A New Model of the Speed of Light Reflected from a Moving Mirror

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16 October 2023

Abstract

The classical emission (ballistic) theory of light predicted that the speed of light reflected from a moving mirror is $c + 2v$, where v is a component of the mirror velocity. In 1913, A.Michelson carried out an experiment to test this hypothesis and concluded that the speed of light reflected from a moving mirror is constant c independent of mirror velocity, to a high degree of precision. With the advent of Albert Einstein's special relativity theory, and with additional experimental counter evidences such as moving source experiments, the classical emission theory was finally abandoned. Many years later, in 1967, an experiment was being carried out to test Einstein's gravitational time dilation by bouncing radar pulses grazing the sun off the planet Venus. As analyzed and disclosed by Bryan G Wallace, large 'anomalous' first order variations in the round trip time were found in the raw data, in complete disagreement with Einstein's light postulate, but conforming to the long forgotten classical emission/ ballistic theory. In this paper, I present a new model of the speed of light reflected from a moving mirror that resolves these contradictions. Although the model can make correct predictions, its physical meaning is inexplicable. Light behaves *as if* it is reflected from the point in space where the mirror is/was *at the instant of emission*, and the speed of the reflected light is the sum of the speed of light c and twice a component of the mirror velocity, i.e. $c + 2v$. Logically, one would have to take into account the motion of the mirror during the transit time of light to determine the point in space where light is reflected. This paper shows that this logical and conventional thinking is possibly wrong in the case of light.

Introduction

With the failure of the 1887 Michelson-Morley experiment to detect the expected ether wind, the scientific community was in complete disarray as to find the correct theory and model underlying the contradictory behavior of the speed of light in the various experiments and phenomena. Yet to some scientists it seemed that the classical emission (ballistic) theory could be a compelling explanation to the null result of the Michelson-Morley experiment. A prediction of this hypothesis was that the speed of light reflected from a moving mirror is $c + 2v$, where v is a component of the mirror velocity. Interestingly, there were several versions of emission theory[1] .

In 1913, A.Michelson carried out an experiment to test this hypothesis[2]. The outcome of the experiment indicated that the speed of light reflected from a moving mirror is constant c independent of mirror velocity, to a high degree of precision. With the advent of Albert Einstein's special relativity theory, and with additional experimental counter evidences such as moving source experiments, the classical emission theory was abandoned, with few advocates today. The emission theory and its advocates are now in oblivion[3][9].

Many years later, in 1967, an experiment was being carried to test Einstein's gravitational time dilation by bouncing radar pulses grazing the sun off the planet Venus, as proposed by Irwin Shapiro. As analyzed and disclosed by Bryan G Wallace, large 'anomalous' first order variations in the time delay were found

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in the raw data, in complete disagreement with Einstein's light postulate, but conforming to the long forgotten classical emission /ballistic theory.

In this paper, I present a new model of the speed of light reflected from a moving mirror that resolves these contradictions. It is possible that the same mystery underlies the A.Michelson moving mirror experiment, the Venus planet radar range data anomaly, and the Lunar Laser Ranging experiment.

The speed of light reflected from a moving mirror is usually described as : $V = c + kv$ where V is the velocity of the reflected light and v is a component of the mirror velocity and $k = 0$, 1 or 2 depending on the version of emission theory. In this paper I present a new and unconventional theory in which $k = 2$, which is different from the classical counterpart.

The theory of relativity has 'defied' all experimental and theoretical/logical counter evidences to date by continuing to be a mainstream theory. Therefore, it is not enough to present new theories that solve the light speed problem. Decisive experimental and theoretical disproof of relativity need to be presented in order to shake the firm belief in relativity among the scientific community that has been hindering progress in science for one century. A simple disproof relativity theory is presented in the APPENDIX.

A new model of the speed of light reflected from a moving mirror

The new model of the speed of light reflected from a moving mirror is formulated as follows.

Consider a light source S, an observer O and a mirror M (Fig.1). At $t = 0$ the source emits light and the mirror is at distance D from the observer (at the moment of emission), moving with velocity *vrelative to the observer*, towards the observer.

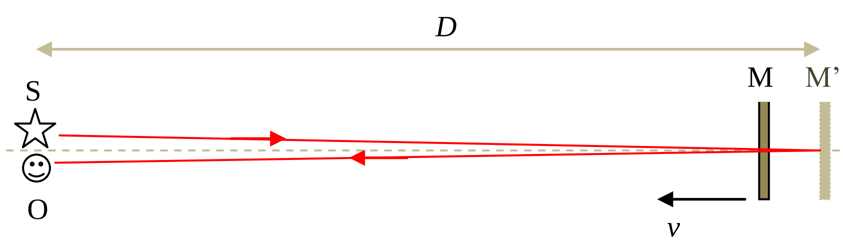

Fig.1 Moving mirror experiment

M' is the position of the mirror <u>at the instant of emission</u>. M is the position of the mirror at the instant of detection of reflected light by the observer/detector.

The new theory being proposed in this paper is that the result of the experiment (in this case the time delay between emission of light and detection of reflected, the transit time of light) is, inexplicably, determined by two factors.

1. *The position of the mirror <u>at the instant of emission</u> and*

2. *The velocity of the mirror <u>at the instant of emission</u>*

Therefore, the light is reflected from (behaves ***as if*** it is reflected from) the point in space where the mirror was <u>at the instant of emission</u> and the speed of the reflected light is $c + 2v$, where v is a component of the mirror velocity relative to the observer.

The observer is always considered to be at rest and v is the velocity of the mirror *relative to the observer*. Moreover, the speed of light is independent of the velocity of its source.

Let the distance between the source and the mirror be D at the instant of light emission, as shown above (Fig.1).Therefore, the round trip time of the light will be:

$$\tau = \frac{D}{c} + \frac{D}{c+2v} = \frac{2D(c+v)}{c(c+2v)}$$

The new model is unlike all classical theories (emission theory and ether theory) and special relativity. All these theories agree on the fact that the point in space (relative to the observer) where light is reflected from a moving mirror depends on the mirror velocity. In all of these theories, the speed of light (which depends on the respective theories) and the velocity of the mirror are to be taken into account to determine the point in space where light is reflected from the mirror.

Next we apply this model to some known experiments.

The A. Michelson moving mirror experiment

According to the new theory, the A.Michelson's 1913 moving mirror experiment (Fig.2) is analyzed as follows.

T_1 is the time taken by the beam along the path ADECBA [2]

T_2 is the time taken by the beam along the path ABCEDA.

$$T_1 = \frac{2D}{V_1}$$

$$T_2 = \frac{2D}{V_2}$$

$$T_1 - T_2 = 2D\,(\frac{1}{V_1} - \frac{1}{V_2})$$

where

$$V_1 = c + 2v \quad \text{and} \quad V_2 = c - 2v$$

Therefore,

$$\Rightarrow T_1 - T_2 = 2D\left(\frac{1}{c+2v} - \frac{1}{c-2v}\right) \dots\dots\dots\dots.. \ (1)$$

The fringe shift will be:

$$\Delta = \frac{c\,(T_1 - T_2)}{\lambda} = \frac{c\;2D}{\lambda}\left(\frac{1}{c+2v} - \frac{1}{c-2v}\right)$$

$$\Rightarrow \Delta = \frac{-\,c\;2D}{\lambda}\frac{4v}{c^2 - 4v^2}$$

$$\Rightarrow \Delta \cong \frac{-\,2Dc}{\lambda}\frac{4v}{c^2}, \qquad \text{since } 4v^2 \ll c^2$$

$$\Rightarrow \Delta \cong \frac{-8D}{c}\frac{v}{\lambda} \ldots\ldots\ldots\ldots\ldots..(2)$$

Except for the negative sign, this formula is the same as Michelson's formula [2] that was confirmed by his experiment!Almost one century after this experiment, the speed of light remains a mystery. I propose repeating this experiment once again to test the negative fringe shift predicted by the new model.

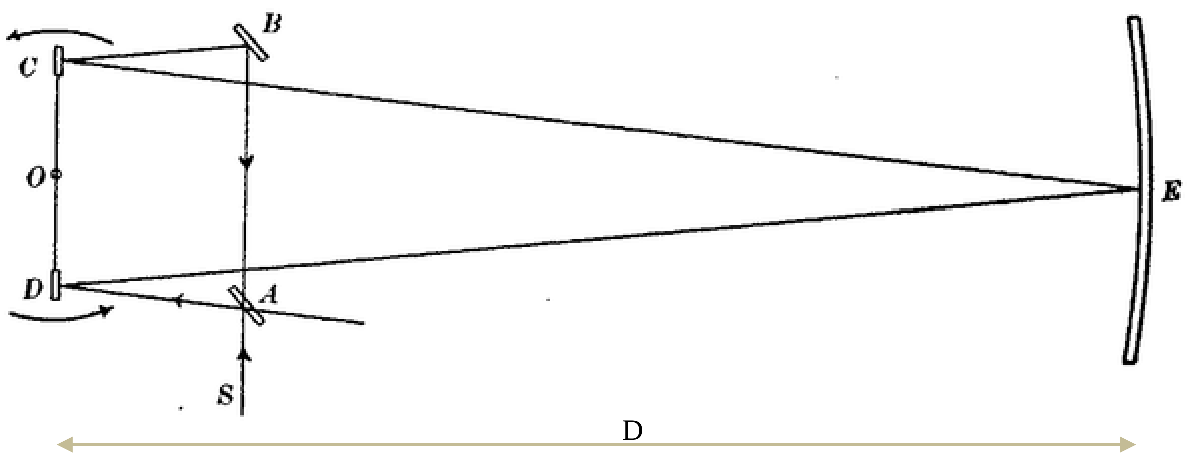

Fig.2 The A. Michelson's 1913 moving mirror experiment. This image is taken from Michelson's paper.

The Venus planet radar ranging experiment

The Venus planet radar range experiment anomaly, as analyzed and announced by Bryan G.Wallace [4], is re-analyzed as follows, first according to the new theory and then according to classical analysis.

<u>According to new theory</u>

In Fig.3 two positions of Venus are indicated. The grey one (on the right side) shows the position of Venus *at the instant of radio pulse emission* from Earth and the brown one (on the left) its position at the moment of detection of the reflected pulse on Earth. Therefore, D is the Earth-Venus distance *at the moment of emission* of the RF pulse from Earth.

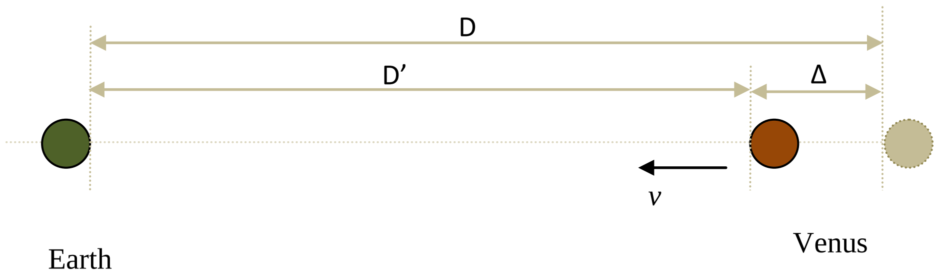

Fig.3 Venus planet radar ranging experiment, new analysis

The round trip time of the pulse is:

$$\tau = t_1 + t_2$$

where t_1 is the time taken for the radio pulse to travel from Earth to Venus and t_2 is the time taken for the reflected RF pulse to return to Earth.

$$t_1 = \frac{D}{c} \qquad \text{and} \qquad t_2 = \frac{D}{c+2v}$$

where v is Earth-Venus relative velocity.

Therefore, the round trip time τ will be:

$$\tau = t_1 + t_2 = \frac{D}{c} + \frac{D}{c+2v}$$

$$\Longrightarrow \quad \tau = D\left(\frac{1}{c} + \frac{1}{c+2v}\right)$$

$$\Longrightarrow \quad \tau = 2D\frac{c+v}{c(c+2v)} \quad \Longrightarrow \quad D = \frac{\tau\, c(c+2v)}{2(c+v)}$$

From the last equation, the Earth-Venus distance (D') at the moment of reflected pulse detection on Earth will be:

$$D' = D - \Delta$$

Δ is determined as follows. During the time interval that reflected light travels the distance D, the planet Venus moves a distance Δ. Therefore:

$$\frac{D}{c+2v} = \frac{\Delta}{v}$$

$$\Longrightarrow \Delta = D\frac{v}{c+2v} \quad \ldots\ldots\ldots.(3)$$

Therefore,

$$\Longrightarrow \; D' = D - \Delta = D - D\,\frac{v}{c+2v} \;=\; D\,\frac{c+v}{c+2v}$$

$$\Longrightarrow \; D' \;=\; \frac{\tau\, c(c+2v)}{2(c+v)}\frac{c+v}{c+2v} \;=\; \frac{\tau c}{2} \qquad \ldots\ldots\ldots\ldots\ldots \; (4)$$

This is the same formula that Bryan G. Wallace [4] claimed the radar range data confirmed!

Conventional / classical analysis

For comparison, next we analyze the experiment by the classical emission theory in which the speed of light reflected from a moving mirror is $c+2v$.

In Fig.4 three positions of Venus are indicated. The grey one (on the right side) shows the position of Venus *at the instant of radar pulse emission* from Earth , the grey one in the middle its position at the moment of reflection and the brown one (on the left) its position at the moment of detection of reflected pulse on Earth. Therefore, *D* is the Earth-Venus distance *at the moment of emission* of the RF pulse from Earth.

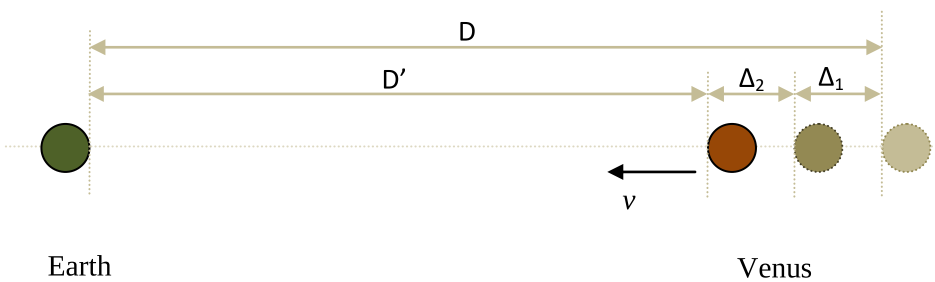

Fig.4 Venus planet radar ranging experiment, conventional/classical analysis

The round trip time of the pulse is:

$$\tau \;=\; t_1 \;+\; t_2$$

where t_1 is the time taken for the radio pulse to travel from Earth to Venus and t_2 is the time taken for the reflected RF pulse to return to Earth.

$$t_1 \;=\; \frac{D-\Delta_1}{c} \qquad \text{and} \qquad t_2 \;=\; \frac{D-\Delta_1}{c+2v}$$

where v is Earth-Venus relative velocity.

Therefore, the round trip time τ will be:

$$\tau \;=\; t_1 \;+\; t_2 = \frac{D-\Delta_1}{c} \;+\; \frac{D-\Delta_1}{c+2v}$$

$$\Rightarrow \quad \tau = (D - \Delta_1)\left(\frac{1}{c} + \frac{1}{c+2v}\right)$$

$$\Rightarrow \quad \tau = 2(D - \Delta_1)\frac{c+v}{c(c+2v)} \quad \Rightarrow \quad D - \Delta_1 = \frac{\tau\, c(c+2v)}{2(c+v)}$$

Δ_1 is determined as follows. During the time interval that the light travels the distance D-Δ_1, the planet Venus moves a distance Δ_1. Therefore:

$$\frac{D - \Delta_1}{c} = \frac{\Delta_1}{v}$$

$$\Rightarrow \Delta_1 = D\frac{v}{c+v} \quad \dots\dots\dots(5)$$

By substituting this value of Δ_1 in the previous equation:

$$D - D\frac{v}{c+v} = \frac{\tau\, c(c+2v)}{2(c+v)} \quad \Rightarrow \quad D\frac{c}{c+v} = \frac{\tau\, c(c+2v)}{2(c+v)}$$

From which:

$$\tau = D\frac{c}{c+v}\frac{2(c+v)}{c(c+2v)} = \frac{2D}{c+2v} \quad \Rightarrow \quad D = \frac{\tau\,(c+2v)}{2}$$

Compare this value of the light transit time (τ) with the value already obtained in the new theory.

Since our aim is to determine the position of Venus at the moment thereflected pulse is detected on Earth, we need to determine Δ_2 or ($\Delta_1 + \Delta_2$) .

$$\Delta_1 + \Delta_2 = \tau\, v = 2D\frac{v}{c+2v}$$

Therefore, the distance D’ of Venus at the moment of detection of reflected signal on Earth will be:

$$D' = D - (\Delta_1 + \Delta_2) = D - 2D\frac{v}{c+2v} = D\frac{c}{c+2v}$$

$$\Rightarrow \quad D' = \frac{\tau\,(c+2v)}{2}\frac{c}{c+2v} = \frac{\tau c}{2}$$

which is again the same formula experimentally confirmed according to Wallace’s analysis.

As mentioned above, however, the two models give different formulas for τ. However, the two expressions are almost equal for $v \ll c$, so it is difficult to prove which one is the correct model by this experiment alone. But we already know that the A. Michelson moving mirror experiment disproves the classical analysis.

$$\tau = 2D\frac{c+v}{c(c+2v)} (New\ theory) \qquad Vs \qquad \tau = \frac{2D}{c+2v} \quad (\ classical\ analysis)$$

Lunar Laser Ranging experiment

Yet another opportunity to explore the real/correct model of the speed of light reflected from a moving mirror is the Lunar Laser Ranging (LLR) experiment [5]. Applying the Bryan G Wallace kind of analysisto the LLR data would shed more light on the problem. He compared the range predicted by the *c* model against Newcomb's orbit and the range predicted by the *c+v* model against Cowell's orbit, and found a significant discrepancy between the former two and a close fit between the latter two.

Discussion

We consider three possible models for the speed of light reflected from a moving mirror.

1. The speed of light reflected from a moving mirror is *c*, and therefore not affected by mirror velocity. The motion of the mirror is considered to determine the point in space where the light is reflected. That is, the light is reflected from the point in space where the mirror will have moved to during the transit time of light.We call this <u>conventional *c* model</u>.

2. The speed of light reflected from a moving mirror is *c+2v*, where *v* is (a component of) the mirror velocity. The motion of the mirror is considered to determine the point in space where the light is reflected. We call this <u>conventional *c+2v* model</u>.

3. The speed of light reflected from a moving mirror is *c+2v*, where *v* is mirror velocity. Light is reflected (behaves as if it is reflected) from the point in space where the mirror was *at the moment of emission*. We call this <u>unconventional *c+2v* model</u>.

Of the three experiments discussed so far, the A.Michelson moving mirror experiment is the most reliable one because it is a controlled experiment in that it is confined and carried out in a lab. Therefore, we will use it as the first guide in our exploration of the model of the speed of light reflected from a moving mirror. This experiment clearly agrees with the *c* model, and therefore disproves the conventional *c+2v* model. (Note that this experiment also disproved conventional $c + v$ model [2])

On the other hand, the Bryan G. Wallace analysis of the Venus ranging data clearly indicated that the conventional *c* model is wrong.The conventional *c*+2*v* model agrees with Wallace's analysis, as shown already. However, as stated above, this model is disproved by the A. Michelson mirror experiment.

Therefore, we are left only with the <u>unconventional $c + 2v$</u> model, which is the new theory proposed in this paper. The new model appears to agree with all the three experiments. However, the physical meaning of this model is not clear. How can light be reflected from the point where the mirror was at the instant of emission?

Consider co-located and stationary light source and observer (Fig.1). Suppose that at $t = 0$ light is emitted from the source and a mirror is at distance *D* from the observer , moving with velocity *v* towards the observer. In my previous papers[6][7][8], I introduced a new theory about the fundamental nature of quantum particles, such as photons and electrons. Therefore, the reflection of light from the point where the mirror was at the moment of emission is only an apparent phenomenon, and is therefore not as inexplicable as one would think, i.e. if one accepts the new theories proposed in the papers[6][7][8]. Therefore, light is not actually reflected from the point where the mirror was at the instant of emission. Light only behaves as if it is reflected from the point where the mirror was at the instant of emission. The transit time(τ) of light reflected from a moving mirror is exactly as if this is the case.

Conclusion

The problem of the speed of light reflected from a moving mirror is considered to have been settled more than a century ago and is rarely even discussed today, if ever. The few anomalies that have been encountered during the last decades, such as in the Venus planet radar ranging experiment , have been ignored by the scientific community. Yet these experiments are clear disproof of Einstein's constancy of the speed of light. However, even if the scientific community somehow acknowledged the challenges posed by these evidences to the special relativity theory, there would be no way forward because the correct model of the speed of light responsible for these experimental outcomes has remained a mystery to this date. This paper has revealed perhaps one of the greatest mysteries of the speed of light. Conventionally, light speed experiments involving moving mirrors are analyzed by determining the point in space where light is reflected from a moving mirror, by taking into account the velocity of the mirror and the speed of light (which depends on the respective theories). The point in space where light is reflected from the moving mirror is determined by the *logical* approach that during the time interval that the light catches up with the mirror, the mirror will have moved from its position at the moment of light emission. This paper has uncovered one of the apparently inexplicable mysteries of the speed of light: light behaves *as if* it is reflected from the pointin space where the mirror was *at the instant of emission*. Moreover, the speed of light reflected from a moving mirror is the sum of the speed of light c and twice a component of the mirror velocity$v$, that is $c \pm 2v$. I propose repeating the 1913 A. Michelson moving mirror experiment to test the negative fringe shift predicted by the new theory (as compared to the fringe shift predicted by A. Michelson's formula).

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

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APPENDIX 1

A Disproof of the Principle and Theory of Relativity

Galileo's ship thought experiment:

Consider a light source emitting a light pulse from some point in the Earth's frame, at t=0. The velocity of the source is irrelevant. At the instant of light emission, an observer is at distance D from the source and is moving away from the source with velocity v, in the Earth's frame.

We know that the light will catch up with the observer at $t = D/(c - v)$. This is a well-known and accepted fact even in the Special Relativity Theory SRT and has been confirmed by experiments. Now I will use this in my argument against the principle of relativity.

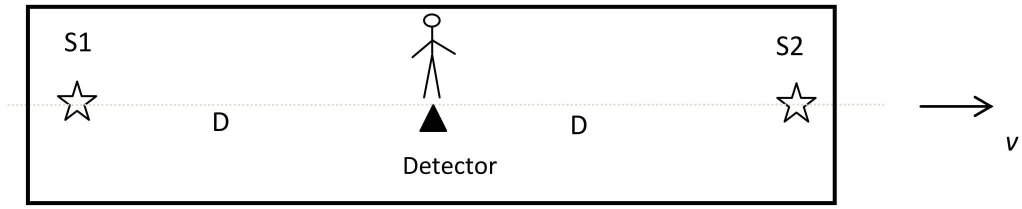
Consider Galileo's ship thought experiment. An observer in a closed room of the ship is doing a physics experiment. There are two light sources S_1 and S_2, with the distance between them equal to$2D$. The line connecting the sources is parallel to the longitudinal axis of the ship, and hence to the velocity of the ship. S_2 is in front of S_1. A detector is placed at the midpoint between the sources, at distance D from each of the sources. The light sources each emit a short light pulse simultaneously every second. The detector detects the time difference between the pulses.

The observer in the closed room first has to synchronize the clocks at S_1 and S_2. For this, a short light pulse is emitted from S_1 towards S_2. Suppose that S_1 emits the light pulse at t=0. The observer in the closed room (a relativist) synchronizes the clocks based on the principle of isotropy of the speed of light, because according to SRT the speed of light is isotropic in Galileo's ship!. However, unknown to him/her, we know that the clocks synchronized by this procedure will be out of synch by an amount:

$$\frac{2D}{c-v} - \frac{2D}{c} = 2D\frac{v}{c(c-v)}$$

The clock at S_2 will be behind the clock at S_1 by this amount.

It should be noted that, according to special relativity, the clocks synchronized by this procedure will be in synch. However, from experience we know that the clocks will be out of synch. I think even relativists implicitly accept this (i.e. the clocks being out of synch); they only claim that this does not contradict SRT, using inconsistent arguments as usual. Physicists usually describe SRT by using thought experiments in deep space, claiming that SRT is a correct theory of the universe. However, when it comes to terrestrial experiments, they usually switch their interpretation of SRT to a one that agrees with experimental outcomes. Note that in the above Galileo's thought experiment, we assumed a terrestrial experiment. However, if a relativist was given the same problem, except that the experiment is done in deep space, he/she would say that the clocks will be in synch. Therefore, we know that the relativistic procedure is wrong, based on experience and inconsistency in the analysis of SRT. Therefore we analyze the experiment classically as follows.



The sources each emit a short light pulse 'simultaneously' (quoted because the clocks are not actually in synch), every second. The observer in the ship expects the pulses to arrive simultaneously, which they do not.

Let S_1 emit the light pulse at $t = t_0$. Then S_2 will emit 'simultaneously' at time

$$t_0 + \ 2D \frac{v}{c(c-v)}$$

The light from S_1 arrives at the detector at time

$$t_0 + \frac{D}{c-v}$$

The light from S_2 arrives at the detector at time

$$[\ t_0 + \ 2D \frac{v}{c(c-v)}\ ] + \frac{D}{c+v}$$

The difference in the time of arrival of the two pulses at the detector will be:

$$\Delta = \ \left[t_0 + \ 2D \frac{v}{c(c-v)} + \frac{D}{c+v}\right] - \ \left[t_0 + \frac{D}{c-v}\right]$$

$$\Rightarrow \ \Delta = \frac{2D}{c} \frac{v^2}{c^2} \frac{1}{1 - \frac{v^2}{c^2}}$$

The relativist observer synchronized the clocks, placed the detector at the midpoint between the sources and the sources emitted light pulses 'simultaneously'. He/she would expect the light pulses to arrive simultaneously at the detector, which they didn't. The light pulses always arrive with a time difference of Δ that depends on velocity. The observer would have no way to explain this. To any one rejecting this argument, my response is this: let an actual experiment be done to test it. We know that the origin of the problem lies in the observer assuming isotropy of the speed of light while synchronizing the clocks. This disproves the principle and theory of relativity.