Inconsistency and Asymmetry in Special Relativity and Lorentz Transformation

Henok Tadesse
Email: *entkidmt@yahoo.com*

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Abstract

We will analyze the problem of light source and observer in relative motion according to Lorentz transformation equations and special relativity postulates and show the asymmetry and internal inconsistency of special relativity and inconsistency with experimental facts. Consider a light source and an observer moving with velocities *u* and *v*, respectively, in inertial reference frame S. Consider two events: emission of a short light pulse by the source and detection of the light pulse by the observer. The conventional procedure is to determine the space and time coordinates of the two events in frame S and use Lorentz transformation equations to determine the coordinates of the same events in the rest frame (S') of the observer, from which, for example, we can determine the time interval between the two events in frame S'. However, we should get the same result (time interval) in another way. In frame S', the source emits the light pulse from some point while moving in that frame. Since, according to the second postulate of special relativity, the velocity of light is constant *c* in all inertial reference frames, independent of source velocity in that frame, the time interval between emission and detection in frame S' can be obtained by dividing the distance of the point of light emission from the observer by the speed of light *c*. In this paper, we show that the two approaches will not give the same time difference between the two events. The actual (incorrect) practice in mainstream physics is to use whichever result agrees with experiments. This asymmetry exists not only for time interval transformations but also for length transformations. Suppose that there is a rod of length L at rest in inertial reference frame S. Reference frames S' and S'' are moving with velocities *v* and *u*, respectively, relative to frame S. The conventional approach to find the length of the rod in frame S'' is to use the Lorentz transformation equations *directly* between S and S''. In this paper we argue that, if there is complete symmetry between frames S, S' and S'', we should be able to get the same length of the rod by first using Lorentz transformations *indirectly*, between S and S' , and then between S' and S''. It is found that this is not the case.

Introduction

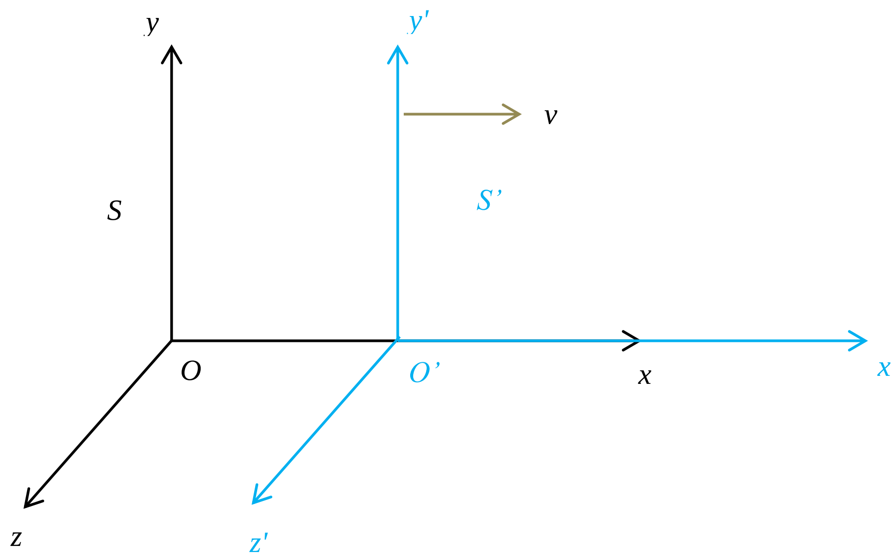
One of the most debated topics regarding the theory of relativity is the application of special relativity theory to the Global Positioning System (GPS) and the Sagnac effect. Different authors have also disclosed the practice in mainstream physics of making adjustments of first order effects observed in the data of a number of experiments, such as the GPS, lunar laser ranging experiments[1] and the Venus planet radar ranging experiment[2]. One wonders how mainstream physicists accept such adjustments as consistent with special relativity theory. However, mainstream physicists have their own arguments. In this paper, we show that these arguments are incorrect and the root cause of the longstanding confusion is the lack of complete symmetry between inertial reference frames of special relativity theory.

Electrical engineer, BSc, Debrezeit, Ethiopia   Mobile: +251 910 751339
or +251 912 228639   Alternate email: *wchmar@gmail.com*

Lorentz Transformations

We briefly review Lorentz transformation equations[3].

Consider two reference frames S and S'. S' moves relative to S in the $+x$ direction with velocity v. The origins of S and S' , which are O and O' respectively, coincide at $t = t' = 0$. An event observed in S' has coordinates (x', y', z', t'). The same event observed in S has coordinates (x, y, z, t).



The Lorentz transformation specifies that these coordinates are related in the following way:

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

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

$$y' = y$$

$$z' = z$$

where

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

Writing the Lorentz transformation and its inverse in terms of coordinate differences, where for instance, one event (Event 1) has coordinates (x_1 , t_1) and (x_1' , t_1') , another event (Event 2) has coordinates (x_2 , t_2) and (x_2' , t_2') , and the differences are defined as:

$$\Delta x' = x_2' - x_1' \quad , \quad \Delta x = x_2 - x_1$$

$$\Delta t' = t_2' - t_1' \quad , \quad \Delta t = t_2 - t_1$$

we get

$$\Delta x' = \gamma \; (\; \Delta x - v \, \Delta t \;) \quad , \quad \Delta x = \gamma \; (\Delta x' + v \, \Delta t' \,)$$

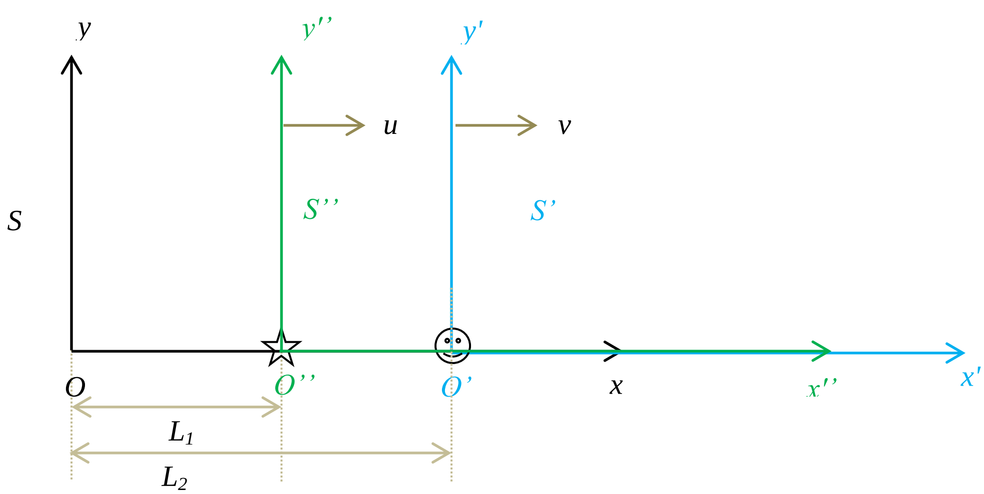
$$\Delta t' = \gamma \left(\Delta t - \frac{v \Delta x}{c^2} \right) \quad , \quad \Delta t = \gamma \left(\Delta t' + \frac{v \Delta x'}{c^2} \right)$$

Light source and observer in relative motion

We analyze the problem of light source and observer in relative motion according to Lorentz transformation equations and special relativity postulates and show the internal inconsistency of special relativity and its inconsistency with experimental facts.

Consider a light source and an observer moving with velocities u and v, respectively, in inertial reference frame S. We consider two events: emission of a short light pulse from the source and detection of the light source by the observer. In general, velocities u and v will not be equal, so the light source will also be moving in the rest frame (S') of the observer. The rest frame of the source is S''. Assume that $v > u$.

At $t = t' = t'' = 0$, the origins of S, S' and S'' coincide. Let the light source emit a short light pulse when the source is at $x = L_1$ and when the observer is at $x = L_2$ in reference frame S. This means that the distance between the source and the observer is equal to $L_2 - L_1$ at the instant of light emission, in frame S.



Now, we have two events:

Event 1 is the emission of light from the source, with coordinates (x_1, y_1), (x_1', y_1'), (x_1'', y_1'') in reference frames S, S' and S'' respectively.

Event 2 is the detection of light by the observer, with coordinates (x_2, y_2), (x_2', y_2'), (x_2'', y_2'') in reference frames S, S' and S'' respectively.

Event 1 in S

Event 1, which is the emission of light, occurs in S frame at:

$$x_1 = L_1$$

$$t_1 = \frac{L_1}{u}$$

Event 1 in frame S'

The coordinates of the same event (light emission) in S' is determined from the Lorentz transformation equations :

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

$$t' = \gamma_v \ (t - \frac{vx}{c^2})$$

By substituting the values of x_1 and t_1 obtained above:

$$x_1' = \gamma_v \ (x_1 - v\, t_1) = \gamma_v \left(L_1 - v \frac{L_1}{u} \right) = -\gamma_v L_1 \,(1 - \frac{v}{u})$$

$$t_1' = \gamma_v \left(t_1 - \frac{v\, x_1}{c^2} \right) = \gamma_v \left(\frac{L_1}{u} - \frac{v * L_1}{c^2} \right) = \gamma_v \, L_1 \,(\frac{1}{u} - \frac{v}{c^2})$$

where

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

Event 1 in frame S''

The coordinates of the same event (light emission) in S'' is determined from the Lorentz transformation equations :

$$x'' = \gamma_u \ (x - ut)$$

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

By substituting the values of x_1 and t_1 obtained above:

$$x_1'' = \gamma_u \left(x_1 - u\, t_1 \right) = \gamma_u \left(L_1 - u \frac{L_1}{u} \right) = 0$$

$$t_1'' = \gamma_u \left(t_1 - \frac{u\, x_1}{c^2} \right) = \gamma_u \left(\frac{L_1}{u} - \frac{u * L_1}{c^2} \right) = \gamma_u\, L_1 \left(\frac{1}{u} - \frac{u}{c^2} \right)$$

where

$$\gamma_u = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}}$$

<u>Event 2 in frame S</u>

To determine the time delay of light to catch up with the observer in reference frame S, we proceed as follows.

During the time interval that the observer moves distance δ to the right, the light travels a distance of:

$$L_2 + \delta\,.$$

From which,

$$\frac{\delta}{v} = \frac{L_2 + \delta}{c} \quad \Longrightarrow \quad \delta = L_2 \frac{v}{c - v}$$

and the time delay of light in frame S will be:

$$\frac{\delta}{v} = \frac{L_2 \frac{v}{c - v}}{v} = \frac{L_2}{c - v}$$

Therefore,

$$x_2 = L_2 + \delta = L_2 + L_2 \frac{v}{c - v} = L_2 \frac{c}{c - v}$$

and

$$t_2 = t_1 + \frac{\delta}{v} = \frac{L_1}{u} + \frac{L_2}{c - v}$$

Event 2 in frame S'

The same event, that is detection of light by the observer, occurs at (x_2', t_2') in frame S'.

We determine x_2' and t_2' from the Lorentz transformation equations.

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

$$t' = \gamma_v (t - \frac{vx}{c^2})$$

Substituting the values of x_2 and t_2 obtained above:

$$x_2' = \gamma_v (x_2 - v\, t_2) = \gamma_v \left(L_2 \frac{c}{c-v} - v \left(\frac{L_1}{u} + \frac{L_2}{c-v} \right) \right)$$

$$= \gamma_v \left(L_2 - \frac{vL_1}{u} \right)$$

$$\Longrightarrow x_2' = \gamma_v (L_2 - vt_1) = \gamma_v (L_2 - L_2) = 0$$

$$t_2' = \gamma_v \left(t_2 - \frac{v\, x_2}{c^2} \right) = \gamma_v \left(\left(\frac{L_1}{u} + \frac{L_2}{c-v}\right) - \frac{v\, L_2 \frac{c}{c-v}}{c^2} \right) = \gamma_v \left(\frac{L_1}{u} + \frac{L_2}{c} \right)$$

Event 2 in frame S''

The same event, that is detection of light by the observer, occurs at (x_2'', t_2'') in frame S''.

We determine x_2'' and t_2'' from the Lorentz transformation equations.

$$x'' = \gamma_u (x - ut)$$

$$t'' = \gamma_u (t - \frac{ux}{c^2})$$

Substituting the values of x_2 and t_2 obtained above:

$$x_2'' = \gamma_u (x_2 - u\, t_2) = \gamma_u \left(L_2 \frac{c}{c-v} - u \left(\frac{L_1}{u} + \frac{L_2}{c-v}\right) \right) = \gamma_u \left(L_2 \frac{c-u}{c-v} - L_1 \right)$$

$$t_2'' = \gamma_u \left(t_2 - \frac{u\, x_2}{c^2} \right) = \gamma_u \left(\left(\frac{L_1}{u} + \frac{L_2}{c-v}\right) - \frac{u\, L_2 \frac{c}{c-v}}{c^2} \right) = \gamma_u \left(\frac{L_1}{u} + L_2 \frac{c-u}{c(c-v)} \right)$$

Inconsistency and asymmetry in special relativity and Lorentz transformations

The time interval between Event 1 and Event 2 , that is between emission and detection of the light, in the rest frame (S') of the observer will be:

$$\Delta t' = t_2{}' - t_1{}' = \gamma_v \left(\left(\frac{L_1}{u} + \frac{L_2}{c} \right) - L_1 \left(\frac{1}{u} - \frac{v}{c^2} \right) \right) = \gamma_v \left(\frac{L_2}{c} + L_1 \frac{v}{c^2} \right)$$

But we should get the same value of $\Delta t'$ above if we consider the light source in reference frame S'. According to the second postulate of special relativity, the speed of light in any inertial reference frame is constant *c* independent of the velocity of the source in that frame.

In frame S', the light source is at:

$$x_1{}' = -\gamma_v L_1 \left(1 - \frac{v}{u} \right)$$

at the instant of light emission and moving in the $-x'$ direction. According to the second postulate of special relativity, the speed of light in any inertial reference frame is constant *c*, independent of the velocity of the source in that frame. So the time delay of light between emission and detection of light in S' is:

$$\Delta t' = \frac{the\ distance\ of\ the\ point\ where\ light\ was\ emitted\ from\ the\ observer}{speed\ of\ light}$$

$$\Delta t' = \frac{x_2{}' - x_1{}'}{c} = \frac{0 - \left(-\gamma_v L_1 \left(1 - \frac{v}{u} \right)\right)}{c} = \gamma_v \frac{L_1}{c} \left(1 - \frac{v}{u} \right)$$

We can see that the values of $\Delta t'$ obtained by the two approaches do not agree. This is an internal inconsistency and asymmetry of special relativity and Lorentz transformation equations.

Asymmetry in Lorentz transformations of lengths

So far we have seen the inconsistency/asymmetry of time interval transformations. This asymmetry can also be shown for length transformations. Suppose we have three inertial reference frames, S, S' and S''. S' and S'' are moving with velocities *u* and *v* , respectively, relative to S.

Suppose that two events happen simultaneously in frame S and the distance between the two events in frame S is L. The two events can be thought of as flashing of lights from the ends of a rod of length L that is at rest in frame S. The coordinates of the two events in frame S are (x_1, t_1), (x_2, t_2) , where $x_2 - x_1 = L$ and $t_1 = t_2$.

Event 1 in frame S

The coordinates of Event 1 in S are :

$$x = x_1 \qquad t = t_1$$

Event 1 in frame S'

The coordinates of Event 1 in frame S' is determined from the Lorentz transformation equations:

$$x' = \gamma_v \, (x - vt)$$

$$t' = \gamma_v \, (t - \frac{vx}{c^2})$$

By substituting x_1 and t_1:

$$x_1{}' = \gamma_v \, (x_1 - v\, t_1)$$

$$t_1{}' = \gamma_v \left(t_1 - \frac{v\, x_1}{c^2} \right)$$

Event 1 in frame S''

The coordinates of Event 1 in frame S' is determined from the Lorentz transformation equations:

$$x'' = \gamma_u \, (x - ut)$$

$$t'' = \gamma_u \, (t - \frac{ux}{c^2})$$

By substituting x_1 and t_1:

$$x_1{}'' = \gamma_u \, (x_1 - u\, t_1)$$

$$t_1{}'' = \gamma_u \left(t_1 - \frac{u\, x_1}{c^2} \right)$$

Event 2 in frame S

The coordinates of Event 2 in S are :

$$x = x_2 \qquad t = t_2$$

Event 2 in frame S'

The coordinates of Event 2 in frame S' is determined from the Lorentz transformation equations:

$$x' = \gamma_v \, (x - vt)$$

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

By substituting x_2 and t_2:

$$x_2' = \gamma_v \left(x_2 - v\, t_2 \right)$$

$$t_2' = \gamma_v \left(t_2 - \frac{v\, x_2}{c^2} \right)$$

Event 2 in frame S''

The coordinates of Event 2 in frame S'' is determined from the Lorentz transformation equations:

$$x'' = \gamma_u \left(x - ut \right)$$

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

By substituting x_2 and t_2:

$$x_2'' = \gamma_u \left(x_2 - u\, t_2 \right)$$

$$t_2'' = \gamma_u \left(t_2 - \frac{u\, x_2}{c^2} \right)$$

Now let us consider the distance between the two events (length of the rod) in frame S''.

$$\Delta x'' = x_2'' - x_1'' = \gamma_u \left(x_2 - u\, t_2 \right) - \gamma_u \left(x_1 - u\, t_1 \right)$$

$$\Longrightarrow \Delta x'' = \gamma_u \left(x_2 - x_1 \right) - u\, \gamma_u \left(t_2 - t_1 \right)$$

Since $x_2 - x_1 = L$ and $t_1 = t_2$

$$\Longrightarrow \Delta x'' = \gamma_u L - u\, \gamma_u * 0 = \gamma_u L$$

Now we should get the same value of $\Delta x''$ above if we use Lorentz transformation *indirectly*, between frame S' and frame S''. Reference frame S'' is moving with velocity $w = u - v$ relative to reference frame S'. So we use the relative velocity w in the Lorentz transformations between S' and S''.

The coordinates of Event 1 in frame S', as determined above are:

$$x_1' = \gamma_v \left(x_1 - v\, t_1 \right)$$

$$t_1{}' = \gamma_v \left(t_1 - \frac{v\, x_1}{c^2} \right)$$

The coordinates of the same event (Event 1) in frame S'' will be:

$$x_1{}'' = \gamma_w \left(x_1{}' - w\, t_1{}' \right) = \gamma_w \left(\gamma_v \left(x_1 - v\, t_1 \right) - w\, \gamma_v \left(t_1 - \frac{v\, x_1}{c^2} \right) \right)$$

$$\Rightarrow x_1{}'' = \gamma_w\, \gamma_v \left(\left(x_1 - v\, t_1 \right) - w \left(t_1 - \frac{v\, x_1}{c^2} \right) \right)$$

$$\Rightarrow x_1{}'' = \gamma_w\, \gamma_v \left(x_1 \left(1 + \frac{v\, w}{c^2} \right) - t_1 \left(v + w \right) \right)$$

where

$$\gamma_w = \frac{1}{\sqrt{1 - \frac{w^2}{c^2}}} = \frac{1}{\sqrt{1 - \frac{(u - v)^2}{c^2}}}$$

and

$$t_1{}'' = \gamma_w \left(t_1{}' - \frac{w\, x_1{}'}{c^2} \right) = \gamma_w \left(\gamma_v \left(t_1 - \frac{v\, x_1}{c^2} \right) - \frac{w\, \gamma_v \left(x_1 - v\, t_1 \right)}{c^2} \right)$$

$$\Rightarrow t_1{}'' = \gamma_w\, \gamma_v \left(\left(t_1 - \frac{v\, x_1}{c^2} \right) - \frac{w \left(x_1 - v\, t_1 \right)}{c^2} \right)$$

$$\Rightarrow t_1{}'' = \gamma_w\, \gamma_v \left(t_1 \left(1 + \frac{w\, v}{c^2} \right) - x_1 \frac{(v + w)}{c^2} \right)$$

$$\Rightarrow t_1{}'' = \gamma_w\, \gamma_v \left(t_1 \left(1 + \frac{(u - v)\, v}{c^2} \right) - x_1 \frac{u}{c^2} \right)$$

The coordinates of Event 2 in frame S', as determined above are:

$$x_2{}' = \gamma_v \left(x_2 - v\, t_2 \right)$$

$$t_2{}' = \gamma_v \left(t_2 - \frac{v\, x_2}{c^2} \right)$$

The coordinates of the same event (Event 2) in frame S'' will be:

$$x_2{}'' = \gamma_w \left(x_2{}' - w\, t_2{}' \right) = \gamma_w \left(\gamma_v \left(x_2 - v\, t_2 \right) - w\, \gamma_v \left(t_2 - \frac{v\, x_2}{c^2} \right) \right)$$

$$\Rightarrow x_2{}'' = \gamma_w\, \gamma_v \left(\left(x_2 - v\, t_2 \right) - w \left(t_2 - \frac{v\, x_2}{c^2} \right) \right)$$

$$\Rightarrow x_2'' = \gamma_w \gamma_v \left(x_2 \left(1 + \frac{v\,w}{c^2} \right) - t_2 (v + w) \right)$$

and

$$t_2'' = \gamma_w \left(t_2' - \frac{w\,x_2'}{c^2} \right) = \gamma_w \left(\gamma_v \left(t_2 - \frac{v\,x_2}{c^2} \right) - \frac{w\,\gamma_v\ (x_2 - v\,t_2)}{c^2} \right)$$

$$\Rightarrow t_2'' = \gamma_w \gamma_v \left(\left(t_2 - \frac{v\,x_2}{c^2} \right) - \frac{w\ (x_2 - v\,t_2)}{c^2} \right)$$

$$\Rightarrow t_2'' = \gamma_w \gamma_v \left(t_2 \left(1 + \frac{w\,v}{c^2} \right) - x_2 \frac{(v+w)}{c^2} \right)$$

$$\Rightarrow t_2'' = \gamma_w \gamma_v \left(t_2 \left(1 + \frac{(u-v)\,v}{c^2} \right) - x_2 \frac{u}{c^2} \right)$$

Now, the distance between the two events in reference frame S'' will be:

$$\Delta x'' = x_2'' - x_1''$$

$$\Delta x'' = \gamma_w \gamma_v \left(x_2 \left(1 + \frac{v\,w}{c^2} \right) - t_2 (v + w) \right) - \gamma_w \gamma_v \left(x_1 \left(1 + \frac{v\,w}{c^2} \right) - t_1 (v + w) \right)$$

$$\Delta x'' = \gamma_w \gamma_v \left(\left(1 + \frac{v\,w}{c^2} \right) (x_2 - x_1) - (v + w)\,(t_2 - t_1) \right)$$

$$\Delta x'' = \gamma_w \gamma_v \left(\left(1 + \frac{v\,w}{c^2} \right) L - (v + w) * 0) \right)$$

$$\Delta x'' = \gamma_w \gamma_v \left(\left(1 + \frac{v\,w}{c^2} \right) L \right) = \gamma_w \gamma_v L \left(1 + \frac{v\,w}{c^2} \right)$$

The *Δx''* above, which is the length of the rod as transformed from S to S' then to S'' is more complicated and different from the length of the rod transformed directly from S to S'', which is, as calculated already in this paper:

$$\Delta x'' = \gamma_u L$$

Leading to the contradiction

$$\Delta x'' \neq \Delta x''$$

$$\gamma_w \gamma_v L \left(1 + \frac{v\,w}{c^2} \right) \neq \gamma_u L$$

Alternative theory

In the past, many authors have disclosed the logical inconsistencies of the theory of special relativity and the Lorentz transformations. The very principle of relativity has also been disproved in a number of ‘ether’ drift experiments, such as the Miller, the Marinov, the Silvertooth and several other experiments.

Although there are so many logical and experimental evidences against special relativity, to this date, there is no known theoretical model of the speed of light that is fully consistent with experiments. The problem is not only the lack of a correct model of the speed of light; mainstream physicists do not believe in the failure of relativity theory and the need for a new model.

This author has proposed a new theory called Apparent Source Theory (AST) in a number of papers [4][5][6]. Apparent Source Theory is consistent with (or, has the potential to consistently explain) the Michelson-Morley, the Kennedy-Thorndike, the Silvertooth, the Marinov, the Bryan G Wallace, the Sagnac and other experiments. No single known theory has achieved this so far. Conventional theories such as ether theories, emission theories and the special relativity theory have decisively failed on more than one experiments.

An extensive explanation of Apparent Source Theory is found in [4][5][6].

Conclusion

There have been long standing confusions regarding the applications of special relativity theory and the Lorentz transformation equations, such as to the Global Positioning System, the Sagnac effect, stellar aberration and moving source experiments. In this paper we have disclosed the root cause of these confusions as lack of complete symmetry between the inertial reference frames of special relativity. We have argued that, if we have three inertial reference frames, S, S’ and S’’ in relative motion, complete symmetry between these frames requires that the coordinates of an event in S’’ be obtained:

1. Either by *directly* by using Lorentz transformation between S and S’’

2. Or by using Lorentz transformation *indirectly*, between S and S’, and then between S’ and S’’.

Symmetry requires that the coordinates of the event in S’’ obtained using both approaches be the same. We have shown that this is not the case.

Thanks to Almighty God Jesus Christ and His Mother Our Lady Saint Virgin Mary

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