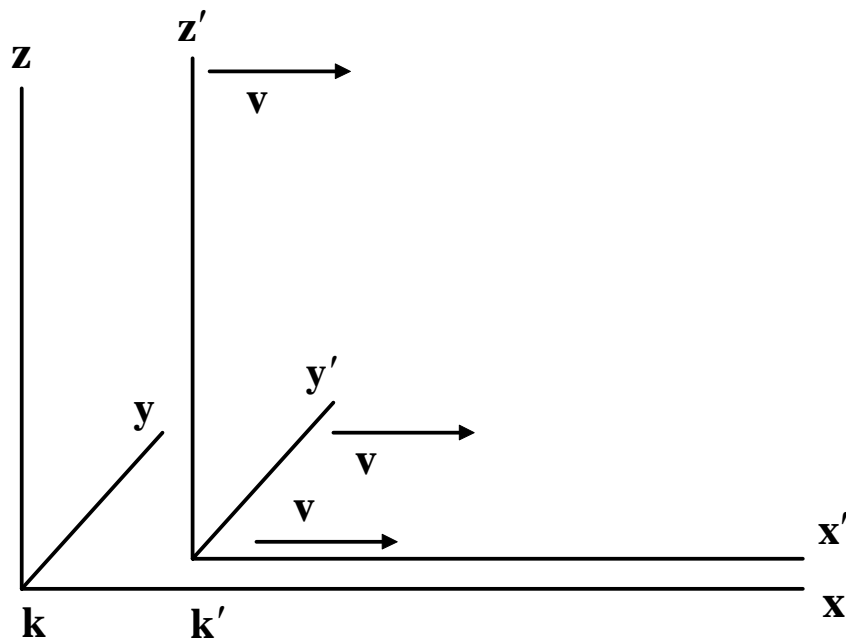


REALITY vs. LORENTZ TRANSFORMS

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1. INTRODUCTION

We begin with the illustration given by Einstein in 'RELATIVITY: The Special and General Theory' first published in 1916.



(Originally given as Fig. 2)

FIGURE 1

Einstein gave the resulting Lorentz transformations in this same book as:

$$\Rightarrow \begin{cases} x' = (x - vt)\gamma \\ y' = y \\ z' = z \\ t' = \left(t - \frac{vx}{c^2}\right)\gamma \end{cases}$$

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

Einstein also supported Lorentz-Fitzgerald contraction by analyzing the first equation with respect to the initial condition of $t = 0$:

$$x' = (x - vt)\gamma, \quad t = 0$$

$$x' = x\gamma$$

$$\Rightarrow x = x'\gamma^{-1}$$

We must now define the variables utilized by Einstein. In accordance with 'RELATIVITY: The Special and General Theory', the following is readily apparent.

v- Relative velocity between the rest frame k and the inertial frame k'.

c- Velocity of propagation of electromagnetic waves.

x- Distance traversed with respect to the rest frame k.

x'- Distance traversed with respect to the inertial frame k'.

t- Time span with respect to a clock at rest in k.

t'- Time span with respect to a clock at rest in k'.

This is all that is required in order to start the comparison with reality.

2. FUNDAMENTAL ORIGIN SEPARATION

The Newtonian mechanical equations are derived (in an approximate sense) by allowing the relative velocity v to be approximately equal to zero, or $v \ll c$.

$$\gamma_{v \ll c} \approx 1$$

frames will still advance ($t, t' > 0$) as expected since there is no reason why they would not advance.

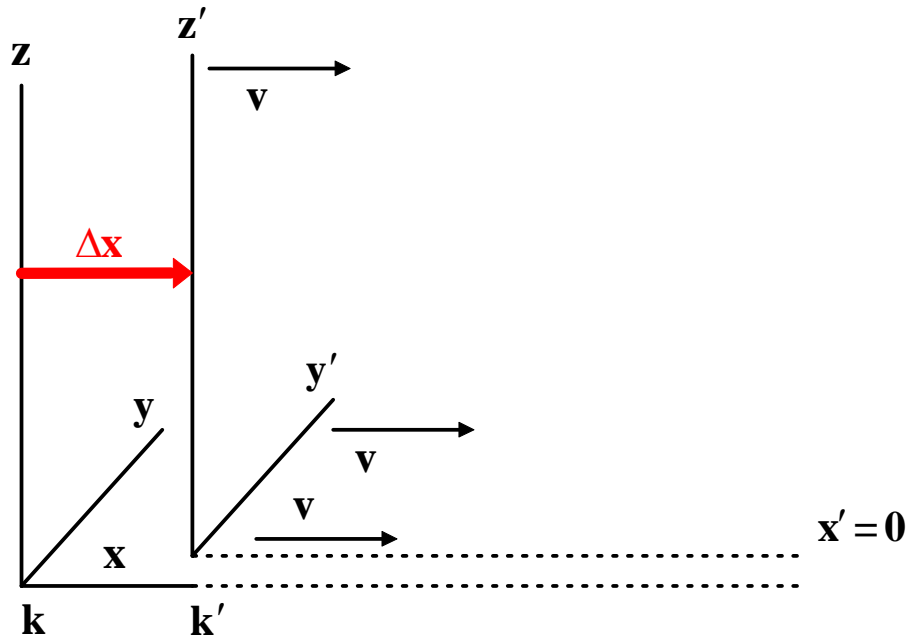


FIGURE 3

Now we impose this initial condition upon the first equation of the transformations.

$$x' = (x - vt)\gamma, \quad x' = 0$$

$$0 = (x - vt)\gamma$$

$$0 = x - vt$$

$$x = vt, \quad x = \Delta x$$

$$\Rightarrow \boxed{\Delta x = vt}$$

This is no surprise since the Newtonian approximation ($v \ll c$) must ensue from the Lorentz transformations. Now we can summarize the resulting relationship with respect to the origin separation distance Δx .

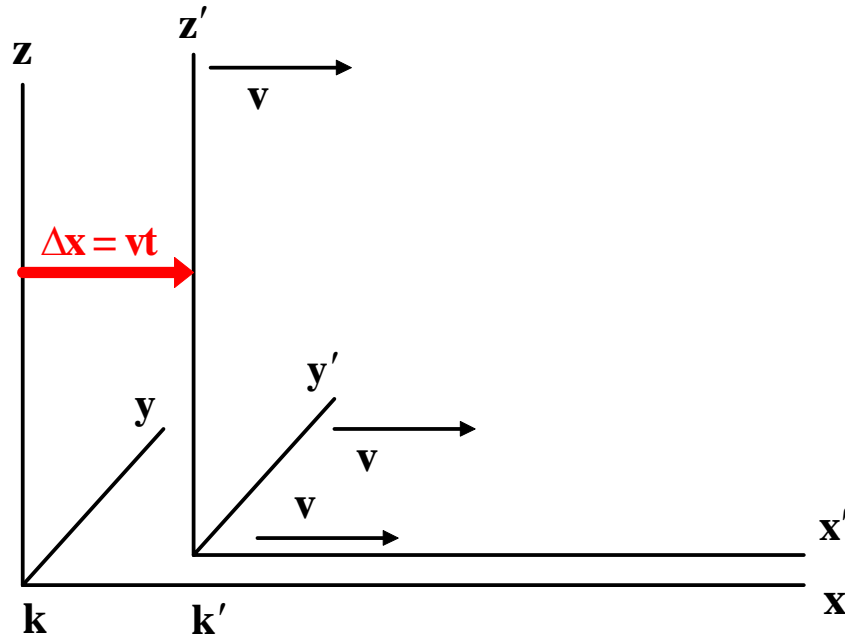


FIGURE 4

There should be no doubt that in the same time t that an event traverses the distance x with respect to k , or the distance x' with respect to k' , then the origin of k' will advance by the separation distance vt with respect to the origin of k .

3. RELATIVISTIC ORIGIN SEPARATION

Now we simply analyze figure 4 with respect to the equations given by Einstein. Even in the relativistic sense, the origin separation distance must be a linear expression as clearly observed in the diagram.

$$\Delta x = x - x', \quad x' = (x - vt)\gamma$$

$$\Delta x = x - (x - vt)\gamma$$

$$\Delta x = x - (x\gamma - vt\gamma)$$

$$\Delta x = x - x\gamma + vt\gamma$$

$$\Rightarrow \Delta x = x(1 - \gamma) + vt\gamma$$

Now we simply reduce this equation even further utilizing the known origin separation distance vt derived previously.

$$\Delta x = x(1 - \gamma) + vt\gamma, \quad \Delta x = vt$$

$$vt = x(1 - \gamma) + vt\gamma$$

$$x(1 - \gamma) = vt - vt\gamma$$

$$x(1 - \gamma) = vt(1 - \gamma)$$

⇒ $x \neq vt$

We know this is only true when the initial condition $x' = 0$ is met. Obviously, there is an error in reasoning with respect to one of the variables associated with the transformations.

4. INERTIAL FRAME LENGTH

Now we simply analyze our spatial separation variables for a potential fault in reasoning.

1. x - This traversed distance is directly measurable by k and is not subject to transformation, with respect to k , due to this fact. This variable is not questionable at this time.
2. x' - This traversed distance is not directly measurable by either k or k' (k' will measure the same distance as it would in a state of rest due to the first postulate of relativity) by any means. This variable thus becomes questionable at this time.
3. Δx - This origin separation distance is directly measurable by both k and k' . This variable is not questionable at this time.

Since the distance x' must be considered questionable due to the verification by direct observation of all other spatial separation variables, then we must portray this distance as an unknown distance δ until such time that this variable is determined.

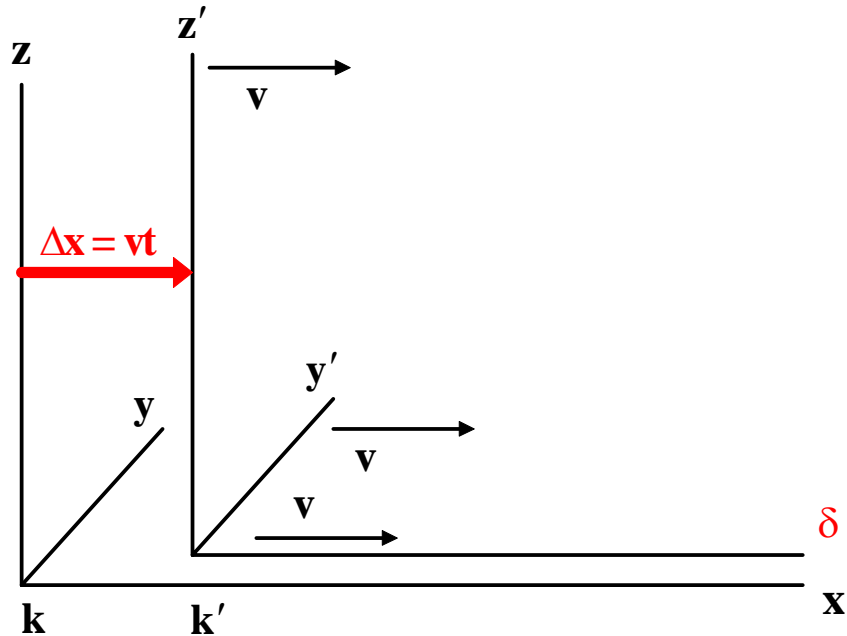


FIGURE 5

Based upon this geometrical relationship, the following linear equation must be true.

$$\Rightarrow \delta = x - vt$$

In order to ascertain this unknown distance, we return again to the first equation of the transformations.

$$x' = (x - vt)\gamma$$

$$x'\gamma^{-1} = x - vt$$

$$\Rightarrow x = x'\gamma^{-1} + vt$$

Therefore, the resulting unknown distance is ascertained as follows:

$$x = x'\gamma^{-1} + vt$$

$$x'\gamma^{-1} = x - vt, \quad \delta = x - vt$$

$$\Rightarrow \delta = x'\gamma^{-1}$$

This leaves us with the resulting geometrical relationship based upon sound observed properties of mechanics.

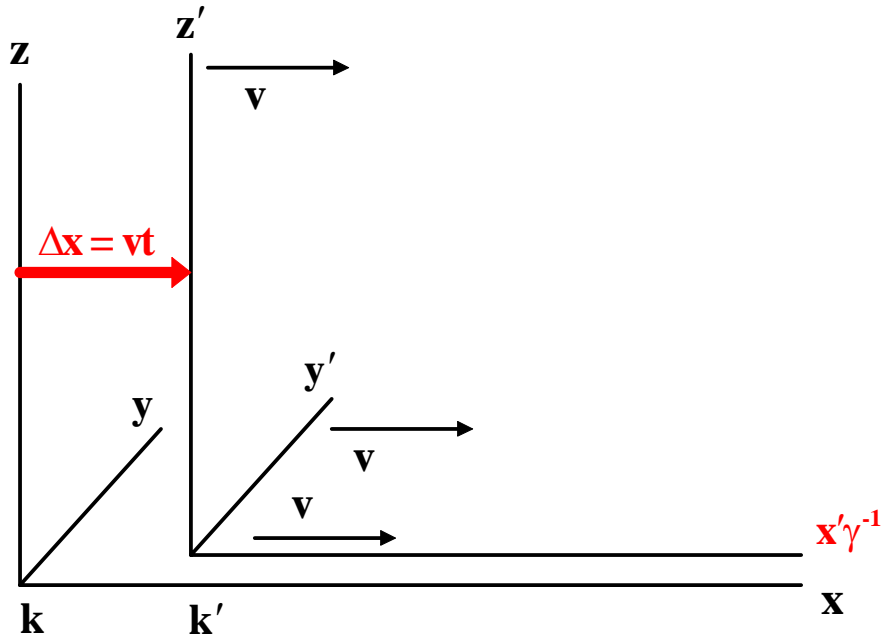


FIGURE 6

This geometrical relationship must be adhered to in accordance with the known and observed fundamental mechanics of motion as discussed previously. This relationship is directly derived from the first equation of the transformations, which gives great credibility to this treatment. We can further justify this inertial frame distance by realizing the fact that Einstein embraces the Lorentz-Fitzgerald contraction within his theory.

$$\Rightarrow \boxed{L = L_0 \gamma^{-1}}$$

The distance L must represent the length with respect to the inertial frame k' by definition, which must correspond to the aforementioned distance with respect to k' . The distance L_0 must represent the length with respect to the inertial frame k while in a state of rest with respect to the rest frame k by definition. We can now form an identity with respect to these known distances.

$$x' \gamma^{-1} = L_0 \gamma^{-1}$$

$$\Rightarrow \boxed{x' = L_0}$$

What this means is that the distance x' originally defined by Einstein as representing the distance with respect to the inertial frame k' is in actuality the distance that the event would travel with respect to k' while k' is actually in a state of rest with respect to k . In order to prove that this is indeed a

fact, we merely return to the original definition of the Lorentz-Fitzgerald contraction.

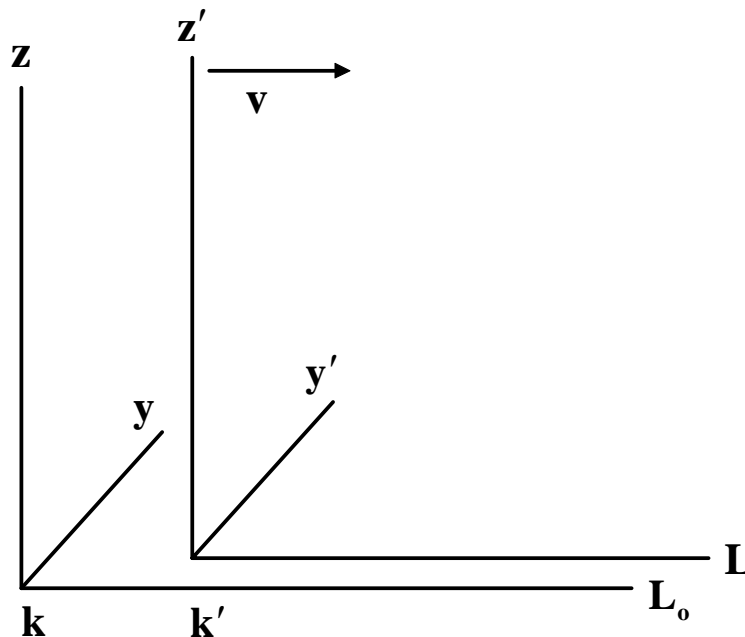


FIGURE 7

As originally defined, a length L_0 defined while in a system k in a state of rest will undergo a Lorentz-Fitzgerald contraction L when this same system k' is in uniform translatory motion. Simple inductive reasoning leads us to the fact that the relationship as defined within figure 6 must be true.

Therefore, the figure contained within 'RELATIVITY: The Special and General Theory' is incorrect and is more precisely defined by figure 6. The variable x' corresponds to the distance that the event would traverse with respect to k' while k' is in a state of rest with respect to k . The resulting distance $x'\gamma^{-1}$ is the distance traversed with respect to k' .

5. RELATIVISTIC TIME

With the relativistic length hereby established, we turn our attention to the description of relativistic time. In accordance with Einstein, the following equation applies for relativistic time interval:

$$\Rightarrow t' = \left(t - \frac{vx}{c^2} \right) \gamma$$

Now we simply return to our previous example by allowing the distance with respect to k' to equal zero ($x' = 0$). This merely changes the event to

that of the reference frames separating vice both frames observing an external event traversing both of their frames of reference.

$$t' = \left(t - \frac{vx}{c^2} \right) \gamma$$

$$t' = t\gamma - \frac{vx}{c^2} \gamma, \quad x = x'\gamma^{-1} + vt$$

$$t' = t\gamma - \frac{v}{c^2} \gamma (x'\gamma^{-1} + vt)$$

$$t' = t\gamma - \frac{vx'}{c^2} - \frac{v^2 t}{c^2} \gamma$$

$$t' = t\gamma \left(1 - \frac{v^2}{c^2} \right) - \frac{vx'}{c^2}$$

$$t' = t\gamma^{-1} - \frac{vx'}{c^2}$$

$$t\gamma^{-1} = t' + \frac{vx'}{c^2}$$

$$t = \left(t' + \frac{vx'}{c^2} \right) \gamma, \quad x' = 0$$

⇒ $t = t'\gamma$

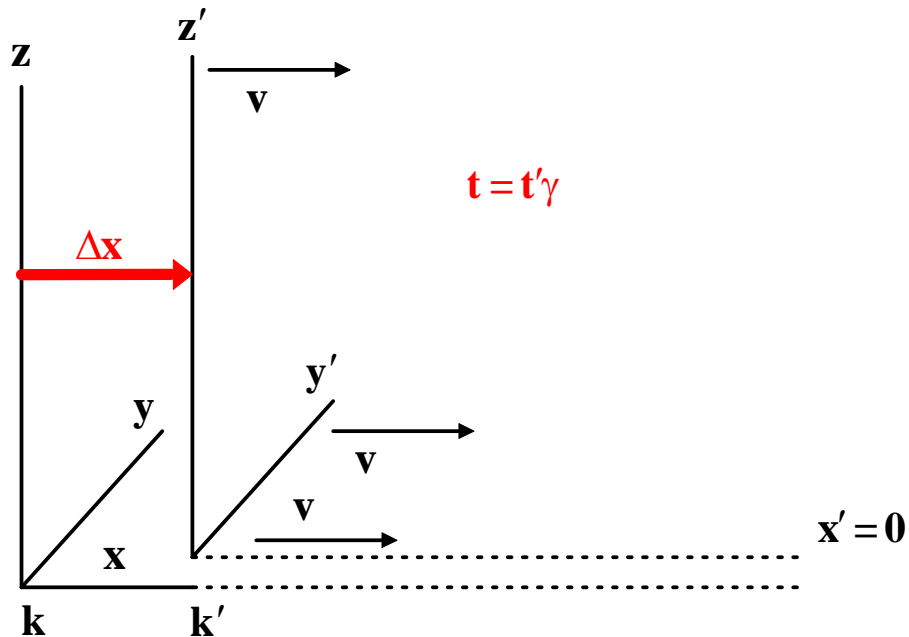


FIGURE 8

This equation was reported by Einstein to represent relativistic time dilation. If we now analyze Einstein's event, the following becomes readily apparent.

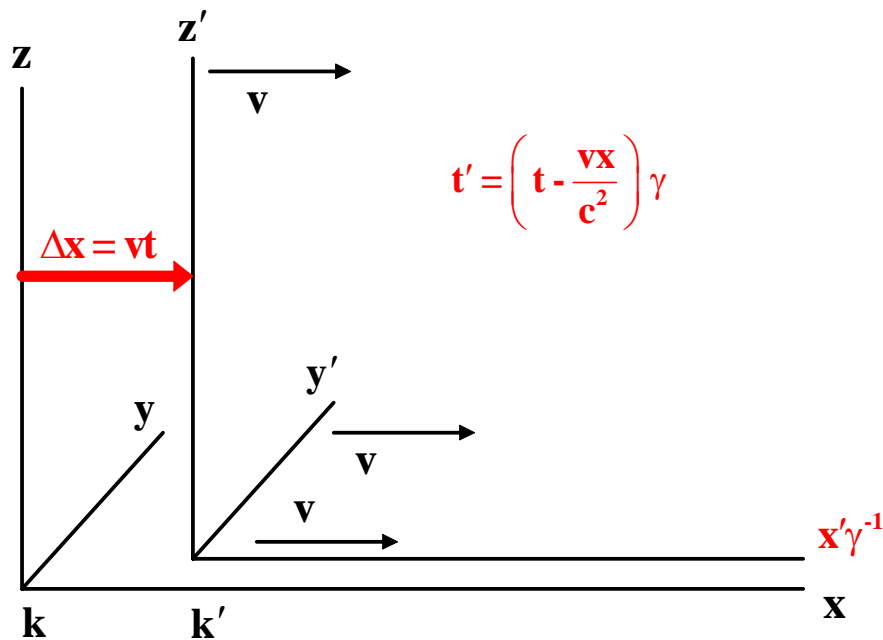


FIGURE 9

The contradiction is now apparent. How can the time span for both these events differ? The only true answer is that they cannot differ since the origin separation event is identical for both scenarios, with the added external event taking part within the identical time span. This proves that the distance variable contained within the relativistic time span equation is an extraneous variable and does not belong on the relativistic description of this event. Determination of the equation lies in evaluating an electromagnetic event.

$$t' = \left(t - \frac{vx}{c^2} \right) \gamma, \quad x = ct$$

$$t' = \left(t - \frac{vct}{c^2} \right) \gamma$$

$$t' = \left(t - \frac{v}{c} t \right) \gamma$$

$$\Rightarrow t' = t \left(1 - \frac{v}{c} \right) \gamma$$

This makes perfect sense due to the fact that relativistic length and time are fundamental physics quantities and must only rely upon the relativistic velocity between reference frames. The event distance does not affect the transformation of time span, as the event distance is what defines the original time variable t only.

6. REALITY TRANSFORMS

Based upon the previous reasoning, the following must now readily be apparent.

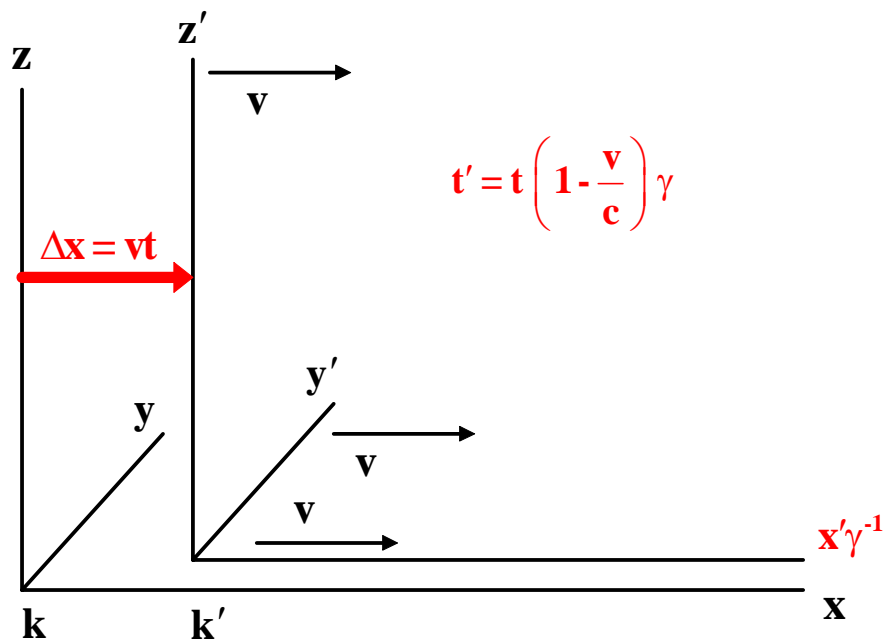


FIGURE 10

This geometrical and mathematical relationship is what is supported by what is observed in reality and is also known to be the fundamental mechanics of Newtonian physics. Failure to comply with this relationship results in a deviation from the accepted Newtonian relationship observed throughout history. This is the true relativistic relationship.

$$\Rightarrow \begin{cases} x' = (x - vt)\gamma \\ y' = y \\ z' = z \\ t' = t\left(1 - \frac{v}{c}\right)\gamma \end{cases}$$
$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

These are the equations which support Newtonian mechanics during low velocities as well as basic mechanical relationships known to be observed in everyday observations.