Modified Lorentz Transformations and Minkowski Space Splits in Inverse Relativity

Michael Girgis

PO box 11000, Gamal Abu Al-Rish str. Tallah, Menia, Egypt

E-mail: michael.grgs@yahoo.com

June 3, 2022

ABSTRACT : New transformations of space and time coordinates achieve kinds of symmetry that the classic Lorentz transformations fail to achieve, we get the new transformations When analyzing a four-dimensional vector in Minkowski space into two four-dimensional vectors, the first is known as the symmetry vector and the second is known as the parallel vector, Where each vector is represented in a new four-dimensional space, this analysis leads to the splitting of the Minkowski space into a positive and a negative space, Thus, we have new transformations of the coordinates of space and time called modified Lorentz transformations, Which expresses one of those spaces, the positive space (positive spacetime), which adheres to the principles of special relativity

Keywords: Lorentz transformations - Four-dimensional vector - Minkowski space - Spatial symmetry - Principles of relativity - Causality and light speed - Inverse Relativity - Energy and time paradox

1 INTRODUCTION

Lorentz transformations are transformations of space and time coordinates from one inertial reference frame to another, with the stability of the speed of light for all observers in the reference frames, It was founded by Hendrik Lorentz in 1903 to explain the experiment carried out by Michelson–Morley [5] [3] in 1887, The Lorentz transformations are the mathematical and physical basis for both the special and general theory of relativity as well, It revealed to us the properties of space and time such as length contraction, time dilation, and the merge of time as a fourth dimension of space in a four-dimensional space known as Minkowski space, Lorentz transformations are achieved through certain observing conditions in which the speed of light is constant, , but what if we change the observing conditions used in these transformations, even if that is from a purely theoretical point of view, Will we get the same Lorentz transformations or a new transformations? Just to change our observation conditions followed! , And if we obtain new transformations, will it reveal to us other properties of space and time that differ from the properties of space and time in the special theory of relativity?! Or will we reach the same properties as before?

2 METHODS

2-1 Vector Symbol in The Lorentz Transformations

We also know from the special theory of relativity that the Lorentz transformations [2] [3] [5] are a set of equations that express the transformations of the space and time coordinates of a four-dimensional vector from one inertial reference frame [13] to another, so we prefer that the set of equations be written with the vector symbol, In order to distinguish between them and the new transformations, where the vector symbol here is $\overrightarrow{\alpha}$

$$x`_{\alpha_0} = \gamma\ (x_\alpha - V_s t_\alpha) \tag{1.2}$$

$$y`_{\alpha_0} = y_\alpha \tag{2.2}$$

$$z`_{\alpha_0} = z_\alpha \tag{3.2}$$

$$t`_{\alpha_0} = \gamma \left(t_\alpha - \frac{V_s\, x_\alpha}{c^2} \right) \tag{4.2}$$

$$\gamma = \frac{1}{\sqrt{1 - \frac{V_S^2}{c^2}}} \tag{5.2}$$

The zero symbol here expresses the occurrence of the event in the frame of reference S' and therefore it is not necessary to be on the left side in the previous set of equations, while the inverse Lorentz transformations for the same event are written in the following set

$$x_\alpha = \gamma\ (x`_{\alpha_0} + V_s t`_{\alpha_0}) \tag{6.2}$$

$$y_\alpha = y`_{\alpha_0} \tag{7.2}$$

$$z_\alpha = z`_{\alpha_0} \tag{8.2}$$

$$t`_{\alpha_0} = \gamma \left(t_\alpha + \frac{V_s\, x_\alpha}{c^2} \right) \tag{9.2}$$

2-2 Symmetry of the Lorentz Vector in Space

We assume that there are two reference frames S and S' [2] [13] from Cartesian coordinate system, each frame of reference has an observer at the origin point O and O', as we assume that the frame S' is moving at a uniform velocity V_S relative to the S frame in the positive direction of the x-axis as shown in Figure: 1-2

$$S` \rightarrow x` y` z` t`$$
$$S \rightarrow x \ y \ z \ t$$

During the passage of the reference frame S' and at the moment when the frames S and S' match (that is, when O' matches with O) where $x = x` = 0$ and $t = t` = 0$, an event occurred in this frame which is the emission of a photon from a light source at origin point O', After a period of time Δt, the photon reached the point P in space, and the frame of reference S' reached the point Q on the x-axis (see Figure: 1-2), where every observer here observes the displacement vector of the photon under the conditions of the first observation, i.e. according to the classical observation conditions used in special relativity

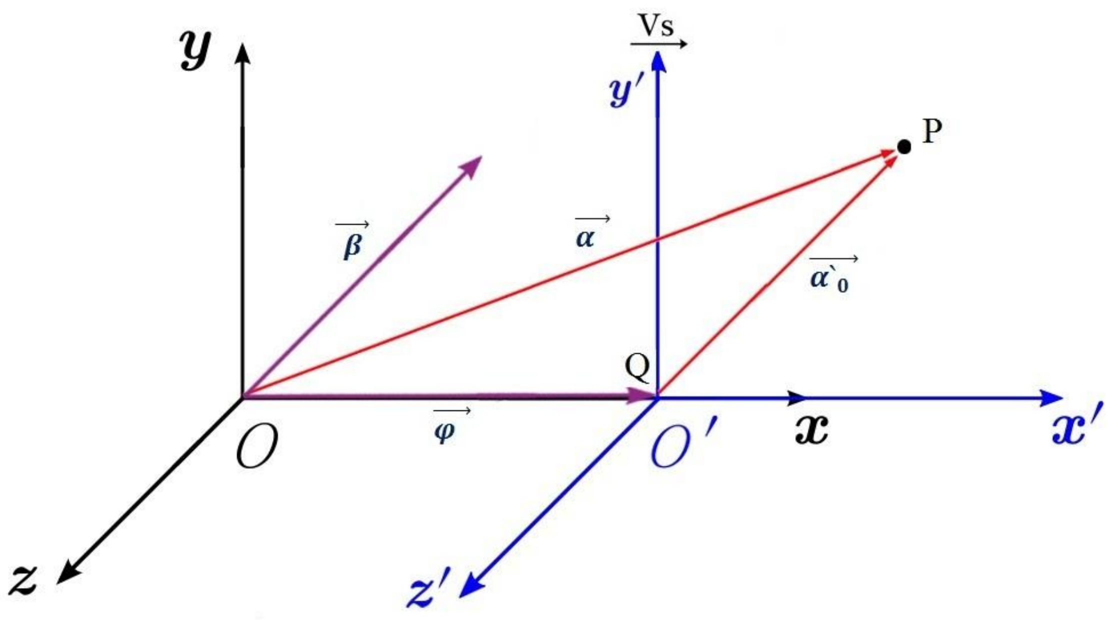

Figure: 1-2

The observer O' observes the displacement vector of the photon (event path) relative to its reference frame S' (i.e. observes the displacement vector of the photon relative to him) from the origin point O' to the point P which is the three-dimensional position vector $\overrightarrow{\alpha`_0}$ or $\overrightarrow{O'P}$, So the length of this vector in the S' coordinate system is

$$\left\|\overrightarrow{\alpha`_0}\right\| = \sqrt{x`^2_{\alpha_0} + y`^2_{\alpha_0} + z`^2_{\alpha_0}} \tag{10.2}$$

The previous formula is slightly different from the formula used in mathematics because mathematics is concerned with the vector only, but here we are interested in the vector variables (components), the number zero represents the occurrence of the event in this frame as we mentioned previously

$$x`^2_{\alpha_0} + y`^2_{\alpha_0} + z`^2_{\alpha_0} = \alpha`^2_0 \tag{11.2}$$

The length of the displacement vector can be obtained by the velocity of the photon $V`_{\alpha_0}$ on this vector, and $t`_{\alpha_0}$ is the time that the photon takes along this vector

$$V`_{\alpha_0} = \frac{\alpha`_0}{t`_{\alpha_0}} \tag{12.2}$$

$$\alpha`^2_0 = V`^2_{\alpha_0}\, t`^2_0 \tag{13.2}$$

Substituting from Equation 11.2 into Equation 13.2, we get the time dimension in the equation and thus we arrive at the four-dimensional description of the vector $\overrightarrow{\alpha`_0}$ [6]

$$x`^2_{\alpha_0} + y`^2_{\alpha_0} + z`^2_{\alpha_0} - V`^2_{\alpha_0}\, t`^2_{\alpha_0} = 0 \tag{14.2}$$

$\overrightarrow{V`_{\alpha_0}}$ represents the velocity of the photon on the vector $\overrightarrow{\alpha`_0}$, which is observed by the observer O' relative to the frame of reference S', i.e. in the first observation conditions, but the previous equation is a general equation where $V`_{\alpha_0} \leq c$, and the velocity of the photon here is equal to the speed of light because it is in first observation conditions [12], So we write the equation in the following form

$$x`^2_{\alpha_0} + y`^2_{\alpha_0} + z`^2_{\alpha_0} - c^2\, t`^2_{\alpha_0} = 0 \tag{15.2}$$

As for the observer O, he observes the displacement vector of the photon relative to his reference frame S (that is, he observes the vector of the displacement of the photon relative to him, i.e., in the first observation conditions) from the origin point O where the moment of photon emission was O' matches O) to the point P in space which is a 3D position vector $\overrightarrow{\alpha`}$ or $\overrightarrow{OP}$, so the length of this vector in the S-coordinate system is

$$\|\overrightarrow{\alpha`}\| = \sqrt{x_\alpha^2 + y_\alpha^2 + x_\alpha^2} \tag{16.2}$$

By following the same previous steps in equations 12.2, 13.2, 14.2, we arrive at the four-dimensional form of the vector $\overrightarrow{\alpha}$

$$x_\alpha^2 + y_\alpha^2 + x_\alpha^2 - V_\alpha^2\, t_\alpha^2 = 0 \tag{17.2}$$

$\overrightarrow{V_\alpha}$ is the velocity of the photon on the vector $\overrightarrow{\alpha}$ that the observer O observes relative to the S frame, i.e. in the first observation conditions, t_α is the time that the photon takes along this vector, the previous equation is also a general equation where $V_\alpha \leq c$, and the velocity of the photon here also is equal to the speed of light because it is in the same conditions of observation, So we write the previous equation in the following form

$$x_\alpha^2 + y_\alpha^2 + x_\alpha^2 - c^2\, t_\alpha^2 = 0 \tag{18.2}$$

We notice from equations 15.2 and 18.2 that the photon velocity in the first observation conditions, is constant for the observers or relative to the two frames, Which fulfills the second postulate of special relativity [5] [9], So the transformation between these two vectors is through the above mentioned Lorentz transformations, as we also notice from the previous two equations that the vectors $\overrightarrow{\alpha}$, $\overrightarrow{\alpha`_0}$ as four-dimensional vectors are symmetrical in the magnitude (Rotational Geometric Symmetry) [15] and thus are represented in a four-dimensional vector space, which is Minkowski space [2] [8], We also find that the speed of light is symmetrical in this space and thus appears as a cosmic constant

$$x_\alpha^2 + y_\alpha^2 + x_\alpha^2 - c^2\, t_\alpha^2 = x`^2_{\alpha_0} + y`^2_{\alpha_0} + z`^2_{\alpha_0} - c^2\, t`^2_{\alpha_0} \tag{19.2}$$

But from the inverse Lorentz transformations equation No. 9.2 we conclude that

$$c^2\, t_\alpha^2 > c^2\, t`^2_{\alpha_0} \tag{20.2}$$

Thus

$$x_{\alpha}^{2} + y_{\alpha}^{2} + x_{\alpha}^{2} \; > \; x`_{\alpha_0}^{2} + y`_{\alpha_0}^{2} + z`_{\alpha_0}^{2} \quad \therefore \quad \left\| \overrightarrow{\alpha} \right\| > \left\| \overrightarrow{\alpha`_0} \right\| \tag{21.2}$$

From the inverse Lorentz transformations also equations 7.2, 6.2 we conclude that

$$x_{\alpha} > x`_{\alpha_0} \tag{22.2}$$

This means that the two vectors $\overrightarrow{\alpha}$, $\overrightarrow{\alpha`_0}$ as three-dimensional vectors in three-dimensional vector space (Spatial Euclidean Space) [7] are unequal in length and are not parallel in direction, we conclude that the Lorentz transformations do not preserve the magnitude and direction of the vector in three-dimensional space, that is, it violates the transitional symmetry [16] of the vector in three-dimensional space, as shown in Figure: 1-2, or in other words, it violates the symmetry of the spatial space

2-3 Postulate Change the Conditions of Observation

The reason why Lorentz transformations [11] violate this type of symmetry (Transitional Symmetry) is the observation conditions on which the Lorentz transformations depend, where each observer observes the same 4D vector with relative to his reference frame as shown in the previous item, but when changing these observing conditions where each observer observes the same vector, but 3D and relative to only one frame of reference, we find here both observers agree on the length of the vector in spatial space, Thus, transitional symmetry is achieved with the new observation conditions and when these observation conditions apply to the previous event.

We find that the observer O observes the displacement vector of the photon, but not relative to its reference frame S, but relative to the reference frame S', (i.e. not relative to him but relative to the observer O'), in other words, observer O wants to observe a three-dimensional displacement vector in his frame of reference S, corresponding to the vector $\overrightarrow{\alpha`_0}$ in magnitude and direction, In order for the observer O to fulfill these observing conditions, he analyzes the displacement vector of a photon $\overrightarrow{\alpha}$ in his reference frame S into two displacement vectors.

2-4 Lorentz Vector Analysis in Reference Frames

The first vector is the displacement vector $\overrightarrow{OR}$ *or* $\overrightarrow{\beta}$ In order for this vector to fulfill the second observation conditions, we assume that it is parallel in direction and equal in magnitude the vector $\overrightarrow{\alpha`_0}$ in three-dimensional space, In other words, we assume that the vector $\overrightarrow{\beta}$ is in symmetry with $\overrightarrow{\alpha`_0}$ (the symmetry here is transitional geometric), so the vector $\overrightarrow{\beta}$ is called the symmetric vector, it is also a position vector in the S-coordinate system, so it is written in the same formula Equation 10.2

$$\| \overrightarrow{\beta} \| = \sqrt{x_\beta^2 + y_\beta^2 + z_\beta^2} \tag{23.2}$$

By following the same previous steps in 12.2, 13.2, 14.2, we arrive at the four-dimensional description of the vector $\overrightarrow{\beta}$

$$x_\beta^2 + y_\beta^2 + z_\beta^2 - V_\beta^2 \, t_\beta^2 = 0 \tag{24.2}$$

Where $\overrightarrow{V_\beta}$ is one of the components of the velocity $\overrightarrow{V_\alpha}$ in the reference frame S, and it represents the velocity of the photon relative to the frame S' when observed by the observer O in the second observation conditions (i.e. the photon's velocity relative to the observer O' from the point of view of the observer O) t_β is the time that the photon takes along the vector $\overrightarrow{\beta}$, to determine the components values of the four-dimensional vector $\overrightarrow{\beta}$, we conclude from the above that the two vectors $\overrightarrow{\beta}$ *and* $\overrightarrow{\alpha`_0}$ are equal

$$\overrightarrow{\beta} = \overrightarrow{\alpha`_0} \tag{25.2}$$

Thus the components of both vectors are also equal in the three-dimensional vector space (spatial space)

$$x_\beta = x`_{\alpha_0} \tag{26.2}$$

$$y_\beta = y`_{\alpha_0} \tag{27.2}$$

$$z_\beta = z`_{\alpha_0} \tag{28.2}$$

Since the space-coordinate transformation equations here are symmetrical, therefore, the time transformation t_β must be symmetric with respect to the dimensions of the spatial space, In other words, the value of the time transformation should not change from one spatial dimension to another, unlike the Lorentz transformations in which the time transformation t_α with respect to the X dimension is greater than the y, Z dimensions (see Equation 9.2), this means that the time transformation here is subject to another kind of symmetry, which is the symmetry of the time-transformation value with respect to the dimensions of the spatial space, so we assume the following transformation for it

$$t_\beta = t`_{\alpha_0}\ \gamma \tag{29.2}$$

Arranging the equations 26.2, 27.2, 28.2, 29.2 in this form

$$x_\beta = x`_{\alpha_0} \tag{26.2}$$

$$y_\beta = y`_{\alpha_0} \tag{27.2}$$

$$z_\beta = z`_{\alpha_0} \tag{28.2}$$

$$t_\beta = t`_{\alpha_0}\ \gamma \tag{29.2}$$

The previous set of equations represent the inverse Lorentz transformations, but in the new observation conditions, so they are called inverse modified Lorentz transformations, As for getting the modified Lorentz transformations for the same event, it is by analyzing the observer O' of the displacement vector $\overrightarrow{\alpha`_0}$ in the reference frame S'

$$x`_{\beta_0} = x_\alpha \tag{30.2}$$

$$y`_{\beta_0} = y_\alpha \tag{31.2}$$

$$z`_{\beta_0} = z_\alpha \tag{32.2}$$

$$t`_{\beta_0} = t_\alpha\ \gamma \tag{33.2}$$

Modified and inverse modified Lorentz transformations are characterized by the transitional symmetry of the vector in three-dimensional space (spatial space) [7], it represents the transformation of a four-dimensional vector from one inertial reference frame to another while maintaining the symmetry and homogeneity of the three-dimensional space (spatial space), Thus, the laws of physics remain unchanged with these transformations, i.e. we must use the same mathematical formulas for the laws of physics for transferring from one inertial reference frame to another in the new observation conditions, and this is considered a commitment to the principle of special relativity [2] [10], but with the new observation conditions.

The second vector resulting from the analysis process is the displacement vector $\overrightarrow{OQ}\ or\ \overrightarrow{\varphi}$ it is also a three-dimensional position vector in the S-coordinate system as shown in Figure: 1-2, so it is written in the same formula as equation 10.2

$$\|\overrightarrow{\varphi}\| = \sqrt{x_\varphi^2 + y_\varphi^2 + z_\varphi^2} \tag{34.2}$$

By following the same previous steps in 12.2, 13.2, 14.2, we arrive at the four-dimensional description of the vector $\overrightarrow{\varphi}$

$$x_\varphi^2 + y_\varphi^2 + z_\varphi^2 - V_\varphi^2\, t_\varphi^2 = 0 \tag{35.2}$$

Where $\overrightarrow{V_\varphi}$ represents the photon's velocity on the vector $\overrightarrow{\varphi}$ it is the second component of the velocity $\overrightarrow{V_\alpha}$, t_φ is the time that the photon takes along the vector $\overrightarrow{\varphi}$, to determine the components values of the four-dimensional vector $\overrightarrow{\varphi}$, we conclude from Figure: 1-2 that

$$\overrightarrow{\varphi} = \overrightarrow{\alpha} - \overrightarrow{\beta} \tag{36.2}$$

Thus, the vector components $\overrightarrow{\varphi}$ are the product of the process of subtracting the components of the vector $\overrightarrow{\beta}$ from the components of the vector $\overrightarrow{\alpha}$, taking into account that the subtraction of times is through the velocity components on the X-axis

$$x_\varphi = x_\alpha - x_\beta \tag{37.2}$$

$$y_\varphi = y_\alpha - y_\beta \tag{38.2}$$

$$z_\varphi = z_\alpha - z_\beta \tag{39.2}$$

$$V_{x_\varphi}\, t_\varphi = V_{x_\alpha}\, t_\alpha - V_{x_\beta}\, t_\beta \tag{40.2}$$

Because the last equation contains two unknowns $\overrightarrow{V}_{x_\varphi}\ and\ t_\varphi$ So we must assign a value to one of them, so we assume that the component $\overrightarrow{V}_{x_\varphi}$ is equal to the speed of light, and in this case the component $\overrightarrow{V}_{x_\beta}$ will be equal to zero because the speed of light is the maximum speed of a photon [12] according to the second postulate of special relativity, and the equation becomes as follows

$$ct_\varphi = ct_\alpha - 0 \tag{41.2}$$

Substituting for the vector transformations $\overrightarrow{\alpha}$ (Inverse Lorentz Transformations) [4] [11] and the vector transformations $\overrightarrow{\beta}$ (Modified Inverse Lorentz Transformations) which we have imposed

$$x_{\varphi} = \gamma\left(x`_{\alpha_0} + V_s t`_{\alpha_0} \right) - x`_{\alpha_0} \tag{42.2}$$

$$y_{\varphi} = y`_{\alpha_0} - y`_{\alpha_0} \tag{43.2}$$

$$z_{\varphi} = z`_{\alpha_0} - z`_{\alpha_0} \tag{44.2}$$

$$ct_{\varphi} = c\gamma\left(t`_{\alpha_0} + \frac{V_s\, x`_{\alpha_0}}{c^2} \right) \tag{45.2}$$

We get the next

$$x_{\varphi} = \gamma\left(V_s t`_{\alpha_0} + x`_{\alpha_0}(1-\gamma^{-1}) \right) \tag{46.2}$$

$$y_{\varphi} = 0 \tag{47.2}$$

$$z_{\varphi} = 0 \tag{48.2}$$

$$t_{\varphi} = \gamma\left(t`_{\alpha_0} + \frac{V_s\, x`_{\alpha_0}}{c^2} \right) \tag{49.2}$$

The previous set of equations represents the inverse transformations of the vector $\overrightarrow{\varphi}$ and they show us that the direction of the vector $\overrightarrow{\varphi}$ is parallel to the direction of the displacement of the reference frame S' on the X-axis, In other words, the vector $\overrightarrow{\varphi}$ is always parallel to displacement of the reference frame S', so it is called the parallel vector, as shown in Figure:1-2, , by following the same previous steps but with the classical and modified Lorentz transformations we get the vector transformations $\overrightarrow{\varphi}$

$$x`_{\varphi_0} = \gamma\left(- V_s t_{\alpha} + x_{\alpha}(1-\gamma^{-1}) \right) \tag{50.2}$$

$$y`_{\varphi_0} = 0 \tag{51.2}$$

$$z`_{\varphi_0} = 0 \tag{52.2}$$

$$t`_{\varphi_0} = \gamma\left(t_{\alpha} - \frac{V_s\, x_{\alpha}}{c^2} \right) \tag{53.2}$$

2-5 Minkowski Space Split

As we analyze the Lorentz vector in the Minkowski space [2] [8] into two four-dimensional vectors, we also represent each vector resulting from the analysis process in its own space, As a result, the Minkowski space splits into two four-dimensional spaces.

The Positive Space

We find from equations 14.2 and 24.2 that the four-dimensional vectors $\overrightarrow{\beta}$, $\overrightarrow{\alpha`_0}$ are equal in the magnitude, and therefore they can be represented in a new four-dimensional space called positive space (or Positive Spacetime).

$$x_\beta^2 + y_\beta^2 + z_\beta^2 - V_\beta^2\, t_\beta^2 \quad = \quad x`^2_{\alpha_0} + y`^2_{\alpha_0} + z`^2_{\alpha_0} - V`^2_{\alpha_0}\, t`^2_{\alpha_0} \tag{54.2}$$

Substituting from the modified inverse Lorentz transformations of equations 26.2, 27.2, 28.2, we conclude that

$$V_\beta^2\, t_\beta^2 \quad = \quad V`^2_{\alpha_0}\, t`^2_{\alpha_0} \tag{55.2}$$

Substitute also from the modified inverse Lorentz transformations of equations 29.2 to 55.2

$$V_\beta^2 \;\; t`^2_{\alpha_0}\, \gamma^2 = V`^2_{\alpha_0}\, t`^2_{\alpha_0} \tag{56.2}$$

$$V_\beta^2 \; = V`^2_{\alpha_0}\, \gamma^{-2} \tag{57.2}$$

$$V_\beta = V`_{\alpha_0}\, \gamma^{-1} \tag{58.2}$$

But as we mentioned earlier that $V`_{\alpha_0} \; \leq \; c$, So we can write the equation in the following form also $V_\beta = \; c\, \gamma^{-1}$, This means that the speed of light decreases in the new observation conditions with the increase of Vs, meaning that the observer O observes that the velocity of the photon decreases relative to the observer O' with the increase in the velocity of the reference frame Vs, although both vectors $\overrightarrow{\alpha`_0}$ and $\overrightarrow{\beta}$ have the same length (Event Path) or are in a homogeneous spatial space, but the time dilation causes the velocity of the photon to slow down on the event path, In other words, if the speed of light in the Minkowski space is constant relative to all observers in exchange for the contraction of length and the dilation of time, we find here in the positive space that the spatial space is symmetric relative to all observers in exchange for the dilation of time and reduction of the speed of light

To understand the positive space in a deeper way, we suppose an event other than the emission of a photon in the reference frame S', such as an elastic collision between two particles of equal mass and velocity, We represent this event through two vectors whose intersection point represents the collision point as shown in Figure**:** 2-2, This event expresses a causality where each particle is the cause of changing the direction of the other particle, As a result of the symmetry of the spatial space for all observers in the positive space, this causality is also the same, In other words, any causality that occurs between two vectors in the observer's space O' also occurs between their symmetric vectors.

Through this example, we can provide a mathematical, geometric and physical definition of the positive space

Definition

Mathematically it is a four-dimensional beta space resulting from modified or inverse modified Lorentz transformations, geometrically it is the space of the intersection vectors, physically it is the space of causality where the laws of physics appear in constant mathematical formulas

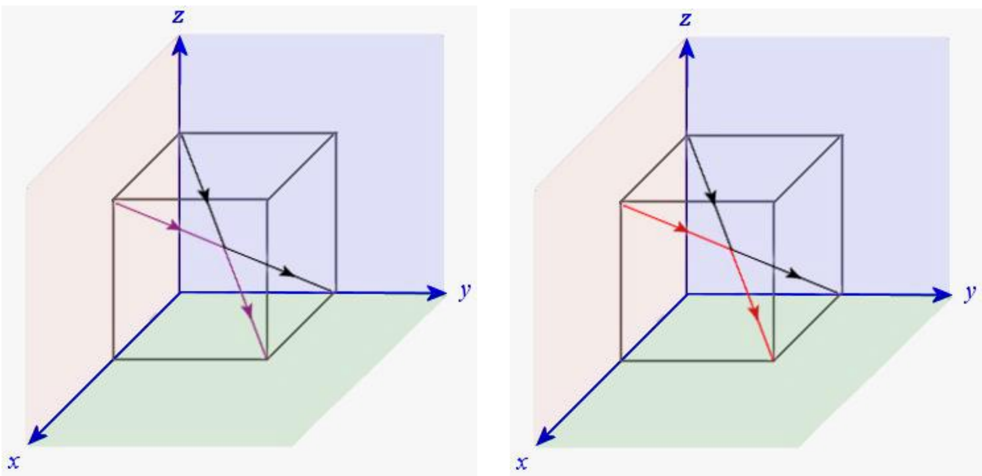

Figure: 2-2

Negative or Parallel Space

From equations 14.2 and 35.2 we find that the four-dimensional vectors $\overrightarrow{\varphi}$, $\overrightarrow{\alpha`_0}$ are equal in the magnitude, and therefore we represent them in a new space called negative space (or negative spacetime)

$$x_\varphi^2 + y_\varphi^2 + z_\varphi^2 - V_\varphi^2\, t_\varphi^2 \quad = \quad x`^2_{\alpha_0} + y`^2_{\alpha_0} + z`^2_{\alpha_0} - V`^2_{\alpha_0}\, t`^2_{\alpha_0} \tag{59.2}$$

Substituting from 47.2, 48.2 to 59.2

$$x_\varphi^2 - V_s^2\, t_\varphi^2 \; = \; x`^2_{\alpha_0} + y`^2_{\alpha_0} + z`^2_{\alpha_0} \; - V`^2_{\alpha_0}\, t`^2_{\alpha_0} \tag{60.2}$$

The last equation shows us that the vector $\overrightarrow{\varphi}$ always has a constant direction (which is the positive direction of the X-axis) in the spatial space of the negative space for any event that occurs in the space of the observer O', This means that all events that occur in the observer's space O' or positive space in general are represented in the spatial space of negative space by vectors parallel in the direction relative to all observers, Thus, we have here another type of symmetry, which is the directional symmetry in the negative space for the different vectors in the positive space, and because the vectors of this space are always parallel to each other, therefore, no causality occurs in it, that is, there are no points of intersection, collision or connection, When representing the previous collision event in negative space, we find that each vector $\overrightarrow{\varphi}$ moves along the vector $\overrightarrow{\beta}$ in spatial space without changing direction, as shown in Figure: 3-2

Here we can also provide a mathematical, geometric and physical definition of negative space

Definition

Mathematically it is a four-dimensional phi space resulting from transformations or inverse transformations of the vector phi, geometrically it is the space of parallel vectors in which the vectors remain without changing their direction, physically it is a non-causal space, i.e. without causality

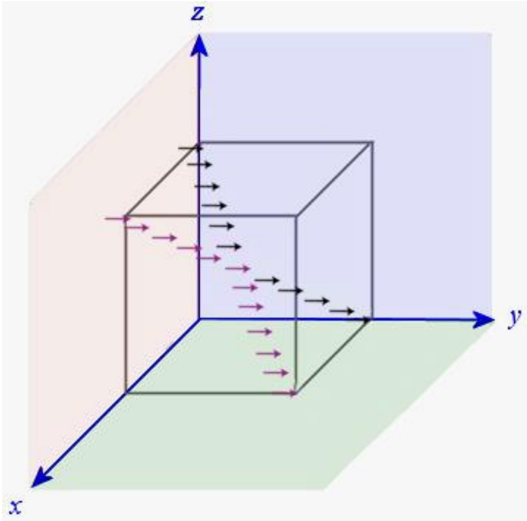

Figure: 3-2

2-6 Transformations of Velocity Vectors

We can now obtain transformations of photon velocity vectors from one frame of reference to another with the new observation conditions, to transform the velocity vectors from the frame of reference S' to the S frame in one degree of freedom, we use the inverse modified Lorentz transformations but in differential form

$$dx_\beta = dx`_{\alpha_0} \quad (61.2)$$

$$dy_\beta = dy`_{\alpha_0} \quad (62.2)$$

$$dz_\beta = dz`_{\alpha_0} \quad (63.2)$$

$$dt_\beta = dt`_{\alpha_0}\ \gamma \quad (64.2)$$

By dividing the equation of time by the equation of distance

$$\frac{dx_\beta}{dt_\beta} = \frac{dx`_{\alpha_0}}{dt`_{\alpha_0}}\ \gamma^{-1} \quad (65.2)$$

$$\frac{dy_\beta}{dt_\beta} = \frac{dy`_{\alpha_0}}{dt`_{\alpha_0}}\ \gamma^{-1} \quad (66.2)$$

$$\frac{dz_\beta}{dt_\beta} = \frac{dz`_{\alpha_0}}{dt`_{\alpha_0}}\ \gamma^{-1} \quad (67.2)$$

We shorten the previous set of equations to the following formula

$$\dot{x}_{\beta} = \dot{x}`_{\alpha_0}\ \gamma^{-1} \qquad\qquad V_{x_{\beta}} = V`_{x_{\alpha_0}}\ \gamma^{-1} \tag{68.2}$$

$$\dot{y}_{\beta} = \dot{y}`_{\alpha_0}\ \gamma^{-1} \qquad OR \qquad V_{y_{\beta}} = V`_{y_{\alpha_0}}\ \gamma^{-1} \tag{69.2}$$

$$\dot{z}_{\beta} = \dot{z}`_{\alpha_0}\ \gamma^{-1} \qquad\qquad V_{z_{\beta}} = V`_{z_{\alpha_0}}\ \gamma^{-1} \tag{70.2}$$

As for the transformation of the velocity vectors from the frame of reference S' to the frame S in three degrees of freedom, it is through the equation that was previously proven in the positive space item.

$$V_{\beta} = V`_{\alpha_0}\ \gamma^{-1} \tag{58.2}$$

To get the transformation of the velocity vector $\overrightarrow{V_{\varphi}}$ from the reference frame S' to the frame S we use equations 46.2, 49.2 from the inverse transformations of the vector $\overrightarrow{\varphi}$ but also in differential form

$$dx_{\varphi} = \gamma\left(V_s dt`_{\alpha_0} + dx`_{\alpha_0}(1-\gamma^{-1})\right) \tag{71.2}$$

$$dt_{\varphi} = \gamma\left(dt`_{\alpha_0} + \frac{V_s\ dx`_{\alpha_0}}{c^2}\right) \tag{72.2}$$

By dividing the equation of time by the equation of distance

$$\frac{dx_{\varphi}}{dt_{\varphi}} = \frac{\gamma\left(V_s dt`_{\alpha_0} + dx`_{\alpha_0}(1-\gamma^{-1})\right)}{\gamma\left(dt`_{\alpha_0} + \frac{V_s\ dx`_{\alpha_0}}{c^2}\right)} \tag{73.2}$$

By dividing both the numerator and denominator in the equation by $dt`_{\alpha_0}$

$$V_{\varphi} = \frac{\frac{dt`_{\alpha_0}}{dt`_{\alpha_0}} V_s + \frac{dx`_{\alpha_0}}{dt`_{\alpha_0}}(1-\gamma^{-1})}{\frac{dt`_{\alpha_0}}{dt`_{\alpha_0}} + \frac{V_s}{c^2}\frac{dx`_{\alpha_0}}{dt`_{\alpha_0}}} \tag{74.2}$$

$$V_{\varphi} = \frac{V_s + V`_{x_{\alpha_0}}(1-\gamma^{-1})}{1 + \frac{V_s V`_{x_{\alpha_0}}}{c^2}} \tag{75.2}$$

The last equation represents the velocity vector transformation equation $\overrightarrow{V_{\varphi}}$ by velocity components on the x-axis, and when we assume the values of V_s and $V_{x`_{\alpha_0}}$ are theoretically equal to the speed of light [4], and by substituting for that in the previous equation

$$V_{\varphi} = \frac{c + c \ \ (1-0)}{1 + \frac{c\ c}{c^2}} = c \qquad \therefore \qquad V_{\varphi} = V_s \tag{76.2}$$

We find that the first component of the velocity $\overrightarrow{V_{\varphi}}$ in the reference frame S is equal to the speed of light, while the second component of the velocity $\overrightarrow{V}`_{x_\beta}$ which is represented in quantity $V_{x`_{\alpha_0}}\gamma^{-1}$ is equal to zero (see at Equation 68.2), Thus, Equation 76.2 also maintains the second postulate of special relativity, but when the speed of the reference frame is much less than the speed of light

$$V_s \ll c \qquad \frac{V_s\, V^{`}_{x_{\alpha_0}}}{c^2} \approx 0 \qquad V^{`}_{x_{\alpha_0}}\,(1-\gamma^{-1}) \approx 0 \tag{77.2}$$

$$V_{\varphi} = V_s \tag{78.2}$$

We conclude from equations 76.2 and 78.2, that at minimum and maximum values of V_s and $V^{`}_{x_{\alpha_0}}$ in the positive direction, the velocity $\overrightarrow{V_{\varphi}}$ is equal to the velocity $V_s$ Thus, we can generalize this result for any value of $V_s$ $and$ $V^{`}_{x_{\alpha_0}}$, meaning that $\overrightarrow{V_{\varphi}}$ is always parallel in the direction and equal to the magnitude V_s , but if we want to transform the velocity vectors from the reference frame S to the frame S', we follow the same previous steps, but with the modified Lorentz transformations, and we get the following in one degree of freedom

$$\dot{x}`_{\beta_0} = \dot{x}_{\alpha}\ \gamma^{-1} \qquad\qquad V^{`}_{x_{\beta_0}} = V_{x_\alpha}\ \ \gamma^{-1} \tag{79.2}$$

$$\dot{y}`_{\beta_0} = \dot{y}_{\alpha}\ \gamma^{-1} \qquad OR \qquad V^{`}_{y_{\beta_0}} = V_{y_\alpha}\ \gamma^{-1} \tag{80.2}$$

$$\dot{z}`_{\beta_0} = \dot{z}_{\alpha}\ \gamma^{-1} \qquad\qquad V^{`}_{z_{\beta_0}} = V_{z_\alpha}\ \gamma^{-1} \tag{81.2}$$

And in three degrees of freedom

$$V^{`}_{\beta_0} = V_{\alpha}\ \gamma^{-1} \tag{82.2}$$

And with vector transformations $\overrightarrow{\varphi_0`}$ we get

$$V`_{\varphi_0} = -\frac{V_s + V_{x_\alpha}\,(1-\gamma^{-1})}{1-\frac{V_s\,V_{x_\alpha}}{c^2}} \tag{83.2}$$

3 RESULTS

The hypothesis of changing the observation conditions used in the Lorentz transformations or in special relativity (which is achieved through a process of mathematical analysis of one of the basic vectors resulting from the Lorentz transformations) leads to our obtaining two four-dimensional vectors, The first is known as the symmetry vector, which fulfills the new observation conditions, and the second is the parallel vector, This analysis also leads to the splitting of the Minkowski space into two spaces, where the parallel vector is represented in a four-dimensional space known as negative space without any causality, while the symmetry vector is represented in a four-dimensional space known as positive space and its transformations are modified Lorentz transformations, which achieve new types of symmetry broken by the classic Lorentz transformations, such as the vector transitional symmetry in spatial space and the symmetry of the laws of physics or adherence to the principles of special relativity, and they are also the transformations that express the new observation conditions

Therefore, we find in the new observation conditions that the length contraction disappears while the time dilation remains present, we also find that the speed of light decreases relative to one of the observers and does not appear as a cosmic constant in all inertial reference frames.

4 DISUSSIONS

The classic observation process or the observation conditions used in the Lorentz transformations and in special relativity appear on measuring devices, which can be tested experimentally, Such as observing the speed of light for each observer, as in the experiment of Michelson–Morley [11], but the observation process or the new observation conditions used in the modified Lorentz transformations are achieved through a process of mathematical analysis only, This means that it is not achieved from an empirical point of view, but rather from a purely theoretical point of view, despite that, it reveals to us important results such as the disappearance of length contraction, the speed of light is no longer a cosmic constant in all observation conditions, generalizing the principle of relativity even with different observation conditions and revealing a new structure of space-time that is also related to the concept of causality, which is positive and negative spacetime.

Symmetry [14] in the Lorentz transformations is a rotational symmetry of the four-dimensional vector in Minkowski space from the geometric side and the symmetry of the speed of light and the laws of physics for all inertial reference frames from the mathematical side, but we find Lorentz transformations that break the transitional symmetry of vector in the three-dimensional Euclidean space (spatial space), while the modified Lorentz transformations are characterized by rotational symmetry of the four-dimensional vector in positive space and transitional symmetry of the vector in three-dimensional space (spatial space) from the geometric side and symmetry of the laws of physics from the mathematical side as well, that is, it achieves geometric symmetry in the 3D and 4D space besides the mathematical symmetry and the symmetry of the time transformation also with respect to the dimensions of the spatial space, and thus it is multi-symmetric (see the comparison table).

The causality in Minkowski space [3] depends on the velocity factor only, as we find that the speed of light is the maximum causal speed that exists among observers in the universe, but in the positive and negative space (Minkowski space split), we get another description of causality that depends on a geometric factor, which is the direction of the velocity vectors, where we find that the velocity vectors express the presence or absence of the causality in each space

As for the transformations of velocity vectors, they are distinguished from the transformations of velocity vectors in special relativity [5] in the distribution of the velocity of a particle (photon), where it shows us the velocity of the particle parallel to the velocity of the reference frame and the velocity of the particle in three degrees of freedom relative to a moving reference frame and the effect of the movement of the reference frame on this distribution

Comparison table of velocity transformations in special and inverse relativity

Transformations of Velocity	**Special Relativity**	**Inverse Relativity**
Observation conditions used	The first or classic observation conditions	The second or new observation conditions
In one Degree of Freedom	$V_{x_\alpha} = \frac{V_s + V^`_{x_{\alpha_0}}}{1 + \frac{V_s V^`_{x_{\alpha_0}}}{c^2}}$ $V_{y_\alpha} = \frac{V^`_{y_{\alpha_0}}}{\gamma\left(1 + \frac{V_s V^`_{x_{\alpha_0}}}{c^2}\right)}$ $V_{z_\alpha} = \frac{V^`_{z_{\alpha_0}}}{\gamma\left(1 + \frac{V_s V^`_{x_{\alpha_0}}}{c^2}\right)}$	$V_{x_\beta} = V^`_{x_{\alpha_0}}\ \gamma^{-1}$   $V_{y_\beta} = V^`_{y_{\alpha_0}}\ \gamma^{-1}$ $V_{z_\beta} = V^`_{z_{\alpha_0}}\ \gamma^{-1}$
In Three Degrees of Freedom	There is no	$V_\beta = V^`_{\alpha_0}\ \gamma^{-1}$
The purpose of Transformations	Add parallel velocities while keeping the speed of light constant	Analyzing parallel and non-parallel velocities while keeping the speed of light constant

Types of Symmetry	Special Relativity	Inverse Relativity
Rotational symmetry of the vector magnitude	There is in 4D vector	There is in 4D vector
Transitional symmetry of the magnitude and direction of the vector	There is no	There is in 3D vector
Time symmetry with respect to spatial dimensions	There is no	There is in the positive space
Directional symmetry of different vectors	There is no	There is in negative space
Symmetry of physics laws	There is	There is
Symmetry of the speed of light	There is	There is no

References

[1] *Michelson, Albert A. (1881). "The Relative Motion of the Earth and the Luminiferous Ether". American Journal of Science*

[2] Albert Einstein (2001). *Relativity: The Special and the General Theory* (Reprint of 1920 translation by Robert W. Lawson), *p. 5.14. 36. 65*

[3] *McGlinn, William D. (2004), Introduction to relativity, JHU Press, p. 9. 10. 21*

[4] *R.C. Tolman (1934), Relativity, Thermodynamics, and Cosmology, Oxford: Clarendon Press,* Reissued (1987), New York: Dover, *p. 19. 25*

[5] Morin, David (2008). "Chapter 11: Relativity Kinematics)" (PDF). *Introduction to Classical Mechanics: With Problems and Solutions, p.* XI-5, XI-7, XI-19 , XI-24

[6] Schutz, John W. (1977). *Independent Axioms for Minkowski Space–Time* (illustrated ed.). CRC Press. *p 4*

[7] Elementary Linear Algebra - Chapter 8: Three-dimensional Geometry Keith Matthews from University of Queensland, 1991

[8] Minkowski space From Wikipedia, the free encyclopedia

[9] Albert Einstein (1905) "*Zur Elektrodynamik bewegter Körper*", *Annalen der Physik* 17: 891; English translation On the Electrodynamics of Moving Bodies by George Barker Jeffery and Wilfrid Perrett (1923); Another English translation On the Electrodynamics of Moving Bodies by Megh Nad Saha (1920)

[10] Einstein, A., Lorentz, H. A., Minkowski, H., & Weyl, H. (1952). The Principle of Relativity: a collection of original memoirs on the special and general theory of relativity. Courier Dover Publications. p. 111

[11] Darrigol, Olivier (2005). "The Genesis of the Theory of Relativity" (PDF). *Séminaire Poincaré*. **1**: 1–22. Bibcode:2006eins.book....1D. Retrieved 15 November 2018

[12] Lauginie, P. (2004). "Measuring Speed of Light: Why? Speed of what?" (PDF). *Proceedings of the Fifth International Conference for History of Science in Science Education*

[13] RG Takwale (1980). *Introduction to classical mechanics*. New Delhi: Tata McGraw-Hill. p. 69

[14] Martin, G. (1996). *Transformation Geometry: An Introduction to Symmetry*. Springer. p. 28

[15] Vladimir G. Ivancevic, Tijana T. Ivancevic (2005) *Natural Biodynamics* World Scientific

[16] Stenger, Victor J. (2000) and Mahou Shiro (2007). *Timeless Reality*. Prometheus Books. Especially chapter 12. Nontechnical.

.