to Max Plank, the amount of change is a quantization, the Plank’s constant. If internal change of space – time is a constant, it is difficult to accept that any local variation is not a constant. Thus, Plank’s constant is the result of the internal change of the space – time that changes at the same rate everywhere in the Universe. Again, if speed of light \( c \) is a constant and smallest amount of change \( h \) in 1 second is also a constant, then time also a constant too. Thus, the change of position of sphere from point \( A \) to point \( B \) is \( d \) at the same constant rate \( c \). The velocity of the change is the speed of light and duration of all changes in the universe is also constant or the multiple of constant (time is a constant – constant duration implies that). If time is constant, velocity is constant, amount of change is constant, space (the quantization of the universe) is also a constant too. The speed of light \( c \) and Plank’s constant \( h \) is experimentally verified, time is constant can be verified from \( c \) and \( h \). Thus space is also a constant. Quantization of the volume of the universe means the universe can be subdivided into smaller divisions that have identical characteristics. That is basically the structure (identical building blocks) of the universe.

In accordance to the Einstein’s Special Theory of relativity, the relationship between rest mass and relativistic mass is [10, 11]–

\[
m_r = \frac{m}{\sqrt{1 - \frac{V^2}{c^2}}}
\]  

Where, \( m_r \) is actually the relativistic mass of any cosmic body having non-zero velocity \( V \)

\( m \) is the rest mass of an cosmic body having no velocity \( V = 0 \).

\( c \) is speed of light, the universal speed limit of the Universe
Equation 1 explains that if the velocity of an astronomical body becomes the velocity of light \( V = C \), then, the relativistic mass \( m_r \) attains infinity. From equation 1, we can subsequently derive, [12, 13] –

\[
m_r^2 = \frac{m^2}{(1 - \frac{V^2}{C^2})}
\]

\[
\left( \frac{m}{m_r} \right)^2 = 1 - \frac{V^2}{C^2}
\]

Given an astronomical body that has a rest mass \( m = \text{Constant}, K \) and the speed of light which is a Universal constant \( C = \text{Universal Constant}, K_U \)

\[
\left( \frac{K}{m_r} \right)^2 = 1 - \frac{V^2}{K_U^2}
\]

\[
\left( \frac{K}{m_r} \right)^2 + \left( \frac{V}{K_U} \right)^2 = 1
\]

Let \( m_r = \text{Variable} \ x \) and \( V = \text{Variable} \ y 

\[
\left( \frac{K}{x} \right)^2 + \left( \frac{y}{K_U} \right)^2 = 1
\]

Let \( K = \text{Constant} \ a \) and \( K_U = \text{Constant} \ b 

\[
\frac{a^2}{x^2} + \frac{y^2}{b^2} = 1
\]

Thus, relativistic mass and velocity of the same particle have very non-linear relationship. And they are related with equation 7. A sufficiently very large rest mass is assumed (like 100000 Kg) to plot the following graphs.

![Graph showing the relationship between relativistic mass and velocity](image)

**Figure 2.** The plot between relativistic mass \( m_r \) of a particle and its velocity is when 30 km/sec
Figure 3. Plot between relativistic mass $m_r$ of a particle and its velocity is when 300 km/sec.

Figure 4. Plot between relativistic mass $m_r$ of a particle and its velocity is when 3000 km/sec.

Figure 5. Plot between relativistic mass $m_r$ of a particle and its velocity is when 30000 km/sec.
The variation in relativistic mass for a big enough astronomical body is shown with variation of its speed. The plot is very nonlinear, shaping like almost growing exponential signal. Thus mass and velocity have a very nonlinear relationship can be approximated as growing exponential signal.

According to the theory of Special Relativity, the relativistic mass can be expressed as derived by Einstein in 1905 is given as [14, 15]–

$$m_r = \frac{m}{\sqrt{1 - \frac{V^2}{C^2}}}$$  \hspace{1cm} (8)

Where, $m_r$ is the relativistic mass of a cosmic body with velocity $V$

$m$ is the rest mass of a cosmic body with velocity $V = 0$

$C$ is speed of light, the universal speed limit of the Universe

Equation 8 tells if the body attains a velocity $V = C$, then, the relativistic mass $m_r$ goes to infinity. From equation 8, we can derive, [16, 17] –

$$m_r^2 = \frac{m^2 C^2}{|C^2 - V^2|}$$  \hspace{1cm} (9)

$$m_r^2 \propto \frac{1}{|C^2 - V^2|}$$  \hspace{1cm} (10)
For a particular body with rest mass constant, \( m = \text{Constant}, K, \)

\[
m_r^2 = \frac{Kc^2}{|c^2 - V^2|}
\]

\( m_r = f(V) \) \hspace{1cm} (11)

If we plot the equation 9,

\( m_r^2 \)

\( m_r \)

\( C < V \)

\( C = V \)

\( C > V \)

\( C^2 - V^2 \)

**Figure 8.** Plot between relativistic mass \( m_r^2 \) and relativistic speed \( |C^2 - V^2| \) with rest mass \( m \) constant

Equation 9 tells, there is actually a breaking point at \( C = V \) where \( m_r \) goes to infinity [5, 6]. After the breaking point, if relativistic velocity increases further beyond \( C \), \( m_r \) will decrease. Because we are unable to solve the breakdown point at \( C = V \), we are unable to go to the future. Thus, time travel at the future is impossible unless we break the breakdown point. If we can attain \( C = V \), then, we can
always remain in present, in other words, time will stop, the clock will be stagnant, we can ever remain in present at $C = V$ [7, 8]. Equation 5 tells, $m_r$ is a function of $V$.

$$t = f(V)$$

$$f(V = C) = 0 (t = 0)$$

$$f(C) = 0$$

(13)

(14)

(15)

If the normalized physical time is 1 (one) at $V = 0$, which is actually the highest possible temporal flow with respect to inertial frame of reference. And if the normalized physical time is 0 (zero) at $V = C$[8, 9], then,

$$t = 0 \text{ at } V = C$$

$$t \neq 0 \text{ at } V \neq C$$

(16)

(17)

So, $|t^2| = 1 - \frac{V^2}{C^2}$

(18)

Equation (18) derived from the figure 9 tells that velocity can never go negative (but the relativistic velocity $|C^2 - V^2|$ can go negative) but the mass (either relative mass or rest mass) cannot go negative. But $|t^2| = \pm t^2$ depending on the physical time is for particle (positive) or for antiparticle (negative).

By putting equation (18) into equation (2), we get,

$$m_r = \frac{m}{\sqrt{|t^2|}}$$

$$m_r = \frac{m}{|t|}$$

(19)

(20)

From equation (20), we get, for constant rest mass $m$

**Figure 10.** Plot between relativistic mass $m_r$ and the physical time $t$ with rest mass $m$ constant

Equation 20 tells that relativistic mass $m_r$ and the physical time $t$ with rest mass $m$ constant have very linear relationship. Also they have a reciprocal relationship. Temporal flow increases when $m_r$ decreases and temporal flow decreases when $m_r$ increases and vice versa. But $m_r$ is infinity when $t$ approaches to zero. That is the reason why, we cannot attain the speed of light. There is a limit of maximum temporal flow can be called $|T_{max}|$ with respect to the frame of reference. When $t = |T_{max}|$
tends to infinity, $m_r$ tends to zero. The physical time is allowed to be positive or negative (past or future), but $m_r$ is always allowed to be positive only.

$$m_r \propto \frac{1}{|t|} \quad (21)$$

$$|t| \propto \frac{1}{m_r} \quad (22)$$

The plot is discontinuous at both $m_r = 0$ and $t = 0$.

4. Topology
The consequence of the identical building blocks of the universe is the property is called invariance. Because the unit structure is invariant, the unit structure must be topological homeomorphism. Only one field in the universe that has topological properties is the electric field that exists all over the universe. The Higgs field also can be found everywhere in the universe, but it is a scalar field and does not have topological property. Thus, Albert Einstein’s curved space – time is related to the electric field only and not the gravitational field. It is because gravity can be manipulated with the beam of light. Thus, gravity does not have topological property. If the general relativity is the measure of electric field, then, it describes the mutual relations among the concentrations of energy – topological transformations within the energy in a geometrical way only.

If the unit change is $h$, then the total change is $Kh$, where $K$ is a constant.

The time dilation is $T_D$

The velocity is $V$

$$T_D = K h V \quad (23)$$

If $V$ is zero, the time dilation is zero, the time is of reference, a constant. If $V$ is non-zero, there is non-zero-time dilation. The time dilation is related to the observer (made of particle or anti-particle) only, otherwise time is always a constant does not matter the object is moving or stationary or type of observer. As the velocity increases, the spatial alterations are such that spatial configurations get reduced so that an observer sees time dilations.

5. Conclusion
The time is constant, the space is constant. The space and time are mutually independent. It is the observer who sees non-linearity in the space – time geometry. Otherwise, everything is linear. Any change is the change at the rate equal to the speed of light. Thus, we move at the speed of light, but we do not recognize it because we are the observer made of particle. To observe a change with rate less than the speed of light is an observer limitation only otherwise the change is at the same rate – the speed of light.

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