Apparent Constancy of the Speed of Light and Apparent Change of Time of Light Emission Relative to an Inertial Observer in Absolute Motion

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Abstract

Many experiments have been performed over decades and centuries to investigate the problem of absolute motion and the speed of light, with reported results ranging from complete null results and very small fringe shifts to large first order effects. All classical and modern theories, including ether theory, emission theory, and special relativity theory, have failed to consistently explain all of these experiments. In this paper, a new model of motion and the speed of light is proposed that can consistently explain many of the known light speed experiments including the Michelson-Morley experiments, stellar aberration, moving source, moving observer and moving mirror experiments, the Bryan G Wallace Venus radar range data anomaly, the GPS, the Ives-Stilwell experiments, the Marinov, the Silvertooth , and the Sagnac effect. The new model is proposed as follows. 1. Light always behaves as if it is emitted from the point where the source is relative to the observer/ detector *at the instant of emission*. 2. The speed of light in vacuum is always constant c relative to the observer/detector. 3. The effect of absolute motion of the observer/ detector is to create *an apparent change in time of emission*. 4. Light behaves as if it is reflected from the point in space where the mirror is/was at the moment of emission, with the speed of the reflected light equal to $c \pm 2v$, where v is a component of the mirror velocity relative to the observer, which is perpendicular to the plane of the mirror. The new theory not only can explain why the Michelson-Morley experiments give null results, but also why the Silvertooth experiment gives large first order effect. It also reconciles the Michelson-Morley experiment and the Sagnac effect. This paper also solves one of the profound puzzles in physics: the speed of electrostatic and gravitational fields. Is the speed of gravity finite or infinite? The answer is that the speed of gravity has dual nature: finite and infinite. Suppose that the Sun disappeared at $t = 0$. Would Sun's gravity on Earth disappear instantaneously or with the delay of the speed of light? At $t = -8.3$ minutes, the Sun 'anticipates' its own disappearance after 8.3 minutes and sends a zero gravitational field towards the Earth, which travels at the speed of light and reaches the Earth at $t = 0$, coinciding exactly with the instance of disappearance of the Sun!

Introduction

The failure of the 1887 Michelson-Morley experiment to detect the *expected* fringe shift was the basis of the theory of relativity. Many experiments have been performed ever since to investigate the problem of absolute motion and the speed of light, with reported results ranging from complete null results[1] and very small fringe shifts[2] to large first order effects[3].

Numerous other light speed experiments have been performed over the decades and centuries to probe the nature of the speed of light, including the Roamer experiment, Bradley stellar aberration, the Arago and the Airy star light refraction and aberration experiments, the Fizeau experiment, the Sagnac effect, moving source, moving observer and moving mirror experiment[4], the Eschaglon experiment[5], and the Venus planet radar range data anomaly[6].

All existing classical and modern theories, including the ether theory, emission/ballistic theory, special relativity and their variations, have failed to consistently explain all light speed experiments. In principle, if a theory can explain the Michelson-Morley experiment but fails to explain the Silvertooth experiment or stellar aberration or the Sagnac effect, then that theory's explanation of the Michelson-Morley experiment itself must be *fundamentally* wrong. In mainstream physics, the culture has been to keep

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pushing the limits on those experiments that apparently agree with special relativity but completely ignore those experiments that seem to contradict it. This is not in accordance with the scientific method. Therefore, contrary to all claimed advances in theoretical physics during the past century, there is no model of the speed of light today that can *consistently* explain *all* the known light speed experiments. All known theories are known to have failed to agree with several experiments. For example, emission theory is disproved by moving source experiments and the Arago and the Airy experiments, ether theory is disproved by the Michelson-Morley experiment and Special Relativity theory is disproved by the Silvertooth experiment and the Marinov experiment.

Many alternative theories have also been proposed over the decades by researchers who realized the failure of the special relativity theory. These are often modifications of ether theory and Einstein's and Lorentz's theories, and sometimes new exotic ideas. Most of these theories are usually constructed to explain some light speed experiments (for example, the Michelson-Morley null-result) while just ignoring other experiments that they fail to explain.

I have, over a period of many years, developed a new model of the speed of light[7][8][9][10][11], that can successfully explain many of the light speed experiments. However, although I gained the crucial insight early on, the complete development and refinement of the theory has taken many years. I gained the crucial insight while trying to reconcile the null result of the Michelson-Morley experiment with the fringe shift in the Sagnac effect. However, ironically, the precise/rigorous application of the new theory to the Sagnac effect took many years. The stellar aberration was yet another daunting problem that took several years to understand according to the new theory. Several other experiments have also played a key role. Therefore, the development of the theory was a result of a continuous effort to *consistently* apply it to all known light speed experiments. On the other hand, there were also apparent paradoxes identified in the theory.

I have also attempted to test some of the unique predictions of the theory by carrying out some crude experiments (I couldn't do more refined experiments due to lack of access to parts and lack of funding). Remarkably, these experiments have helped me to make significant refinements to the theory, which also helped to solve the paradoxes mentioned above. I have also proposed other experiments that test predictions of the theory.

The present paper is a continuation of these efforts. In particular, I have recently discovered that my theory is not in agreement with one experiment, namely the A. Michelson moving mirror experiment, and this has helped me uncover yet another subtlety and intricacy of the speed of light as presented in another paper [12]. Therefore, I can say that my theory has developed to the point that it can consistently explain almost all known light speed phenomena, with few anomalies. In this paper, I will first introduce the formulation of the new theory and then apply it to as many experiments as possible, in an effort to summarize the nearly ten years of extensive theoretical research on the problem of absolute motion and the speed of light. With significant refinement of the theory, some of the experiments that were analyzed in my previous papers also need to be reanalyzed in this paper.

In order not to delay the introduction of the new theory and to avoid confusions, I will not discuss in detail the previous version of my theory, but will go directly to the refined version. Just to give some ideas, according to the previous version of the theory (Apparent Source Theory, AST), the effect of absolute motion is to create an apparent change in the position of the light source, as seen by the observer . I had figured out several experiments to test this theory and recently carried out some crude experiments. The effect predicted by the theory was so large that it could be tested even by a crude experiment. The outcome of the experiment was null, which I did not expect. After some despair [13], this led me to the new version of the theory presented in this paper called Apparent Time of Emission (ATE) theory, instead of 'Apparent Source Theory'. Moreover, recently I realized that I haven't really and clearly solved the problem of the speed of light reflected from a moving mirror in my previous papers. The mystery of the speed of light reflected from a moving mirror is also revealed in my previous paper [12]. The Doppler effect (including transverse Doppler effect) will also be analyzed. The Sagnac effect, the Silvertooth experiment and other experiments will be re-analyzed.

I will start by stating and explaining the principle of constancy of the speed of light and build on it in order to construct the new model of absolute/relative motion and the speed of light. I have presented a disproof of SRT in the APPENDIX, more details can be found in my papers [14][15][25][26].

Constancy of the speed of light relative to all observers

The constancy of the speed of light is one of the greatest mysteries of the universe, with many experimental and theoretical evidences pointing to it. One such experiment implying the constancy of the speed of light is the Michelson-Morley experiment. Albert Einstein was the first to explicitly and boldly state the constancy of the speed of light relative to all observers, irrespective of the velocity of the source or the observer. However, the correct and precise interpretation and formulation of this principle has eluded physicists for more than a century, despite all claimed successes of relativity theory.

The Special Relativity Theory (SRT) is an interpretation of the principle of constancy of the speed of light. SRT is based on the two postulates: 1. The principle of relativity and 2. Constancy of the speed of light. Today SRT is a universally accepted theory in the mainstream physics community. However, despite its wide acceptance, the theory of relativity is increasingly being challenged by experimental, observational, logical and theoretical counter-evidences.

On the other hand, there are indisputable experimental evidences, such as the Silvertooth and the Marionv experiments, proving the existence of absolute motion, and therefore disproving the principle of relativity. But we know that absolute motion is apparently in contradiction with the principle of constancy of the speed of light.

As if this was not enough, there is yet another less known experiment that appears to contradict not only SRT, but also absolute motion, and this is the Venus planet radar ranging experiment data anomaly, as disclosed by Brian G. Wallace. This experiment appears to confirm the long forgotten emission theory of light in which the velocity of light reflected from a moving mirror depends on the mirror velocity.

There is no theory of the speed of light today that acknowledges and resolves these and other contradictions. In this paper, I propose a new alternative explanation of the constancy of the speed of light that can resolve these apparent contradictions and can explain the Michelson-Morley experiments, the Sagnac effect, stellar aberration, the Silvertooth experiment, the Marinov experiment, the GPS Sagnac correction, and many other experiments. I will start by presenting the new explanation of the constancy of the speed of light and then build on it to construct the new *model* of the speed of light. Although this is not necessarily the actual path that I followed during the years of research, this approach will make it easier to present the new theory with more clarity.

Now consider a light source and an observer moving away from the source with *absolute* velocity V_{abs}, as shown below. Although the absolute motion of the light source is irrelevant in this case, let us assume that the source is at absolute rest just for the sake of simplicity.

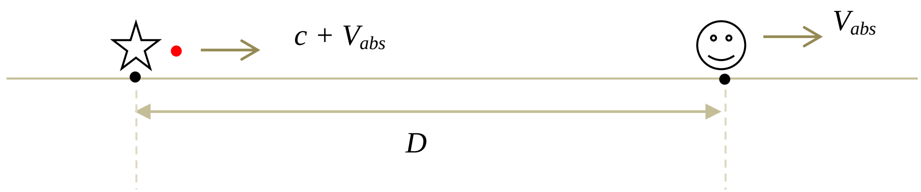


Fig.1

Let the observer be at a distance D from the source at $t = 0$, which is also the moment of emission of a short light pulse. Classically, according to ether theory, the speed of light relative to the observer will be $c - V_{abs}$, because both the observer and the light pulse are moving in the same direction. This is an experimentally confirmed fact that no physicist disagrees with. On the other hand, however, there are also significant experimental and theoretical evidences pointing to the constancy of the speed of light relative to all observers. This is obviously a contradiction.

In order to resolve this contradiction, here we choose the constancy of the speed of light relative to all observers to be a *fundamental* law of nature and then seek an alternative explanation to the experimental fact that the speed of light is apparently $c \pm V_{abs}$ relative to the moving observer. As it turns out, the latter is only an apparent phenomenon.

Now, what is the explanation for the constancy of the speed of light relative to the moving observer (Fig.1)? As shown, there is a simple yet counter-intuitive explanation: the light is emitted from the source with velocity $c + V_{abs}$ relative to the absolute reference frame, so that the speed of light relative to the observer will be constant: $(c + V_{abs}) - V_{abs} = c$, and is therefore always constant c regardless of however fast the observer is moving.

$$velocity\ of\ light\ relative\ to\ the\ observer\ =$$

$$velocity\ of\ light\ relative\ to\ the\ absolute\ reference\ frame\ -$$

$$velocity\ of\ the\ observer\ relative\ to\ the\ absolute\ reference\ frame$$

$$\Rightarrow\ velocity\ of\ light\ relative\ to\ the\ observer\ =\ (c + V_{abs}) - V_{abs}\ =\ c$$

Thus, the light pulse always approaches the observer with velocity c.

In the case of an observer moving towards the light source (Fig.2), the same theory applies. The light is emitted from the source with velocity $c - V_{abs}$ relative to the absolute reference frame, so that the speed of light relative to the observer will be constant: $(c - V_{abs}) + V_{abs} = c$, and is always constant c regardless of however fast the observer is moving.

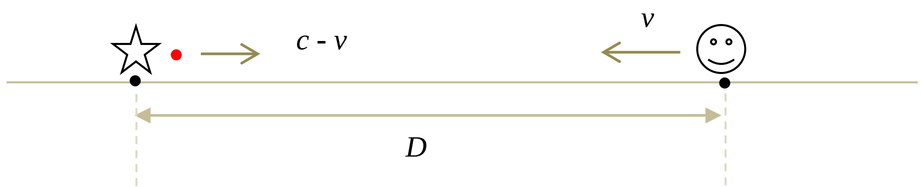


Fig.2

$$velocity\ of\ light\ relative\ to\ the\ observer\ =$$

$$velocity\ of\ light\ relative\ to\ the\ absolute\ reference\ frame\ +$$

$$velocity\ of\ the\ observer\ relative\ to\ the\ absolute\ reference\ frame$$

$$\Rightarrow\ velocity\ of\ light\ relative\ to\ the\ observer\ =\ (c - V_{abs}) + V_{abs}\ =\ c$$

This can be summarized as:

1. *The velocity of the center of the light wave fronts relative to the absolute reference frame is always equal to the absolute velocity of the observer*
2. *The velocity of light is always constant c relative to the center of the wave fronts*
3. *Therefore, the velocity of light is always constant c relative to the observer*.

So far we have seen the effect of motion of the observer. What about the motion of the source? It is an experimentally established fact that the motion of the source does not have any effect on the speed of light. The absolute velocity of the observer is all that determines *the velocity of light relative to the absolute reference frame*. If the observer is at absolute rest, then the velocity of light relative to the absolute frame (and therefore relative to the observer) is always constant *c*. If the observer is moving with velocity V_{abs}, then the velocity of light relative to the absolute frame is $c \pm V_{abs}$ as stated above.

This is the mystery that has eluded physicists for centuries. Therefore, I have shown that the speed of light in vacuum is always constant *c* relative to the observer by using a novel yet simple idea, without assuming SRT's relativity of length and time.

However, this hypothesis/theory raises a fundamental question. How can the light source 'know' the (absolute) velocity *v* of the observer so that it can 'adjust' the velocity of the photons it emits, so that the photons always approach the observer with velocity *c ?*

The answer to this question is a mystery that I discovered in an apparently unrelated area of physics: quantum phenomena. While struggling to understand the quantum phenomena of interference of photons/electrons, wave-function collapse and, particularly, the Which-Way quantum experiment, I got the unprecedented insight that God is behind all the quantum mysteries. This also unlocked the key to many problems in physics, including the problem of the speed of light.

Therefore, we can think of the solution as follows. God has a foreknowledge of the absolute velocity *v* of the observer, so He makes the source emit the photons accordingly, with velocity $c \pm V_{abs}$ relative to the absolute frame. This theory of direct intervention of God in the universe was the single most important insight I gained during the years of theoretical research[7][8][9][10][11].

However, a profound feature of the constancy of the speed of light relative to all observers is that it is *fundamentally inaccessible to direct confirmation by any physical experiments*. We will explain this later. As I said earlier, the speed of light *appears* to vary with observer velocity.

The observed (apparent) non-constancy of the speed of light relative to moving observers

The principle of constancy of the speed of light proposed above is in apparent contradiction with experiments because all physicists agree that light takes more time to catch up with an observer/detector moving away from the light source than an observer that is at rest.

To illustrate this apparent contradiction, consider two light sources S_1 and S_2 and an observer at the mid-point between the sources, all co-moving with absolute velocity V_{abs} on a common platform (Fig.3)

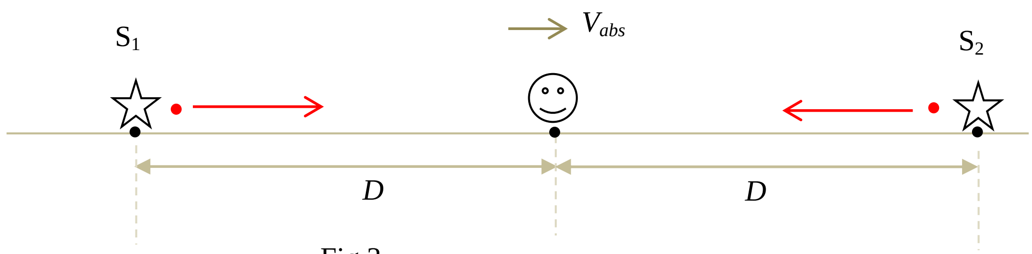


Fig.3

Suppose that the two sources emit light pulses simultaneously, at time $t = 0$. (For now let us assume that clock synchronization is not a problem, as I have shown in other papers[14][15]). According to the principle of constancy of the speed of light proposed above, the velocity of the light pulse emitted by S_1 will be $c+V_{abs}$ to the right relative to the absolute frame, and the velocity of the light pulse emitted by S_2 will be c-V_{abs} to the left relative to the absolute frame, so that the velocity of both light pulses relative to the observer will always be constant c, irrespective of the velocity V_{abs} of the platform. In this case, then the two pulses would arrive simultaneously at the observer/detector. This contradicts with experiments and experience.

To solve the above problem, we make the following crucial modification to our model as follows. In the above statement of the problem, we assumed that the two sources emit light pulses simultaneously, at time $t = 0$. The mystery lies in the statement of the problem itself. The new finding is that, for the observer/detector co-moving with the light sources, the emission of the light pulses will not be simultaneous. The simultaneous emission of the two pulses is only what can be measured physically, that is if two synchronized clocks are put at the sources, one clock at each source, the clocks will record simultaneous emission of the pulses. At the most fundamental level, however, the two pulses are not emitted simultaneously. But again this is only an apparent phenomenon *inaccessible to direct confirmation by any physical experiments*. This is only a correct model to predict the outcome of experiments and cannot be tested *directly* by any physical experiments. This will be explained later on in this paper. (Thus, for the first time I have come across Einstein's relativity of simultaneity?! Note that the apparent non-simultaneity in the new theory is completely different from Einstein's relativity of simultaneity.)

The source S_1 emits the light pulse with velocity $c + V_{abs}$ to the right , but (apparently) *later* than $t = 0$. The source S_2 emits the light pulse with velocity $c - V_{abs}$ to the left , but (apparently) *earlier* than $t = 0$. I will explain this as follows.

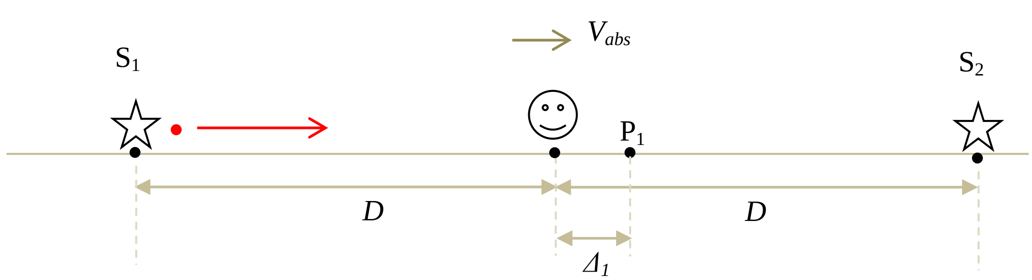


Fig.4

Let us first consider the light from S_1 (Fig.4). Let us assume that the co-moving observer detects the light from S_1 at point P_1 in the absolute reference frame. Consider another observer who is at absolute rest at point P_1. Naturally, we assume that both observers detect the light at point P_1. We will see how this assumption leads to a contradiction.

Relative to the moving observer, the speed of light is constant *c* and therefore the light moves a distance *D*. (Note that, in the absolute frame the light has to move a distance $D + \Delta_1$ to catch up with the observer)

Therefore, the time taken by the light pulse to reach the co-moving observer will be:

$$\frac{D}{c}$$

Relative to the observer at absolute rest at point P_1, the speed of light is constant *c* and the light moves the distance $D + \Delta_1$. Therefore, the time taken by the light pulse to reach the observer at rest will be:

$$\frac{D + \Delta_1}{c}$$

But we have already assumed that both observers detect the light pulse simultaneously at point P_1. If the light pulse takes different times to reach the two observers, then how can the two observers detect the light pulse simultaneously?! This is a contradiction.

Then if all the assumptions we have made so far about the speed of light are correct, this leads us to an unconventional, counter-intuitive conclusion that, if the two observers are to detect the light pulse simultaneously at point P_1 , then the light pulse from S_1 must be emitted apparently *later* than $t = 0$ *for the moving observer*. Note that the light pulse is emitted at $t = 0$ for the observer at rest. Since the path length (*D*) of the light for the moving observer is shorter than the path length ($D + \Delta_1$) for the stationary observer, then the light for the moving observer must be emitted apparently later than the light for the stationary observer if both observers are to detect the light pulse simultaneously.

The light for the moving observer is emitted at the time:

$$t_1 = \frac{D + \Delta_1}{c} - \frac{D}{c} = \frac{\Delta_1}{c}$$

But Δ_1 is determined by the (classical) fact that during the time interval that the observer moves the distance Δ_1 , the light moves the distance $D + \Delta_1$.

$$\frac{D + \Delta_1}{c} = \frac{\Delta_1}{V_{abs}}$$

$$\Longrightarrow \Delta_1 = D \frac{V_{abs}}{c - v_{abs}}$$

Therefore,

$$t_1 = \frac{\Delta_1}{c} = \frac{D}{c} \frac{V_{abs}}{c - V_{abs}}$$

Therefore we state the following:

The effect of absolute motion of the observer/detector is to create an apparent change in the time of light emission for that observer.

The new theory may be called Apparent Time of Emission (ATE) theory [16].

I introduce a new important principle as follows.

Unconventionally, the distance between the center of the light wave fronts and the inertial observer always stays constant between the moment of light emission and the moment of light detection and is equal to the distance between the source and the observer <u>at the moment of emission</u>. The position (distance and direction) of the center of the light wave fronts relative to the inertial observer is always constant and will not change between the moment of light emission and the moment of light detection. The speed of light is constant relative to the center of the wave fronts and therefore relative to the observer. The effect of absolute motion is only to create an apparent change in the time of light emission relative to the observer in absolute inertial motion.

Classically, the distance between the center of the wave fronts and the observer changes between the moment of emission and the moment of detection depending on the velocity of the observer. For example, the distance of the center of the wave fronts of sound continuously changes relative to a receiver moving relative to the air.

This new principle is crucial to understand the phenomenon of stellar aberration and many other light speed experiments.

<u>*Dual* nature of the speed of light: *constant and variable*</u>

We can say that the speed of light relative to the observer/detector has *dual* nature:
1. Constant *c* independent of the observer absolute velocity V_{abs} , and
2. Variable c ± V_{abs} , where V_{abs} is the absolute velocity of the observer

The first is fundamental and is inaccessible to any physical experiments for direct confirmation. The second is apparent (not fundamental) and is based on the definition of speed: *speed = distance/time*.

Thus we have succeeded in explaining the apparent change in the speed of light relative to a moving observer. The speed of light is always constant *c* relative to a moving observer/detector, irrespective of his/her/its absolute velocity. However, the absolute velocity of the observer causes a change in the time of detection of light. But this change in the time of detection of the light is not because of change in velocity of the light relative to the observer, but due to an <u>apparent</u> change in the time of emission of light <u>*for that observer*</u>.

Logically, and in reality, the same event of emission of a single light pulse cannot happen at different times for a moving observer and for a stationary observer. To state that the same event happens at different times for two relatively moving observers/detectors would be illogical and is not possible in reality. This is why I have used the word ‘apparent’ in the above statement.

But how can this apparent change in time of light emission for a moving observer be explained?

There is no doubt that at this stage the reader will be puzzled by this proposal that the same event of light emission occurs earlier for the moving observer compared to the time of emission for the observer at rest. However, it should be clear that this is only an apparent phenomenon *not accessible to any physical experiments* and therefore can only be inferred. The mystery is revealed as follows.

Consider a light source and an observer at rest as shown below.

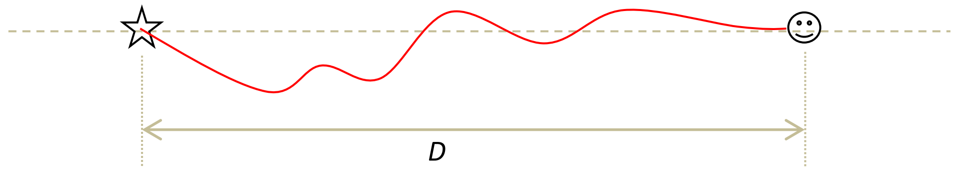


Fig. 5

In my previous paper [17] , I proposed that quantum particles such as photons and electrons do not travel in straight line at the most fundamental level, even with no external force applied to them, that is even in field-free regions (in the case of the electron). But this phenomenon is fundamentally inaccessible to any physical experiments. That they travel in straight line is only an apparent / average/observed/measured phenomena. A photon emitted from the source (Fig.5) travels in a curved path (the exact path depends on the initial conditions of the internal dynamics of the photon[17]),with its instantaneous velocity along its path continuously varying between subluminal and superluminal values.

Although the path of the photon is not straight line and although its instantaneous velocity varies along its path, the average speed/velocity of the photon is always equal to the known speed of light *c*:

$$average\ speed\ of\ photon = \frac{D}{\Delta t} = c$$

where Δt is the time of flight.

Now returning to the case of an observer in absolute motion, the change in the time of emission of light for an absolutely moving observer is only an apparent phenomenon. The initial conditions of the internal dynamics of the photon (unknown to current physics) are set so that the photon arrives at the observer at a time that is predicted by the new model proposed in this paper, that is *as if* the time of its emission is changed, as if the center of the light wave-fronts moves with the absolute velocity of the observer and as if the velocity of light is constant *c* relative to the *apparent* center of light wave-fronts and therefore relative to the observer. The new model proposed in this paper is supposed to be just a model that always agrees with actual measurements. This is a deep mystery of the universe and we will only concentrate on the *model* in this paper.

Therefore, we will only focus on the *model* and not on the underlying fundamental mechanism described above. So far we have described the model. However, our model is slightly incomplete. We have stated that for the co-moving observer, the light pulse is emitted at a *later* time (t_1) than $t = 0$, which is the moment of emission for the observer at rest at point P_1. If the moving observer is at the mid-point between the two sources at time $t = 0$, then at a later time the observer will be at point X_1 in the absolute frame at $t = t_1$. Since the distance between the observer and the center of the light wave fronts is always equal to *D*, the light for the co-moving observer is apparently emitted from point Y_1 in the absolute frame.

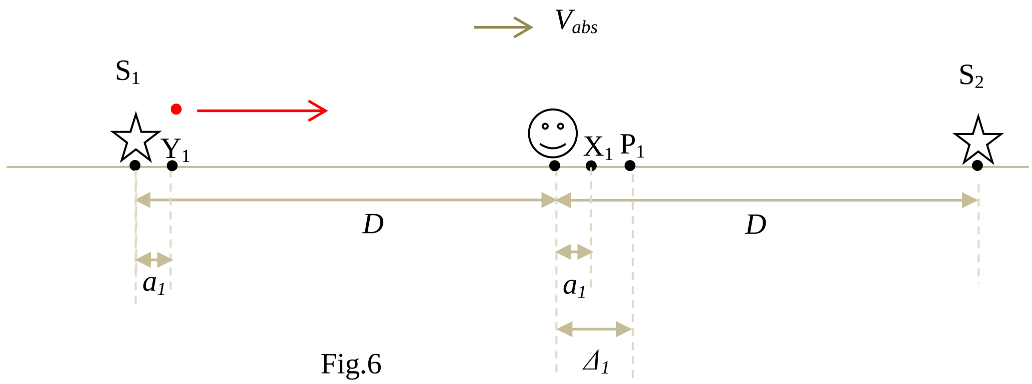


Fig.6

The distance a_1 is :

$$a_1 = V_{abs}\, t_1 = V_{abs} \; \frac{D}{c} \; \frac{V_{abs}}{c - V_{abs}} = D\, \frac{V_{abs}}{c} \; \frac{V_{abs}}{c - V_{abs}}$$

Therefore, whereas the light is emitted from point S_1 for the observer at rest, it is emitted from point Y_1 for the moving observer. However, as explained above, all of this is only an apparent phenomena and the light is emitted from point S_1 for both observers in reality.

However, this is just to give a complete model as seen in the absolute reference frame. Although we can apply this in the analysis of light speed experiments in the absolute reference frame, it is easier to do the analysis in the frame of the observer in which we only need to consider the time t_1 of light emission and not the distance a_1.

We analyze all light speed experiments relative to the observer, and therefore there is no (apparent) change of the point of light emission relative to the observer. The point of light emission (and therefore the center of the wave fronts) relative to the observer is the same as the position (distance and direction) of the source relative to the observer *at the moment of emission* and stays fixed relative to the observer/detector between the moment of light emission and the moment of light detection.

This is why I chose to leave out the apparent change in the point of light emission in the title of this paper because that applies only when we analyze the experiment relative to the absolute reference frame.

. . . ~~apparent change in the time and point of light emission~~

. . . apparent change in the time of light emission

Similar argument applies to the light from source S_2 .

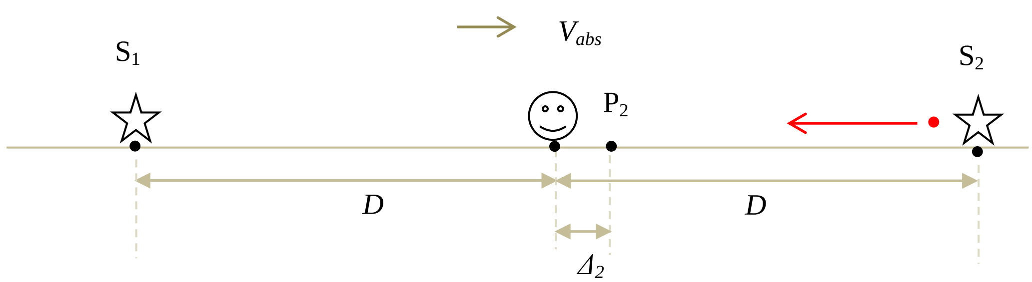


Fig.7

Again let us assume that the co-moving observer detects the light from S_2 at point P_2 in the absolute reference frame (Fig.7). Consider another observer who is at absolute rest at point P_2. Naturally, we assume that both observers detect the light at point P_2. We will see how this assumption leads to a contradiction. The arguments are similar to that of the light from S_1.

Relative to the moving observer, the speed of light is constant c and therefore the light moves a distance D . (Note that, in the absolute frame the light has to move a distance $D - \Delta_2$ to meet the observer.)

Therefore, the time taken by the light pulse to reach the co-moving observer will be:

$$\frac{D}{c}$$

Relative to the observer at absolute rest at point P_2, the speed of light is constant c and the light moves the distance $D - \Delta_2$.

Therefore, the time taken by the light pulse to reach the observer at rest will be:

$$\frac{D - \Delta_2}{c}$$

But we assume that both observers detect the light pulse simultaneously at point P_2. If the light pulse takes different times to reach the two observers, then how can the two observers detect the light pulse simultaneously?! This would be a contradiction.

Then if all the assumptions we have made so far about the speed of light are correct, this will lead us to the unconventional, counter-intuitive conclusion that, if the two observers are to detect the light pulse simultaneously, then the light pulse from S_2 must be emitted apparently *earlier* than $t = 0$ *for the moving observer*. Note that the light pulse is emitted at $t = 0$ for the observer at rest at point P_2. Since the path length (D) of the light for the moving observer is greater than the path length ($D - \Delta_2$) for the stationary observer, then the light for the moving observer must be emitted earlier than the light for the stationary observer if both observers are to detect the light pulse simultaneously at point P_2.

The light for the moving observer is emitted at the time:

$$t_2 = -\left(\frac{D}{c} - \frac{D - \Delta_2}{c}\right) = -\frac{\Delta_2}{c}$$

The negative sign is because the light for the moving observer is emitted earlier than $t = 0$.

But Δ_2 is determined by the (classical) fact that during the time interval that the observer moves the distance Δ_2 , the light moves the distance $D + \Delta_2$.

$$\frac{D - \Delta_2}{c} = \frac{\Delta_2}{V_{abs}}$$

$$\Longrightarrow \Delta_2 = D \frac{V_{abs}}{c + V_{abs}}$$

Therefore,

$$t_2 = -\frac{\Delta_2}{c} = -\frac{D}{c}\frac{V_{abs}}{c + V_{abs}}$$

Therefore we state the following again:

The effect of absolute motion of the observer/detector is to create an apparent change in the time of light emission.

Similar to our discussion about the model of the speed of light for the light from S_1, we need to complete our model for the light from S_2. We have stated that for the co-moving observer, the light pulse is emitted at an *earlier* time (t_2) than $t = 0$, which is the moment of emission for the observer at rest at point P_2. If the observer is at the mid-point between the two sources at time $t = 0$, then at an *earlier* time the observer will be at point X_2 in the absolute frame at $t = t_2$. Since *the distance between the observer and the center of the light wave fronts is always equal to D between the moment of light emission and the moment of light detection*, the light for the co-moving observer is emitted from point Y_2 in the absolute frame.

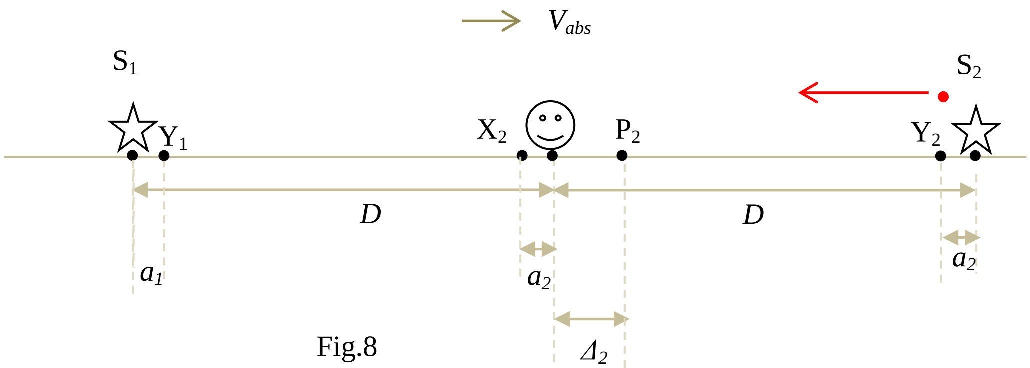


Fig.8

The distance a_2 is :

$$a_2 = V_{abs}\, t_2 = V_{abs}\ \frac{D}{c}\frac{V_{abs}}{c + V_{abs}} = D\,\frac{V_{abs}}{c}\ \frac{V_{abs}}{c + V_{abs}}$$

Therefore, whereas the light is emitted from point S_2 for the observer at rest, it is emitted from point Y_2 for the moving observer. By the time the observer is at the mid-point between the sources, the light for the co-moving observer will have moved a distance of:

$$c\,t_2 = c\,\frac{D}{c}\frac{V_{abs}}{c + V_{abs}} = D\,\frac{V_{abs}}{c + V_{abs}} = \Delta_2$$

towards the observer.

However, as explained above, all of this is only an apparent phenomena and the light is emitted from point S_2 at $t = 0$ for both observers in reality.

A new model of the speed of light

Next we formulate the general procedure of analysis of light speed experiments. We start by assuming the classical absolute reference frame or the ether relative to which absolute velocity is defined.

Suppose that an observer O is moving with absolute velocity V_{abs} to the right as shown below. A light source emits light from point S *in the absolute reference frame* at time $t = 0$. At the instant of light emission ($t = 0$) the observer is just passing through point O.

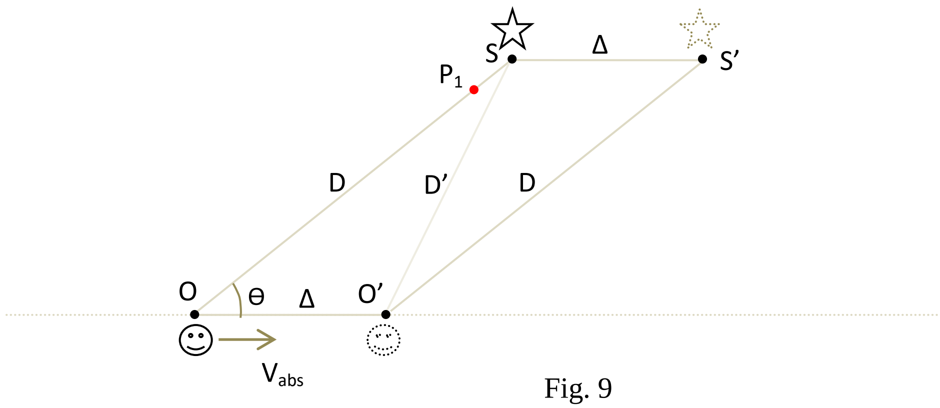


Fig. 9

According to ether (absolute motion) theory, the observer will detect the light at point O', where

$$\frac{D'}{c} = \frac{\Delta}{V_{abs}}$$

The above equation means that during the time interval that the light moves from point S to point O', the observer moves from point O to point O'.

From the triangle SOO'

$$D' = \sqrt{D^2 + \Delta^2 - 2D\Delta\cos\theta}$$

Therefore, given D, θ and V_{abs}, D' and Δ can be determined from the last two equations.

Combining the last two equations :

$$D'^2\left(1 - \frac{V_{abs}{}^2}{c^2}\right) + D'\left(2D\,\frac{V_{abs}}{c}\right)cos\theta - D^2 = 0 \qquad . \quad . \quad . \quad (1)$$

from which D', and then Δ can be determined.

$$D' = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-\left(2D\,\frac{V_{abs}}{c}\right)cos\theta + \sqrt{\left(\left(2D\,\frac{V_{abs}}{c}\right)cos\theta\right)^2 + 4\left(1 - \frac{V_{abs}{}^2}{c^2}\right)D^2}}{2\left(1 - \frac{V_{abs}{}^2}{c^2}\right)}$$

$$\Rightarrow \quad D' = \frac{-\left(D\,\frac{V_{abs}}{c}\right)cos\theta + D\sqrt{\frac{V_{abs}{}^2}{c^2}\,(cos^2\theta - 1) + 1}}{\left(1 - \frac{V_{abs}{}^2}{c^2}\right)}$$

$$\Rightarrow \quad D' = \frac{-\left(D\,\frac{V_{abs}}{c}\right)cos\theta \;+ D\sqrt{1 - \frac{{V_{abs}}^2}{c^2}\,sin^2\theta}}{\left(1 - \frac{{V_{abs}}^2}{c^2}\right)} \qquad . \; . \; . \; . \quad (2)$$

$$\Rightarrow \quad D' \cong D\left(1 - \frac{V_{abs}}{c}\,cos\theta\right) \quad , \qquad for \quad V_{abs} \ll c \quad . \; . \; . \; . \quad (3)$$

The observer will detect the light at point O' after a time delay of:

$$\frac{D'}{c} = \frac{\Delta}{V_{abs}}$$

The analysis we have made so far is classical and there is nothing new about it. However, we will see that the mystery of the speed of light that has eluded physicists so far lies in the new *interpretation* of these results, as already discussed in the last section.

As already discussed, assume that there is another observer at absolute rest at point O'. Since the moving observer and the observer at rest will both detect the light pulse at point O' simultaneously, then the light for the moving observer must be emitted *earlier* than $t = 0$, which is the moment of emission for the stationary observer and which is also the *real* moment of emission as detected by, for example, by a detector close enough to the source. For the moving observer, the light is emitted at the time:

$$t_1 = -\left(\frac{D}{c} - \frac{D'}{c}\right) \quad . \; . \; . \quad (4)$$

where the negative sign outside the bracket indicates the light for the moving observer is emitted *earlier* than $t = 0$. Since the distance D' can be determined from the last equations, t_1 can be determined. Substituting the expression of D' in the above equation:

$$\Rightarrow \; t_1 = -\left(\frac{D}{c} - \frac{D\left(1 - \frac{V_{abs}}{c}\,cos\theta\right)}{c}\right)$$

$$\Rightarrow \; t_1 = -\frac{D}{c}\,\frac{V_{abs}}{c}\,cos\,\theta \;, \quad for \; V_{abs} \ll c \qquad . \; . \; . \quad (5)$$

Therefore, unconventionally, *the absolute motion of the observer affects not only the time of light detection, but also the (apparent) time of light emission*!

At the *real* moment of emission ($t = 0$), the observer is at point O as shown (Fig. 9). At this moment, the light for the moving observer will have already travelled a distance of ($c\,t_1$) along the line SO to point P_1 as shown by the red dot, where the distance P_1O is equal to D' .

$$distance\ OP_1 = D'$$

To restate the principle introduced in the last section:

The position (distance and direction) of the center of the light wave fronts relative to the observer is always fixed relative to the observer between the moment of emission and the moment of detection, and this is the same as the position of the source relative to the observer at the moment of emission. In other words, the center of the light wave fronts is always fixed relative to the observer and is therefore co-moving with the observer.

Accordingly*, the position of the center of the wave fronts* at $t = 0$ is at point S. As the observer moves with absolute velocity V_{abs} from point O to point O', the center of the wave fronts also moves with the same velocity V_{abs} from S to S', along the line SS'.

To contrast this with classical theory, according to classical waves, the position of the center of the wave fronts relative to the observer when the observer is at point O (line OS) is different from its position when the observer is at point O' (line O'S). This can explain the phenomenon of stellar aberration as we will see later.

Since the observer and the center of the light wave fronts are co-moving with the same velocity V_{abs} *to the right, and since the velocity of light is always constant c relative to the center of the wave fronts, the velocity of light relative to the observer is also always equal to c.*

So far we have considered the motion of the observer and the motion of the center of the light wave fronts relative to the absolute reference frame. However, instead of thinking of the observer (and the center of the wave fronts) as moving, we can always assume the observer to be at rest and then accounting for the absolute motion of the observer by assuming an apparent change in the time of light emission.

From the above, we can see that what matters is the absolute velocity of the observer and the position of the source (point of light emission) relative to the observer *at the instant of emission*, at $t = 0$.
Next I formulate the new theory called Apparent Time of Emission (ATE) theory as follows:

1. The inertial observer/detector is always considered to be at rest and any light speed experiment is analyzed in the reference frame of the observer / relative to the observer. Unlike the theory of relativity, in which the observer is any inertial reference frame, according to the new theory the observer is the actual detector of the light photons. This could be seen as the molecules in the retina of the human observer, or the atoms inside an electronic light detector, etc. In this case, the inertial observer/detector is at the origin of the observer's reference frame (Fig.10). This is always what we are referring to in the new theory whenever we say 'reference frame of the observer', 'relative to the observer'.

2. The position of the source relative to the observer *at the instant of emission* (at the instant of emission with respect to observers at rest, at $t = 0$) is the point of light emission relative to the observer, point S. In Fig.10 the position of the source relative to the observer *at the moment of emission* is shown. As stated already, only two factors matter: the absolute velocity of the inertial observer/detector and the position of the source relative to the observer at the instant of light emission (the effect of mirror velocity will be considered below). Classically, the point of light emission *relative to the observer/detector* at the instant of detection (O'S) is different from the point of light emission relative to the detector at the instant of light emission (OS) (Fig.9). According to the new theory, the point of light emission relative to the observer at the instant of light detection (O'S') is the same as the point of light emission relative to the observer at the instant of light emission (OS).

3. To account for the absolute motion of the observer/detector, we assume *an apparent change in the time of light emission*. Let a light pulse be emitted at $t = 0$ for observers at absolute rest. Unconventionally, light is emitted apparently *earlier* or *later* than $t = 0$ for moving observers, depending on the magnitude and direction of their absolute velocity.

4. The speed of light in vacuum is always constant c relative to the observer, i.e. in the reference frame of the observer, except for light reflected from a moving mirror.

5. The velocity of light reflected from a mirror moving relative to the observer (i.e. in the reference frame of the observer) is the sum of the velocity of light c and twice the component of the mirror velocity perpendicular to the plane of the mirror, in the reference frame of the observer. Unconventionally, light is apparently reflected from a moving mirror *from the point in space where the mirror is at the instant of emission*[12].Logically, light is reflected from a moving mirror from the point in space where the mirror will have moved to during the forward transit time of light. It turns out that this logical and conventional view is possibly wrong in the case of light.

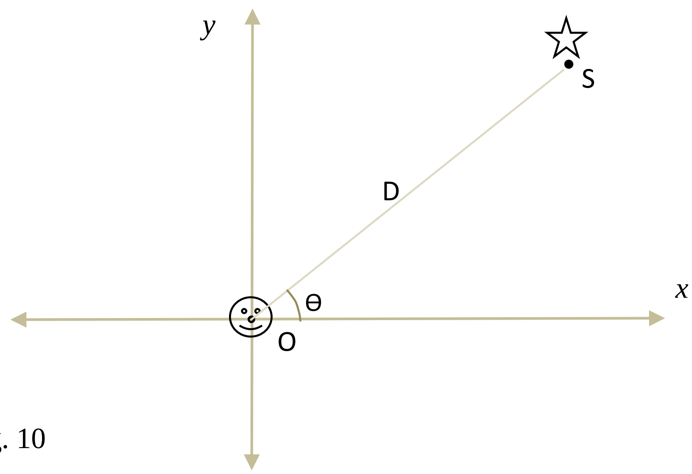


Fig. 10

Since light is emitted earlier than $t = 0$, at $t = -t_1$, by the time light is emitted for observers at rest (at $t = 0$) , the light for the moving observer will have travelled a distance of:

$$ct_1 = c\left(\frac{D}{c} - \frac{D'}{c}\right) = D - D'$$

That is, at $t = 0$, the light will have travelled a distance of SP_1 (red dot in Fig. 9).

The light will arrive at the detector at the time:

$$\frac{D - ct_1}{c} = \frac{D - (D - D')}{c} = \frac{D'}{c}$$

In this case, *the effect of absolute motion of the observer is to cause detection of light earlier than if the observer was at rest at point O, by an amount* t_1.

Since the observer is moving towards (approaching) the point of light emission (Fig.9), the observer will detect the light pulse coming directly from the source *earlier* at t_1 (equation (4)) than if the observer (and co-moving mirror) was at absolute rest.

$$t_1 = -\left(\frac{D}{c} - \frac{D'}{c}\right)$$

D' is determined from equation (3),

$$\Longrightarrow \quad D' = D\left(1 - \frac{V_{abs}}{c}\cos\theta\right) \quad , \quad for \quad V_{abs} \ll c$$

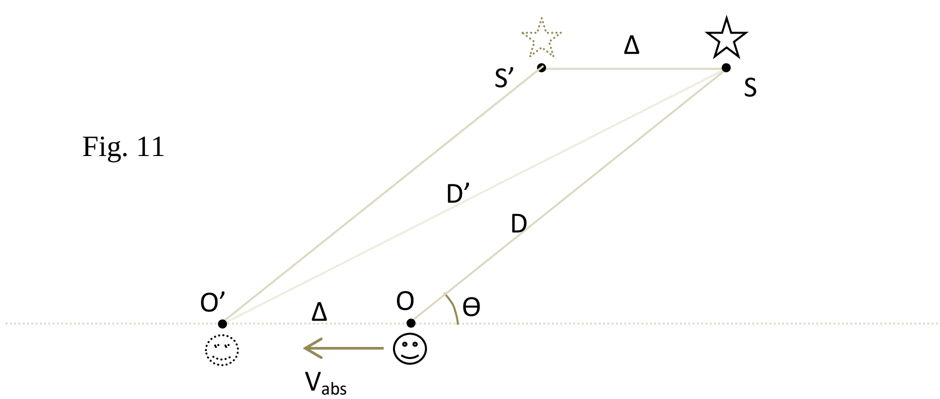
Therefore,

$$t_1 = -\left(\frac{D}{c} - \frac{D'}{c}\right) = -\left(\frac{D}{c} - \frac{D\left(1 - \frac{V_{abs}}{c}\cos\theta\right)}{c}\right)$$

$$\Longrightarrow \quad t_1 = -\frac{D}{c}\frac{V_{abs}}{c}\cos\theta \ , \quad for \ V_{abs} \ll c \qquad . \ . \ . \qquad (6)$$

In Fig.9 the observer was assumed to be moving towards (approaching) the point of light emission. For an observer moving away from (receding from) the point of light emission, the situation is as follows (Fig.11). The analysis is similar as that of the observer moving towards the point of light emission.

Fig. 11



$$\frac{D'}{c} = \frac{\Delta}{V_{abs}}$$

$$D' = \sqrt{D^2 + \Delta^2 - 2D\Delta\cos(180^0 - \theta)}$$

Combining the last two equations:

$$D'^2\left(1-\frac{{V_{abs}}^2}{c^2}\right)+\ D'\left(2D\ \frac{V_{abs}}{c}\right)cos(180^0-\theta)-\ D^2=0 \qquad . \ . \ . \qquad (7)$$

Since equation (7) is similar to equation (1), except for the angle being (180-θ) in the former and θ in the latter, we just substitute (180-θ) instead of θ in equations (2) and (3) to get the solution to equation (7).

Therefore,

$$D' \ = \ \frac{-\left(D\ \frac{V_{abs}}{c}\right)\cos(180-\theta)\ \ +D\sqrt{1\ -\ \frac{{V_{abs}}^2}{c^2}\ sin^2(180-\theta)}}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)} \qquad . \ . \ . \ . \quad (8)$$

$$\Longrightarrow \quad D' \ \cong \ D\ \left(\ 1+\frac{V_{abs}}{c}\cos\theta\right) \quad , \quad for \quad V_{abs} \ll c \qquad . \ . \ . \ . \quad (9)$$

From these equations, *D'* and *Δ* can be determined. The interpretation is the same as above.

The light for the moving observer is emitted *later* than $t = 0$, at $t = t_1$, that is *later* than the moment of emission for observers at rest, where:

$$t_1 = \left(\frac{D'}{c} - \frac{D}{c}\right) \qquad . \quad . \quad . \quad (10)$$

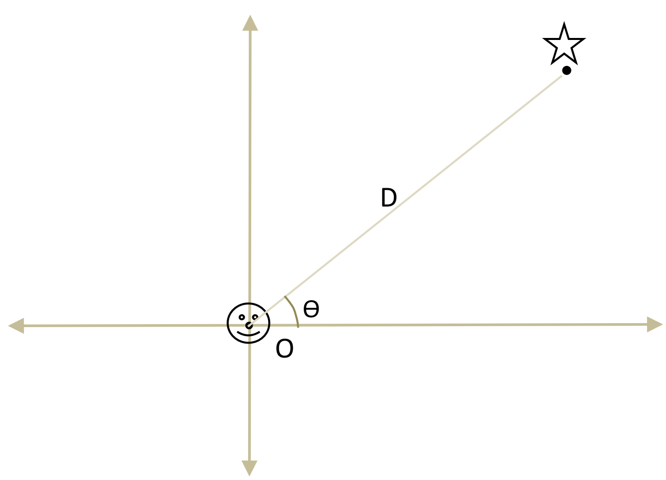


Fig. 12

Therefore, the moving observer will detect the light at the time:

$$t_1 + \frac{D}{c} = \left(\frac{D'}{c} - \frac{D}{c} \right) + \frac{D}{c} = \frac{D'}{c}$$

In this case, *the effect of absolute motion of the observer is to cause detection of light later than if the observer was at rest, by an amount* t_1.

Since the observer is moving away from (receding) the point of light detection (Fig.11), the observer will detect the light pulse coming directly from the source *later* by t_1 (equation (10)) than if the observer (and co-moving mirror) was at absolute rest at point O.

$$t_1 = \left(\frac{D'}{c} - \frac{D}{c} \right)$$

D' is determined from equation (9),

$$\Longrightarrow \quad D' = D \left(1 + \frac{V_{abs}}{c} \cos\theta \right) \quad , \quad for \quad V_{abs} \ll c$$

Therefore,

$$t_1 = \left(\frac{D'}{c} - \frac{D}{c} \right) = \frac{D \left(1 + \frac{V_{abs}}{c} \cos\theta \right)}{c} - \frac{D}{c}$$

$$\Longrightarrow \quad t_1 = \frac{D}{c} \frac{V_{abs}}{c} \cos\theta \quad for \; V_{abs} \ll c \quad . \; . \; . \quad (11)$$

Next we apply the new theory to the different light speed experiments. At first we will only consider experiments involving inertial observers/detectors. The case of non-inertial (accelerating) observers, such as in the Sagnac effect, will be considered later.

Let us consider the special cases of an observer moving directly towards or directly away from a light source. Consider an observer moving directly towards a light source (or towards a point of light emission in the absolute frame) with absolute velocity V_{abs} (Fig.13). We repeat the above analyses.

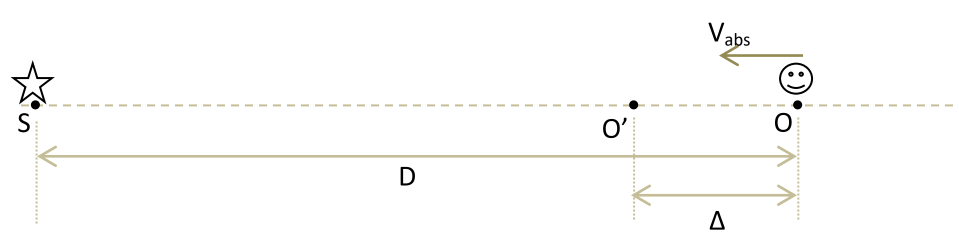


Fig. 13

Suppose that the source emits a short light pulse at $t = 0$, while the observer is just passing through point O. At the moment of emission ($t = 0$), the distance between the source and the observer is D. Classically, we know that the observer meets the light pulse at point O'. To determine Δ, we just assume that the observer is moving relative to the absolute reference frame (the ether) and we note that the time interval taken by the light pulse to move from S to O' equals the time interval taken by the observer to move from O to O', i.e.

$$\frac{D-\Delta}{c} = \frac{\Delta}{V_{abs}} \quad \Longrightarrow \quad \Delta = D\,\frac{V_{abs}}{c+V_{abs}}$$

We will use this value for Δ in the following formulation of the new theory.

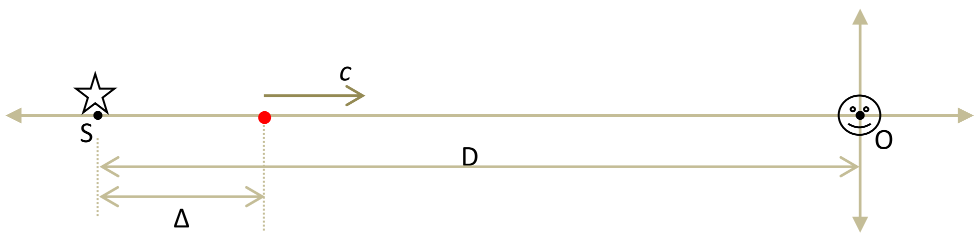


Fig. 14

For the moving observer, light is emitted *apparently earlier* than $t = 0$, at $t = -t_1$, where:

$$t_1 = \frac{D}{c} - \left(\frac{D-\Delta}{c}\right) = \frac{\Delta}{c} = \frac{D}{c}\;\frac{V_{abs}}{c+V_{abs}} \quad . \;\; . \;\; . \quad (12)$$

Since the light pulse is emitted at $t = -t_1$ for the moving observer, by the time the pulse is emitted for observers at rest ($t = 0$), the pulse for the moving observer will have travelled a distance of:

$$c\,t_1 = c\;\frac{D}{c}\;\frac{V_{abs}}{c+V_{abs}} = D\,\frac{V_{abs}}{c+V_{abs}} = \Delta$$

This means that the pulse (red dot, Fig.14) is at a distance of $D - \Delta$ from the observer at $t = 0$. Therefore, the pulse will arrive at the observer (at the origin of the co-ordinate) at the time:

$$\frac{D-\Delta}{c} = \frac{D - D\,\frac{V_{abs}}{c+V_{abs}}}{c} = \frac{D}{c}\;\frac{c}{c+V_{abs}} = \frac{D}{c+V_{abs}}$$

This is equal to the result obtained according to classical (ether) theory, and agrees with experiments.

The observer will detect the light *earlier* by t_1 than if the observer remained at rest, where t_1 is (from equation (6)):

$$t_1 = \frac{D}{c}\;\frac{V_{abs}}{c+V_{abs}}$$

Now consider an observer moving away from a light source with absolute velocity V_{abs} (Fig.15). We can assume the source to be at absolute rest or we can assume that the observer is moving with velocity v_{abs} away from the point of light emission in the absolute frame. Suppose that the source emits a short light pulse at $t = 0$, while the observer is just passing through point O. Classically, we know that the observer meets the light pulse at point O'. To determine Δ, we note that the time taken by the light pulse to move from S to O' equals the time taken by the observer to move from O to O', i.e.

$$\frac{D + \Delta}{c} = \frac{\Delta}{V_{abs}} \quad \Longrightarrow \quad \Delta = D \frac{V_{abs}}{c - V_{abs}}$$

We will use this value for Δ in the formulation of the new theory.

In the same way as above, the time of emission of the light $t = 0$ is for observers at rest. According to the new model, unconventionally, the time of light emission for a moving observer is different from that of an observer at rest.

For the moving observer, light is emitted *later* than $t = 0$, at $t = t_1$, where

$$t_1 = \frac{D + \Delta}{c} - \frac{D}{c} = \frac{\Delta}{c} = \frac{D}{c} \frac{V_{abs}}{c - V_{abs}} \qquad . \quad . \quad . \qquad (13)$$

Fig. 15

In the reference frame of the observer, the experiment looks as follows (Fig.16).

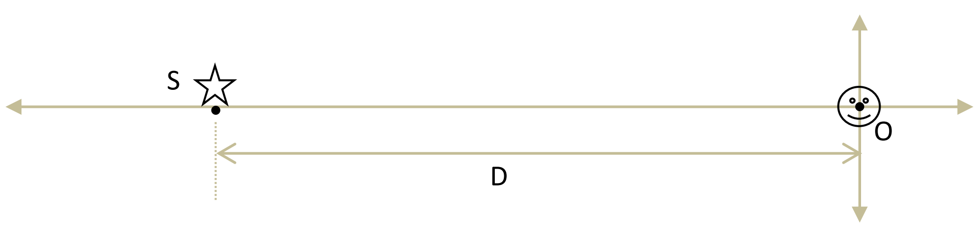


Fig. 16

Since the light pulse for the moving observer is emitted *later* than $t = 0$, that is at $t = t_1$, the light pulse for the moving observer will reach the observer at the time:

$$t_1 + \frac{D}{c} = \frac{D}{c} \frac{V_{abs}}{c - V_{abs}} + \frac{D}{c} = \frac{D}{c} \frac{c}{c - V_{abs}} = \frac{D}{c - V_{abs}}$$

The observer will detect the light *later* by t_1 than if the observer was at rest, where t_1 is (equation (13)),

$$t_1 = \frac{D}{c} \frac{V_{abs}}{c - V_{abs}}$$

So far we have seen light speed experiments in which only the light source and observer are involved. In this case, the light reaches the observer directly from the source. What about light speed experiments in which mirrors are involved?

At first we will consider light speed experiments in which the mirror is at rest relative to the observer. An example is the Michelson-Morley experiment. Suppose that the light source, the observer/detector and the mirror are co-moving (Fig.17).

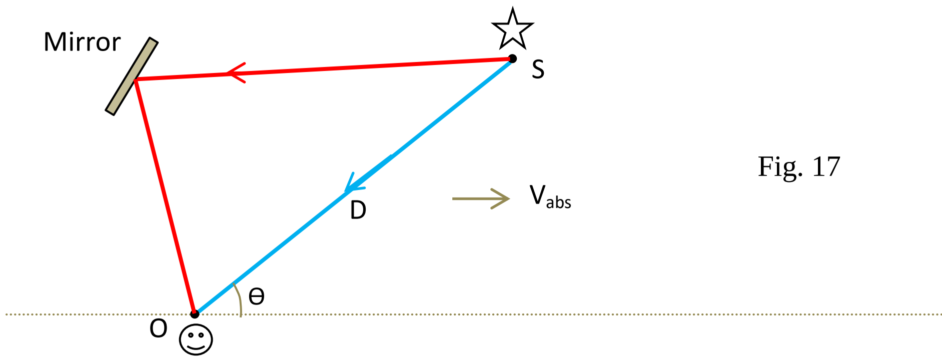


Fig. 17

Consider the two light beams, one (the blue ray) comes to the observer directly from the light source, while the other (the red ray) comes to the observer after reflection from the mirror.

As we have seen, the effect of absolute motion of the observer is to create a time delay or time advance of light emission, and hence light detection, for the light beam coming to the observer directly from the source. According to the new theory, **the light reflected from the mirror will also be delayed or advanced *by the same amount* as the light coming directly to the observer from the source!!!**

In this case, **let the light directly coming from the source be detected earlier than if the observer (and co-moving mirror) was at rest, by an amount t_1 . Then the light reflected from the mirror will also be detected earlier than if the observer (and co-moving mirror) was at rest, *by the same amount* t_1** ! This can explain the null result of the Michelson-Morley experiment.

In the light speed experiments considered so far involving only a light source and an observer, there is no difference between the new theory and classical absolute motion (ether) theory in their predictions. In both theories, an observer moving towards (away from) the point of light emission will detect the light emission earlier (later) than if the observer was at rest. Both theories make the same quantitative predictions. One might ask: then how is the new theory of absolute motion distinct from classical theories? Light speed experiments involving mirrors (such as the Michelson-Morley) distinguish the two theories. The new theory of absolute motion predicts almost null result of the Michelson-Morley experiment, whereas ether theory predicts a fringe shift.

The Michelson-Morley and the Kennedy-Thorndike experiments

Thus, the effect of absolute motion on an inertially moving Michelson-Morley experiment (MMX) is just to create an additional time delay (or time advance) of light detection at the observer/detector compared to the time delay when the MM apparatus is at rest, depending on the magnitude and direction of absolute velocity. This additional time delay (or time advance) is determined solely by the *direct* distance *D* (Fig.18) between the detector/observer and the light source, the angle θ and the magnitude and direction of absolute velocity, at the moment of emission. This additional time delay can be calculated from the equations discussed already, from equation (11) in this case..

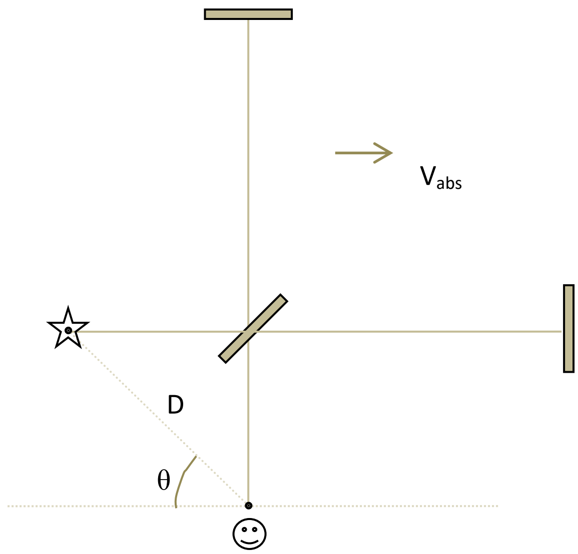


Fig. 18

According to the new theory, the effect of absolute motion of the Michelson-Morley apparatus is to create an additional delay of t_1 in all the light beams reaching the observer. That is, if the light coming to the detector *directly* from the source undergoes additional time delay of t_1 due to absolute motion, then the light beams coming to the detector after reflection from the mirrors will also be delayed by the same amount t_1 ! This is unlike ether theory!

To restate the above clearly, consider the three light beams reaching the observer, one coming directly from the source and the other two coming after reflection from the mirrors. Note that this does not necessarily mean that there must be a light beam actually coming to the detector directly from the source. For example, light directly coming to the observer could be blocked by an obstacle between the source and the observer/detector,

The new theory states that absolute motion causes equal delays of all the three light beams. Thus, no fringe shift will occur because both the longitudinal and transverse light beams are affected identically/equally by absolute motion of the apparatus. Even if the lengths of the two arms are different (as in the Kennedy-Thorndike experiment), the two light beams will always experience equal delay. Both of them are delayed by t_1 compared to the case when the MM apparatus is at rest. This is why, according to the new theory, the Michelson-Morley experiment is not capable of detecting absolute motion. This is unlike ether theory which predicts a fringe shift.

Modern Michelson-Morley experiments

The modern Michelson-Morley experiments based on cryogenic optical cavity resonators are known to give complete null results. The new theory , Apparent Time of light Emission (ATE), gives a straightforward explanation for this. The only effect of absolute motion is to create an apparent change in time of emission of light, which obviously does not affect the resonance frequency of the cavity.

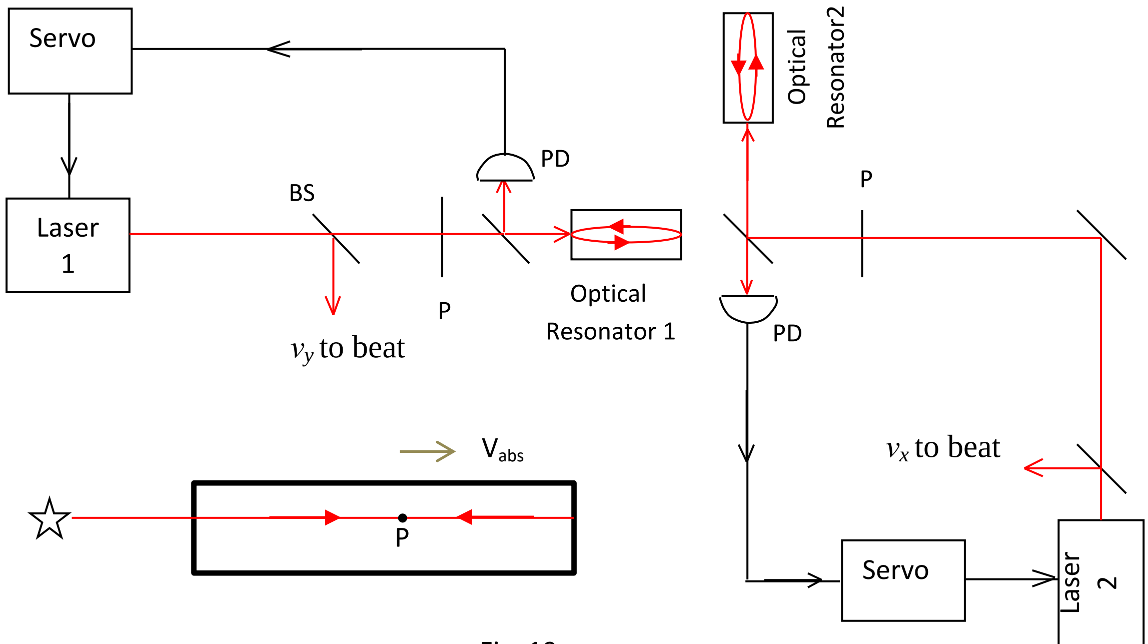


Fig. 19

The effect of absolute motion is to create an apparent change in the time of light emission, *relative to the point of light detection*. In this case, the point of detection is at the PD, and therefore the effect of absolute motion is just to create an apparent change in the time of emission, and hence a change in the time of light detection at the PD. Therefore, there will be no change in the frequency/wavelength of light detected at the PD, and there will be no change in the resonance frequency of the cavity caused by absolute motion. The resonance wavelength of the cavity can be changed only by a physical change in its dimensions.

What about inside the cavity? A detector placed inside the optical cavity can detect absolute motion as observed in the Silvertooth experiment. Note that this is only due to an apparent change in wavelength in the cavity, and not due to any real change in the resonance wavelength of the cavity. The nature of the speed of light is extremely elusive. For any point P inside the cavity, the effect of absolute motion is just to create a time delay or advance (phase delay or advance) for the waves passing through that point. For example, at point P both the incident and reflected waves will be delayed or advanced *by the same amount* due to absolute motion. Absolute motion does not affect the phase *relationship*/*difference* between the incident and reflected waves at that point. However, absolute motion changes the phase relationships between *two points* in the cavity, which does not affect the cavity resonance wave length. Although the phase relationship between the incident and reflected waves at the point P is not affected by absolute motion, there will be a change in the amplitude of the wave at that point due to an apparent change in the wavelength. I propose that a detector be somehow placed inside the optical cavity to test this hypothesis. A recent experiment[21] has confirmed the effect observed in the Silvertooth experiment.

A hypothetical Michelson-Morley experiment

From the above analysis we have seen that it is impossible to detect absolute motion by using conventional Michelson-Morley (MM) kind interferometer experiments. This is because absolute motion of the Michelson-Morley device will not cause any *change in the time difference* of two light beams originating from a *single* source, taking different paths to reach the point of detection. The effect of absolute motion is only to cause *equal time changes* (time delay or time advance) to *both* the light rays, which will not cause any fringe shift. Note that in the theory of Special Relativity, motion of the MM device does not cause any change in the time delay of each light beam. According the new theory, (absolute) motion of the MM device causes a change in the time delay of each light beam, but the changes in the time delay of both light beams caused by absolute motion are always equal, that is both light beams are either delayed or advanced equally so that the time difference between the two light beams remains constant, so no fringe shift will occur with the MM device is in absolute motion.

The key to detect absolute motion by using the Michelson-Morley kind interferometer experiments would be by interference of light from two *independent* sources. However, such an experiment is not feasible with current technology because the coherence time/length of light is very short and because it is impossible to tune the frequency of two laser sources to be equal to within, say, 0.1Hz to get any 'stable' fringe patterns. In this paper we analyze such experiment and show that it would theoretically give thousands of fringe shifts when the orientation of the device in space is changed. Unfortunately, this is only a hypothetical experiment because it is practically impossible to realize with current technology. Since rotating the device and observing the fringe positions can take, say, at least 30 seconds, we would need laser sources with coherence time of at least 30 seconds. One might ask: then why analyze an experiment that is known to be practically impossible? This is to reveal the mystery that has eluded physicists for one century.

We will first consider the effect of absolute motion on the light beam from S_2. It can be shown that the effect of absolute motion on the light beam from S_2 is negligible because the position of S_2 relative to the observer is orthogonal to the direction of absolute velocity. This can be shown by substituting $\theta = 90^0$ in equation (8) (simplified), which will give:

$$D' = \frac{\left(D\,\frac{V_{abs}}{c}\right)cos\theta \;+ D\sqrt{1-\frac{{V_{abs}}^2}{c^2}\,sin^2\theta}}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)} = \frac{D\sqrt{1-\frac{{V_{abs}}^2}{c^2}}}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)}$$

Therefore,

$$t_1 = \frac{D'}{c} - \frac{D}{c} = \frac{\dfrac{D\sqrt{1-\frac{{V_{abs}}^2}{c^2}}}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)}}{c} - \frac{D}{c} = \frac{D}{c}\left(\frac{\sqrt{1-\frac{{V_{abs}}^2}{c^2}}}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)} - 1\right)$$

$$\Rightarrow\; t_1 \cong \frac{D}{c}\;(\,1-1\,) \cong 0\;,\; for \quad V_{abs} \ll c$$

Next we consider the effect of absolute motion on the light beam from S_1. The additional time delay, induced by absolute motion, of the light beam reaching the detector after reflecting from the mirror is given by equation (11):

$$t_1 = \frac{D}{c} \frac{V_{abs}}{c} \cos\theta \quad , \qquad for\ V_{abs} \ll c$$

Therefore, the time difference between the longitudinal and orthogonal light beams will be:

$$t_1 = \frac{\frac{D}{\sin\theta}}{c} \frac{V_{abs}}{c} \cos\theta \; = \frac{D}{c} \frac{V_{abs}}{c} \frac{1}{\tan\theta}$$

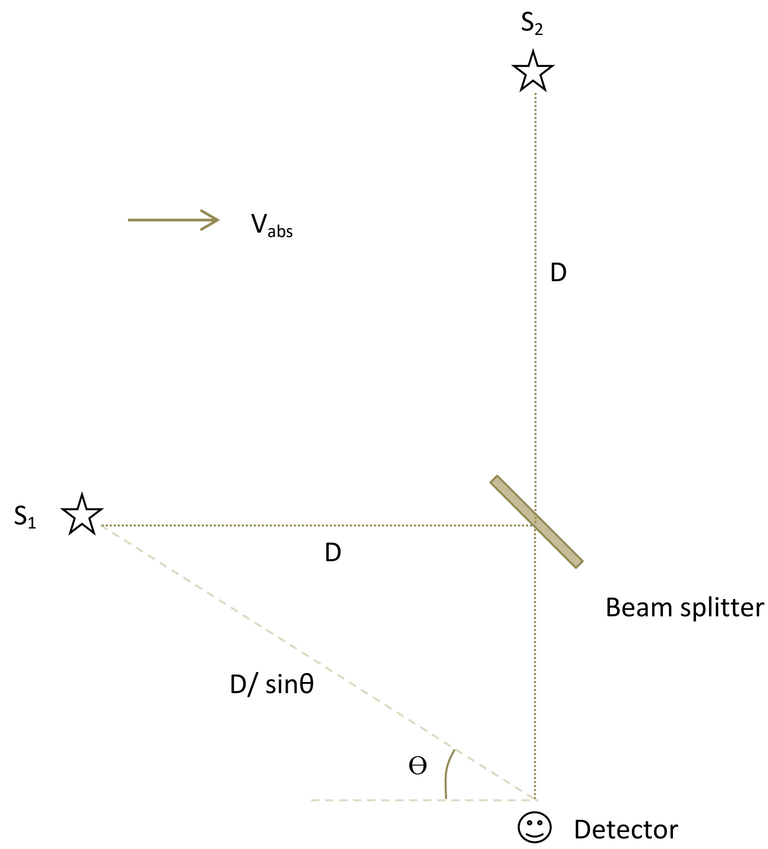


Fig. 20

For example, if D = 1 m = 0.001 km, $\theta = 30^0$, V_{abs} = 390 km/s , c = 300000 km/s

$$t_1 = \frac{D}{c} \frac{V_{abs}}{c} \frac{1}{\tan\theta} = \frac{0.001}{300000} \frac{390}{300000} \frac{1}{\tan 30^0} = 7.5 * 10^{-12}\ s$$

Let the wavelength of the laser light source be 600 nm.

$$the\ fringe\ shift\ caused\ by\ absolute\ motion\ = \frac{c\ t_1}{wavelength}$$

$$= \frac{3 *\ 10^8 *\ 7.5 * 10^{-12}\ s}{600 *\ 10^{-9}} = \ 3750\ fringes$$

Contrast this with the almost null result of the Michelson-Morley experiments!

The Miller experiments

The question arises: if no fringe shift can occur in conventional Michelson-Morley experiments using a single light source, then what are the small, consistent fringe shifts observed in the Miller and other repetitions of the Michelson-Morley experiment?
A possible explanation is that the small fringe shifts are caused by the fact that the light sources used are extended sources, not theoretical point sources assumed in the new theory (ATE). Therefore, the parts of the extended light source can act as *independent* sources and hence causing small fringe shifts.

But one can still argue that, even if the source has finite size, the fundamental sources are the atoms in the macroscopic light sources. Therefore, the new theory applies to atoms which are point sources, in which case no fringe shift occurs. Then what are the consistent fringe shifts observed in the Miller experiments?

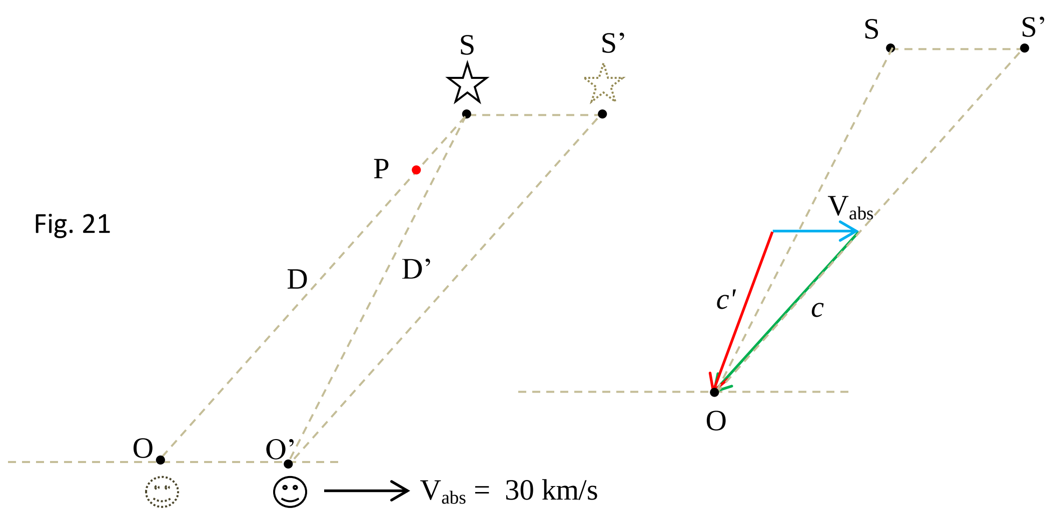
If we follow the conventional view that the atoms inside a finite size (extended source, as opposed to point source) light source emit photons independently and randomly, then no fringe shift would occur in the Miller experiments. The small fringe shifts in the Miller experiments point to yet another mystery of light. The emissions from the atoms in a finite size (extended) light source are not independent and random: the emissions from the atoms are *coordinated*! Therefore, the light source in the Michelson-Morley and the Miller experiments act like classical wave sources in which photons originating from the different points of a finite size source interfere with each other. In this case, the apparent change in time of light emission caused by observer's absolute motion varies from one point to another point in the finite size light source, and therefore the fringe pattern will be affected by observer's absolute motion. This explains the small fringe shifts observed in the Miller experiments.

The same theory can explain the Esclangon experiment [5] and also the C.E. Navia laser diffraction experiment [18].

Stellar aberration

Consider an observer that is moving to the right at point O at the instant of light emission, at $t = 0$. (Fig.21). The light is emitted from point S. From the new theory, however, $t = 0$ is the time instant of light emission for all observer that are at absolute rest and the *apparent* time of light emission of the moving observer will be different due to absolute motion.

Fig. 21



The moving observer will detect the light at point O'. As discussed already, for the moving observer the light moves the distance *D*, whereas for an observer at rest at point O' the light moves the distance D'. We have already introduced the new model of the speed of light as follows:
The position of the center of the light wave fronts is always fixed relative to the absolutely moving observer/ detector, and is the same as the point of light emission relative to the observer. In other words, the position of the center of the light wave fronts relative to the moving observer at the moment of light detection (line S'O') is the same as the position of the source (the point of light emission) relative to the observer at the moment of light emission (line SO). The center of the light wave fronts is always co-moving with the observer. Since the speed of light is constant c relative to the center of the light wave fronts, the speed of light is also always constant relative to the observer. Therefore, whereas the stationary observer at point O' needs to point his/her telescope in the direction SO', the moving observer needs to point their telescope in the direction S'O'. This explains the phenomenon of stellar aberration.

Stellar aberration is an absolute motion effect, whereas Doppler effect of light is a relative motion effect.

The moving observer needs to point his/her telescope in the direction parallel to the line O'S' because the center of the light wave fronts relative to the moving observer at the instant of light detection is the same as the point of light emission relative to the observer at the moment of light emission (line segments OS and O'S' are parallel and equal in length). The stationary observer at point O needs to point his/her telescope in the direction parallel to line O'S. But both the moving and the stationary observers will detect the light simultaneously at point O'. The question is: how can the moving and the stationary observers detect the light at point O' simultaneously if the light travels different distances (*D* and *D'* , respectively) for the two observers? (we have extensively discussed this already in the last sections but we repeat it here to give the reader yet another opportunity to grasp this subtle, elusive and deep mystery of the nature of light).

The solution is that in this case light will be emitted *apparently earlier* for the absolutely moving observer than for the stationary observer. Therefore, by the time light is emitted for observers at absolute rest (t = 0) , the light for the moving observer will have arrived at point P, and hence has already moved distance SP, where:

$$distance\ of\ OP = \ D'$$

For the moving observer light is emitted *apparently earlier* by Δt compared to all observers at rest, where:

$$\Delta t \ = \ \frac{D' - \ D}{c}$$

Let us see the problem relative to the absolute reference frame. The green vector is the velocity of light c relative to the moving observer, which is parallel to line OS (or O'S'). The blue vector is the absolute velocity of the observer. The red vector is the velocity of light (c') for the moving observer (that is, the velocity of light *emitted for the moving observer*) as seen in the absolute frame.

Now we can see that the light for the stationary observer at point O' is coming from the direction of O'S, whereas the light for the moving observer at point O' (red vector) is coming from the direction different from O'S. This is unconventional! Classically, and conventionally, light comes from the same direction O'S, for all observers (moving or stationary) detecting light at point O'.

As shown in Fig.22 below, the path of the light for the moving observer is shown as the broken orange curve, as seen in the absolute reference frame. The path of light for the observer at rest is shown in the broken green curve.

Now let us see the implications of this. We have stated that the light for the observer at rest at point O' comes from the direction O'S, but the light for the moving observer at point O' comes from the direction O'S', relative to the moving observer.
Suppose that an observer is at rest at point O' until just before the light reaches point O'. Here is the puzzle. The observer has been at rest until just before light reaches point O', so we would think that the light for that observer is coming from the direction of O'S, along the green broken path. But let the observer accelerate almost instantaneously to absolute velocity V_{abs} to the right just before the light reaches point O', so now we would think that the light for the moving observer is coming from a different direction, along the orange broken curve. Does the light go back in time to change its path and its direction of arrival at point O' retroactively?

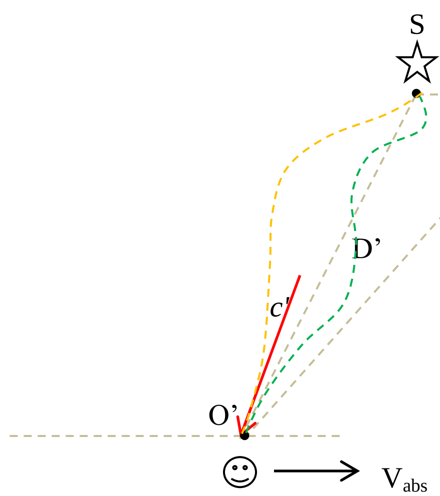
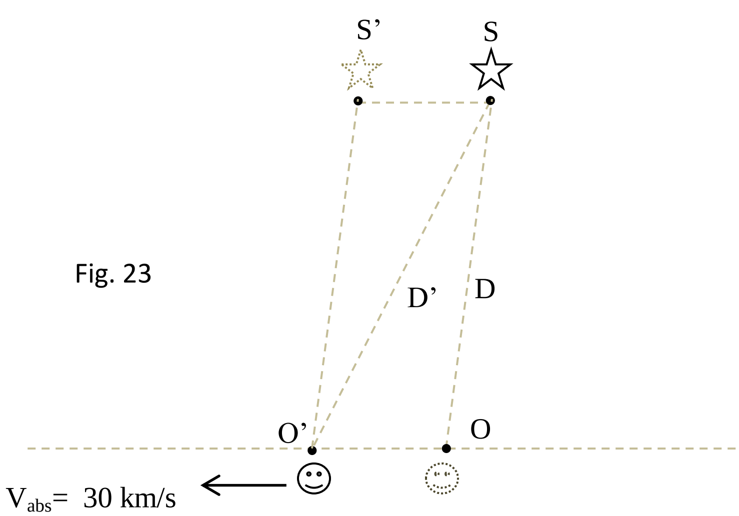


Fig. 22

The answer is 'No'. Here is the profound implication of the new explanation of stellar aberration. *Nature has foreknowledge at the time of light emission that the observer would accelerate to* V_{abs} *at point O' just before the light reaches point O'. Therefore, the light is emitted to reach point O' along the orange broken path, and not along the green broken path in the first place ! This is a deeply profound evidence of God and His literal intervention in the universe !*

For an observer moving in the opposite direction, the situation is as follows (Fig. 23).

Fig. 23



At the instant of light emission ($t = 0$ for all observers at rest) from point S, the observer is moving to the left with absolute velocity V_{abs} , at point O. The moving observer will detect the light at point O', simultaneously as a stationary observer at point O'. However, the moving observer needs to point his/her telescope parallel to line O'S' (which is parallel to OS), whereas the stationary observer needs to point his/her telescope parallel to line O'S. For the moving observer light travels distance *D*, whereas for the stationary observer light travels distance *D'*. Again, the question is: how can the moving and stationary observers detect the light at point O' simultaneously if light travels different distances in the two cases. The solution is that light is emitted *apparently later* by Δt for the moving observer than for the stationary observer where:

$$\Delta t = \frac{D' - D}{c}$$

The Arago and Airy experiments

With the new theory, the explanation of the Arago and the Airy star light refraction and aberration experiments is straightforward. According to the new theory, *the center of the light wave fronts always moves with the same velocity as the absolute velocity of the inertial observer*. *The velocity of light is always constant c relative to the center of the wave fronts, and hence constant relative to the inertial observer.*

Let us consider the detection of light at point O' by a moving observer and by an observer at rest at point O' (Fig.24). The velocity of the center of the light wave fronts for the observer at rest at point O' will be zero because the velocity of that observer is zero. Hence the observer at rest needs to point his/her telescope in the direction parallel to line SO'.

The velocity of the center of the light wave fronts for the moving observer will be 30 km/s to the right because the absolute velocity of that observer is 30 km/s to the right. By the time the observer arrives at point O', the center of the light wave fronts will have arrived at point S'. Therefore, the moving observer needs to point his/her telescope in the direction parallel to line S'O'.

The velocity of light for the moving observer, relative to the moving observer, is shown in red. The velocity of light for the observer at rest is shown in blue.

Therefore, since the center of the light wave fronts always moves with the velocity of the observer, it is impossible to detect absolute motion as a change in refraction angle or aberration angle. Absolute motion of the observer does not affect the refraction of light in the Arago experiment and aberration angle of light in the Airy water-filled telescope experiment.

The Arago star light refraction experiment is shown in Fig.25. Suppose that at first the observer and the telescope are at absolute rest and that there is no prism in front of the telescope. In this case the observer sees the star light as coming from a certain direction. Next the observer puts a prism in front of the telescope. The observer needs to rotate the telescope by an angle θ to see the star again.

The above procedure is repeated but with the observer (and the telescope) moving with absolute velocity V_{abs} to the right. What Arago found is that the angle through which he needed to rotate the telescope is the same (θ) irrespective of the (absolute) velocity of the observer.

The new explanation for this is that the (observed, measured) *phase* velocity of light is always *constant c* regardless of the velocity of the observer. Also, the center of the light wave fronts always moves with the same velocity (magnitude and direction) as the absolute velocity of the *inertial* observer.

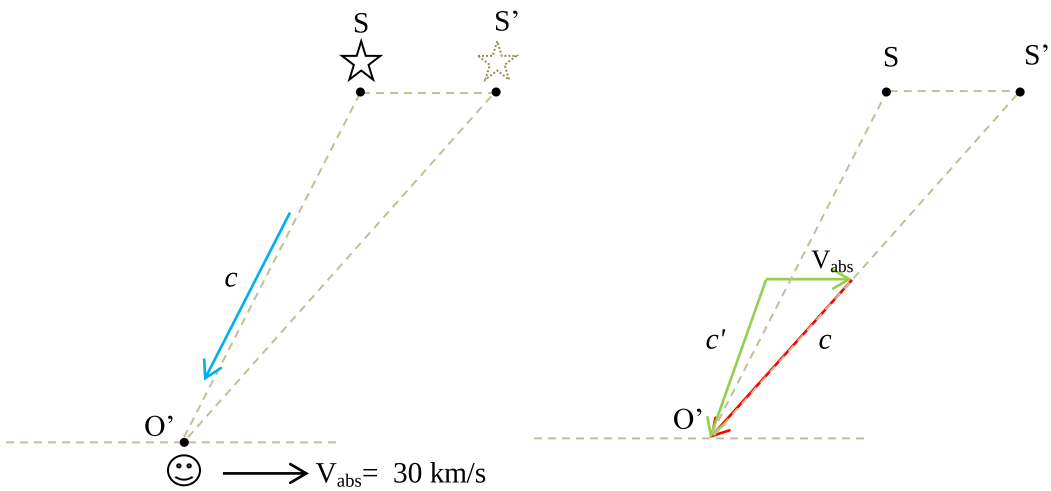


Fig. 24

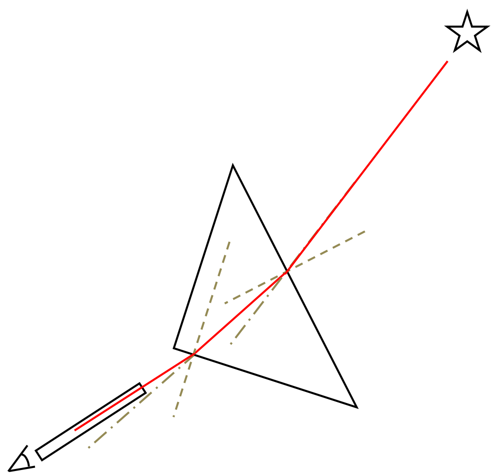


Fig. 25

Also the Airy water-filled telescope experiment was carried out to test if the value of stellar aberration angle depended on whether the telescope was filled with water or with air, and no such dependence was observed. The new explanation is that the center of the light wave fronts always moves with the same velocity (magnitude and direction) as the absolute velocity of the *inertial* observer.

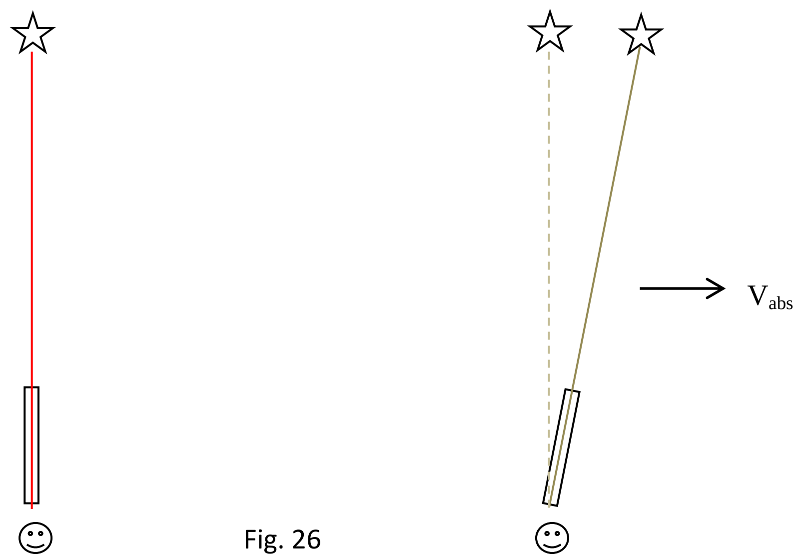


Fig. 26

Moving source, moving observer and moving mirror experiments

Moving source experiments

Obviously the motion of the source does not affect the (actual or apparent) speed of light. This is because, for an observer at rest, there will be no apparent change in the time of light emission.

Moving observer experiments

Consider an observer moving directly towards the point of light emission in the absolute frame (Fig. 27). The distance between the light source and the observer at the moment emission ($t = 0$) is D. However, $t = 0$ is the instant of emission for observers at rest. As discussed already, for the moving observer, the light is emitted apparently *earlier* (at $t = t_1$) than for all observers that are at rest.

From equation (4),

$$t_1 = -\left(\frac{D}{c} - \frac{D'}{c}\right)$$

From equation (2)

$$D' = \frac{-\left(D\,\frac{V_{abs}}{c}\right)cos\theta \;\; + D\sqrt{1 - \frac{{V_{abs}}^2}{c^2}\,sin^2\theta}}{\left(1 - \frac{{V_{abs}}^2}{c^2}\right)}$$

In this case, the angle θ (Fig.9) is zero. Therefore,

$$D' = \frac{-\left(D\,\frac{V_{abs}}{c}\right)\cos 0^0 \;+ D\sqrt{1 - \frac{{V_{abs}}^2}{c^2}\,sin^2\,0^0}}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)}$$

$$\Rightarrow \; D' = \frac{-D\,\frac{V_{abs}}{c} \;+ D}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)} = \frac{D(\;1-\frac{V_{abs}}{c}\;)}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)} = \frac{D}{1+\frac{V_{abs}}{c}}$$

Therefore,

$$t_1 = -\left(\frac{D}{c} - \frac{D'}{c}\right) = -\left(\frac{D}{c} - \frac{\frac{D}{1+\frac{V_{abs}}{c}}}{c}\right) = -\frac{D}{c}\;\frac{\frac{V_{abs}}{c}}{1+\frac{V_{abs}}{c}}$$

The moving observer will detect the light at :

$$\Rightarrow \; t = \; t_1 + \frac{D}{c} = -\frac{D}{c}\;\frac{\frac{V_{abs}}{c}}{1+\frac{V_{abs}}{c}} + \frac{D}{c} = \frac{D}{c + V_{abs}}$$

This is the same as the conventional/ classical result and confirmed by experiments. It should be noted that, according to classical/ ether theory, the denominator indicates that the speed of light relative to the observer depends on the absolute velocity of the observer. According to the new theory, however, the denominator *(* $c + v_{abs}$) indicates that the dependence of the speed of light relative to the observer is only an apparent phenomenon, and the speed of light is always fundamentally constant relative to the observer, irrespective of the observer's velocity.

Fig. 27

Now consider an observer moving directly away from the point of light emission in the absolute frame (Fig. 28). The distance between the light source and the observer at the moment emission ($t = 0$) is D. However, $t = 0$ is the instant of emission for observers at rest. As discussed already, for the moving observer, the light is emitted apparently *later* (at $t = t_1$) than for all observers at that are at rest.

From equation (10),

$$t_1 = \frac{D'}{c} - \frac{D}{c}$$

From equation (8),

$$D' = \frac{-\left(D\,\frac{V_{abs}}{c}\right)\cos(180-\theta) \;+ D\sqrt{1 - \frac{{V_{abs}}^2}{c^2}\,sin^2(180-\theta)}}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)}$$

In this case, the angle θ (Fig.11) is zero. Therefore,

$$D' = \frac{-\left(D\,\frac{V_{abs}}{c}\right)\cos(180-0^0) \;+ D\sqrt{1 - \frac{{V_{abs}}^2}{c^2}\,sin^2(180-0^0)}}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)}$$

$$D' = \frac{\left(D\,\frac{V_{abs}}{c}\right) \;+ D}{\left(1-\frac{{V_{abs}}^2}{c^2}\right)} = \frac{D}{1-\frac{V_{abs}}{c}}$$

Therefore,

$$t_1 = \frac{D'}{c} - \frac{D}{c} = \frac{\frac{D}{1-\frac{V_{abs}}{c}}}{c} - \frac{D}{c} = \frac{D}{c}\;\frac{\frac{V_{abs}}{c}}{1-\frac{V_{abs}}{c}}$$

The moving observer will detect the light at :

$$\Longrightarrow\; t = t_1 + \frac{D}{c} = \frac{D}{c}\;\frac{\frac{V_{abs}}{c}}{1-\frac{V_{abs}}{c}} \;+\; \frac{D}{c} = \frac{D}{c - V_{abs}}$$

Again this is the same as the conventional/ classical result and confirmed by experiments. It should be noted that, according to classical/ ether theory, the denominator indicates that the speed of light relative to the observer depends on the absolute velocity of the observer. According to the new theory, however, the denominator indicates that the dependence of the speed of light relative to the observer is only an apparent phenomenon, and the speed of light is always fundamentally constant relative to the observer, irrespective of observer's velocity.

Fig. 28

Moving mirror experiments and the Venus planet radar range data anomaly

One of the most confusing behaviors of light is manifest in moving mirror experiments. One of the experiments in this regard is the Venus planet radar ranging experiment, which was, ironically, done to test Einstein's General Relativity theory. As reported by Bryan G Wallace, a large first order effect contradicting the constancy of the speed of light was observed. The data contradicted not only Einstein's relativity theory, but also Ether theory, and supported the long forgotten and abandoned emission/ballistic theory. It appears that the velocity of light is affected by the component of the mirror (Venus) velocity relative to (towards) the Earth ! Mainstream physics has nothing to say about this experiment, just like the Silvertooth and the Marinov experiments.

In a way, the new theory can be seen as a fusion of the classical Ether and Emission theories. The effect of absolute motion of an observer is just to create an apparent change in the time of light emission for that observer (i.e. *for light detected by that observer*). Once absolute motion is accounted for in this way, we just assume the emission/ballistic model to analyze experiments.

According to emission theory, a component of the *relative* velocity of the mirror towards the observer will add to or subtract from the velocity of light. However, we need to make a new distinction here: phase velocity and group velocity. The *phase velocity* of light is always constant *c*, regardless of the velocity of the source, of the observer, of the mirror, and regardless of uniform or accelerated motion of the observer. The *group* velocity of light *apparently* varies with the observer/mirror velocity. More precisely, both the phase and group velocity of light are always constant *in the vicinity of the observer*. However, both can continuously vary between subluminal and superluminal along the path of the light.

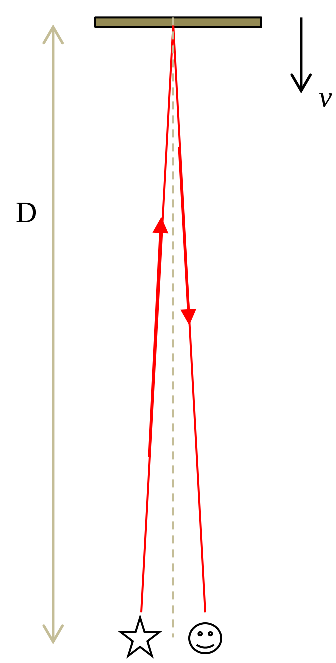


Fig. 29

In the case of Venus planet radar ranging experiment, since the RF source and the observer/detector are almost at the same point in space (both on Earth), the effect of absolute motion of the observer is almost completely suppressed.

The center of the RF pulse wave fronts moves with the same velocity as the (absolute) velocity of the observer, the RF pulse starts from the actual/physical position of the source (antennas). The change in time delay due to absolute motion of the observer (which is 390 Km/s) is negligible because the distance between the source and the observer is very small. We then simply assume the ballistic theory in which the mirror (Venus) velocity component towards the Earth adds to the velocity of the reflected pulse, to analyze the experiment.

Let the distance between the observer and the mirror at the instant of light reflection be *D*. The forward flight time will be:

$$t_1 = \frac{D}{c}$$

The backward time will be:

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

The round trip time will be:

$$T = t_1 + t_2 \quad \Rightarrow T = \frac{D}{c} + \frac{D}{c + 2\,v} \quad \Rightarrow T = \frac{2D(\,c + v\,)}{c\,(c + 2\,v)}$$

Although the above model of the speed of light reflected from a mirror can explain the Venus planet radar range anomaly, this model fails to explain another moving mirror experiment: the A.Michelson moving mirror experiment. I have proposed a new model that can explain both experiments [12].Conventionally, light is reflected from the point where a moving mirror is *at the moment of reflection* which is determined by taking into account the distance between the source and the mirror at the moment of emission and the velocity of the mirror. However, this conventional analysis has failed to consistently explain both the Venus planet radar ranging data anomaly and the A. Michelson moving mirror experiments. According to the new model, unconventionally, light is *apparently* reflected from the point where the mirror is *at the moment of emission*. According to classical ballistic theory, the velocity of the mirror has two effects: 1. The point in space where light is reflected depends on the velocity of the mirror and 2. A component of the mirror velocity perpendicular to the plane of the mirror also adds to the velocity of light. Occasionally in the past I somehow suspected that the motion of the mirror may have only one of these two effects, and not both. As it turns out, the motion of the mirror apparently has no effect on the point in space where the light is reflected; the motion of the mirror only affects the apparent velocity of the reflected light, that is the velocity of the reflected light is $c \pm 2v$, where v is a component of the mirror velocity perpendicular to the plane of the mirror, in the reference frame of the observer[12]. In the A.Michelson paper[19], the CCW light beam arrives at the detector earlier than the CW beam, according to the classical ballistic theory of light. The new theory [12] makes the unconventional prediction that the CW light beam arrives at the detector earlier than the CCW beam.

Constant phase velocity and constant/variable group velocity of light

According to ballistic theory, the velocity of light reflected from a moving mirror is $c + 2v$, where v is the component of the mirror relative velocity towards the observer. The question is: why was this not observed in other moving mirror experiments, particularly in the A. Michelson moving mirror experiment?

The explanation I have already proposed in my earlier papers is that the phase velocity is always constant *c*, irrespective of source/observer/mirror velocity, for all observers, including non-inertial (accelerating) observers. It is the group velocity of light that depends on mirror velocity.
However, the explanation of how the phase velocity can be constant but the group velocity is apparently variable was one of the most difficult problems I faced. This puzzle is finally solved as follows.

All the behaviors of light we know from experience are only *apparent* or *average* of the actual, fundamental property of light. The constancy of the velocity of light is only an apparent/average property. Fundamentally, the speed of light is not constant along its path. Also the fact that light travels in a straight line is again only an apparent property of light. Fundamentally, light travels in curved paths, with continuously changing magnitude and direction of its instantaneous velocity, continuously varying between subluminal and superluminal velocity. However, these properties of light are fundamentally inaccessible to experiments.

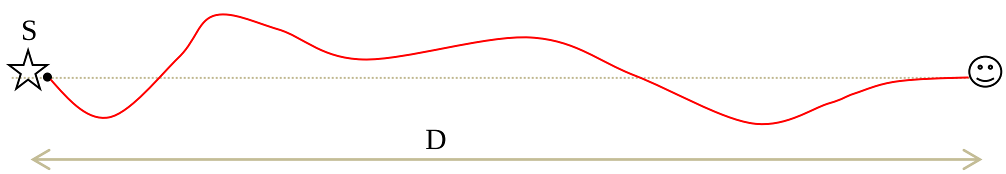


Fig. 30

From the diagram (Fig.30) above, with both the source and the observer are at rest, we can see that light travels in arbitrary curved paths such that the average/apparent speed of light is *always* constant *c*.

$$\text{Observed or measured speed of light} \;=\; \frac{D}{\Delta t} = constant = c$$

where Δt is the time interval between emission and detection.

Along its path, however, light can travel at subluminal or superluminal speeds, accelerating and decelerating.

We can also see that, whatever curved path light takes from the source to the observer, the final part of its path, just before the point of observation is such that the tangent to the curve at the point of observation passes through the source, to simulate that light travels in a straight line from source to observer. Moreover, *the (phase and group) velocity of light just before detection is always constant c, independent of observer velocity*.

Returning to the question of how the group velocity of light reflected from a mirror can be variable ($c \pm 2v$), the mystery that has eluded science so far is that the phase velocity, hence the (*local*) group velocity, of light becomes *c just before detection*. Therefore, the measured/apparent/average group velocity of the reflected light is equal to ($c\pm2v$), whereas the *phase* velocity is always constant *c* .Note that both the *instantaneous* phase velocity and the instantaneous group velocity of light, which are always equal, are not constant along the path of the beam except in the vicinity of the observer. However, fundamentally this is inaccessible to any physical experiments.

This is why some experiments, particularly the A Michelson moving mirror experiment, failed to detect any change in the speed of light due to mirror velocity. Therefore, it is impossible to detect the effect of mirror velocity on the speed of light by experiments based on fringe shifts.

Vacuum permittivity and permeability, Maxwell's equations

One of the mysteries in physics is why vacuum has property (permittivity and permeability) if there is no light carrying medium. Even Albert Einstein, who (rightly) denied the existence of the ether, acknowledged this puzzle and physicists know it too, but just accept it.

The new explanation proposed in this paper is that the permittivity and permeability of vacuum we know are only apparent, average or simulated values. The answer to the question: " if space is empty, how can it have property? " is that the property of space is *simulated*, 'not real' in the sense of classical physics. This is a deep mystery of nature. To assume that vacuum permittivity and permeability are real is to assume the (non-existent) light carrying medium.

Maxwell's equations are far from complete because they are based on the classical view, that is the ether. Their solution does not predict the particle nature of light (photons). I have proposed a new theory of a mysterious internal dynamics of elementary particles such as electrons and photons, which is much more fundamental than Maxwell's equations. That is, this internal dynamics of photons underlies Maxwell's equations. The new theory predicts non-constant instantaneous velocity of light, which means continuously changing velocity and non-rectilinear path of light.

The Roamer experiment

Ole Roamer observed that the eclipse time of Jupiter's moon Io is 22 minutes longer when the Earth was moving away from Jupiter than when it was moving towards Jupiter. From this observation, the speed of light was estimated, for the first time. Before that time the order of the speed of light was unknown, and was even thought to be infinite. The Roamer experiment is one of the decisive experiments that led me to the conclusion that the (group) velocity of light is variable.

The analysis of the Roamer experiment is based on the unconventional theory [12] of the speed of light reflected from a moving mirror.

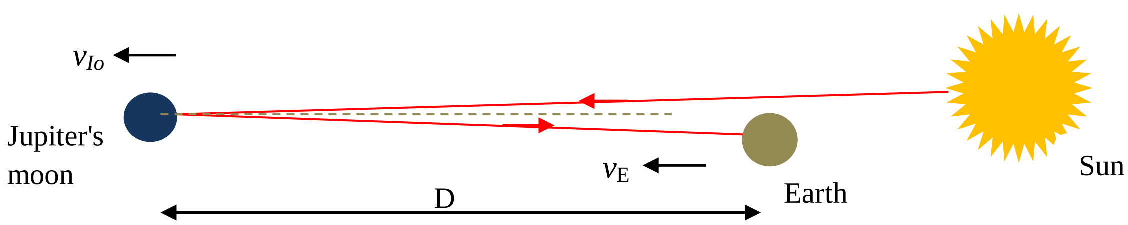


Fig. 31

According to the new theory, light reflected from a moving mirror behaves as if it is reflected from the position of the mirror *at the moment of emission*! In this case, the effect of the velocity of the mirror relative to the observer is not to change the point of light reflection in space, but to change the velocity of the reflected light ($c \pm 2v$) , where v is the velocity of the mirror (Jupiter's moon in this case) relative to and towards the observer (relative to the Earth). Therefore, the increase in the eclipse time of Jupiter's moon when Earth moves away from Jupiter compared to when the Earth moves towards Jupiter is because the velocity of light reflected from Io when the Earth is moving towards Jupiter is $c + 2v$, whereas it is $c - 2v$ when the Earth is moving away from Jupiter.

Suppose the distance between the Earth and Jupiter *at the moment of emission* of a photon from the Sun is *D*, as shown in Fig.31. The time difference between the light detection times when the Earth moves away from Jupiter and towards Jupiter will be:

$$\frac{D}{c-2v} - \frac{D}{c+2v} = D\,\frac{4v}{c^2-4v^2} = \frac{D}{c}\,\frac{\frac{4v}{c}}{1-4\frac{v^2}{c^2}} \cong \frac{D}{c}\,\frac{4v}{c}$$

velocity *v* is the Earth-Jupiter relative velocity.

Note that the absolute motion of the Solar System does not have any significant effect in the Roamer experiment.

According to conventional analysis in the Solar System reference frame:

$$\frac{D_1}{c-\ v_E} - \frac{D_1}{c-v_E} = \cong \frac{D_1}{c}\,\frac{2v_E}{c}$$

where D_1 is the Earth-Jupiter distance at the moment of light reflection from Io and v_E is the velocity of the Earth in the Sun's reference frame.

The Silvertooth experiment

The 1986 Silvertooth experiment is a novel first order experiment which, together with the earlier 1976 Marinov experiment and the CMBR velocity, finally provided an irrefutable evidence of absolute motion. The diagram below is taken from Silvertooth's paper of 1989 from the journal Electronics and Wireless World.

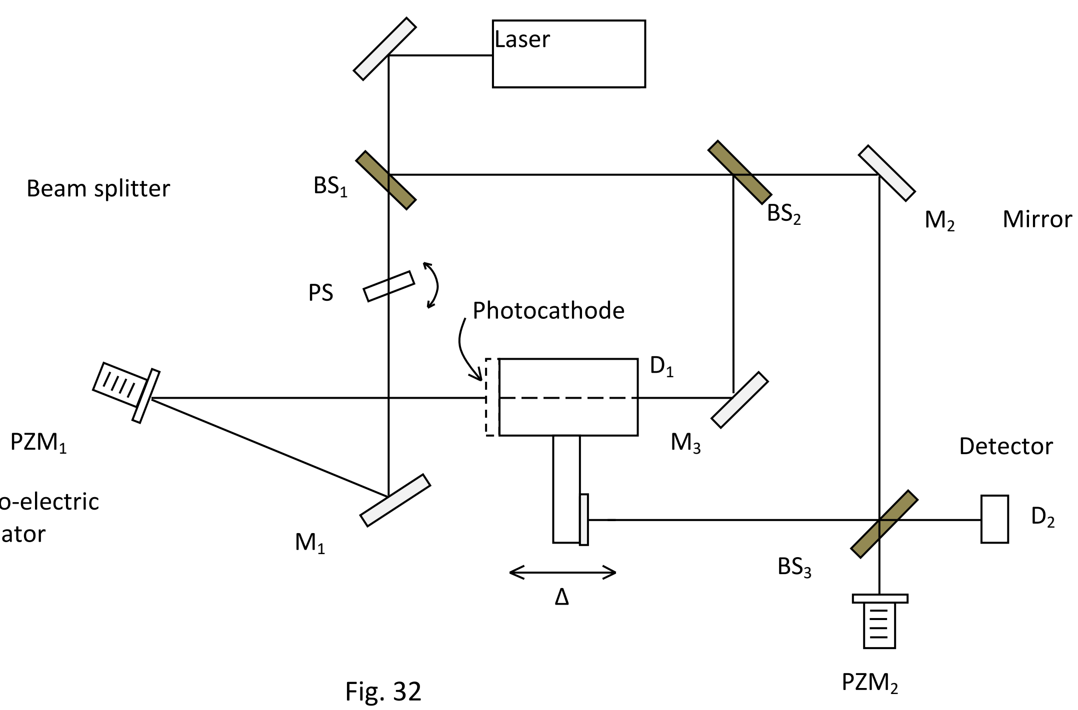


Fig. 32

In this section, the 'wavelength' change effect in the Silvertooth experiment will be analyzed.
Imagine a light source S, an observer O and a mirror M , co-moving with absolute velocity V_{abs} to the right as shown below.

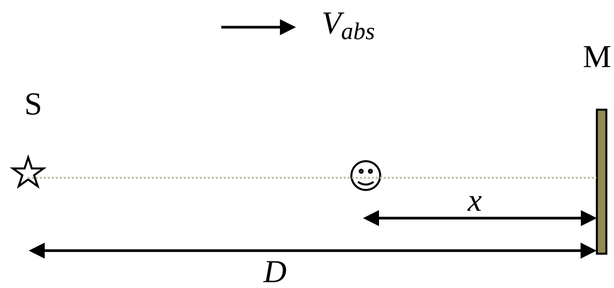


Fig. 33

<u>'Wavelength' and velocity of incident light</u>

Assume that the light is emitted at *t* = 0 (for observers at absolute rest). From equation (13), the time of emission for the absolutely moving observer at distance *x* from the mirror will be:

$$t_1 = \frac{D-x}{c} \quad \frac{V_{abs}}{c-V_{abs}}$$

The observer will detect the light after a time delay of:

$$t_d \;=\; t_1 + \frac{D-x}{c} \;=\; \frac{D-x}{c} \quad \frac{V_{abs}}{c-V_{abs}} + \frac{D-x}{c} \;=\; \frac{D}{c-V_{abs}} - \frac{x}{c-V_{abs}}$$

Assume that the source emits a light wave:

$$\sin \omega t$$

The light wave will be received at the detector as:

$$sin\ \omega(t - \ t_d) = sin\ \omega(t - \frac{D}{c-V_{abs}} + \frac{x}{c-V_{abs}})$$

$$= \sin(\omega t - \frac{\omega D}{c-V_{abs}} + \frac{\omega x}{c-V_{abs}})$$

The above is a wave equation. If we take a 'snapshot' of the wave at an instant of time t = τ ,the above equation will be:

$$\sin(\omega\tau - \frac{\omega D}{c-V_{abs}} + \frac{\omega x}{c-V_{abs}})$$

The two terms $\omega\ \tau$ and $\omega D\ /\ (c\text{-}\ V_{abs})$ represent phase shifts. The 'wavelength' is determined from the third term:

$$\frac{\omega x}{c - V_{abs}}$$

If we have a function:

$$\sin\ kx$$

then the wavelength can be shown to be:

$$\frac{2\pi}{k}$$

In the same way, for the function:

$$\sin\ (\frac{\omega x}{c - V_{abs}})$$

$$k = \frac{\omega}{c - V_{abs}}$$

Hence the 'wave length' of the incident light will be

$$\lambda_{INC} = \frac{2\pi}{k} = \frac{2\pi}{\frac{\omega}{c - V_{abs}}} = (c - V_{abs})\frac{2\pi}{\omega} = \frac{c - V_{abs}}{f}$$

Note that the 'wavelength' predicted here is different in form from the 'wavelength' predicted by Silvertooth, in his paper, but the results obtained are nearly the same as will be shown shortly.

This shows an *apparent* change in wavelength and hence an apparent change of speed of light relative to the observer, for absolutely co-moving source and observer. However, to interpret this as an actual/real change in wavelength is wrong or inaccurate. Neither the wavelength nor the phase velocity changes because of absolute motion. This is because the effect of absolute motion for co-moving light source and observer is only to cause an apparent change in time of emission, which does not obviously affect the wavelength. The photons always approach the observer with a constant speed of light c.

Wavelength and velocity of reflected light

Next we determine the 'wavelength' of the reflected light.

The time of detection of the reflected light will be:

$$t_d = t_1 + \frac{D}{c} + \frac{x}{c} = t_1 + \frac{D + x}{c} = \frac{D - x}{c}\ \frac{V_{abs}}{c - V_{abs}} + \frac{D + x}{c}$$

$$= \frac{D}{c - V_{abs}} + x\,\frac{c - 2V_{abs}}{c(c - V_{abs})}$$

If the source emits a light signal:

$$\sin \omega t$$

The reflected light wave will be received at point x as:

$$\sin \omega(t - t_d) = \sin \omega(\ t - \frac{D}{c - V_{abs}} - x\frac{c - 2V_{abs}}{c(c - V_{abs})}\ )$$

The coefficient of x is:

$$k = \omega \frac{c - 2V_{abs}}{c(c - V_{abs})}$$

As before, the 'wavelength' of reflected light will be:

$$\lambda_{REF} = \frac{2\pi}{k} = \frac{2\pi}{\omega \frac{c - 2V_{abs}}{c(c - V_{abs})}}$$

$$= \frac{c(c - V_{abs})}{f(c - 2V_{abs})} = \frac{1}{f} \cdot \frac{c(c - V_{abs})}{c - 2V_{abs}}$$

Conventionally, one would expect the 'wave length' of the reflected light to be equal to $(c + V_{abs}) / f$, because the 'wavelength' of incident light is $(c - V_{abs}) / f$, such as in ether theory. However, it turns out in the above analysis that this is not the case. However, it can be shown that the actual difference between the two expressions is very small.

Note that this is not the real wavelength which is equal to $\lambda = c / f$. It is only an apparent wavelength. The apparent incident and reflected wavelengths differ as observed by Silvertooth and as shown above. The real incident and reflected wavelengths, which can be measured by a spectroscope, are both : $\lambda = c / f$.

In the above analyses, we considered the simplest cases in which the source, the observer and the mirror are in line, with the light beam incident perpendicularly on a mirror and reflected back on itself. It is possible to extend the analysis to more general cases for a better clarification of the new theory (ATE). In the next section we will look at the application of ATE theory to some of these cases. As the resulting solutions are more complicated (but straightforward) , we will only look at how to proceed.

Next consider the following case. An observer at point *x* will observe the incident light (light reflected from mirror M1, but before reflection from mirror M2) and the reflected light (light reflected from mirror M2).

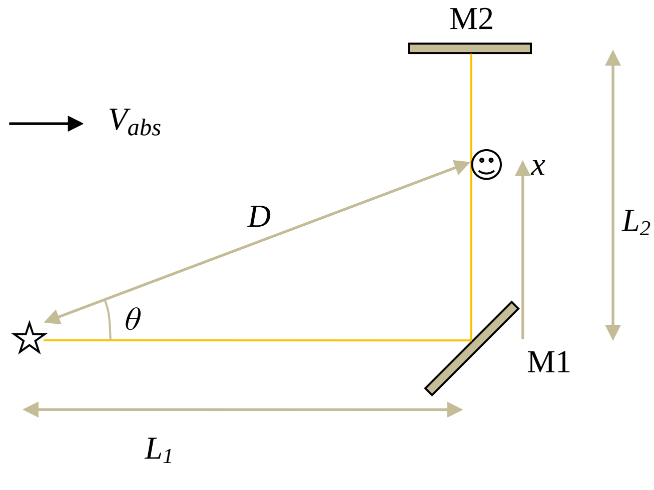


Fig. 34

From equation (9):

$$\Longrightarrow \quad D' \cong D\left(1 + \frac{V_{abs}}{c}\cos\theta\right) \quad , \quad for \quad V_{abs} \ll c$$

From equation (10), the apparent time of emission of light for the co-moving observer will be:

$$t_1 = \left(\frac{D'}{c} - \frac{D}{c}\right) = \frac{D\left(1 + \frac{V_{abs}}{c}\cos\theta\right)}{c} - \frac{D}{c} = \frac{D}{c}\frac{V_{abs}}{c}\cos\theta$$

The time of detection of the incident light will be:

$$t_1 + \frac{L_1}{c} + \frac{L_2 - x}{c}$$

The time of detection of the reflected light will be:

$$t_1 + \frac{L_1}{c} + \frac{L_2}{c} + \frac{L_2 - x}{c}$$

The apparent wavelengths of the incident and reflected beams can be determined as before.

Now that we have seen some of the basic applications of the new theory, let us look at the actual experiment of Silvertooth.

Let us look at a case in which the source – observer/detector relative position is perpendicular to the absolute velocity. We can see that this is the case of the Silvertooth experiment (Fig.32) in which the laser source is nearly at ninety degrees relative to the photo-detector.

From equation (2):

$$D' = \frac{-\left(D\,\frac{V_{abs}}{c}\right)\cos\theta + D\sqrt{1 - \frac{V_{abs}{}^2}{c^2}\sin^2\theta}}{\left(1 - \frac{V_{abs}{}^2}{c^2}\right)}$$

For $\theta = 90^0$

$$D' = \frac{D\sqrt{1 - \frac{V_{abs}{}^2}{c^2}}}{\left(1 - \frac{V_{abs}{}^2}{c^2}\right)} \cong D \quad , \quad for\ V_{abs} \ll c$$

This means that there will be no significant apparent change in the time of emission of light from the laser source. The question is: then how can the apparent change in wave length observed in the Silvertooth experiment be explained?

The above problem arose because we have assumed the light source in the Silvertooth experiment to be a point source. But the light source in the Silvertooth experiment is a laser source.

Suppose that a photon originates from atom A which was excited by the laser pumping system. The photon emitted from atom A will then cause a stimulated emission from atom B, which will then cause a stimulated emission from atom C, and so on, passing through the atom 'gas' and reflecting from the mirrors hundreds of times. Then billions of coherent photons exit through the laser window. It is the sum of the billions of small apparent changes of times of (stimulated) emissions that give rise to the observed apparent change in wavelength in the Silvertooth experiment.

Each of the billions of atoms introduces an apparent change in the time of (stimulated) emission of the coherent photon. The billions of photons of a coherent laser beam all act as a single photon. A proof of this is that, according to the new theory, if the photons were considered as independent photons, they would lose their coherence due to absolute motion, at a relatively short distance from the laser (because of different apparent changes of times of emissions) but we know that a coherent laser light will remain coherent within its coherence length.

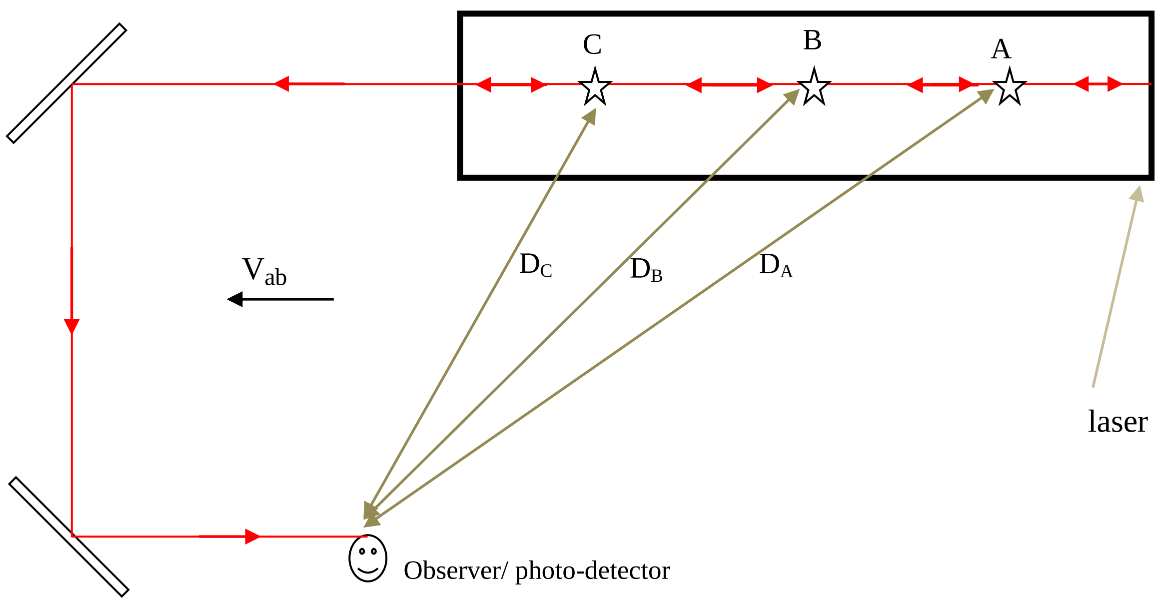


Fig. 35

Acceleration

So far we have considered light speed problems involving inertial observers. Now we will generalize the new theory (ATE) for non-inertial (accelerating) observers. Consider a light source S (at point S) , and an observer O (at point O) moving along the curved path with a continuously changing velocity (continuously changing magnitude and direction of velocity), (Fig. 36). Suppose that the observer is at point O at the instant of light emission, at $t = 0$. However, note that $t = 0$ is the time of emission for observers at absolute rest. As we have already discussed, according to the new theory, for an observer in absolute motion the time of emission of light is not $t = 0$. The *time of emission* for an absolutely moving observer is delayed or advanced ($t \neq 0$), depending on the direction and magnitude of the observer absolute velocity with respect to the line connecting the source and the observer and the position (distance and direction) of the source relative to the observer/detector at the instant of emission.

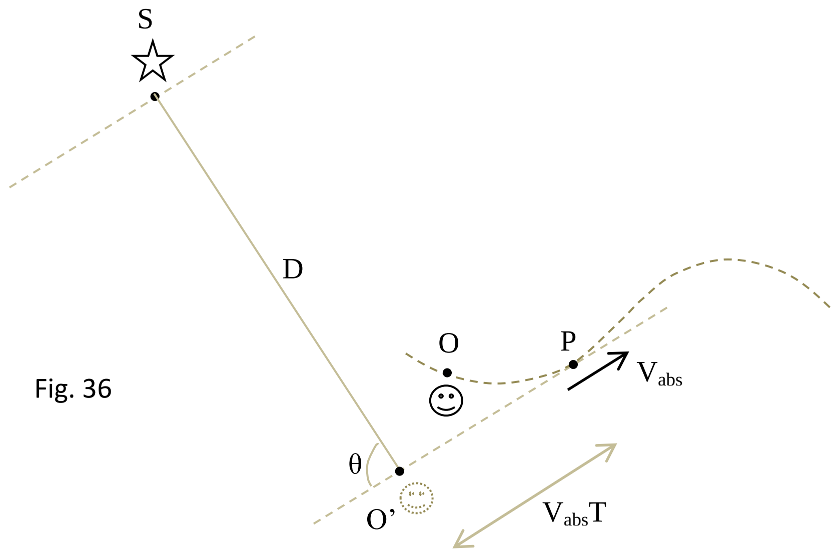


Fig. 36

The problem is to determine the point along the path where the moving observer will detect the light, and the time delay of light for the moving observer. The procedure of analysis is as follows.

We start by assuming some point P along the path where the observer will detect the light. Since the motion and path of the observer is completely defined, we know the time T taken by the observer to move from point O to point P and the instantaneous absolute velocity (V_{abs}) of the observer at point P. We then assume an imaginary inertial observer O' who is moving with the same velocity as the instantaneous absolute velocity of the real observer at point P. We assume that the real *accelerating* observer O and the imaginary *inertial* observer O' detect the light simultaneously at point P. From T and V_{abs} we know the point O' where the imaginary inertial observer is at the instant of light emission ($t = 0$). At $t = 0$, the imaginary observer O' is at distance $V_{abs}T$ from point P. Then from the relative positions of O' and S, the angle θ can be determined, and the time of detection will be:

$$t_1 + \frac{D}{c}$$

From equation (10):

$$t_1 = \left(\frac{D'}{c} - \frac{D}{c}\right)$$

Therefore, the time of detection τ will be:

$$\tau = \left(\frac{D'}{c} - \frac{D}{c}\right) + \frac{D}{c} = \frac{D'}{c}$$

where *D'* is given by the equations (8) or (9). (or from equations (2) or (3) in the case of an observer approaching a light source).

If τ is equal to the time T taken by the observer to move from point O to P , then we have solved the problem. If not, which is much more likely (because we chose point P arbitrarily), we repeat the above procedure until τ = T.

Many actual experiments involve not only a light source and an observer, but also mirrors, beam-splitters, etc.

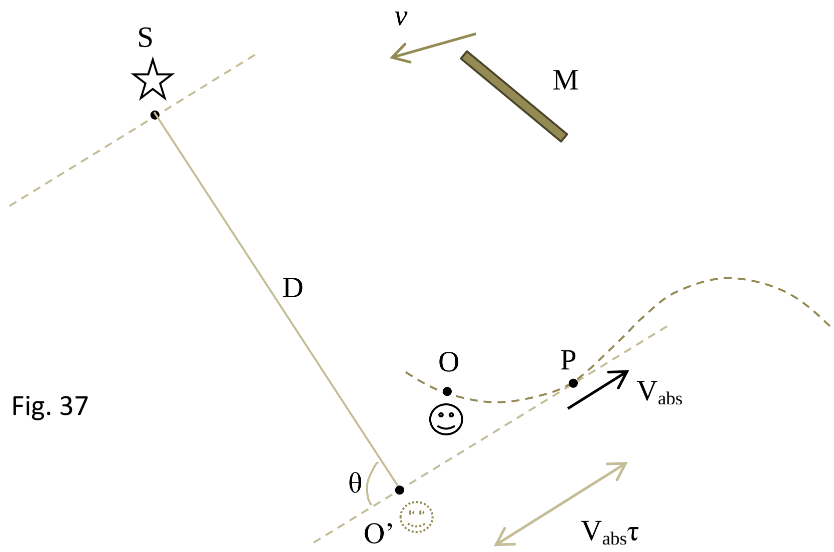


Fig. 37

Consider a light source S , an observer O and a mirror M (Fig. 37). The observer is moving along a defined curved path with continuously changing magnitude and direction of absolute velocity. The mirror M is moving with arbitrary velocity *v* relative to the observer.

At the time *t* = 0 the light source emits a very short light pulse. At the instant of emission (*t* = 0), the observer is at point O. The problem is to find the point P along the path where the observer O will detect the light pulse reflected from the mirror.

We start by assuming that observer O will detect the light pulse reflected from the mirror at some point P. We know the instantaneous absolute velocity V_{abs} of observer O at point P. Then we draw a line tangent to the curved path at point P. Then we assume an imaginary inertial observer O' who is moving with the same velocity as the instantaneous velocity (V_{abs}) of the real observer O at point P. The real accelerating observer O and the imaginary inertial observer O' detect the reflected light pulse simultaneously at point P. Observer O takes time *T* to move from point O to point P.

From V_{abs} and *T*, we determine the location of imaginary inertial observer O' at *t* = 0, and therefore the distance *D* and the angle *θ*, from which *D'* can be determined from equation (8), from which the apparent time of emission t_1 can be determined from equation (10).

$$t_1 = \left(\frac{D'}{c} - \frac{D}{c} \right)$$

Then we apply the new model of the speed of light reflected from a moving mirror [12] to determine the time τ of light detection. If τ = T, then the problem is solved. However, normally it would take many trials to achieve this. Therefore, since τ will most likely not be equal to T on the first trial, the above procedure is repeated until τ =T.

The Sagnac effect

The application of the new theory, Apparent Time of Emission (ATE), to the Sagnac effect has been the most challenging problem in the development of the new theory. The enigma of the Sagnac effect has been resolved in my other paper [20]. The Sagnac effect is an extremely knotty problem to anyone trying to develop an alternative model of the speed of light.

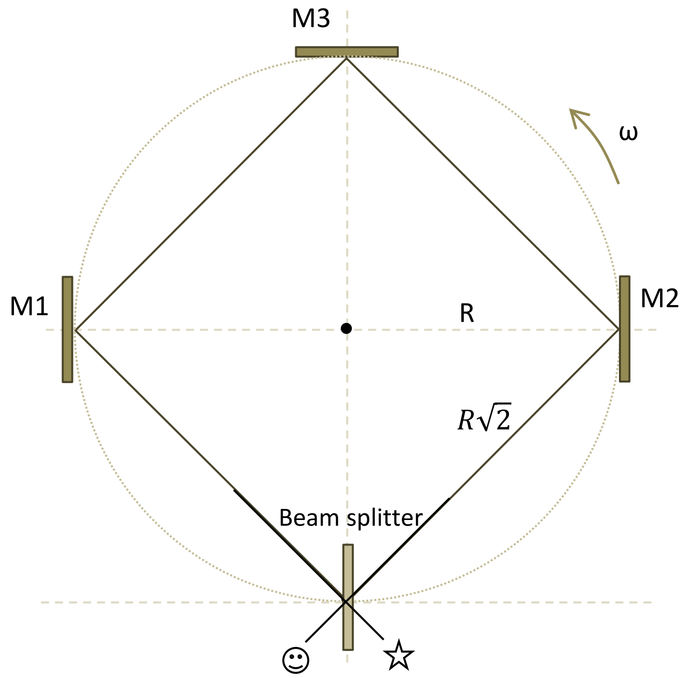


Fig. 38

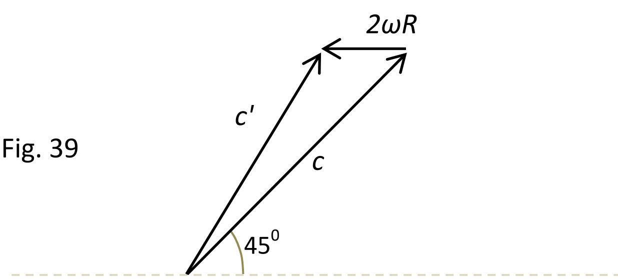


Fig. 39

As proposed already, the procedure of analysis of a light speed experiment in which the observer is in absolute motion is to assume the observer to be at rest and account for the absolute velocity of the observer by assuming an apparent change in time of emission of light. For the sake of simplicity, we assume both the light source and observer/detector to be very close to each other, to be almost at the same point in space, in which case there would be almost no apparent change in the time of light emission.

Once we have accounted for the absolute motion of the observer, we assume the observer to be at rest and analyze the experiment in the reference frame of the observer in which the observer is at the origin of the co-ordinate system (see Fig.10). As extensively discussed already, *the center of the light wave fronts is* *at the position of the light source relative to the observer at the moment of emission, that is at the point of light emission relative to the observer/detector, and is fixed relative to the inertial observer and co-moving with the inertial observer. The center of the light wave fronts is fixed relative to the inertial observer/ detector between the moments of light emission and light detection. The speed of light in vacuum is always constant c relative to the center of the light wave fronts and therefore relative to the observer (except light reflected from a moving mirror). The velocity of light reflected from a moving mirror is equal to c ± 2v , where v is the component of the mirror velocity perpendicular to the plane of the mirror, in the reference frame of the observer/detector*.

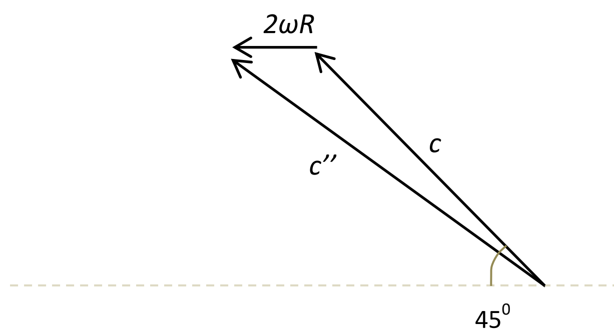
Therefore, in order to analyze the experiment, we first need to determine the component of the mirror velocity perpendicular to the plane of the mirror, in the reference frame of the observer, which is shown in Fig.39. This component of the mirror velocity adds to the velocity of light, as seen in the reference frame of the observer.

Therefore, the velocity of the CW light beam reflected from the mirror M1, in the reference frame of the observer/detector will be (Fig. 39):

$$c' = \sqrt{c^2 + (2\omega R)^2 - c(2\omega R)\cos 45^0} = c\sqrt{1 + (\frac{2\omega R}{c})^2 - \frac{2\omega R\cos 45^0}{c}}$$

$$c' \cong c\sqrt{1 - \frac{2\omega R\cos 45^0}{c}} \quad , \quad for\ \omega R \ll c$$

Fig. 40



Likewise, the velocity of the CCW light beam reflected from the mirror M2, in the reference frame of the observer will be (Fig.40):

$$c'' = \sqrt{c^2 + (2\omega R)^2 + c(2\omega R)\cos 45^0} = c\sqrt{1 + (\frac{2\omega R}{c})^2 + \frac{2\omega R\cos 45^0}{c}}$$

$$c'' \cong c\sqrt{1 + \frac{2\omega R\cos 45^0}{c}} \quad , \quad for\ \omega R \ll c$$

The time taken by the CW light beam is:

$$\tau_{cw} = \frac{2R\sqrt{2}}{c} + \frac{2R\sqrt{2}}{c'}$$

The time taken by the CCW light beam is:

$$\tau_{ccw} = \frac{2R\sqrt{2}}{c} + \frac{2R\sqrt{2}}{c''}$$

(The velocity of the CCW light beam between the beam-splitter and mirror M2 is equal to *c* in the reference frame of the observer/detector because no reflection is involved in the path from the source to the mirror M2. The velocity of the CW light beam between the beam-splitter and mirror M1 is also equal to *c* although it is reflected from the beam-splitter because the velocity of the beam-splitter is almost equal to zero in the reference frame of the observer. This is because the velocity of the beam-splitter and the velocity of the observer are almost equal.)

The time difference between the CW and the CCW beams will be:

$$\tau_{cw} - \tau_{ccw} = 2R\sqrt{2} \left(\frac{1}{c'} - \frac{1}{c''} \right)$$

$$\tau_{cw} - \tau_{ccw} = 2R\sqrt{2} \left(\frac{1}{\sqrt{c^2 + (2\omega R)^2 - c(2\omega R)\cos 45^0}} - \frac{1}{\sqrt{c^2 + (2\omega R)^2 + c(2\omega R)\cos 45^0}} \right)$$

The conventional formula for the time difference between the CCW and the CW beams is:

$$\tau_{ccw} - \tau_{cw} = \frac{4\,A\,\omega}{c^2}$$

The ***magnitude*** of the above two results are almost equal ! (I checked by using Excel). But the signs are different! According to the classical analysis, the CW beam arrives at the detector earlier than the CCW beam. According to the new theory, however, the CCW beam arrives earlier than the CW beam!

However, it should be noted that the above analysis is only approximate (despite the result being equal to the classical formula) because it is not precisely and exactly according to the procedure described for accelerating observers in the last section 'Acceleration'. Moreover, it gives large error of up to 20% for a non-square rectangular enclosed area, with unequal adjacent sides [20].

However, in the Sagnac effect, the observer is in accelerated motion and therefore not inertial. Therefore, we apply the procedure described in the last section 'Acceleration'. We apply the procedure to each light beam separately as follows.

The CCW light beam

Let us first apply the procedure to the CCW light beam. For simplicity, assume that the light source and the detector are almost at the same point (the beam-splitter not shown) and that the path of the light beam forms a square (Fig.39). In reality, the light source and the detector cannot be at the same point (Fig.37). Let the real accelerating observer be at point O at the moment of emission. We start by assuming that the real observer detects the CCW light after a time delay of τ_{ccw}, at point P_1. Assume an imaginary inertial observer at point O' who is moving with the same velocity as the instantaneous velocity of the real observer at point P_1. Assume that both the real accelerating observer and the imaginary inertial observer detect the CCW light simultaneously at point P_1. Note that the positions of the mirrors M1', M2' and M3' are at the moment of light emission, whereas the positions M1, M2 and M3 are at the moment of detection of the CCW light beam.

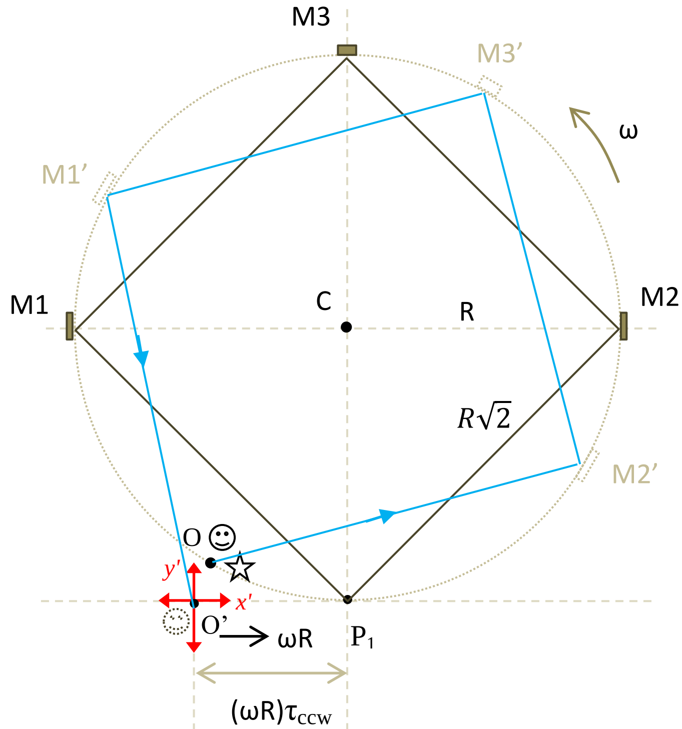


Fig. 39

Since the time delay between emission and detection of the CCW beam is τ_{ccw} , the length of the arc OP_1 and the length of the line segment $O'P_1$ will both be equal to $(\omega R)\tau_{ccw}$. We now analyze the experiment in the reference frame of the imaginary inertial observer (x',y'). Although the imaginary inertial observer is actually moving to the right with velocity ωR in the lab reference frame, we assume that the imaginary inertial observer is fixed at point O’, with the mirrors acquiring a velocity component of ωR to the left (in addition to their velocity due to rotation).

Since we assumed that both the observer and the light source are almost at the same point, the light source is also at point O at the moment of emission. In the reference frame of the imaginary inertial observer (x',y') , the light is emitted from point O. The light emitted from point O is then reflected from mirror M2’, then reflected from mirror M3’, then reflected from mirror M1’ , then detected by the imaginary inertial observer/detector (the blue line).

The CW light beam

Let us assume that the real accelerating observer detects the CW light beam at point P_2 , after a time delay of τ_{cw}. Imagine an imaginary inertial observer who is at point O’’ at the instant of light emission, moving with a velocity equal to the instantaneous velocity of the real accelerating observer at point P_2 . Let the real accelerating observer and the imaginary inertial observer detect the CW light beam simultaneously at point P_2. This means that the length of the arc OP_2 and the length of the line segment $O''P_2$ are both equal to $(\omega R)\tau_{cw}$.

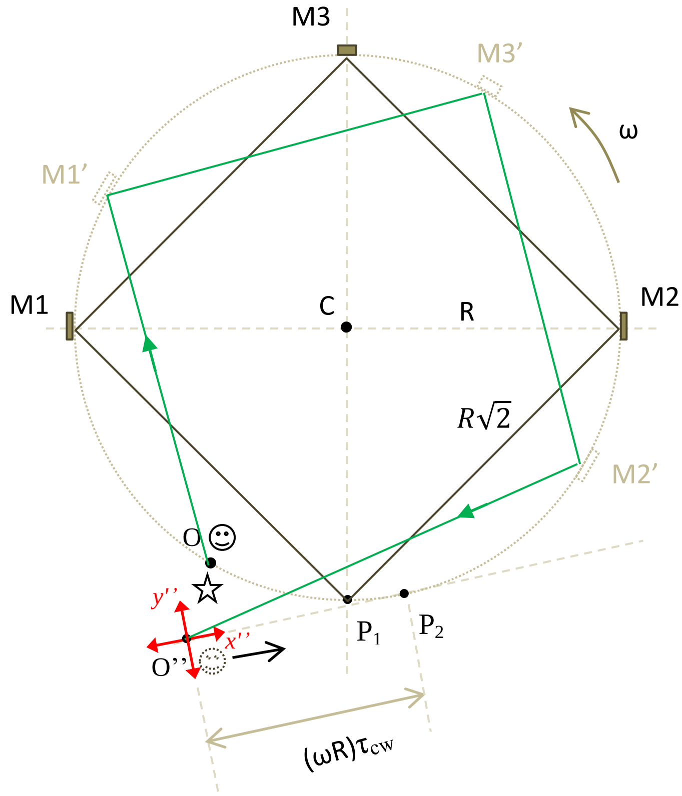


Fig. 39

<u>The point of reflection of the light beams</u>

Unconventionally, the light beams are apparently reflected from the point in space where the mirrors are at the moment of emission as proposed in my paper [12]. Logically and classically the point in space where light is reflected from a moving mirror is determined by taking into account the change in position of the mirror during the transit time of light. It appears that this logical and conventional thinking is wrong. It should be noted that the positions of the mirrors M1, M2, M3 and M4 are at the instant of detection of the CCW beam, which is, unconventionally, the beam that is detected first, according to the new theory. Classically and logically, it is the CW beam that is detected first.

<u>Determination of τ_{ccw} and τ_{cw}</u>

To determine τ_{ccw} , we start with the equation:

$$\text{The time taken by the CCW light beam to move from point O to the imaginary inertial observer at point } O' \text{ after reflection from the mirrors } M2', M3' \text{ and } M1' \; =$$

$$\text{The time taken by the real accelerating observer to move from point O to point } P_1 \; = \; \tau_{ccw}$$

From the analysis in the last section, the CCW light beam travels with a speed *c* from the point O to the mirror M2', with a speed *c''* between M2' and M1', and with a speed of *c* between M1' and O'.

The CCW light path has for legs. The path lengths of the three legs are R√2 each. We need to determine the expression for the length of the path M1'O' .

Consider the triangle M1' C O' . We first need to determine the angle M1' C O' .

$$angle\ M1'\ C\ \ M1 \ = \ \frac{(\omega R)\tau_{ccw}}{R} \ = \ \omega\tau_{ccw}$$

$$angle\ P_1\ C\ O' \ = \ tan^{-1}\ \frac{(\omega R)\tau_{ccw}}{R} = \ tan^{-1}\ (\omega\ \tau_{ccw}\ )$$

Therefore,

$$angle\ M1' C\ O' = angle\ M1'\ C\ M1\ \ + (\ 90^0 - \ angle\ P_1\ C\ O'\ )$$

$$= \omega\tau_{ccw}\ \ + (\ 90^0 - \ tan^{-1}\ (\omega\ \tau_{ccw}\ )\ )$$

The length of line CO' :

$$Length\ of\ C\ O' = \ \sqrt{R^2 + (\omega R\ \tau_{ccw})^2}\ = R\sqrt{1 + (\omega\ \tau_{ccw})^2}$$

Therefore,

$$length\ of\ line\ segment\ M1'\ \ O\ ' =$$

$$\sqrt{(R\ \ )^2 + (\ R\sqrt{1 + (\omega\ \tau_{ccw})^2}\ \ \ )^2\ \ - \ \ 2R\ R\sqrt{1 + (\omega\ \tau_{ccw})^2}\ \cos(\omega\tau_{ccw}\ \ + (\ 90^0 - \ tan^{-1}\ (\omega\ \tau_{ccw}\ )\ ))}$$

$$The\ time\ taken\ by\ the\ CCW\ light\ beam\ to\ move\ from\ point\ O\ to\ the\ imaginary\ inertial\ observer\ \ at\ point\ O' after\ reflection\ from\ the\ mirrors\ M2', M3' and\ M1'\ \ = \tau_{ccw}$$

$$\Longrightarrow\ \ \frac{R\sqrt{2}}{c} + \ \frac{2R\sqrt{2}}{c''} + \ \frac{length\ of\ line\ segment\ M1'\ \ O'}{c}\ \ = \ \tau_{ccw}$$

$$\Longrightarrow\ \ \frac{R\sqrt{2}}{c} + \ \frac{2R\sqrt{2}}{c\sqrt{1 + \frac{2\omega R\cos 45^0}{c}}} + \ \frac{length\ of\ line\ segment\ M1'\ \ O'}{c}\ \ = \ \tau_{ccw}$$

τ_{ccw} is determined from the above equation using numerical method.

Note that the velocity of light reflected from the mirrors M1' and M2' is approximated to be *c'* and *c''* obtained already because the M1' and M2' are almost at the same point and moving with almost the same velocity as M1 and M2, respectively. Note also that we have ignored the apparent change in time of light emission relative to imaginary inertial observers at O' and O'' .

The analysis for the CW beam is similar.

The CW light path has for legs. The path lengths of the three legs are R√2 each. We need to determine the expression for the length of the path M2'O''.

Consider the triangle M2' C O'' . We first need to determine the angle M2' C O''.

$$angle\ M2'\ C\ \ M2 \ = \ \frac{(\omega R)\tau_{ccw}}{R} \ = \ \omega\tau_{ccw}$$

$$angle\ P_2\ C\ O'' = tan^{-1}\frac{(\omega R)\tau_{cw}}{R} = tan^{-1}(\omega\,\tau_{cw})$$

Therefore,

$$angle\ M2'C\ O'' = angle\ P_2\ C\ O'' + angle\ P_2\ C\ M2'$$

$$= tan^{-1}(\omega\,\tau_{cw}) + (\,90^0 - (angle\ P_1\ C\ P_2\ +\ angle\ M2'C\ M2\ )\,)$$

$$= tan^{-1}(\omega\,\tau_{cw}) + (\,90^0 - (\omega\,\tau_{cw} - \omega\,\tau_{ccw}\ +\ \omega\,\tau_{ccw}\ )\,)$$

$$= tan^{-1}(\omega\,\tau_{cw}) + (\,90^0 -\ \omega\,\tau_{cw})$$

Length of line CO'' :

$$Length\ of\ C\ O'' = \sqrt{R^2 + (\omega R\,\tau_{cw})^2} = R\sqrt{1 + (\omega\,\tau_{cw})^2}$$

Therefore,

$$length\ of\ line\ segment\ M2'\ \ O'' =$$

$$\sqrt{(R\ )^2 + (\,R\sqrt{1 + (\omega\,\tau_{cw})^2}\ \ )^2\ -\ 2R\,R\sqrt{1 + (\omega\,\tau_{cw})^2}\ \cos\ (tan^{-1}(\omega\,\tau_{cw}) + (\,90^0 -\ \omega\,\tau_{cw})\ )}$$

$$The\ time\ taken\ by\ the\ CW\ light\ beam\ to\ move\ from\ point\ O\ to\ the\ imaginary\ inertial\ observer\ \ at\ point\ O''after\ reflection\ from\ the\ mirrors\ M1', M3'and\ M2'\ = \tau_{cw}$$

$$\Rightarrow\ \frac{R\sqrt{2}}{c} + \frac{2R\sqrt{2}}{c'} + \frac{length\ of\ line\ segment\ M2'\ \ O''}{c} = \tau_{cw}$$

$$\Rightarrow\ \frac{R\sqrt{2}}{c} + \frac{2R\sqrt{2}}{c\sqrt{1 - \frac{2\omega R\cos 45^0}{c}}} + \frac{length\ of\ line\ segment\ M2'\ \ O''}{c} = \tau_{cw}$$

τ_{cw} is determined from the above equation by using numerical method, using Ms Excel for example.

Once τ_{ccw} and τ_{cw} are obtained, the fringe shift can be determined from:

$$\tau_{cw} - \tau_{ccw}$$

I propose an experiment to test this hypothesis, that is the unconventional hypothesis that the CCW beam arrives earlier than the CW beam. This experiment looks for the direction of the fringe shift for a given direction of rotation (say, CCW rotation as shown in the figure) of the device!

The procedure would be first to identify the direction of the fringe shift by introducing a phase shift in one of the light beams, with the Sagnac device at rest (not rotating). Imagine that there was a way to introduce more phase delay in the CW beam than in the CCW beam (for example by inserting a hypothetical special thin glass plate that has different refractive indexes in opposite directions). The direction of the fringe shift is noted when the special glass plate is inserted in the light path, with the Sagnac device at rest. Then the Sagnac device is set in CCW rotation with the glass plate removed from the light path. If the direction of the fringe shift due to the rotation is the same as the direction of the fringe shift due to the glass plate, then the new theory is confirmed and the conventional view, including the SRT analysis, is disproved.

Perhaps a more feasible experiment would be to slightly vary the path length of each light beam by adjustment of the mirror angles or positions, so that the path length of one beam is increased more than the path length of the other beam.

The interference fringes are caused by the two source images. Let S' be the image of the CW beam and S'' be the image of the CCW beam (actually this has to be determined by geometrical optics analysis). Changing the angle or position of one of the mirrors will affect the path length and phase of the light beams at the detector. However, not both light beams will be affected equally.

Fig. 41

Slight adjustment of the angle of one of the mirrors (for example, M3 in Fig. 38) will affect both light beams. For example, if S' shifts backwards and to the left due to the mirror adjustment, and the CW beam is delayed more than the CCW beam, this will cause a fringe shift to the left (the central bright fringe will shift to the left). Instead if the path length of S'' is increased, the central bright fringe will shift to the right. In reality, both the path length and direction of the image sources of both CW and CCW beams will be affected by adjustment of the mirror angle and the geometrical optics analysis to determine which beam is delayed more for a given adjustment of mirror angle will be much more complicated. It should be noted that once the direction of fringe shift is determined, the mirror should be returned back to its initial position for the actual experiment.

An alternative experiment would be to use a time of flight experiment, instead of an interference experiment described above, with only one light beam (CW or CCW) used at a time . There will be no beam splitter in this case. If the side of the square in Fig.38 is long enough, say 20000 km, the time difference between the CW and CCW beams will be about 1.3 μs. Such an experiment or its modifications, necessarily involves mirrors mounted on geostationary satellites. It should be clear that the mirrors in this experiment cannot/ should not be replaced by repeaters!

A more feasible version of such an experiment would be to use an experiment with a triangular light path (Fig.42). A short light beam is emitted from the laser S1 source towards mirror M2. The light pulse is then detected by the detector and the time interval between emission and detection recorded. Then, immediately, a short light pulse is emitted from laser S2 towards mirror M1, and the time of flight measured. Then the CCW and CW beams times of flight can be compared.

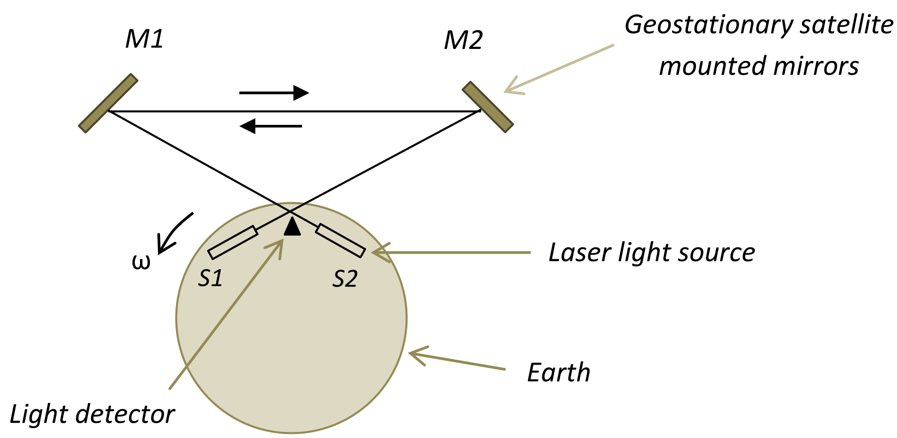


Fig. 42

Doppler effect of light - a new model of the longitudinal Doppler effect of light and the absence of transverse Doppler effect

In this section, we introduce a new theory of Doppler effect of light. A new law of Doppler effect of light is proposed that can explain the Ives-Stilwell experiment. The new explanation of Doppler effect is based on an important distinction between the Doppler effect of light and the Doppler effect of classical waves. In the case of light, unlike classical waves, absolute motion does not affect Doppler effect. The formulation of a new model of the Doppler effect of light has to take in to account the following.
1. The Ives-Stilwell experiments 2. That no absolute motion effect has been observed in the modern Ives-Stilwell experiment. 3. Constancy of the phase velocity of light in vacuum, regardless of the velocity of the observer, of the source, of the mirror.

Disentanglement of absolute motion of an observer and Doppler effect of light and Non-existence of transverse Doppler effect

Let us see why Doppler effect of light should not be affected by absolute motion of the observer. Consider an observer moving with absolute velocity V_{abs} to the right as shown (Fig.43). The light source is stationary at point S. The observer is at point O at the moment of light emission. The observer detects the light at point O', as coming from the direction of S'.

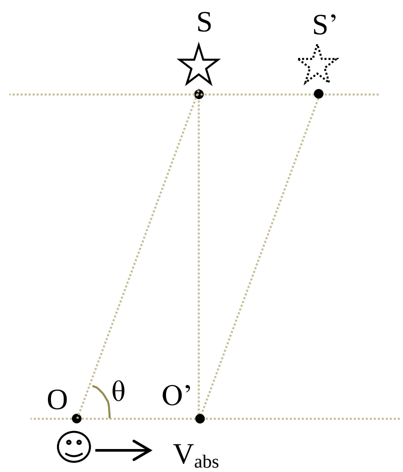


Fig. 43

I was tempted to speculate that the Doppler effect of light for an inertial observer is also determined at the moment of light emission, just like the angle of stellar aberration is determined at the moment of emission according to the new theory (ATE theory). If Doppler effect was determined at the moment of emission, then the light detected at point O' would be Doppler shifted and the Doppler shift would be determined by the angle θ , that is $V_{abs} \cos \theta$. There would be 'transverse Doppler effect'.

However, we know that Doppler effect is only determined by the source-observer *relative* velocity, and not by observer's absolute velocity. *The (longitudinal)Doppler effect of light is determined by the radial component of the difference between the velocity of the source at the moment of emission and the velocity of the inertial observer at the moment of light detection (the velocities are relative to some inertial frame).* Thus, there is no Doppler effect of light detected at point O' (Fig.43). This means that, as in classical waves, there is no transverse Doppler effect of light.

A complete analysis of any light experiment on Doppler effect is done by first determining the point in space and time where and when light emitted is detected by the observer, by applying the new Apparent Time of Emission (ATE) theory extensively discussed already. Once the point in space where light is detected by the observer is determined, the Doppler effect of the detected light is determined from *the radial component of the difference between the velocity of the source at the moment of emission and the velocity of the observer at the moment of detection*. This theory disentangles absolute motion and Doppler effect of light, as observed in the fast ion beam experiment (modern version of the Ives-Stilwell experiment). For classical waves, Doppler effect depends on the velocity of the source and the velocity of the observer relative to the medium (air). *The absolute motion of an observer only determines the time delay of light between emission and detection. Absolute motion has no effect on the Doppler effect of light*.

Therefore, light is different from classical waves in that Doppler effect of light is disentangled from the absolute motion of the observer. On the other hand, light is similar to classical waves in that transverse Doppler effect of light does not exist.

A new model of the longitudinal Doppler effect of light

There is no classical model of the speed of light that can explain the Ives-Stilwell experiment so far. Ironically, this experiment is perhaps the only unique 'prediction' (actually, explanation) of the Special Relativity Theory that has been confirmed experimentally.

In my paper [22], I have proposed a new theory called Exponential Doppler Effect of light that can be an alternative explanation for the Ives-Stilwell experiment. As I have already mentioned, one of the criteria for a new model of the Doppler effect of light must predict the constancy of the phase velocity of light.

Constant phase velocity of light

Although there are experiments that have unambiguously detected absolute motion, such as the Silvertooth and the Marinov experiments, and therefore disprove the theory of relativity, there are also experiments that appear to agree with the Special Relativity theory, particularly the Ives-Stilwell experiments. Moreover, Einstein's light speed thought experiment is very compelling when one considers the non-existence of the ether as deduced from the null result of the Michelson-Morley experiment.

Several years ago I developed a new model of the phase velocity and Doppler effect of light, called Exponential Doppler Effect (EDE) of light in an effort to understand constancy of the speed of light and the Ives-Stilwell experiments. The development of this model was guided by my belief that the phase velocity of light in vacuum must always be constant, irrespective of any source, observer or mirror velocity. Therefore, I formulated the following requirement for the (phase) velocity to be constant.

$$f'\lambda' = f \lambda = c$$

where *f '* and λ' are the frequency and wavelength measured by the observer in the case of source-observer in relative motion and *f* and λ are the frequency and wavelength measured by the observer in the case of no source-observer relative motion (i.e. $v = 0$)

This law predicts that , unlike all classical theories, *not only the frequency but also the wavelength changes* in the case of Doppler effect of light. In the case of classical waves, there is no change in the wavelength due to the receiver moving relative to the medium, only the frequency changes.

However, the above law only says that the product of the frequency and wavelength is always constant c . It does not reveal how the frequency and wavelength depend on the relative velocity v, i.e. it does not reveal how *f* ' is related to *f* and how λ' is related to λ . This led me to search for an expression (a law) satisfying the above requirement of constancy of phase velocity. Moreover, the new law should be able to explain the Ives-Stillwell experiment. After some effort, I was able to find the mysterious law governing the Doppler effect of light as follows.

$$\lambda' = \lambda\, e^{-v/c} \quad \text{and} \quad f' = f e^{v/c}$$

where v is the source- observer relative velocity and v is positive for source and observer approaching each other.

We can see that this law satisfies the constancy of the speed of light.

$$f'\lambda' = f e^{v/c}\, \lambda\, e^{-v/c} = f \lambda = c$$

<u>The Ives-Stilwell experiment</u>

As mentioned above, the other requirement for the new Doppler effect law is that it should explain the Ives-Stilwell experiment. We can say that this experiment is the single most important factor that led to the wide acceptance of relativity theory in the mainstream. Although we can also say the same about the Michelson-Morley and the Kennedy-Thorndike experiments, these experiments gave null results, which has a classical explanation: emission/ballistic theory. The Ives-Stilwell experiment, on the other hand, is a non-null experiment and is therefore considered to be a unique prediction of special relativity theory. Also there is no classical explanation for it.

The new analysis is as follows. In the Ives-Stilwell experiment, the wavelength of the light emitted from the ion in the forward direction will be:

$$\lambda'_f = \lambda e^{-v/c}$$

The wavelength of light emitted in the backward direction will be:

$$\lambda'_b = \lambda e^{v/c}$$

The average wavelength:

$$\Lambda = \frac{1}{2}\left(\lambda'_{\mathrm{f}} + \lambda'_{\mathrm{b}}\right) = \frac{1}{2}\lambda\,(e^{-v/c} + e^{v/c})$$

$$\mathit{\Delta} = \Lambda - \lambda = \lambda\left(\frac{1}{2}e^{-v/c} + \frac{1}{2}e^{v/c} - 1\right) \approx \frac{1}{2}\left(v/c\right)^2 \lambda = \frac{1}{2}\beta^2\lambda \quad \text{(using Taylor's expansion)}$$

This is the same formula predicted by Special Relativity and confirmed by the Ives-Stilwell experiment.

<u>Modern Ives-Stilwell experiment: fast ion beam experiment</u>

The fast ion beam experiment is a modern version of the Ives-Stilwell experiment. S_1 and S_2 are laser light sources. The positive hydrogen ion is shown in the middle moving with velocity *v* to the right.

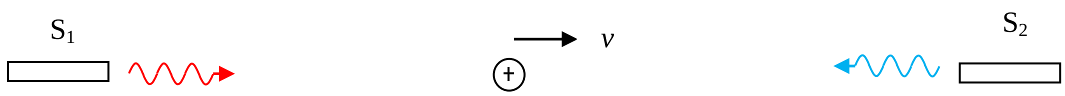


Fig. 44

The frequencies of the two laser beams as seen by the hydrogen ion are related to the transition frequencies as follows:

$$f_{01} = f_1 e^{-V/c}$$

$$f_{02} = f_2 e^{V/c}$$

where f_1 and f_2 are the frequencies of the parallel and anti-parallel lasers shown in the figure.

Therefore,

$$f_{01} f_{02} = f_1 e^{-v/c}\, f_2 e^{v/c} = f_1 f_2 \implies \frac{f_{01} f_{02}}{f_1 f_2} = 1$$

where f_{01} and f_{02} are the two transition frequencies.

The above result is consistent with the outcome of the fast ion beam Ives-Stilwell experiments.

<u>What is the velocity *v* in the new Exponential Doppler Effect of Light theory?</u>

The velocity v in the new Doppler effect formula:

$$\lambda' = \lambda\, e^{-v/c} \quad \text{and} \quad f' = f\, e^{v/c}$$

is the radial component of the difference between the velocity of the observer <u>at the moment of light detection</u> and the velocity of the source <u>at the moment of light emission</u>.

Speed of electrostatic and gravitational fields

The speed of gravitational (and electrostatic) fields is one of the greatest puzzles in physics. Tom Van Flandern described the confusions regarding the speed of gravitational fields [23]. The fundamental mechanism of how two massive objects attract each other or how a charged particle attracts or repels another charged particle is still a mystery in physics. I have proposed a solution in a previous paper[24]

The problem and confusion regarding the speed of gravitational fields is usually presented as follows. Suppose that the Sun disappeared suddenly. Obviously, sunlight would disappear on Earth after a delay of about 8.3 minutes. The question is: would the gravitational pull of the Sun on Earth disappear suddenly or with the delay of the speed of light? What is the speed of gravity? Finite (light speed) or infinite?

The profound mystery behind the speed of gravity is revealed as follows. *The speed of gravity has dual nature: is both finite (the speed of light c) and infinite*.

Suppose that the Sun suddenly disappeared at $t = 0$. About 8.3 minutes *before* the actual disappearance of the Sun (that is, at $t = -8.3$ minutes), zero gravitational field will be emitted towards the Earth, propagating at the speed of light c. The zero gravitational field reaches the Earth at $t = 0$, exactly at the instant of disappearance of the Sun. Therefore, by (apparent) violation of causality, the effect of disappearance of the Sun is felt instantaneously on Earth, implying (apparent) instantaneous action, although the change in gravitational field travelled at the finite speed of light c to reach the Earth.

Next let us see the effect of absolute motion of the observer with regard to gravitational fields. Imagine a cosmic object (for example, the Sun) and an observer (the Earth), both at rest. The distance between them is D. The gravitational field at the location of the Earth is determined by Newton's law of gravitation. The force of gravity is directed towards the Sun.

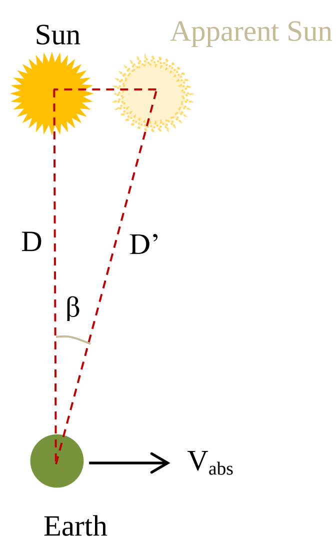


Fig. 45

Now suppose that the observer/detector (in this case the Earth) is moving with absolute velocity, V_{abs} to the right (Fig.45). I propose that the direction of the gravitational force is towards the actual instantaneous position of the Sun now, but the magnitude of the gravitational force is as if the Sun is at an apparent position, ahead of its real position. Therefore, the apparent distance D', and not the real distance D, will be used in Newton's gravitational formula to determine the gravitational force of the Sun on the Earth in this case. It is a kind of 'gravitational aberration'. Whereas aberration in the case of light is an apparent change of the direction of Sunlight (this is according to current conventional understanding, not precisely according to the new theory, as already discussed), aberration in the case of gravity does not affect the direction of the gravitational force, but the magnitude of the gravitational force. The 'aberration angle' θ depends on the absolute velocity of the observer/detector (i.e. the Earth).

To determine the angle θ, we use the diagram of Fig.9, shown below.

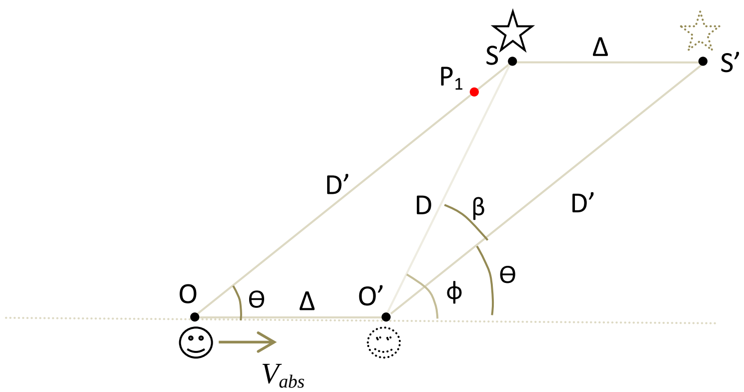


Fig. 46

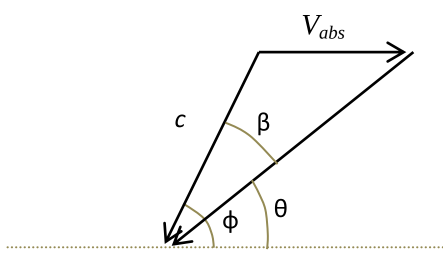


Fig. 47

Given ϕ and v_{abs} , β can be determined from the above triangle, from which θ can be determined from $\theta = \phi - \beta$. Then D' can be determined which is then used in Newton's formula of gravitation to determine the gravitational force of the Sun on Earth.

$$F = G\,\frac{Mm}{r^2}$$

By substituting $r = D'$

$$F = G\,\frac{Mm}{D'^2}$$

In fig.45 the angle β is 90^0. The angle β can also be determined from:

$$\tan\beta = \frac{V_{abs}}{c}$$

Once the angle β is determined, D' can be determined from:

$$\cos\beta = \frac{D}{D'}$$

Mercury perihelion advance could be due to 'gravitational aberration'

The above theory can be applied to the problem of the anomalous Mercury perihelion advance (Fig.48).

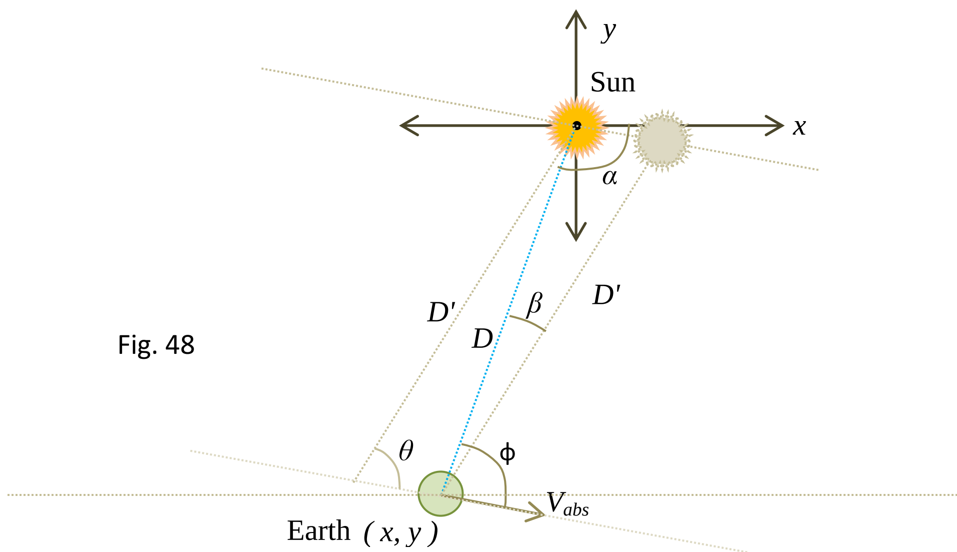


Fig. 48

$$\frac{GMm}{D'^2}\cos\,(180^0 - \alpha\,) \;=\; m\,\frac{d^2x}{dt^2}$$

$$\frac{GMm}{D'^2}\sin\,(180^0 - \alpha\,) \;=\; m\,\frac{d^2y}{dt^2}$$

The value for D' is obtained in the same way as discussed in the last section.

These can be solved by computer numerical method (by using Ms Excel) to see if the anomalous 41 arc seconds per century is predicted correctly. The initial conditions are initial α , initial r , initial V_{abs} and initial ϕ .

Conclusion

In this paper, we have seen a new model of the speed of light. 1. The speed of light is constant relative to the center of the wave fronts, which is the position of the light source relative to the observer at the moment of emission and is always fixed relative to and co-moving with the observer between the moment of emission and the moment of detection. Therefore, the speed of light is also always constant *c* relative to the observer. 2. There is an apparent change in the time of emission of light for an observer in absolute motion. 3. A new law of the Doppler effect of light has also been introduced, which can explain Einstein's light speed thought experiment and the Ives-Stilwell experiment. We have applied this model to consistently explain many of the light speed experiments that have defied all endeavors by generations of physicists for more than a century. This paper has not only presented a new model of the speed of light, but also has shown the extremely elusive nature of the speed of light.

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

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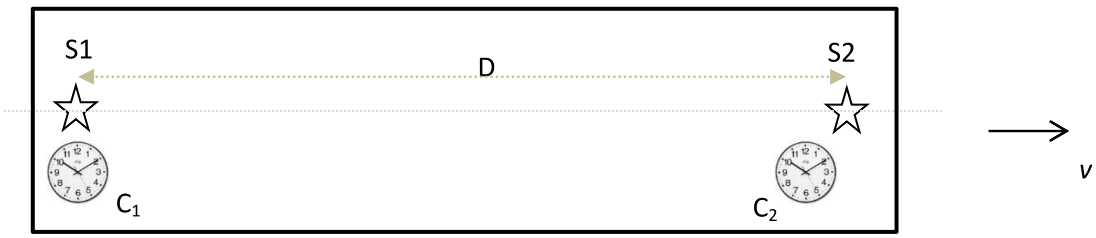
APPENDIX

1. Synchronizing distant clocks and measuring the one-way speed of light

Consider a physicist doing a light speed experiment in a closed lab on Earth or somewhere in space. There are two clocks C_1 and C_2 in the lab, each with their own associated light transmitters and detectors to exchange time signals. The experiment is setup to measure the one-way speed of light in the lab. For this, the clocks C_1 and C_2 need to be synchronized first. The time of clock C_1 is set to $t_0 = 0$ and at the same time a short synch light pulse is sent to clock C_2. The clocks are synchronized by assuming isotropy of the speed of light.

$$t_1 = \frac{D}{c}$$



However, this synchronization procedure will result in clock C_2 lagging behind clock C_1 by an amount:

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

Now, at some later time t_2 , let clock C_2 send time signal back to clock C_1 . At this instant the time of clock C_1 will be:

$$t_2 + \delta = t_2 + D\,\frac{v}{c(c-v)}$$

Clock C_1 will receive the time signal at:

$$t_2 + D\,\frac{v}{c(c-v)} + \frac{D}{c+v}$$

which is the *actual* time of clock C_1 . The $c+v$ is because clock C_1 and the time signal are moving in opposite directions.

However, the *calculated* time of clock C_1 will be:

$$t_2 + \frac{D}{c}$$

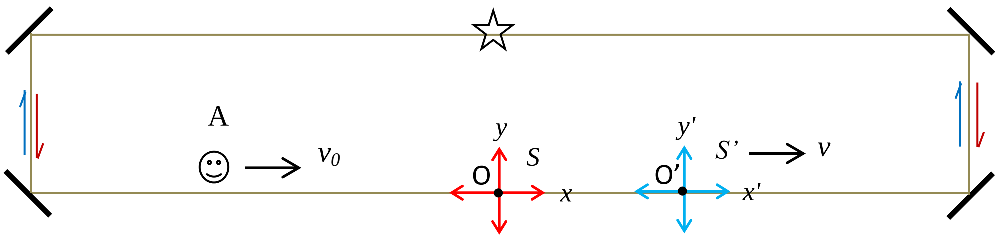
The difference between the *actual* and *calculated* times of clock C_1 will be:

$$\Delta = t_2 + D\,\frac{v}{c(c-v)} + \frac{D}{c+v} - \left[\, t_2 + \frac{D}{c} \,\right] = \frac{2D}{c}\,\frac{\frac{v^2}{c^2}}{1-\frac{v^2}{c^2}}$$

From measurement of Δ , the value of the velocity v and hence the one-way speed of light can be determined from the above equation. This experiment will give a velocity different from zero, as we know from experience, such as the GPS Sagnac correction, and therefore disproving the theory of relativity. Thus we have strictly applied SRT's postulate of isotropy of the speed of light to synchronize the clocks and showed that this leads to a contradiction : absolute motion.

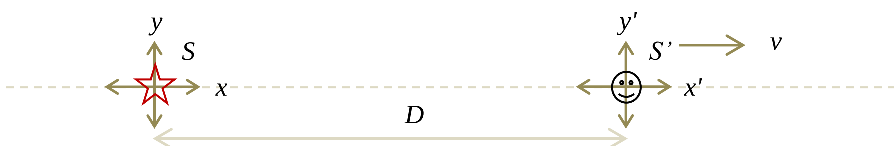
2. A Contradiction in Special Relativity Theory

In my paper entitled " A Possible Contradiction in Special Relativity Theory" , I was able to create a hypothetical light speed experiment (see figure below) in which the standard Special Relativity Theory led to a contradiction: SRT predicted different fringe shifts in the lab frame S and in a reference frame moving relative to the lab frame, S'. This contradiction led me to propose a new formulation of SRT [see (3) below].



3. Proper Space Time Coordinates of Events – Completing and Disproving Special Relativity

Consider an inertial reference frame S with a light source at the origin. At $t = 0$, the source emits a light pulse. At $t = 0$ an observer/detector is at $x = D$, moving with velocity v in the + x direction, in reference frame S. The question is: what is the time of detection of the light by the detector, relative to S, according to STR?



Let the reference frame of the moving observer/detector be S'. At $t = 0$ the origins of S and S' coincide and the clocks are synchronized. We start by determining the proper space time coordinates of the first event: emission of light. This is the space time coordinates of the event (emission) in the reference frame of the source.

$$x = 0 \qquad \text{and} \qquad t = 0$$

The next step is to determine the proper space-time coordinates of the detection of light, which is the coordinates of the event (detection) in the reference frame of the detector, which is S'. For this we first need to determine the coordinates of the emission of light in frame S'. For this, we apply Lorentz Transformations.

$$x' = \gamma\ (x - vt) = \gamma\ (0 - v * 0) = 0$$

$$t' = \gamma\ \left(t - \frac{vx}{c^2}\right) = \gamma\ \left(0 - \frac{v * 0}{c^2}\right) = 0$$

Now that we have determined the coordinates of emission of light in frame S', we can determine the proper space time coordinates of the light detection event in S'.

$$x' = D \qquad \text{and} \qquad t' = 0 + \frac{D}{c} = \frac{D}{c}$$

where D is the position of the detector in the reference frame in which it is at rest, frame S', *at the instant of light emission*. Therefore, the time of light detection in the reference frame of the observer is not affected by the observer's velocity ,which is in contradiction with experiments.
Therefore, both the standard SRT and the new formulation of SRT have been disproved.