Constancy of the Speed of Light Relative to All Observers

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Abstract

The constancy of the speed of light is one of the greatest mysteries of the universe. All experimental and logical evidences point to the constancy of the speed of light. However, the precise formulation of this theory is still lacking, for more than a century. In this paper, I will present a new alternative interpretation. It is shown that constancy of the speed of light and absolute motion can co-exist in the universe.

Introduction

The constancy of the speed of light is one of the greatest mysteries of the universe. Albert Einstein was the first scientist who explicitly and boldly stated it in his second postulate (the light postulate). More than a century after this mystery has been revealed, it still remains a mystery today. Einstein's light postulate and its interpretation has long been a source of confusions and debates. Special relativity theory is the interpretation universally accepted by the scientific community.

On the other hand, there have always been claims of detection of absolute motion (the ether) ever since Einstein denied its existence in 1905, such as in the Miller experiments and more recently in the Marinov and the Silvertooth experiments. Experimental and logical evidences against relativity theory are accumulating and more and more researchers, and increasingly some mainstream physicists, are questioning Einstein's relativity theory and its foundations.

The problem is that there is no better alternative theory known to the scientific community, even if they decided to abandon relativity theory. There is yet another problem unknown to the scientific community : the link between Einstein's light postulate and the special relativity theory (relativity of space and time). No one has ever questioned this link. A physicist who accepts the light postulate automatically accepts special relativity theory, and those who reject special relativity automatically reject the light postulate also.

This author questioned this internal link in a paper [1] written years ago, and has proposed the divorcing of the two. All experimental and logical evidences so far point to constancy of the speed of light, but the precise formulation of this theory is still lacking for more than a century. In this paper, I propose that the light postulate be retained and special relativity abandoned. I propose a new alternative interpretation of the constancy of the speed of light.

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How can the (vacuum) speed of light be constant for a moving observer, regardless of his/her velocity?

The solution to century-old mystery is proposed as follows.

The speed of light (a photon) is adjusted at the instant of emission so that it is always constant relative to the observer.

Consider a light source that is at absolute rest and an observer who is moving directly away from the source with a velocity V. The photons will be emitted from the source with velocity $c + V$, so the speed of the photons relative to the observer will be:

$$(c + V) - V = c$$

This basic idea is can be developed to build a more complete model of the speed of light that can easily explain many of the light speed experiments. The new model is proposed below.

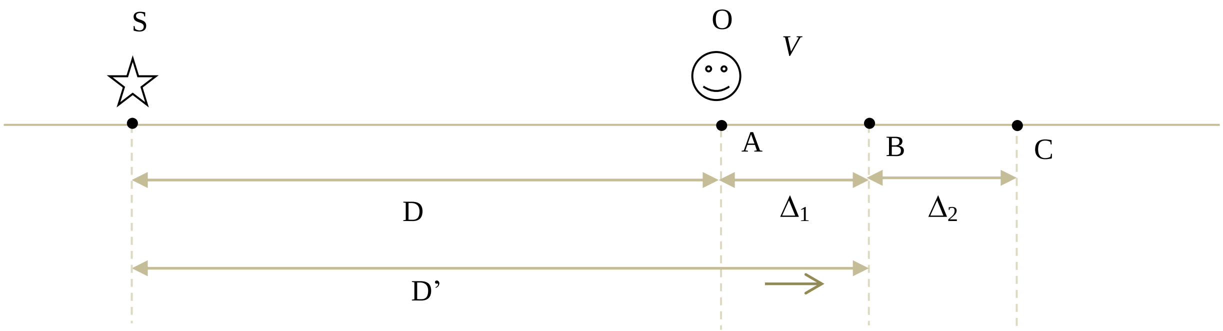
Constancy of the speed of light relative to an inertial observer

Consider an observer O who is at rest in the absolute reference fame. A light source S emits a short light pulse, from a distance D, as shown below.

Obviously, the light pulse travels from the source to the observer with speed c and the time delay of light will be:

$$\tau = \frac{D}{c}$$

Now suppose that the observer is moving with absolute velocity *V* to the right. Let the distance between the light source and the observer be *D*, at the instant of light emission.



Conventionally, the light catches up with the observer at point B. During the time interval that light moves from the source to point B, the observer moves from point A to point B. Therefore:

$$\frac{D'}{c} = \frac{\Delta_1}{V}$$

But,

$$\Delta_1 = D' - D$$

From which:

$$D' = D \frac{c}{c - V}$$

According to conventional analysis, the speed of light relative to the moving observer is $c - V$. This conventional analysis is known to have repeatedly failed for over a century. However, we will use this result in the new interpretation we present in this paper.

In this paper, we introduce a novel theory that reconciles the constancy of the speed of light with absolute motion, both of which have experimental evidences.

We formulate the new theory as follows, in two postulates.

1. *The phenomenon of emission of light does not occur at the same instant of time for all observers. Conventionally, the instant of light emission is the same for all observers; the instant of light detection differs between observers and is determined by the position and motion of the observers. According to the new theory proposed here, the instant of light emission is not the same for all observers and is determined by the position and motion (path, velocity,*

acceleration) of the observers. For an absolutely moving observer, (it is AS IF) light is emitted at the instant it would be detected conventionally.

2. *The center of the wave fronts of light always moves with the same velocity as the absolute velocity of the inertial observer. This means that if an observer is moving with a certain absolute velocity in a certain direction, the center of the wave fronts of the light (photon) that is meant for that observer also moves with the same velocity in the same direction as the observer.*

Therefore, the light pulse is emitted for the moving observer O when it is just passing through point B, not point A. Point A is the point where the observer would detect the light if conventional theory were correct. If the light pulse is emitted at time $t = 0$ for all observers who are at absolute rest, then the same phenomenon (emission of light pulse) occurs at a later time $t \neq 0$ for an observer in absolute motion. For a moving observer, it is ***as if*** light is emitted at the same instant of time it would be detected by that observer if conventional theory were correct.

Therefore, light for observer O is emitted when he is just passing through point B, with the center of the light wave front moving with velocity V to the right, which is the same as the velocity of the observer. Therefore, the velocity of light in the absolute reference frame will be the speed of light (c) plus the velocity of the center of the wave fronts (V).

$$\text{The velocity of light in the absolute reference frame} \\ = \text{the speed of light (c)} + \text{the velocity of the center of the wave fronts} = \text{c} + \text{V}$$

Therefore, the velocity of light relative to observer O will be:

$$\text{The velocity of light } \textit{relative} \text{ to an observer} \\ = \text{the velocity of light in the absolute reference frame} \\ - \text{the absolute velocity of the observer} = (\text{c} + \text{V}) - V = c$$

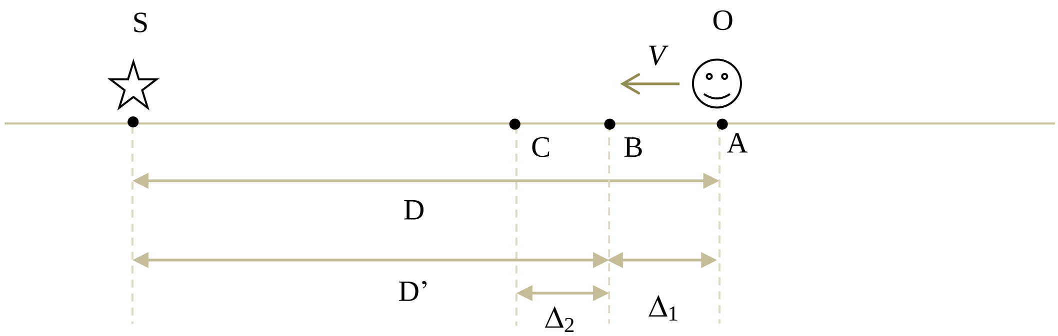
Since the center of the wave fronts is moving with (is at rest relative to) the observer, the time delay of light to reach the observer will be:

$$\tau = \frac{D'}{c} = \frac{D\,\frac{c}{c-V}}{c} = \frac{D}{c-V}$$

The point C where the observer will detect the light (distance Δ_2) is determined as follows.

$$\Delta_2 = \tau V = \frac{D}{c - V} V = D \frac{V}{c - V}$$

For an observer moving towards the light source, the situation is as follows.



With the same argument as before, during the time interval that light moves from the source to point B, the observer moves from point A to point B.

$$\frac{D'}{c} = \frac{\Delta_1}{V}$$

But,

$$\Delta_1 = D - D'$$

From which:

$$D' = D \frac{c}{c + V}$$

In this case also, light is emitted for observer O at the instant that it is just passing through point B, the point where the observer would detect the light if conventional (ether) theory were correct. In this case also the center of the wave fronts moves to the left with velocity V, which the same as direction and velocity/speed of the observer.

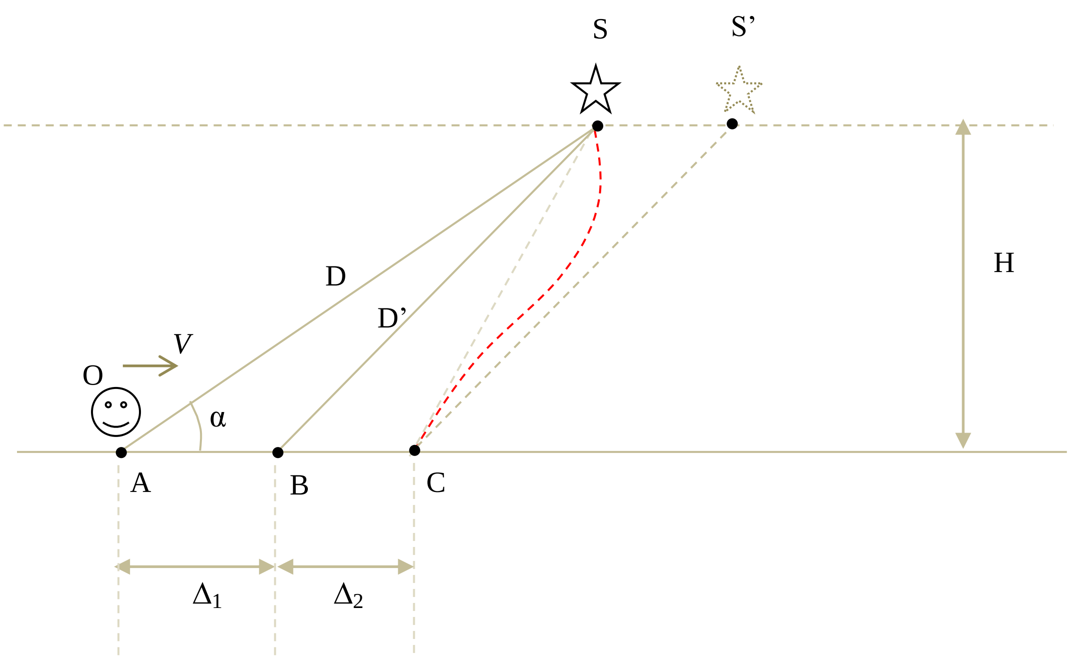
The time delay of light to reach the observer will be:

$$\tau = \frac{D'}{c} = \frac{D\,\dfrac{c}{c+V}}{c} = \frac{D}{c+V}$$

The point C where the observer will detect the light (distance Δ_2) is determined as follows.

$$\Delta_2 = \tau\ V = \frac{D}{c+V}\ V = D\ \frac{V}{c+V}$$

So far we have seen the case when the observer is inertially moving directly towards or away from a light source. However, in general, the observer may not be moving inertially in any direction, as shown below.



At time instant t = 0 light is emitted for all observers who are at absolute rest, and observer O is at point A , moving with absolute velocity V to the right. Since the observer is in absolute motion, for this observer the light will be emitted at a later time $t \neq 0$, just as the observer is passing through point B, the point where the observer would detect the light pulse if conventional (ether) theory were correct. The center of the light wave fronts for this observer will move with velocity V to the right, the same as the velocity and direction of the observer.

The time taken for the light to reach the observer will be:

$$\tau = \frac{D'}{c}$$

The observer will detect the light at point C, where:

$$\Delta_2 = \tau \ V = \frac{D'}{c} \ V$$

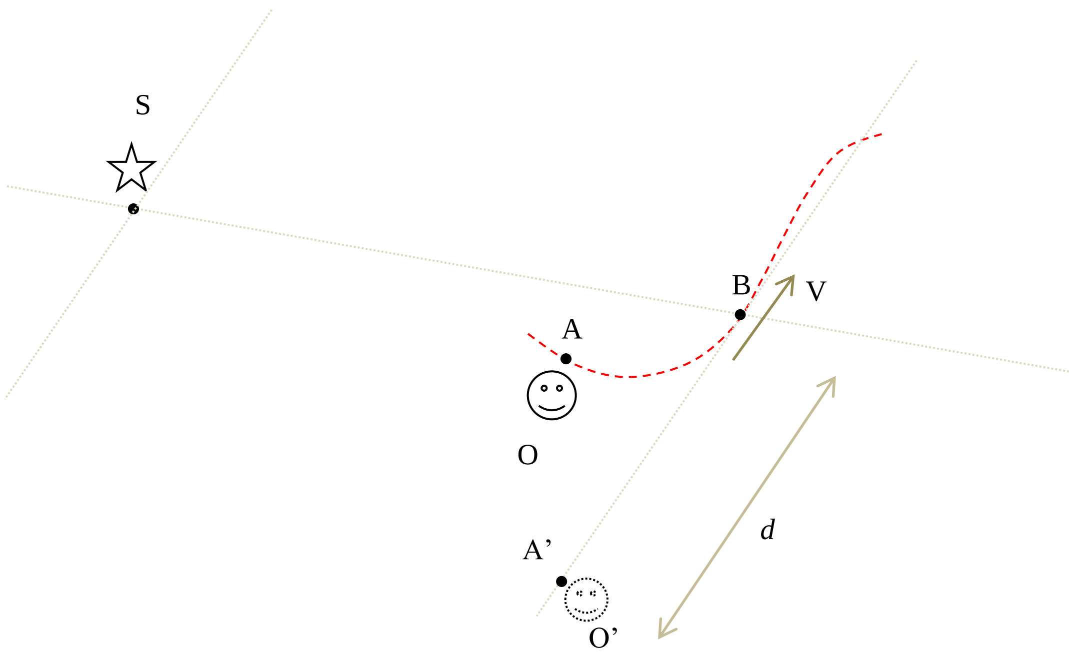
Given the exact position of the observer relative to the source at the instant of light emission, that is, given *D* and *H*, or given *D* and α , Δ_1 , Δ_2 and *D'* can be determined.

Stellar aberration

The new theory explains the phenomenon of stellar aberration as follows. We have said that light will be emitted for the moving observer O, just as he/she is passing through point B. The center of the wave fronts of light emitted for observer O starts from point S and moves to the right with the same velocity *V* to the right, which is the same as the velocity of the observer. The center of the light wave fronts moves along the broken line to the right, starting from point S. When the observer detects the light at point C, the center of the wave fronts will have reached point S'. Therefore, the moving observer needs to point his telescope towards point S', whereas a stationary observer at point C points his telescope towards point S. Note that line CS' is parallel to BS. Note that the photons can be actually coming along the red path shown, as seen in the absolute reference frame [3].

Acceleration

So far we have considered the case of inertial observers. In this section we present the analysis for an accelerating observer, whose magnitude and direction of absolute velocity continuously changes with time, moving along curved paths with continuously changing velocity.



Suppose that the source emits a short light pulse at $t = 0$ (for all observers at absolute rest), and observer O is at point A at this instant (at $t = 0$), moving along the curved path shown. The problem is to determine the point B where the observer will detect the light pulse.

Basically, the procedure is first to start from any arbitrary point along the path of the observer, such as point B shown in the figure. We assume the motion of the observer is completely known. We determine the time interval τ for the observer to move from point A to point B. We know the velocity (V) of the observer at point B. We assume an *imaginary inertial observer* O’ who just happens to pass through point B simultaneously with the real accelerating observer O, and whose velocity is equal to the instantaneous velocity V of observer O at point B. From the time interval τ and the velocity V, we know the position of the imaginary inertial observer O’ at $t = 0$, which is point A’. The distance between points A’ and B will, which is d, will be:

$$d \;=\; \tau\, V$$

Therefore, once we have determined distance d we know the location of imaginary inertial observer O’ at the instant of light emission, that is at $t = 0$. This means that we know the position of the imaginary inertial observer O’ relative to the source S at the instant of light emission, $t = 0$. Then we follow the previous procedure for inertial observers to determine the point where the imaginary inertial observer O’ will detect the light along its path. If that point happens to be point B (which is unlikely, because we chose point B arbitrarily), then we have solved the problem. If that point differs from point B (which is highly likely, because we chose point B arbitrarily), we repeat the above procedure by choosing another point on the curved path. In reality, the correct point can be obtained only after much iteration.

This procedure applies to light speed experiments in which acceleration is involved, such as the Sagnac effect.

Scientific proof of God

In our discussion in the last section on an accelerating observer, we can see that the photon needs to be emitted at the right time in the right direction in order to meet the accelerating observer whose motion is unpredictable. The question is *what/who* aims the photons in the right direction and makes them emitted at the right moment?

In my other papers[2][3][4], I have proposed a compelling explanation to quantum phenomena such as the ‘Which-Way’ experiment, quantum entanglement, ‘wave function collapse’ and photon/electron interference pattern. I have proposed that God is behind all the mysteries of quantum phenomena and the speed of light.

Special relativity and Lorentz transformations

So far we have seen a new interpretation of the constancy of the speed of light, which is one of the postulates of special relativity theory. The reader may ask the implication of this on relativity theory. Next we show a contradiction in special relativity theory and Lorentz transformations.

It is a basic requirement of special relativity theory (SRT) that all relatively moving inertial observers agree on an observable (an interference fringe shift, for example). We show that SRT leads to a disagreement on the observables (interference fringe shift) in two relatively moving inertial reference frames.

<u>Fringe shift predicted in two relatively moving inertial reference frames</u>

Consider two inertial reference frames S and S’ , with origins O and O’ respectively (see figure on page 11). S’ is moving with velocity v relative to S, in the + x direction. S is the reference frame of the laboratory. At time $t = 0$, the origins O and O’ coincide. An observer A with an interferometer is moving with velocity v_0 in the lab frame S , in the + x direction and is just passing through the origin O at $t = 0$. For ease of analysis, we assume that the light source is stationary in the lab. However, to avoid the complications due to Doppler effect we could also think of the source to be moving with velocity v_0 to the left, just passing through point E at $t = 0$.

The difference form of the Lorentz transformation equations is given below.

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

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

where

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

Δx is the difference in path lengths of the two light beams in frame S, and $\Delta x'$ is the difference in the path lengths of the two light beams in frame S'. Δt is the difference in the time of arrival of the two light beams in frame S, and $\Delta t'$ is the difference in time of arrival of the two light beams in frame S'.

Suppose that the interference fringe shift of the light speed experiment predicted in frame S is N, and the fringe shift predicted in frame S' for the same experiment is N'. It is a requirement of special relativity theory that there should be an agreement on the observable (the fringe shift) in both frames, i.e. $N = N'$. Let us see if this is actually the case.

We know that,

$$N = \frac{c \, \Delta t}{\lambda} \quad and \quad N' = \frac{c \, \Delta t'}{\lambda'}$$

or

$$N = \frac{\Delta x}{\lambda} \quad and \quad N' = \frac{\Delta x'}{\lambda'}$$

But, because of time dilation [1]:

$$\lambda' = \gamma \, \lambda$$

Therefore,

$$N' = \frac{c \, \Delta t'}{\lambda'} = \frac{c \, \gamma \, (\Delta t - \frac{v \Delta x}{c^2})}{\gamma \lambda} = \frac{c \, (\Delta t - \frac{v \Delta x}{c^2})}{\lambda} = \frac{c \, \Delta t}{\lambda} - \frac{\frac{v \Delta x}{c}}{\lambda} = N - \frac{v \Delta x}{c \lambda} \neq N$$

Galilean relativity, however, does not lead to such disagreement, as shown below.

$$\Delta x' = \Delta x - v\,\Delta t$$

$$\Delta t' = \Delta t$$

$$c' = c \pm V \implies \frac{c'}{c} = 1 \pm \frac{v}{c}$$

$$f' = f \implies \frac{c'}{\lambda'} = \frac{c}{\lambda} \implies \lambda' = \lambda\,(1 \pm \frac{v}{c})$$

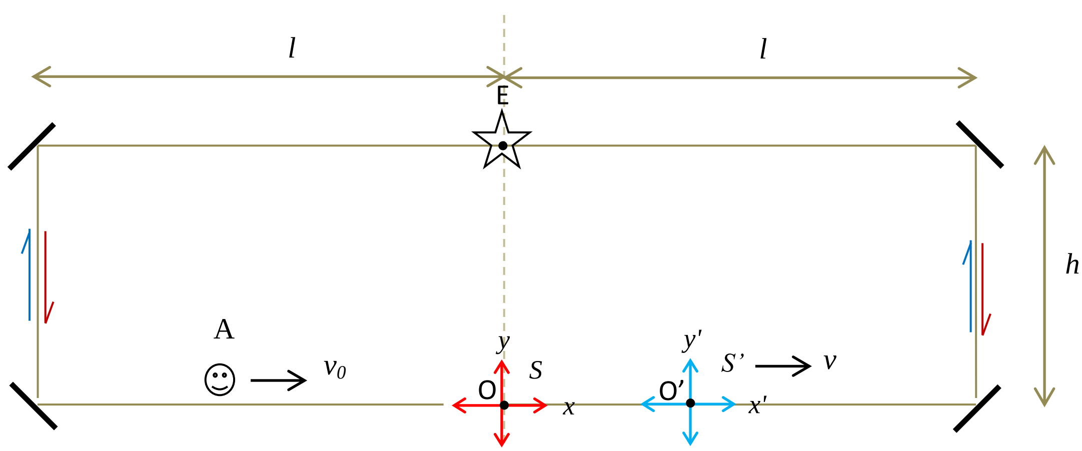
Therefore,

$$N' = \frac{c'\,\Delta t'}{\lambda'} = \frac{(c \pm v)\,\Delta t}{\lambda(1 \pm \frac{v}{c})} = \frac{c\,\Delta t}{\lambda} = N$$

However, this is not to say that Galileo's principle of relativity is correct, but to say that at least it does not lead to contradiction.

Consider the following hypothetical experiment for illustration.

In the lab frame S, the moving observer A detects the clockwise propagating light at (x_2, t_2) and the counter-clockwise propagating light at (x_3, t_3).



In frame S, for the clockwise propagating light:

$$\frac{2l + h - x_2}{c} = \frac{x_2}{v_0}$$

$$\Rightarrow x_2 = \frac{v_0 \,(2l + h)}{c + v_0}$$

and

$$t_2 = \frac{x_2}{v_0} = \frac{(2l + h)}{c + v_0}$$

For the counter-clockwise propagating light:

$$\frac{2l + h + x_3}{c} = \frac{x_3}{v_0}$$

$$\Rightarrow x_3 = \frac{v_0 \,(2l + h)}{c - v_0}$$

and

$$t_3 = \frac{x_3}{v_0} = \frac{(2l + h)}{c - v_0}$$

$$\Delta x = x_3 - x_2 = v_0 \,(2l + h)\, \frac{2v_0}{c^2 - v^2}$$

$$\Delta t = t_3 - t_2 = (2l + h)\, \frac{2v_0}{c^2 - v^2}$$

The fringe shift as predicted in frame S can be written as:

$$N = \frac{\Delta x}{\lambda} = \frac{v_0 \,(2l + h)\, \frac{2v_0}{c^2 - v^2}}{\lambda}$$

But

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

$$\Rightarrow \Delta x' = \gamma \ (v_0 - v \ (2l + h) \frac{2v_0}{c^2 - v^2} \ )$$

$$\Rightarrow \Delta x' = \gamma \ (2l + h) \frac{2v_0}{c^2 - v^2} \ (v_0 - v \ )$$

The fringe shift predicted in frame S' will be:

$$N' = \frac{\Delta x'}{\lambda'} = \frac{\gamma \ (2l + h) \frac{2v_0}{c^2 - v^2} \ (v_0 - v \ )}{\gamma \, \lambda} = \frac{(2l + h) \frac{2v_0}{c^2 - v^2} \ (v_0 - v \ )}{\lambda}$$

We already obtained,

$$N = \frac{\Delta x}{\lambda} = \frac{v_0 \ (2l + h) \ \frac{2v_0}{c^2 - v^2}}{\lambda}$$

We can see that special relativity leads to a disagreement on the observed fringe shift in two inertial reference frames:

$$N' \neq N$$

Conclusion

One hundred years ago Einstein made a revolutionary claim that the vacuum speed of light is always constant *c*. However, the interpretation of the light path resulted in the special relativity theory. In this paper, we have adopted the light postulated without special relativity, and have shown a compelling alternative interpretation of the constancy of the speed of light. The new insight is that the speed of light is constant relative to the observer because light is emitted with velocity $c + V$, where V is the absolute velocity of the observer, so that the speed of light relative to the observer, $(c + V) - V = c$. We have seen that Einstein's interpretation of the light postulate, i.e. special relativity theory, leads to a contradiction : a disagreement on observables (fringe shift) between two inertial reference frames.

Glory be to God and His Mother, Our Lady Saint Virgin Mary

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