Derivation of Special Theory of Relativity from Absolute Inertial Reference Frame: Michelson-Morley Experiment, Lorentz Contraction, Transverse Doppler Red-Shift, Time Dilation

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October 8th, 2013

Abstract

This paper presents an innovating way of deriving the special theory of relativity (SR). This paper proposes that, contrary to the popular belief, the SR is derived from the absolute inertial reference frame (AIRF). In other words, the AIRF exists and can be found. To validate the derivation, this paper uses the AIRF to explain Michelson-Morley experiment, Lorentz contraction, transverse Doppler red-shift, and time dilation. Then most importantly, a method of finding the AIRF will be revealed by examining the effect of simultaneity on the wave phases observed by a moving inertial frame.

Introduction

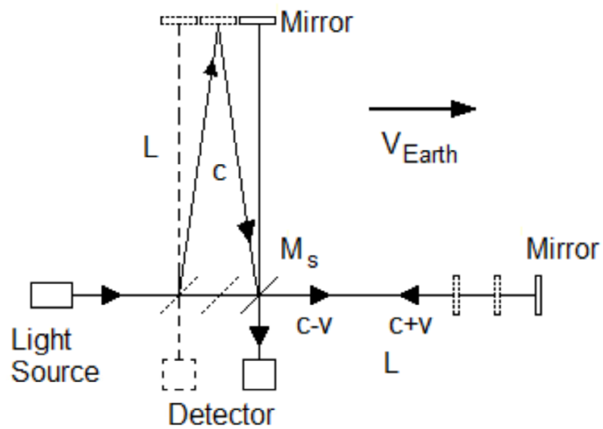
For a long time, people believed the existence of the AIRF. Sir Isaac Newton theorized the existence of AIRF, calling it the Sensorium Dei -- "God's sensory organ" (Rindler 2009:5). Then came the advent of Einstein's SR, which negated the very existence of the AIRF (Griffiths 1989:449). Some of many experimental evidences that support the SR are Michelson-Morley experiment, Lorentz contraction, transverse Doppler red-shift, and time dilation. Nevertheless, in my previous paper, the question on the existence of the AIRF has been brought back to life (Lee 2013). In this paper, I will explore further consequences of the AIRF by deriving SR as a surprising result of the AIRF, and come up with a new method of finding the AIRF.

First, Michelson-Morley experiment will be analyzed in context of the AIRF by using Lorentz contraction. Then, the Lorentz contraction will be used to derive the transverse Doppler red-shift and subsequently time dilation. Therefore, SR will be derived from the AIRF. Ultimately, the effect of simultaneity on the wave phases of two expanding light wave fronts observed by a moving inertial frame will be examined to find the AIRF.

Methods

Michelson-Morley experiment

For many years, people tried to detect the AIRF using Michelson interferometer in a hope to observe a supposed change in the speed of light as shown below in Figure 1 (Serway 1990:1107). The outcome of this well known experiment was the null result, which inspired Einstein to introduce the SR (Griffiths 1989:449).



Serway 1990:1107; Figure 1
Michelson-Morley experiment setup is moving with Earth.

Figure 1 depicts the experiment setup where a single incoming beam of light is split into two by the splitter mirror M_s of the interferometer. One of the split beam continues traveling horizontally in a longitudinal direction; the other vertically in a transverse direction. Next, these two beams are reflected back to their splitting point, where they merge and travel to the detector where the supposed fringe shift would be measured.

The experiment was trying to measure the effect of the time difference between the round trip time of the horizontal beam, t_h, and the round trip time of the vertical beam, t_v (Serway 1990:1109).

$$t_h = L/(c-v) + L/(c+v) = 2Lc/(c^2-v^2) = 2L/c(1-v^2/c^2) = \gamma^2\ 2L/c$$ (Serway 1990:1108; Equation 1)

$$t_v = 2L/(c^2-v^2)^{1/2} = 2L/c(1-v^2/c^2)^{1/2} = \gamma\ 2L/c$$ (Serway 1990:1108; Equation 2)

where

t_h = total round trip time along the horizontal path

t_v = total round trip time along the vertical path

L = horizontal length or vertical length from the splitter to the reflecting mirror.

c = speed of light

v = velocity of Earth
$\gamma = 1/(1 - v^2/c^2)^{1/2}$ = Lorentz factor

Fitzgerald and Lorentz tried to explain why the experiment had the null result, by introducing an assumption of Lorentz contraction of a moving object along the direction of the uniform rectilinear motion by a factor of $(1-v^2/c^2)^{1/2}$ (Serway 1990:1109). In such case, they showed that the horizontal light would take shorter time to make the round trip as calculated below, and consequently, the time difference would become zero -- thus, explaining the null result of the experiment.

$$t_{h\ contracted} = [2L/c(1-v^2/c^2)]\ (1-v^2/c^2)^{1/2} = 2L/c(1-v^2/c^2)^{1/2} = \gamma\ 2L/c \qquad \text{(Equation 3)}$$

Unfortunately, their assumption of Lorentz contraction has been considered to be only an improvised postulation (Serway 1990:1109), despite Lorentz's attempt to justify it based on the known contraction of electromagnetic field of a moving charge (Rindler 2009:10). And although their theory included all of the Einstein's basic findings and it was equivalent to the SR in terms of calculation, it did not convince people at the end (Rindler 2009:11).

Lorentz Contraction

At this point, I would like to revitalize this Lorentz-Fitzgerald theory with my new findings.

In my previous paper, I have discussed Gjurchinovski's paper where he analyzed a reflection of light from a uniformly moving mirror, and how he derived the Lorentz contraction by utilizing Huygen's construction in conjunction with the postulates of the SR (Gjurchinovski 2004). Then, I interpreted his paper without referring any of the SR postulates, to state how the analysis of the moving mirror would also result in validating the Lorentz contraction in the context of the AIRF (Lee 2013).

This is important because it means that the Lorentz contraction in the AIRF is no longer just an ad-hoc assumption, but a derived conclusion.

To summarize, the AIRF leads to the Lorentz contraction. And the Lorentz contraction explains the null result of the experiment. Therefore, Michelson-Morley experiment can also be used to support the existence of the AIRF; the experiment does not disprove the AIRF.

Time Dilation (Derivation Attempt)

Next, let us see how the Lorentz contraction leads to time dilation. Notice how in Equation 2 and Equation 3, the round trip time in both horizontal (longitudinal) and vertical (transverse) directions are delayed by Lorentz factor γ -- similar to how in the SR, the time is dilated by the same Lorentz factor γ.

Unfortunately, although these two time dilations are similar with each other, they are not exactly the same. That is because the time dilation from Equation 3 is for the horizontal round trip where the speed of light differs in the forward and backward directions.

However, this issue can be resolved once we consider the Doppler red-shift, which we will derive purely from the AIRF and Lorentz contraction in the upcoming section.

Doppler Red-Shift Review

Before continuing with our derivation, let us first review how the Doppler red-shift works in Einstein's SR. According to the SR, the equation of the Doppler shift can be written as follows:

$$f_s/f = (1 + v_h/c) / (1 - v^2/c^2)^{1/2}$$ (Rindler 2009:79; Equation 4)

where
f_s = source frequency of the stationary light
f = observed frequency of the moving light source
v = observed velocity of the moving light source
v_h = horizontal (longitudinal) component of the observed velocity to the observer located at the origin
c = speed of light

Substitute $v_h = v \cos\theta$, and convert frequency into wavelength, then the equation becomes:

$$\lambda/\lambda_s = \gamma\,(1 + v_h/c) = \gamma\,(1 + v\cos\theta/c)$$ (Equation 5)

where
λ_s = source wavelength of the stationary light
λ = observed wavelength of the moving light source
v = observed velocity of the moving light source
θ = angle between the observed velocity and the longitudinal direction to the light source at emission
$\gamma = 1/(1 - v^2/c^2)^{1/2}$ = Lorentz factor

This is very similar to the classical Doppler shift shown below:

$$\lambda/\lambda_s = 1 + v_h/c$$ (Sher 1968:106; Equation 6)

The only difference between the relativistic Doppler shift (Equation 5) and the classical Doppler shift (Equation 6) is that the relativistic Doppler shift contains the Lorentz factor γ, which is contributed to the time dilation factor (Sher 1968).

This Lorentz factor in the relativistic Doppler shift produces an additional red-shift on top of the classical Doppler shift, and this red-shift is used as a proof for time dilation of the SR because it has no counterpart in classical theory (Rindler 2009:80; Sher 1968).

<u>Longitudinal Doppler Red-shift</u>

Now, let us get back to our derivation and derive the longitudinal Doppler red-shift (when θ = 0° or θ = 180°) using only the AIRF and Lorentz contraction, without referring the SR.

There are two cases that need to be considered for this derivation:
1. when the light source is stationary and the observer is moving, and
2. when the light source is moving and the observer is stationary.

<u>Longitudinal Doppler Red-shift: Case #1</u>

Let us consider the case #1, where a moving observer observes a stationary light source, as shown below.

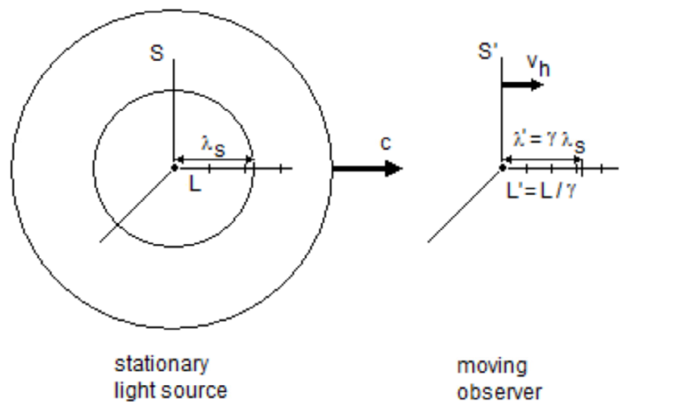


Figure 2

An observer moves away from a stationary light source with the velocity v_h.

Figure 2 depicts a light source in the stationary inertial frame S emitting a wavelength of λ_s (when measured by S). The length in the stationary inertial frame is measured with a measuring stick of the length L. The stationary inertial frame measures the wave front of the light to be moving with the speed of light, c. The stationary inertial frame measures an observer moving horizontally away from the light source with the velocity, v_h. The moving inertial frame S' of the observer experiences the Lorentz contraction along its longitudinal (horizontal) direction -- the measuring stick of the length, L, would become shorter as L/γ in the moving inertial frame. This in turn would cause the moving inertial frame to measure the same wavelength to become longer as $\gamma\lambda_s$.

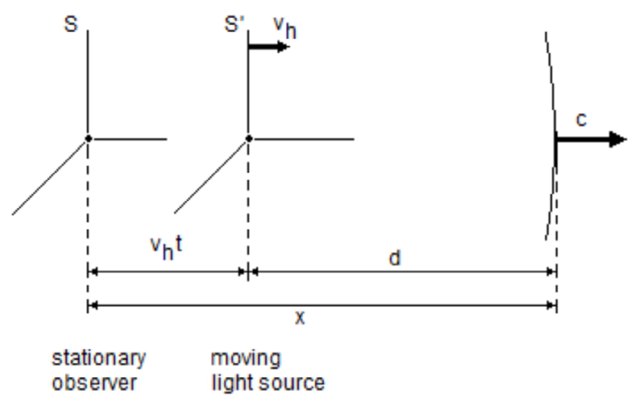
The inertial frame S' of the moving observer experiences the Lorentz contraction along the longitudinal direction. This means the measuring stick of the moving observer becomes physically shorter than the measuring stick of the same length of the stationary light source by Lorentz factor γ. Consequently, any longitudinal length measured in the stationary inertial frame S, is going to be longer when measured by the moving observer. Since the wavelength is measured to be λ_s by the stationary light source, the moving observer would measure the same wavelength to be longer as in $\gamma\lambda_s$ due to its shortened measuring stick.

Apply this length factor to the observed wavelength in Equation 6 of the classical Doppler shift, and we get the exactly the same equation as Equation 5 of the relativistic Doppler shift.

Therefore, the longitudinal Doppler red-shift has been derived for the case #1 using only the Lorentz contraction in the AIRF, without referring any of the SR postulates. Also, note that unlike the SR, the Doppler red-shift has been derived from the Lorentz contraction, not from time dilation.

Longitudinal Doppler Red-shift: Case #2

Next, let us consider the case #2, where a stationary observer observes a moving light source as shown below.



Griffiths 1989:461; Figure 3

A light source moves away from a stationary observer with the velocity v_h.

Figure 3 depicts a moving light source in the inertial frame S' emitting a wavelength of λ_s (when measured by S'). A stationary observer in the inertial frame S measures the wave front of the light moving with the speed of light, c. The stationary observer measures the light source moving horizontally away from with the velocity, v_h. At time t=0, these two inertial frames coincided at their origins.

In order to derive the longitudinal Doppler shift, first we need to figure out how the position in the horizontal (longitudinal) axis would get transformed between S and S'. The transformation equation can be obtained in the same manner as how the SR obtains the Lorentz transformation.

From Figure 3, we see:

$x = d + v_h t$ (Griffiths 1989:460; Equation 7)

where
x = distance measured by S, between the stationary observer and the wave front of the light
d = distance measured by S, between the moving light source and the wave front of the light
v_h = horizontal velocity of the moving light source measured by S
t = time measured by S
c = speed of light, measured by S

We can express d in term of x' by taking into account of Lorentz contraction as shown below:

$d = x' / \gamma$ (Griffiths 1989:461; Equation 8)

where
x' = distance measured by S', between the light source and the wave front of the light
$\gamma = 1/(1 - v^2/c^2)^{1/2}$ = Lorentz factor

Substitute Equation 8 into Equation 7, and we get the usual Lorentz transformation of the longitudinal axis as shown below:

$x' = \gamma (x - v_h t)$ (Griffiths 1989:461; Equation 9)

Next, use x = ct to solve this equation algebraically for x:

$$x' = \gamma (x - v_h t) = \gamma (x - v_h x/c) = x \gamma (1 - v_h/c)$$

$$\begin{aligned} x &= x' / \gamma (1 - v_h/c) = x' (1 - v_h^2/c^2)^{1/2} / (1 - v_h/c) = x' (1 - v_h/c)^{1/2} (1 + v_h/c)^{1/2} / (1 - v_h/c) \\ &= x' (1 + v_h/c)^{1/2} / (1 - v_h/c)^{1/2} = x' (1 + v_h/c)^{1/2} (1 + v_h/c)^{1/2} / (1 - v_h/c)^{1/2} (1 + v_h/c)^{1/2} \\ &= x' (1 + v_h/c) / (1 - v_h^2/c^2)^{½} \\ &= x' \gamma (1 + v_h/c) \end{aligned} \quad \text{(Equation 10)}$$

Remember: x' is the distance measured by the moving light source, S'. And S' observes the light source to be stationary in its inertial frame. If the light source emits a light with the wavelength, λ_s, then the stationary observer in S would measure the wavelength as follows:

$$\therefore \lambda/\lambda_s = \gamma (1 + v_h/c) \quad \text{(Equation 11)}$$

where
λ_s = source wavelength of the moving light source in S'
λ = observed wavelength of the moving light source in S

Once again, this is the exactly the same as Equation 5 of the relativistic Doppler shift.

Therefore, the longitudinal Doppler red-shift has been derived for the case #2 using only the

Lorentz contraction in the AIRF, without referring any of the SR postulates. Again, note that unlike the SR, the Doppler red-shift has been derived from the Lorentz contraction, not from time dilation.

Transverse Doppler Red-Shift

Now that we have derived the mechanisms for the longitudinal Doppler red-shift, the derivation of the transverse Doppler red-shift (when $\theta = 90°$ or $\theta = 270°$) is straightforward when we consider the fact that the stationary observer observes the wave front of the light emitted from the moving light source to be expanding in a spherical shape with its center located at the retarded position of the moving source at the time of emission (Griffiths 1989:427).

The relationship between the wavelength and the frequency of light is:

$$c = \lambda f$$ (Serway 1990:465; Equation 12)

where
c = speed of light
λ = wavelength of light
f = frequency of light

Because both the longitudinal light and the transverse light share the same light source, their frequencies are the same. And because both the longitudinal wave front and the transverse wave front traveled the same distance within the same time, their speeds are the same. Consequently, it means their wavelengths are the same, according to Equation 12. Thus, if the longitudinal wavelength became longer (red-shifted), then the transverse wavelength must have become red-shifted, too.

Therefore, the transverse Doppler red-shift has been derived using only the Lorentz contraction in the ARIF, without referring any of the SR postulates. Once more, unlike the SR, the Doppler red-shift is contributed by the Lorentz contraction, not by time dilation.

Time Dilation

At this point, we are ready to derive time dilation for the AIRF.

First, as previously mentioned, Equation 2 shows how time dilation occurs in the AIRF in the transverse direction. In fact, this is practically the exact same method used by Einstein in deriving time dilation for the SR (Serway 1990:1114) -- it's just that in the SR, the transverse time dilation is applied to the entire inertial frame, including the longitudinal direction.

In the AIRF, however, we still need to specifically derive time dilation in the longitudinal direction. This can be done by considering Equation 12 and the longitudinal Doppler red-shift.

To recap, the longitudinal wavelength from the moving light source is increased by Lorentz factor γ. Because the speed of the light does not change for the stationary observer in S, it means the frequency of the light must have been decreased by the same Lorentz factor γ as shown below.

$$c = \gamma\lambda_s f_s/\gamma \qquad \text{(Equation 13)}$$

where
c = speed of light observed by the stationary observer in S
λ_S = source wavelength of the moving light source in S'
f_S = source frequency of the moving light source in S'

Isolating the frequency relationship from the above equation shows:

$$f = f_s/\gamma \qquad \text{(Equation 14)}$$

where
f = observed frequency of the moving light source in S
f_S = source frequency of the moving light source in S'

And since the frequency is an inverse of the time period, we can derive the time dilation as follows:

$$t = \gamma\, t_s \qquad \text{(Equation 15)}$$

where
t = time observed in the stationary inertial frame S
t_S = time observed in the moving inertial frame S'

Thus, it proves that time dilation occurs in the AIRF in the longitudinal direction, too.

When we combine time dilation in both the longitudinal and transverse directions, we end up with time dilation for the AIRF, just like Einstein's time dilation for the SR.

Therefore, time dilation occurs in the AIRF in the same manner as the SR, that the moving clock runs slower by Lorentz factor γ when compared to the stationary clock.

<u>Derivation of SR from AIRF</u>

Thus far, it has been shown that without referring any of the SR postulates, both the Lorentz contraction and time dilation have been derived from the AIRF. These two are the exact same Lorentz contraction and time dilation derived by Einstein as the starting foundation to build the SR.

Moreover, a combination of the Lorentz contraction and time dilation results in the constant speed of light for all inertial frames, which in turn results in the principle of relativity.

This means because the same Lorentz contraction and time dilation have been derived from the AIRF, all the rest of the SR, i.e. Lorentz transformation, $E=\gamma mc^2$, etc. can be derived from the AIRF as well.

Detection of AIRF

Now, if the SR derived from the AIRF is equivalent to Einstein's SR, then what is the difference between the two? The difference is that unlike Einstein's SR which negates the existence of the AIRF, the SR derived from the AIRF does not. In this section, I will explain the method of finding the AIRF by examining the effect of simultaneity on the wave phase.

First, let us review how the simultaneity works in Einstein's SR. In the SR, two events that occur simultaneously in one inertial frame may not occur simultaneously in another inertial frame as shown below (Griffiths 1989:463).

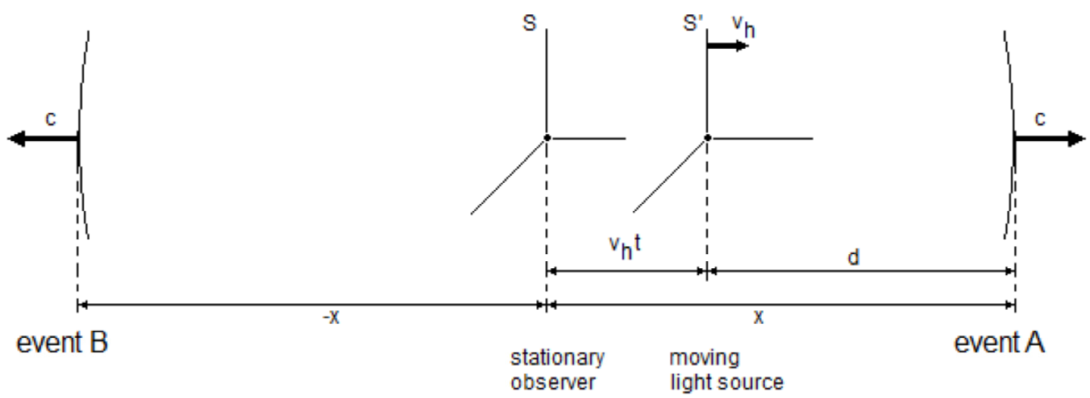


Figure 4

A light source moves away from a stationary observer with the velocity v_h.

Figure 4 depicts Figure 3 with the two events: A and B, which are the two light wave fronts emitted at the origin when t=0, and now are propagating in the opposite direction with each other along the x-axis.

Let us suppose that two light wave fronts in Figure 4 are the two events A and B, where the wave front A moves along the positive x-axis and the wave front B moves along the negative x-axis. If the stationary observer is in the AIRF, then the event A and B are observed to have occurred simultaneously at the same time. However, the moving light source in the moving inertial frame S' would not observe these two events to have occurred simultaneously. For S', the event A occurs first; next, the event B occurs.

Now, according to the SR, we know that in S’, the propagating wave fronts move away from each other in a symmetrically expanding spherical shape. This means that when S’ observes the event A, it has to observe another event C at that moment, along its negative x-axis at the same distance as the event A as shown below.

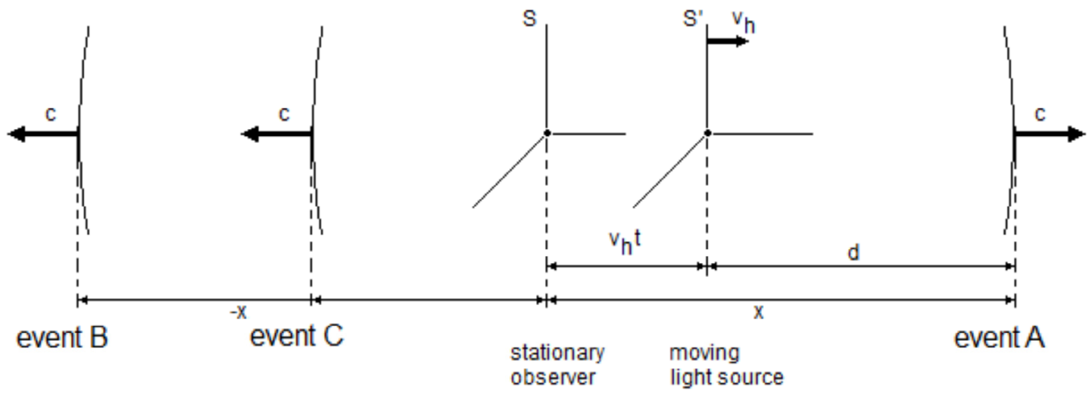


Figure 5

A light source moves away from a stationary observer with the velocity v_h.

Figure 5 depicts Figure 4 with another event C, which is the light wave front emitted at the origin when t=0, and now are propagating along the negative x-axis. S observes the event C first, then the event A and B simultaneously. S’ observes the event A and C simultaneously first, then the event B.

In order to describe these events A, B, and C with respect to S and S’, we need to refer to Lorentz transformation of the x coordinate and the time between S and S‘. According to the SR, Lorentz transformation for the event occurring on the positive x‘-axis of S‘ are as follows:

$$x' = \gamma (x - v_h t)$$ (Griffiths 1989:462; Equation 16)

where
x’ = x coordinate observed in the stationary inertial frame S’
x = x coordinate observed in the stationary inertial frame S

$$t' = \gamma (t - v_h x/c^2)$$ (Griffiths 1989:462; Equation 17)

where
t’ = time observed in the moving inertial frame S’
t = time observed in the stationary inertial frame S

Using x = ct, we can further simplify these equations as follows:

$$x' = x\,\gamma\,(1 - v_h/c) \qquad \text{(Equation 18)}$$

$$t' = t\,\gamma\,(1 - v_h/c) \qquad \text{(Equation 19)}$$

For the event occurring on the negative x'-axis of S', we substitute $x = -ct$ to get:

$$x' = x\,\gamma\,(1 + v_h/c) \qquad \text{(Equation 20)}$$

$$t' = t\,\gamma\,(1 + v_h/c) \qquad \text{(Equation 21)}$$

Now, in order for S' to observe the event C to be simultaneous with the event A, we solve these two equations of Lorentz transformation by allowing the time of these two events to equal each other as follows:

$$t'_A = t'_C \qquad \text{(Equation 22)}$$

where
t'_A = time of the event A observed in the moving inertial frame S'
t'_C = time of the event C observed in the moving inertial frame S'

$$t'_A = t_A\,\gamma\,(1 - v_h/c)$$
$$t'_c = t_c\,\gamma\,(1 + v_h/c)$$
$$t_A\,\gamma\,(1 - v_h/c) = t_c\,\gamma\,(1 + v_h/c)$$

$$\therefore\ t_c = t_A\,(1 - v_h/c) / (1 + v_h/c) \qquad \text{(Equation 23)}$$

Using this t_c, we can find the x coordinate of the wave front C in S':

$$x_c = -ct_c$$
$$x'_c = x_c\,\gamma\,(1 + v_h/c) = -ct_c\,\gamma\,(1 + v_h/c) = -c\,[t_A\,(1 - v_h/c) / (1 + v_h/c)]\,\gamma\,(1 + v_h/c)$$
$$= -ct_A\,\gamma\,(1 - v_h/c) = -x_A\,\gamma\,(1 - v_h/c) = -x'_A$$

$$\therefore\ x'_c = -x'_A \qquad \text{(Equation 24)}$$

Thus, as expected, according to Equation 22, the events A and C occur simultaneously in S', and according to Equation 24, their x coordinates in S' confirm that their distances from the origin of S' are equal. These two quantities verify that in S', the wave fronts A and C are expanding out in a spherical shape from the light source at the center.

So far, this is the expected behavior predicted by the SR. However, it becomes interesting when we consider the wave phases of these two wave fronts A and C as shown below.

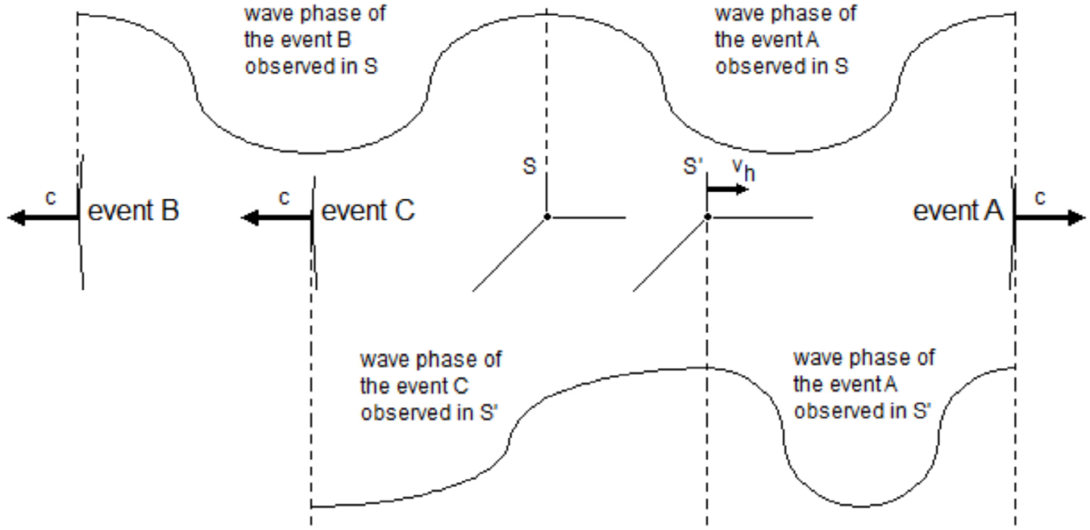


Figure 6

A light source moves away from a stationary observer with the velocity v_h.

Figure 6 depicts Figure 5 with the wave phase at each wave front observed by S and S'. The wave phase function is arbitrarily chosen to be a cosine function for convenience. The wave phase observed by S is drawn on the top. The wave phase observed by S' is drawn on the bottom. Notice how in S', the wavelength observed at the event A becomes shorter than the wavelength observed by S, due to Doppler effect despite Lorentz contraction. Likewise, S' observes the longer wavelength at the event C than the wavelength observed by S, again due to Doppler effect and Lorentz contraction.

Let us suppose that the event A occurs when the wave phase of the emitted light wave makes the first complete frequency cycle in S. As so, S' would also observe the completed phase cycle at the event A. Thus, for the event A, the both S and S' would observe the same wave phase as expected.

Now, in S, the event B occurs simultaneously as the event A. Again, as expected, the wave phase at the event B matches the same phase at the event A.

However, this is not going to be the case with S', the moving inertial frame. In S', the event C occurs simultaneously as the event A. However, when the event C occurs, only the partial frequency cycle would have taken its course, and thus the wave phase is going to be somewhere in the middle of the frequency cycle. This means that in S', the wave phase at the event C is going to be different than the phase at the event A.

It is important to recognize that the wave phase of the light is a part of the event itself, and thus the both S and S' observe the same wave phase, although at a different time and at a different x coordinate.

Again, S' observes the events A and C to occur simultaneously despite their phase differences. In other words, for a moving inertial frame S', although it observes the light wave to propagate symmetrically in a spherical shape, the wave phase of the wave fronts along x-axis are going to be different.

In fact, it is only in the AIRF, where the two wave phases along x-axis are going to match.

Therefore, the comparison of the wave phases of the oppositely moving wave fronts along the longitudinal direction of the uniform rectilinear motion in its own inertial frame would reveal whether the own inertial frame is in motion or is at an absolute rest.

Results

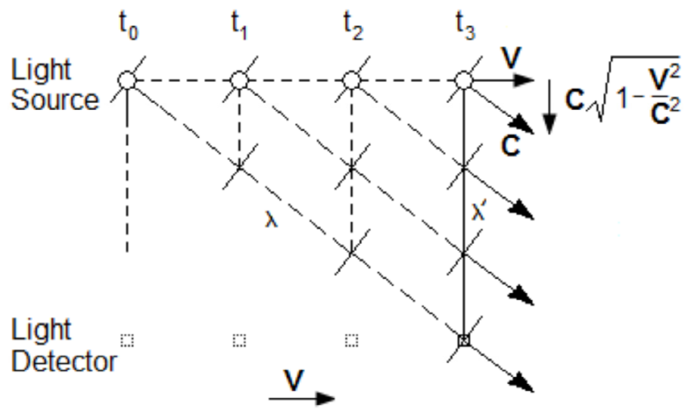
In this paper, the SR has been derived from the AIRF as follows: Lorentz contraction has been derived from the AIRF without referring any of Einstein's SR postulates. Then, this Lorentz contraction is used to derive the longitudinal and transverse Doppler red-shifts. Next, this Doppler red-shift is used to derive time dilation. Finally the rest of the SR equations could be derived from the Lorentz contraction and time dilation.

Until now, the AIRF and the SR have been incompatible with each other like oil and water. Now, the SR has been reconciled into the AIRF because of the unique characteristic of the AIRF which allows us to find the AIRF among other inertial frames.

This paper has presented the method of finding the AIRF. The wave phases of the spherical wave fronts expanding out along the opposite longitudinal directions are only going to be in synchronization in the AIRF. In any moving inertial frame, these wave phases are going to be different.

Discussion

In my previous paper, I have shown that in the AIRF, a light source moving in a uniform rectilinear motion would cause the moving inertial frame to observe an aberration of light in the transverse direction as shown below (Lee 2013).



Lee 2013:3; Figure 7
Propagation of the light wave from a light source in uniform rectilinear motion.

Figure 7 depicts a light source and a detector moving together horizontally with the velocity v, observed by a stationary observer. The light detector is located in the transverse direction (right underneath the light source) and moves along with the light source. The moving light source emits consecutive wave fronts of light with the wavelength λ, in a diagonal direction throughout different time periods. There exists a light source in the past time that had emitted the diagonal light which intercepts the detector at the present time, as the light source and the detector both move together horizontally. To the detector's point of view, these consecutive light wave fronts line up vertically and it would look as if the light is propagating straight down from the light source to the detector (Lee 2013).

As Figure 7 shows, the detector in the moving inertial frame would observe the light wavelength to have been blue-shifted in the transverse direction by Lorentz factor γ (Lee 2013). Using this phenomenon, my previous paper tried to present a way to detect the AIRF.

Unfortunately, this paper nullifies such detection by introducing the transverse Doppler red-shift in the SR derived from the AIRF.

Let us suppose the stationary light source has the wavelength of λ. Now, according to my previous paper, if this light source moves with a constant velocity, then it would have exhibited the transverse blue-shift. And as a result, the detector would have measured the shortened wavelength of λ/γ.

However, because this paper introduces the transverse Doppler red-shift even in the AIRF, the stationary observer would not have observed the moving light source to have emitted the original light wavelength λ. The stationary observer would have observed the moving light source to have emitted the red-shifted wavelength $\gamma\lambda$.

Consequently, this red-shift would cancel out the blue-shift observed by the moving detector. Then, the detector would measure the original wavelength λ in its moving inertial frame, thus eliminating the previous method of finding the AIRF, as well as the paradox mentioned in the previous paper. To find the AIRF, the new method introduced in this paper should be considered instead.

Bibliography

Gjurchinovski, A. 2004. Reflection of light from a uniformly moving mirror. Am J Phys. 72(10):1316-1324.

Griffiths, D. J. 1989. Introduction to electrodynamics. 2nd ed. Englewood Cliffs: Prentice-Hall, Inc.

Lee, J. 2013. Detection of absolute rest frame by measuring light wavelength of light source in uniform rectilinear motion. International Review of Physics. 7(1):1-6.

Rindler, W. 2009. Relativity: special, general, and cosmological. 2nd ed. New York: Oxford University Press.

Serway, R. A. 1990. Physics for scientists & engineers. 3rd ed. Philadelphia: Saunders College Publishing.

Sher, D. 1968. The relativistic Doppler effect. Journal of the Royal Astronomical Society of Canada. 62(3):105-112.

Acknowledgements

I would like to thank Jesus Christ for guidance and encouragement.
I would like to thank Richard Lee for reviewing the paper.