Special Relativity sans Lorentz Transformation (OR) Perceptual Relativity

SEBASTIN PATRICK ASOKAN (✉ spasokan@gmail.com)

Independent Researcher

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Special Relativity sans Lorentz Transformation (OR) Perceptual Relativity

Author:

Sebastin Patrick Asokan
Independent Researcher,
Angelica Grace Retirement Home,
Koothur, No 1 Tolgate, Trichy – 621216, India.
E-Mail: spasokan@gmail.com

Abstract:

This paper shows that from the fact that the same Reality is perceived differently by the observers in different inertial frames, we can draw a simple and straightforward explanation for the constancy of light's speed in all inertial frames without any need for bringing in paradoxical Lorentz Transformation. This paper shows that the premise that each inertial frame has its unique time, which Lorentz Transformation introduced to explain the constancy of the speed of light in all inertial frames is incompatible with the interchangeability of the frames, an essential requisite of the First Postulate of the Special Theory of Relativity. This paper also points out the misconceptions regarding the claimed experimental verifications of Lorentz Transformation's predictions in the Hafele–Keating experiment and μ meson experiment. This paper hints at the possibility of attributing the observed slowing down of fast-moving clocks to the Relativistic Variation of Mass with Velocity instead of Time Dilation. This paper concludes that Einstein's Special Theory Relativity can stand on its own merits without Lorentz Transformation.

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Section 1: Introduction

1.1 Relativity of Truths.

Even though “**Objectivity**” is often associated with “**Science**”, the reality is that a human being cannot jump off his status as a part of the whole system and his “**Science**” is limited to the processing by the human brain (endowed with limited memory and logical faculties of induction and deduction) of the tiny part of the Data about the system supplied to his human brain by his senses of perception, limited in number and range. If physicists were among ants, their Quantum Mechanics and General Relativity would be different from ours but serve their interests better.

Everyone's world is his or her perception. Any absolute reality beyond the perceptual realities of the observers seems to be beyond the cognitive limits of human capabilities. But, fortunately for all human beings, though their perceived 'facts' may differ, the laws of Nature connecting one's perceived 'facts' are the same. A stone's trajectory dropped by a passenger in a moving train is a straight line for him, whereas it is a parabola for an observer standing on the platform. Both observers would agree that the same laws of Physics govern the physical realities perceived by them. The First Postulate of Special Relativity succinctly states this fact as follows; "The laws of nature have the same mathematical form in all inertial reference frames" **[1]**. Though the laws are the same, the scenarios of the same reality observed in different inertial frames need not be the same as has been exemplified by the stone's trajectory being a straight line in the train frame and a parabola in the platform frame. This paper is a relook of Special Relativity in the Light of Perceptual Relativity, which means that the same reality is perceived

differently by the observers stationed in different inertial frames. There is no absolute perception of that reality.

1.2 “Event” is more fundamental than “Time”.

As there is no meaning for “**distance**” in an empty world, there is no meaning for “**Time**” in an eventless world. If the whole universe became frozen and static, Time would disappear. If a single change takes place at a point anywhere in the universe, that change is an “event”. The human brain has an intrinsic faculty known as “Memory”, and an event ‘after’ it has happened becomes a memory in the human brain. The human brain is also capable of arranging the events recorded in its memory in chronological order. It is capable of identifying which events have already happened and which events are currently happening. Based on its analysis of the recorded events, the human brain has the logical faculty to anticipate the events that may occur ‘later’. This faculty of the human brain to classify events as “past events”, “present events”, and “future events” correspond to the notions of “the past”, “the present”, and “the future” that constitute the three segments of the Time chain intellectually visualized by the human brain. The human brain can classify past events further as “far past” and “less past”. Thus, the faculty of memory of the human brain supplied necessary inputs to the faculty of the brain's intellect to develop the concept of Time, which, as an intellectual tool, has facilitated tremendous advancements in the process of our pursuit for understanding Nature from our human perspective. As objects are real and the “distance” between two objects is the relation intellectually constructed by the human brain, events are real; the “time interval” between two events is a relation intellectually built by the human brain to understand Nature. Since all human brains think alike, at least in rudimentary matters, it has become possible to build a consensus to take the instant of occurrence of an event, say Christ’s birth, as the

origin of the time scale and the time interval between the two successive instances of a continuously repeating event as the unit of Time.

Section 2: Discussion

This Section of this paper consists of the following five parts, namely-

- I. An explanation for the constancy of the Speed of Light in all inertial frames, based on Perceptual Relativity,**
- II. The Genesis of the absurdity of Lorentz Transformation**
- III. The Concept of Time in Lorentz Transformation**
- IV. Have Experiments confirmed Lorentz Transformation?**
- V. Lorentz Transformation is unnecessary in Special Relativity.**

PART – I

An explanation for the constancy of the Speed of Light in all inertial frames, based on Perceptual Relativity

2.1.1 Basic Premises

The following two premises underline the whole gamut of Physics.

- 1. The Laws of Physics have been discovered and derived from an observer's perspective while that observer rests in an inertial frame of reference.**
- 2. Space is at rest relative to the observer's Frame of reference, and all other inertial frames are moving in that Space.**

The second premise ensures the certainty of measurements of the distances in Space travelled by the moving objects, which is not guaranteed when Space also is moving relative to the observer.

2.1.2 Space is stationary in every Frame.

Space is static in his Frame for any observer, and the other frames move in that Space. Just like there is a common perception of the stationary observers in every Frame that their Frame alone is at rest while all other frames are moving, those observers share another common perception that Space is at rest in their Frame. Since an observer observes that the objects attached to his Frame are at rest and Space is static, he assumes that Space is also linked to his reference frame. This perception implies that any Point in Space can be claimed to be attached to his Frame of reference by any observer regardless of his motion relative to other observers.

Let an observer stationed in an inertial frame, say **S**, places a minuscule material marker **p** at a spatial point to identify that point. An observer stationed in another inertial frame, say **S'**, which moves at a speed **v m/s** relative to the frame **S**, also places a minuscule material marker **q** at another spatial point to identify that point. Let the distance between the markers **p** and **q** be **v meters** at one instant of time. After **1 second**, the two markers would collide. That spatial point of the happening of the event of collision would be the point **p** from the perspective of the observers of the frame **S**; it would be the point **q** from the perspective of the observers of the frame **S'**.

FIGURE 1
The spatial point where the event occurred
Initial scenario

Final scenario from the perspective of the frame S

Final scenario from the perspective of the frame S'

The event of collision of particles **p** and **q** cannot be said to have happened at any particular point in absolute space. For the observers of each frame, the event occurred at a point in Space attached to their frame.

It may be that there are infinite Spaces – each one belonging to one Inertial Frame, or one single Space perceived as being static in his Frame by every observer.

Einstein did not rule out the possibility of an infinite number of Spaces in motion relative to each other. It is evident from the following extract from the book "**Relativity – The Special and the General Theory**," written by him. (Fifteenth Edition Appendix 5 "Relativity and the Problem of Space" –Pigeon - First Indian Edition 2008 – Page 145

[2]):

*"But it must now be remembered that **there is an infinite number of spaces, which are in motion with respect to each other.** The concept of Space as something existing objectively and independent of things belongs to pre-scientific thought, but not so the idea of an infinite number of spaces in motion relatively to each other. This latter idea is indeed logically unavoidable but is far from having played a considerable role even in scientific thought."* (Emphasis supplied).

2.1.3 For any observer, any Light source is at rest in his Frame alone.

Now, let us consider a point anywhere in the entire Space from which Light originates. The spatial location of the Light emitter is the point in Space from where the Light originates. The emitter's speed is immaterial since it is a verified fact that the speed of the emitter is not passed on to the Emitted Light, and hence the Speed of Light is independent of the speed of the emitter. The spatial location of the emitter is, instantaneously, the point in Space from where Light emanates. An observer intending to measure Light's speed has to place a material marker, say **O**, at the Light-Emitter's spatial location to fix Light's starting point. Obviously, that marker will remain stationary in his Frame. An observer in another frame of reference can also place another marker, say **O'**, at the same point, and that marker will remain stationary in that Frame. There will undoubtedly be relative displacement between the two markers after that instant of time. Still, each observer will assume that his marker has remained at the Same point in Space while the other marker has been moving. Thus, every observer can claim that the light source is stationary in and attached to his Frame.

2.1.4 An observer detects Light using a Light Detector that is at rest in his Frame alone.

Any Light Detector, any material object for that matter, is at rest in only one inertial Frame, and it is moving relative to all other frames. The clock of that Light Detector is synchronized with the other clocks attached to its Frame. For any particular instant of time, all the clocks attached to his Frame would show an identical time, whereas, if Lorentz Transformation were true, the clocks attached to any other frame would appear to be non-synchronized, each clock living in a different instant of time. This scenario implies that for measuring the Speed of Light in his Frame, the observer has to use the Light Detector attached to his Frame to ensure recording of correct durations of time according to his Frame. Let alone Lorentz Transformation. since every observer perceives that the light source is stationary in and attached to his Frame (as has been discussed in the previous paragraph), the Light Detector attached to his Frame at a constant distance, say x meters, from the Light Source, would receive the Light signal that had originated from the Light Source x/c seconds before such detection. Since any Light Detector cannot detect any Light Signal that approaches it with speed relating to it being not equal c in violation of the Principle of Constancy of the Speed of Light, it would detect only the Light Signals originating from the Light Sources attached to its Frame. This reality means that the material marker representing the Light Source's spatial point is at rest relative to the Light Detector.

In fine, for any detection of Light by any observer, he has to ensure that both the Light Source and the Light Detector are attached to his Frame of Reference.

2.1.5 For any observer, Light spreads in his Frame alone.

There is an infinite number of inertial frames of reference – each Frame moving with a non-zero velocity relative to any other frame. When a spherical electromagnetic wave propagates with a speed **c** from a Space point in all directions, it spreads in each of the infinite inertial frames of reference. But, for an observer in any one of those frames, his perceived facts are the following:

- 1. The spatial point from which the light wave has started propagating is stationary in and attached to his Frame (i.e., Space itself is attached to his Frame);**
- 2. The light wave propagates in the Space which is attached to his Frame; and**
- 3. His detection of Light Signals is confined to those originating from Light Sources attached to his Frame and reaching the Light Detectors attached to his Frame. The light waves propagating in 'spaces' of other frames, if any, are beyond his perception and hence of no concern to him.**

Suppose the velocity of a moving material particle (i.e., a particle having mass) relative to a frame of reference is known. In that case, to calculate the particle's velocity relative to another frame of reference, we have to use the **Law of Addition of Velocities**. But, in the case of transmission of Light, for any observer, Light spreads only in his Frame, and he is immune from the perception of or any impact from Light Waves, if any, spreading in other frames and hence there is no question of calculating the speed of Light in any different frame relative to him. **Accordingly, the Law of Addition of velocities has no relevance to the Speed of Light.**

2.1.6 What is the Correct Explanation for the Constancy of the Speed of Light in all inertial frames of reference?

Let us visualize two rectangular slabs, **S** and **S'**, resembling Light Clocks with one end fitted with the Light Sources **O** and **O'** and the other end with Light Detectors **D** and **D'** respectively. Let both slabs be of an identical length, say **L**. Let the two slabs rest relative to one another. When the Light travels from the Source to the Detector, it spans the same distance **L** during the same time interval **L/c** in both slabs (**c** is the universal constant of the speed of Light for any observer.) Let the two frames be set in a relatively uniform linear motion along the horizontal axis with a constant relative velocity equal to **v** m/s. Now, the two slabs **S** and **S'** constitute two different inertial frames of reference. The stationary observers in each Frame perceive that their Frame continues to be in the same state of rest, and only the other frame has started moving. From each Frame's stationary observers' perspective, nothing has changed as far as their Frame is concerned, and Light covers the same length **L** of their Slab in the same **L/c** seconds. The perceptions of the observers in the two frames are as follows:

Let a Light pulse starts from the Light Source **O** and the Light Source **O'** simultaneously when the instant of time is counted as **0** in both frames **S** and **S'**. The scenarios from the viewpoint of **S** and **S'** starting from this instant have been depicted below.

- (i) **At the instant when a Light Signal originates from a spatial point where the material markers representing Light Sources O and O' coincide**

FIGURE 2
Light originates from a Light Source.

(a) From the perspective of the Frame S

FIGURE 3
Light reaches the Light Detector attached to Frame S.

- (1) The Light Signal originated from the Light Source **O** when $t = 0$, is detected by the Light Detector **D**.
- (2) While their Frame has been remaining at rest occupying the same part of the **Space**, the Slab of the other frame **S'** has moved in the Space towards the right through a distance vt and occupied a different part of the Space.

They cannot make any observation regarding detection of Light by the Light Detector **D'** attached to a different frame. Any Light Detector attached to the other frame **S'** cannot detect Light originating from Light Source **O** not attached to that Frame.

(ii) **At the instant when a Light Signal reaches the Light Detector**

(b) From the perspective of Frame S'

FIGURE 4
Light reaches the Light Detector attached to Frame S'.

The stationary observers of the Frame **S'** make the following observations, -

- (1) The Light Signal originated from the Light Source **O'** when **t = 0**, is detected by the Light Detector **D'**.
- (2) While their Frame has been remaining at rest, occupying the same part of the **Space**, the Slab of the other Frame **S** has moved in the Space towards left through a distance **vt** and occupied a different part of the Space.

They cannot observe the detection of Light by the Light Detector **D** attached to a different frame. Any Light Detector attached to the other frame **S** cannot detect Light originating from Light Source **O'** not attached to that Frame.

For the static observers in both frames **S** and **S'**, the Light covered the distance **L** during the time interval **t** so that the speed of Light is **L/t**, i.e., **c**. Regardless of relative displacements between Light Sources **O** and **O'** and between Light Detectors **D** and **D'**, both observers would measure Light's Speed to be **c**.

Any Light Detector can detect Light originating from a light source that is at rest in the same Frame in which it is also at rest. It follows that no static observer in an inertial frame detects Light that has originated from a Light Source that is not at rest relative to his Frame. To make this fact amply clear, we may adopt the following statement as the **Third Postulate of the Special Theory of Relativity (STR)** in place of **Lorentz Transformation**.

"The detection of light by an inertial reference frame is an event that is exclusive to that frame."

The above statement implies that the Speed of Light relative to any inertial reference frame cannot be measured by any observer who is not stationary in that Frame. **The Constancy of the Speed of Light measured in all frames of references is due to each observer's perceptions that Space is at rest relative to his Frame of Reference, and the light source and the light Detector are static in his Frame of reference.**

Space is the medium for the transmission of electromagnetic waves. The speed of the propagation of electromagnetic waves relative to Space is **c**, a constant. Since Space is at rest in any inertial frame of reference, the speed of the transmission of electromagnetic waves relative to any inertial frame of reference is also **c**. Thus, we have derived a precise explanation for the Speed of Light's constancy measured in all frames of references without 'torturing' the observers' measuring rods and clocks.

PART – II

The Genesis of the absurdity of Lorentz Transformation

We shall follow the convention that **x** and **t** denote the space and time intervals between two events respectively from the perspective of an inertial frame of reference, say **S**; and, **x'** and **t'** denote the space and time intervals between the same two events respectively from the perspective of another inertial frame of reference, say **S'** moving with a uniform velocity **v** relative to the frame **S** along the X-Axis.

Whatever way the Lorentz Transformation Equations are derived, the one and only situation covered during that derivation is:

When $x = ct$ (or) $-ct$, $x' = ct'$ (or) $-ct'$ respectively.

Lorentz Transformation assumes that its Equations derived for the above situation are universally valid for all events, including those that have nothing to do with the transmission of Light. We shall prove in the following sections that this assumption is its Achilles heel responsible for its illogical and unrealistic predictions, i.e., clocks of the moving frame becoming unsynchronized with each clock living in a unique time in a continuous infinite spectrum ($t' = t/a - vx'/c^2$), Time Dilation ($t' = t/a - vx'/c^2$) and Length Contraction ($x' = x/a - vt'$). The claimed experimental verification of Time Dilation is presumably due to a possible omission to consider certain relevant factors while conducting those verifications.

For a pair of events whose space and time distances are measured by the observers in the frames **S** and **S'**, let us define two values **p** and **q** as follows:

$$\mathbf{p} = \mathbf{x}/\mathbf{t} \quad \text{and} \quad \mathbf{q} = \mathbf{x}'/\mathbf{t}'$$

We shall derive **Generalized Transformation Equations** involving **p** and **q** so that that in our derived Equations, if we substitute both **p** and **q** with **c** we shall get the usual Lorentz Transformation Equations. In other words, **p = q = c** is a special case

of **Generalized Transformation Equations**; and this special case is **Lorentz Transformation Equations**

Let us consider two events. Let the first event be taken as the Origin Event and assigned the coordinates **(0,0)** by both frames. Let the space difference and the time difference between the events be **pt** and **t** for the frame **S** respectively and **qt'** and **t'** for the frame **S'** respectively.

The following figure depicts the scenario of the second event **E** from the perspective of the frame **S**,

FIGURE 5
Scenario of the Second Event from the perspective of Frame S.
(O at rest; O' has moved the distance vt towards right)

From the above Figure **$x' = x - vt$** **(1)**

The following figure depicts the scenario of the second event **E** from the perspective of the frame **S'**,

FIGURE 6
Scenario of the Second Event from the perspective of Frame S'.
(O' at rest; O has moved the distance vt' towards left)

From the above Figure $x = x' + vt'$ (2)

Equations **(1)** and **(2)** represent the same reality from the perspectives of two referential frames. To satisfy the interchangeability of the frames, an essential requisite of the First Postulate of the Special Theory of Relativity, both equations must be mathematically identical. Since the object is to explain the constancy of the speed of light in all inertial frames, the Transformation Equations should include the scenario **when $x = ct$ (or) $-ct$, $x' = ct'$ (or) $-ct'$ respectively**. This requirement seems to demand $t' \neq t$. But, Equations **(1)** and **(2)** are not identical if $t' \neq t$. To make them identical, Lorentz Transformation includes a factor, say **α** , to the RHS of the two equations with a view to derive an

expression for **a** so as to make the Equations **(1)** and **(2)** identical. This factor **a** (named **γ** in many text books) is called **Lorentz Factor**.

With the inclusion of **Lorentz Factor (a)**, the Equations **(1)** and **(2)** become

$$\mathbf{x'} = \mathbf{a}(\mathbf{x} - \mathbf{vt}) \quad (3)$$

$$\mathbf{x} = \mathbf{a}(\mathbf{x'} + \mathbf{vt'}) \quad (4)$$

When we rewrite the above Equations **(3)** and **(4)** in the following formats,

$$\mathbf{x} - \mathbf{x'}/\mathbf{a} = \mathbf{vt} \quad (3a)$$

$$\mathbf{x}/\mathbf{a} - \mathbf{x'} = \mathbf{vt'} \quad (4a)$$

The above Equations **(3a)** and **(4a)** indicate a significant consequence of the inclusion of **Lorentz Factor (a)**. It is **Length Contraction**. From the perspective of Frame **S**, the length measured by the Frame **S'** has contracted from **x'** to **x'/a**. Similarly, from the perspective of Frame **S'**, the length measured by the Frame **S** has contracted from **x** to **x/a**. This consequence of **Length Contraction**, in turn, has led to another more significant consequence of **Time Dilation**, which we shall discuss later.

Now, let us do the important task of finding a suitable expression for **Lorentz Factor (a)**, to make the Equations **(3)** and **(4)** identical so that the First Postulate of the Special Theory of Relativity is not violated.

Using the two values **p** and **q**, which we have already defined, we can rewrite Equations

(3) and **(4)** as follows:

$$\mathbf{qt'} = \mathbf{a(pt - vt)} = \mathbf{a(p - v)t} \quad (3b)$$

$$\mathbf{pt = a(qt' + vt')} = \mathbf{a(q + v)t'} \quad (4b)$$

$$\text{From (3b), } \mathbf{t'/t = a (p - v) / q = ap(1 - v/p) / q} \quad (3c)$$

$$\text{From (4b), } \mathbf{t'/t = p / [a (q + v)] = p / [aq (1 + v/q)]} \quad (4c)$$

From Equations **(3c)** and **(4c)**,

$$\frac{\mathbf{ap(1 - v/p)}}{\mathbf{q}} = \frac{\mathbf{p}}{\mathbf{aq (1 + v/q)}}$$

$$\mathbf{a^2 = 1 / (1 - v/p) (1 + v/q)}$$

$$\mathbf{a = \frac{1}{\sqrt{(1 - v/p) (1 + v/q)}}} \quad (5)$$

The above **Equation (5)** gives the general expression for **Lorentz Factor (a)**.

For a particular case where **p = q = ± c**,

$$\mathbf{a = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}}$$

Therefore, since Lorentz Transformation takes only the above particular value of **Lorentz Factor a**, it is applicable only to the pairs of events representing transmission of light with speed **c** in positive or negative direction and it cannot be applied to other pairs of events – not even to the events relating to transmission of light in directions other than the direction of relative uniform velocity between the concerned frames (which will be discussed later in this paper.)

Substituting the expression for **a** given by **Equation (5)** in the Equations **(3)** and **(4)**, we get the **Generalized Transformation Equation for Space Difference** as follows:

$$\mathbf{x}' = (\mathbf{x} - \mathbf{vt}) / \sqrt{(1 - v/p)(1 + v/q)} \quad (3d)$$

$$\mathbf{x} = \mathbf{a} (\mathbf{x}' + \mathbf{vt}') / \sqrt{(1 - v/p)(1 + v/q)} \quad (4d)$$

The above Equations may be written in the following format **to make explicit the fact that the two Equations are identical**:

$$\mathbf{x}' = \frac{\sqrt{(1 - v/p)}}{\sqrt{1 + v/q}} \mathbf{x}$$

$$\mathbf{x} = \frac{\sqrt{(1 + v/q)}}{\sqrt{1 - v/p}} \mathbf{x}'$$

For the particular case **p = q = ± c**,

$$\mathbf{x}' = \frac{\sqrt{(1 - v/c)}}{\sqrt{1 + v/c}} \mathbf{x}$$

$$\mathbf{x} = \frac{\sqrt{(1 + v/c)}}{\sqrt{1 - v/c}} \mathbf{x}'$$

The above is the pure form Lorentz Transformation Equation for Space Difference.

Obviously, the above Equations are identical, and also **there is no intertwining of Space and Time.**

Now we shall discuss a real case where **p (or) q $\neq \pm c$** , The following discussion would prove that Lorentz Transformation does **NOT** apply to any event of detection of Light at a spatial point that does not fall on the **X-Axis**, that is, the straight line through the common Origin along the direction of the relative velocity between the Frames.

The following Picture gives an 'assumed' scenario (from the perspective of a stationary observer in the Frame **S**) of an event of detection of Light at a spatial point in the **X-Y Plane** that does **Not** lie on the **X-Axis**.

FIGURE 7
The Observed Event from the perspective of the Frame S

From the perspective of the Frame **S**.

$$\mathbf{x'} = \mathbf{a(x - vt)} \quad (3)$$

Since $\mathbf{x = ct \cos\theta}$, Equation (3) can be written as

$$\mathbf{x' = a (1 - v/c \cos\theta) x} \quad (3e)$$

FIGURE 8
The Observed Event from the perspective of the Frame S'

From the perspective of the Frame **S'**.

$$\mathbf{x} = \mathbf{a}(\mathbf{x}' + \mathbf{vt}')$$
(4)

Since $\mathbf{x}' = \mathbf{ct} \cos \Phi$, Equation (3) can be written as

$$\mathbf{x} = \mathbf{a} (1 + \mathbf{v}/\mathbf{c} \cos \Phi) \mathbf{x}'$$
(4e)

Substituting the value of $\mathbf{x}'$ given by the **Equation (4e)** in **Equation (3e)**

$$\mathbf{x}' = \mathbf{a} (1 - \mathbf{v}/\mathbf{c} \cos \theta) \mathbf{a} (1 + \mathbf{v}/\mathbf{c} \cos \Phi) \mathbf{x}'$$

This means, -

$$\mathbf{a} = \frac{1}{\sqrt{(1 - \mathbf{v}/\mathbf{c} \cos \theta) (1 + \mathbf{v}/\mathbf{c} \cos \Phi)}}$$
(6)

We can get the same expression for $\mathbf{a}$ by taking $\mathbf{p} = \mathbf{c} \cos \theta$ and $\mathbf{q} = \mathbf{c} \cos \Phi$ in

Equation (5), which we derived as a general case.

$$\mathbf{a} = \frac{1}{\sqrt{(1 - \mathbf{v}/\mathbf{p}) (1 + \mathbf{v}/\mathbf{q})}}$$
(5)

The factor **a** in the **Equation (6)** would be equal to Lorentz factor $\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ only

when $\theta = 0^0$ so that $\cos \theta = 1$, $\Phi = 0$ and $\cos \Phi = 1$.

The above restriction for the value of θ means that Lorentz Transformation's ambit is confined to the events of detection of Light on the spatial points lying on the **X-Axis** in Pictures **S** and **S'**.

Therefore, Lorentz Transformation fails in respect of the events of detection of Light at the spatial points **NOT** lying on the **X-Axis**, that is, the straight line through the common Origin along the direction of the relative velocity between the Frames.

We can derive the **Generalized Lorentz Transformation Equation for Time Difference** as follows:

$$\begin{aligned}
 t' &= x' / q \\
 &= a (x - vt) / q \\
 &= a (pt - vt) / q \\
 &= a(p/q) (t - vt/p) \\
 &= a(p/q) (t - vx/p^2) \text{ since } t = x/p
 \end{aligned}$$

When $p = c \cos \theta$ and $q = c \cos \Phi$

$$t' = a (\cos \theta / \cos \Phi) (t - vx/c^2 \cos^2 \theta)$$

When $\theta = \Phi = 0$

$t' = a (t - vx/c^2)$, which is the Lorentz Transformation Equation for Time Difference.

Similarly, it can be shown

$$t = a(q/p) (t' + vx'/q^2)$$

When **$p = c \cos \theta$** and **$q = c \cos \Phi$**

$$t = a (\cos \Phi / \cos \theta) (t' + vx'/c^2 \cos^2 \Phi)$$

When **$\theta = \Phi = 0$**

$t = a (t' + vx'/c^2)$, which is the Reverse Lorentz Transformation Equation for Time Difference.

Apart from **Length Contraction**, another important consequence of Lorentz Transformation is **Time Dilation**. It suggests that a moving clock goes slow. Let **t** and **t'** be the time interval between the event of the moving clock being at one spatial point and the later event of its being at a distance **vt** from that point, **v** being the speed of the moving clock. For the said pair of events,

$$p = x/t = vt/t = v, \text{ and}$$

$$q = x'/t' = 0/t' = 0$$

$$a = \frac{1}{\sqrt{(1 - v/p) (1 + v/q)}}$$

If we substitute **v** for **p** and **0** for **q**, then the value of **a** would take the form **0/0** and thereby become an indeterminate. So, in order to define **a** in this circumstance, let us proceed as follows.

$$\mathbf{a^2 (1 - v/p) (1 + v/q) = 1}$$

$$\mathbf{a^2 (1 + v/q - v/p - v^2/pq) = 1}$$

$$\mathbf{a^2 (1 + v/q - 1 - v/q) = 1 \quad \text{since } p = v}$$

$$\mathbf{a^2 (0) = 1}$$

Therefore, **a = ∞**

The same value for **a** can be obtained in the following manner also.

$$\mathbf{\text{For Frame S, } x' = a (x - vt) = a (1 - v/v) x \text{ since } t = x/v}$$

$$\mathbf{\text{For Frame S'}, x = a (x' + vt') = a (1 + v/v) x' \text{ since } t' = x'/v}$$

$$\mathbf{\text{Therefore } x' = a (1 - v/v) a (1 + v/v) x'}$$

$$\mathbf{a (1 - v/v) a (1 + v/v) = 1}$$

$$\mathbf{a (0) (2) = 1}$$

Therefore, **a = ∞**

If **a = ∞** is absurd, then taking the value of **a** as equal to $\sqrt{1 - \frac{v^2}{c^2}}$ by applying the value related to transmission of light to the moving clock is also equally absurd. The genesis of absurdity is the very ‘invention’ of **a** as **Lorentz Factor**. Even if one assumes for argument’s sake that there is a need for **Lorentz Factor a** (in fact, there is no such need), its value has to be individually calculated for every pair of events based on the values of **p** i.e., **(x/t)** and **q** i.e., **(x'/t')** and there is no universal value of **a**

applicable to a given relative velocity, say $\mathbf{v}$, as has been adopted in the Special Theory of Relativity. The following expression for $\mathbf{a}$, Lorentz Factor in the Special Theory of Relativity

$$\mathbf{a} = 1 / \sqrt{1 - \frac{v^2}{c^2}}$$

is applicable only to the events of transmission of light along the direction of relative uniform velocity of the two concerned frames. It would be absurd to have one time for the transmission of Light Signals and another one for all other events. The spoiler seems to be the artificial introduction of Lorentz Factor to satisfy the First Postulate of the Special Theory of Relativity constituting the essence of that celebrated theory.

In some text books, Lorentz Transformation Equations have been derived from the identity

$$\mathbf{x'^2} + \mathbf{y'^2} + \mathbf{z'^2} - \mathbf{c^2t'^2} = \mathbf{x^2} + \mathbf{y^2} + \mathbf{z^2} - \mathbf{ct^2}$$

Since $\mathbf{y'} = \mathbf{y}$, $\mathbf{z'} = \mathbf{z}$, the above identity is reduced to

$$\mathbf{x'^2} - \mathbf{c^2t'^2} = \mathbf{x^2} - \mathbf{ct^2}$$

FIGURE 9
The Detection of a Light Signal at a spatial point in X-Y plane (not on X-axis) from the perspective of the Frame S'

$$\mathbf{c^2t'^2} = \mathbf{x'^2} + \mathbf{y'^2}$$

$$t' = \sqrt{\frac{x'^2 + y'^2}{c^2}}$$

The expression for t' can have a linear form

$$t' = x' / c = a (x - vt) / c = a[(x/c) - v(x/c) / c] = a (t - vx/c^2)$$

if and only if $y' = 0$ i.e., the point of detection of Light Signal falls on X-axis

In fine, Lorentz Transformation has failed in its attempt to do the impossible task of establishing $t' \neq t$ to explain the constancy of the speed of Light in all inertial frames without contradicting the interchangeability of frames demanded by the First Postulate of the Special Theory of Relativity.

PART – III

The Concept of Time in Lorentz Transformation

3.3.1 Events happen independently of Space and Time.

Contrary to a popular misconception, Lorentz Transformation has not rejected the Absoluteness of Time enunciated by Sir Isaac Newton. In Newton's own words, Time is "absolute, true and mathematical time, of itself, and from its own nature, flows equably without relation to anything external". Lorentz Transformation also adheres to this concept of Time. When there are agreements on the uniform standard unit for the measurement of Time and the starting instant for calibration of Time, each moment will have a unique time value. Any event may be arbitrarily chosen as the Origin Event, and the Time of happening of the event is the starting point of the Time Scale.

The focus of Lorentz Transformation is on events. Events happen independently of space and Time. The observers of each frame assign a space coordinate and time coordinate to any observed event based on their observation of that event from their perspectives. Time is a continuous chain of instants of Time – continuing forever independent of events happening in the universe. When an event occurs, the observers in different inertial frames would observe it. Each frame assigns a time instant to that event - one among the infinite time instants constituting an ever-growing Time chain. The absoluteness of Time is not affected by either the happening of events or the observers assigning different time instants to the same event.

The Relativity of Simultaneity in Special Relativity does not mean that the simultaneous events for one frame also happen simultaneously in other frames; still, those events get different values only because of the non-synchronization of their clocks. The correct interpretation of Lorentz Transformation is that the events that have simultaneously happened for one frame **S** have happened at different times for the other frame **S'**. When an event is defined as **(x,t)** by the frame **S**, and **(x',t')** by the frame **S'**, it does not mean that **t** and **t'** denote the same instant of time; it means that the event happens at the instant **t** from the perspective of **S** and the same event happens at the instant **t'** from the standpoint of **S'**. **t** and **t'** are two different instants among the infinite time instants constituting the Time chain. An event is absolute in the sense that the observers in all inertial frames would agree that it has happened, but they differ on only when it happened.

3.3.2 Mutual Length Contraction.

When Jill is shorter than Jack, it means Jack is taller than Jill. But, according to Lorentz Transformation, when two rods of equal length L , say $\mathbf{AB}$ and $\mathbf{A'B'}$ are in motion with a uniform, linear, relative velocity, say $\mathbf{v}$, for the observer $\mathbf{S}$ stationed on the rod $\mathbf{AB}$, the moving rod $\mathbf{A'B'}$ would be found to be shorter than his rod by the factor $\mathbf{a}$. Mystically, for the observer $\mathbf{S'}$ stationed on the rod $\mathbf{A'B'}$ also, the moving rod $\mathbf{AB}$ would be found to be shorter than his rod by the same factor $\mathbf{a}$. Let us see how this seemingly impossible feat happens.

When the ends $\mathbf{A}$ and $\mathbf{A'}$ coincide, let the observers set the clocks to read $\mathbf{0}$. Let us use the notation $(\mathbf{x}, \mathbf{t})$ to define an event, where $\mathbf{x}$ gives the space coordinate, and $\mathbf{t}$ provides the Time with a coordinate. Let us take the coincidence of the ends $\mathbf{A}$ and $\mathbf{A'}$ as the Origin Event $(\mathbf{0}, \mathbf{0})$.

We can see from the above diagram that the length $\mathbf{A'B'}$ is measured to be $\mathbf{L/a}$ by the observer $\mathbf{S}$. But, the above measurement of the length of $\mathbf{A'B'}$ as $\mathbf{L/a}$ by $\mathbf{S}$ would not be

agreeable to **S'** for the reason that **S** noted the ruler mark of the end **B'** at the instant, $-vL/c^2$, and later the ruler mark of the end **A'** at the instant **0**. According to **S'**, the ruler marks of the two ends of the rod were not simultaneously noted by **S** at the instant **0** but with a time gap of $-vL/c^2$ during which the end **B** would have moved towards the right a distance equal to av^2L/c^2 and coincided with the ruler mark L/a , i.e., $(aL - av^2L/c^2)$ of **S'**. The correct scenario, according to **S'** at the instant **0**, would be as depicted in the following diagram:

But now, the above measurement of the length of **AB** as L/a by **S'** would not be agreeable to **S** for the reason that **S** noted the ruler mark of the end **A** at the instant **0**, and later the ruler mark of the end **B** at the instant vL/c^2 . The vicious cycle repeats.

Discussion

If every event happens at the same instant of time for all observers, then the physical realities observed by both observers would have been the same, and the mutual accusation of one rod is shorter than the other rod would not have arisen. **Lorentz Transformation**

unrealistically predicts that whenever an event happens at a particular time for a frame, it has already happened in the past or will happen in the future for any other frame.

The end **B'** of the rod **A'B'** coinciding with the ruler marker **L/a** of the rod **AB** really happened because **the observers on both frames did not deny the event's happening.** They disagree only on when that event occurred. According to the observer in frame **S**, it happened when the Time was **0**. According to the observer in frame **S'**, it happened when the Time was **$-vL/c^2$** , and at that instant, its end **A'** was not coinciding with the end **A** but was at a distance **v^2L/c^2** from it. This stand of **S'** is unassailable because it is axiomatic that all clocks of each frame are always synchronized, and it would be unrealistic to say that the clocks at its two ends were showing different times at the instant when the observer in another frame was observing them simultaneously.

The event of the end **B'** of the rod **A'B'** coinciding with the ruler marker **L/a** of the rod **AB** happening at time **$t = 0$** is true for the observer in the Frame **S**. The same event happening **vL/c^2** seconds earlier is true for the observer **S'**.

According to Lorentz Transformation, every event in the universe happens at different times for different inertial frames, which implies that the same event recurs infinite times.

When a specific event is represented by **(X, T)** in the frame **S**, for that frame, it had happened when the Time was **T**. For any other frame moving with a velocity **v** relative to it, the same event has occurred at the time **t'** given by the following expression.

$$t' = \frac{T - vX/c^2}{\sqrt{1 - v^2/c^2}}$$

Since the value of **v** is different for different frames, it varies between **- ∞** to **+ ∞**. So, the event repeats infinite times –one instance for each inertial frame. The following Graph depicts Simultaneous Events observed in one frame being spread over an infinite time spectrum for another frame.

FIGURE 12
Simultaneous Events for one Frame spread over an infinite spectrum for another Frame

$$\tan \theta = -av/c^2$$

$$t' = x \tan \theta + at$$

The simultaneous events happening in the entire universe at an instant of time t relative to an observer in any inertial frame spread over an infinite time spectrum for the observers in all other frames.

PART – IV

Have Experiments confirmed Lorentz Transformation?

The oft-quoted reason for the continuing acceptance of the Lorentz Transformation in Special Relativity despite its apparent shortcomings is that it has the backing of a solid experimental confirmation of its prediction of Time Dilation. However, the natural curiosity of how such a logically absurd theory could make accurate predictions makes it necessary to carefully verify whether the experimental results are exclusively attributable to that theory, or they might have been the outcomes of some other causes.

4.4.1 Moving clocks do not slow down due to Time Dilation.

The expression $t' = t/\alpha$ quantifying **Time dilation** in the theory of special relativity does not indicate any slowing down of a moving clock, but it is only a natural consequence of **Length Contraction**, which is one of the building blocks of Lorentz Transformation that accounts for the interchangeability of the moving frame and the stationary frame.

When the time difference between the two events is t relative to the stationary frame **S**, during this time interval, each clock in the moving frame **S'** would cover a distance vt according to the observers in the frame **S**. This distance vt would be equal to vt/α for

the moving frame **S'** on account of Length Contraction. Consequently, the time **t'** taken by a clock in the frame **S'** to cover this distance of **vt/a** at the speed **v** would be **(vt/a) / v**, i.e., **t/a**. Hence, **Time dilation** is a consequence of more fundamental **Length Contraction** and not due to any slowing down of the moving clocks.

When a super speed aircraft flies with a speed **v**, which is nearer to the speed of light, the distance between the two cities London and Paris, is **x** for the observers on the earth, and it is **x/a** for the pilot of the aircraft. If the earth observers and the pilot of the aircraft flying towards Paris set their clocks to zero at the instance of the aircraft crossing London, the aircraft would cover the distance **x/a** between London and Paris in **x/av** seconds. When the time shown by all clocks of the earth and aircraft was **x/av**, the aircraft pilot would see the aircraft crossing Paris at that time, and for the earth observers, the aircraft was yet to cross Paris. When the time shown by all clocks was **x/v** second, the earth observers would see the aircraft crossing Paris at that time; but for the pilot of the aircraft, there was no crossing Paris at that instant because it had already crossed that city. The same event happening at different times for different inertial frames would be the correct interpretation of Lorentz Transformation if it were true. The same events occur in the same sequence for all inertial frames, but different frames would assign different time values to those events, if Lorentz Transformation were true.

The observed slowing down of clocks moving with a high-speed relative to the Earth in **Hafele–Keating experiment** has to be traced to some reason other than Lorentz Transformation. It may be examined whether it is due to the variation of the mass of a

body with its velocity. $[m = m_0 / (1 - u^2/c^2)^{1/2}]$ or variation of gravity with altitude. Nevertheless, we shall proceed to verify whether **Hafele-Keating experiment** experimentally confirms Lorentz Transformation.

4.4.2 Hafele-Keating Experiment

On a presupposition that special relativity predicts the “slowing down” of moving clocks, Hafele-Keating Experiment claims to have experimentally confirmed that prediction. Firstly, any Coordinate Transformation proceeds based on an implied premise that the measuring tools used for making measurements are faultless.

Lorentz Transformation is a coordinate transformation giving the space interval and time interval between two events relative to one Frame in terms of those intervals in another frame. Therefore, for any experimental verification of Lorentz Transformation, at least two events separated by non-zero Space and time intervals must be examined. The interchangeability of Frames and their mirroring features are relevant factors in any verification of Lorentz Transformation.

When Lorentz Transformation connects two frames, the frames are interchangeable – one Frame being the 'moving' frame for the other and vice versa. The transformation equation relates the time intervals say Δt and $\Delta t'$ measured by the two frames **S** and **S'** with a uniform linear relative velocity **v** between them.

From the viewpoint of **S**,

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

From the viewpoint of **S'**,

$$\Delta t = a\Delta t' + av\Delta x'/c^2$$

Where Δx = Space interval between the events relative to S;

$\Delta x'$ = Space interval between the events relative to S'; and

$$a = \sqrt{1 - \frac{v^2}{c^2}}$$

Since the Lorentz Transformation is a coordinate transformation, ideally, it should not alter physical reality. Any experiment intended to validate the Lorentz Transformation should verify whether it correctly transforms from one Frame to another space and time intervals of any two events. Keeping it in mind, let us examine the results obtained in the **Hafele–Keating experiment** and the subsequent verification of those results by more accurate methods [3]. In those experiments, high-precision clocks carried in aircraft were running slower than the earth clock by a very close factor. We shall proceed on the premise that the results of those experiments are accurate. Let us visualize the following scenario:

Let **A**, **B** and **C** be three clocks fixed on the earth so that **AB = v** meters and **BC = v** meters. Let **F1** and **F2** be two aircraft set with clocks flying with uniform linear velocity **v** m/s relative to the earth. Let **F1** be above **A** and **F2** be above **B** at an instant of time at

which the three clocks **A**, **B** and **C** fixed on the earth and the clock fixed with the aircraft **F1** are set to read **zero**.

FIGURE 13
F1 above A and F2 above B at an instant of time

After **1** second, each aircraft would have moved a distance **v** meter relative to the earth, and the new scenario would be as follows:

FIGURE 14
F1 above B and F2 above C after 1 second

Now we can consider four events:

Event 1: The Aircraft **F1** was above point **A** on the earth.

Event 2: The Aircraft **F2** was above point **B** on the earth.

Event 3: The Aircraft **F1** was above point **B** on the earth.

Event 4: The Aircraft **F2** was above point **C** on the earth.

The following table gives the time intervals between any two of the above four events relative to the aircraft frame as predicted by Lorentz Transformation and the actual time intervals measured in the **Hafele–Keating experiment** and other subsequent similar experiments.

TABLE 1
Predicted and Experimentally verified Time Intervals between the Observed Events

	Between	Time Interval in the Earth Frame (Seconds)	Time Interval in the Aircraft Frame (Seconds)	
			Predicted by Lorentz Transformation	Measured in the Experiment
1	Event 1 and Event 2	0	$-av^2/c^2$	0
2.	Event 2 and Event 3	1	a	1/a

3.	Event 1 and Event 3	1	$1/a$	$1/a$
4	Event 1 and Event 4	1	$1/a - av^2/c^2$	$1/a$
5.	Event 2 and Event 4	1	$1/a$	$1/a$
6.	Event 3 and Event 4	0	$-av^2/c^2$	0

It may be seen that out of the above six pairs of events, the predictions of Lorentz Transformation were found to agree with the experimental results only in respect of two pairs of events. Hence, Lorentz Transformation cannot be said to have been experimentally confirmed.

4.4.3 The Mu-Meson Experiment

Let us consider the phenomenon of rapidly falling μ mesons first from a frame of reference attached to the earth and then from the perspective of a frame of reference attached to a frame of reference that moves with the mesons.

In the following figures, an event is defined as **($\mathbf{x}$, $\mathbf{t}$)**, where **$\mathbf{x}$** and **$\mathbf{t}$** denote the space and time coordinates, respectively.

4.4.3.1 From the standpoint of a frame of reference attached to the earth

FIGURE 15
Initial Scenario from the standpoint of Earth Frame

Event Definition in Earth Frame		Event Definition in μ meson Frame
$(-h, 0)$		$(-ah, +avh/c^2)$
$(0, 0)$		$(0, 0)$

FIGURE 16
Final Scenario from the standpoint of Earth Frame

Event Definition in Earth Frame		Event Definition in μ meson Frame
$(-h, h/v)$		$(-2ah, avh/c^2 + ah/v)$
$(0, h/v)$		$(-ah, ah/v)$

$$\begin{aligned} \text{Time elapsed in } \mu \text{ mesons frame} &= ah/v - avh/c^2 = ah/v (1 - v^2/c^2) \\ &= h/av \end{aligned}$$

$$\text{Time elapsed in earth frame} = h/v - 0$$

$$= h/v$$

4.2.2 From the stand point of a frame of reference that moves with the mesons

FIGURE 17
Initial Scenario from the standpoint of μ meson Frame

Event Definition in Earth Frame		Event Definition in μ meson Frame
$(-h, -vh/c^2)$		$(-h/a, 0)$
$(0, 0)$		$(0, 0)$

FIGURE 18
Final Scenario from the standpoint of μ meson Frame

Event Definition in Earth Frame		Event Definition in μ meson Frame
$(0, h/a^2v)$		$(-h/a, h/av)$
$(0, h/v)$		$(-ah, ah/v)$

Time elapsed in μ mesons frame = $h/av - 0$

$$= h/av$$

Time elapsed in earth frame = $h/a^2v - 0$

$$= h/a^2v$$

Since the time elapsed in μ mesons frame is h/av from the viewpoint of both earth frame and μ mesons frame, it has been concluded that the time dilation is a fact of experience.

But, in the perspective of μ mesons frame, the time elapsed in the earth frame is h/a^2v , which is less than h/av , which is the time elapsed in μ mesons frame. It means that for an observer moving along moving μ mesons, the μ mesons stationary on the earth would be decaying at a slower rate. This reduction of the decay rate of μ mesons stationary on the earth from the perspective of an observer moving along with moving μ mesons has not been experimentally verified. When Time Dilation has been predicted as a mutual phenomenon between the two frames, one-sided verification of the phenomenon cannot be taken as the confirmation of that prediction.

Therefore, the reduction in fast-moving μ mesons' decay rate cannot be attributed to Time Dilation predicted by Lorentz Transformation. The real reason for such reduction has to be traced elsewhere. The possibility of attributing such delayed decay of radioactive substances to the Relativistic variation of Mass with Velocity may be examined.

4.4.4 The observed slowing down of moving clocks may be due to Relativistic Variations of mass with velocity and Gravity with Altitude.

The observed slowing down of clocks moving with a high-speed relative to the Earth has to be traced to some reason other than Lorentz Transformation. It may be examined whether it is due to the variation of the mass of a body with its velocity

$$\mathbf{m} = \mathbf{m}_0 / (1 - \mathbf{u}^2/\mathbf{c}^2)^{1/2}$$

The variation of gravity with altitude may also be another contributing factor for slowing down of clocks moving at high altitudes. The above possibility deserves a thorough examination because “The oscillation frequencies within the atom are determined by the mass of the nucleus and the gravity and electrostatic "spring" between the positive charge on the nucleus and the electron cloud surrounding it.” [4]

PART – V

Lorentz Transformation is unnecessary in Special Relativity.

5.1 Mass – Energy equivalence can be derived without Lorentz Transformation.

Suppose the mass of a particle when it is at rest in an inertial frame is $\mathbf{m}_0$. Let its relativistic mass be $\mathbf{m}$, while it is moving with speed $\mathbf{u}$ relative to that Frame. We know -

$$\mathbf{m} = \mathbf{m}_0 / (1 - \mathbf{u}^2/\mathbf{c}^2)^{1/2}$$

Generally, the above equation **[5]** is derived using Lorentz Transformation Equations.

But the above equation can be arrived at without the use of Lorentz Transformation Equations based on the following observed facts, -

1. **It has been experimentally proved that no particle can travel faster than c , the Speed of Light. When a particle's speed is accelerated to a value near c , the inertial mass m that resists acceleration tends to become ∞ , thereby making it impossible to make the particle reach Light's speed.**
2. **The rest mass of any particle is found to be the same in all inertial frames.**
When $u = 0$, $m = m_0$
3. **The above equation corresponds to the fact that the work done on a particle by an external force becomes the particle's kinetic energy with an approximate value of $mu^2/2$.**

As already said, the observed slowing down of clocks moving with a high-speed relative to the Earth in **Hafele–Keating experiment** may be due to the variation of the mass of the clock with its velocity.

It has been shown in many textbooks **[6]** on Special Theory of Relativity that from the above equation giving a variation of mass with velocity, the following famous **mass-energy equivalence** equation can be derived;

$$\mathbf{E = mc^2}$$

Thus, Einstein's Special Theory Relativity can stand on its own merits without paradoxical Lorentz Transformation,

Section 3: Conclusions

- 1.** The Constancy of the Speed of Light measured in all frames of references is due to each observer's perceptions that Space is at rest relative to his Frame of Reference, the Light Source is static in his Frame of Reference, the Light originating from that stationary Source spreads as a spherical electromagnetic wave in all directions with a speed **c** in his static Space; and the Light so spreading is capable of being detected only by any Light Detector that is stationary in the Frame.
- 2.** The detection of Light by an inertial reference frame is an event that is exclusive to that Frame.
- 3.** Lorentz Transformation is conceptually flawed.
- 4.** Time is absolute. There is no Interdependence of Space and Time.
- 5.** The results obtained in the **Hafele–Keating experiment** and **μ meson experiment** do not support the predictions of the Lorentz Transformation.
- 6.** The Mass – Energy equivalence **E = mc²** can be derived without Lorentz Transformation.

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