Apparent Contraction and Expansion of Space Relative to Absolutely Moving Observer - New Explanation of the Phenomena of Stellar Aberration, Doppler Effect and Mercury Anomalous Perihelion Advance

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21 October 2018

Abstract

Could Albert Einstein be wrong about absolute motion ,absolute time and gravity but right about space contraction and the speed of light?Perhaps the great physicist is not completely wrong. In this paper, a new law of transformation of reference framesfor absolutely moving observers is proposed. We may call this Apparent Source Transformation (AST). With this transformation, the space in front of an absolutely moving observer apparently contracts whereas the space behind an absolutely moving observer expands. Profoundly, AST changes current understanding of the phenomenon of stellar aberration. Stellar aberration occurs because of compression (or expansion) of space in front of (behind) an *absolutely* moving observer. The apparent change in position of the star is not in the direction of absolute velocity, but in the opposite direction! Mercury's anomalous perihelion advance can be explained by expansion of space as seen by the Sun and as seen by Mercury. AST also provides physical explanation for a new theory already proposed by this author: Exponential Doppler Effect of light: $f' = f e^{V/c}$, $\lambda' = \lambda e^{-V/c}$. This agrees with the constancy of the speed of light: $f'\lambda' = f\lambda = c$ and can explain the Ives-Stilwell experiment. Not only frequency but also wavelength changes for an absolutely moving observer and the change in wave length for a moving observer can only be explained by apparent expansion or contraction of space as seen by an absolutely moving observer. AST has differences from and similarities to Special Relativity Theory (SRT) and/or Lorentz Contraction (LC) as follows:1. AST postulates that the speed of light is constant c irrespective of source or observer uniform motion, but the group velocity of light varies with mirror velocity 2. AST postulates absolute time 3. According to AST, absolute motion exists, but the ether doesn't exist as we know it 4. According to AST, space apparently contracts in front of an absolutely moving observer and expands behind him/her, only as seen by the absolutely moving observer, whereas space (or length) only contracts, both in the forward and backward directions, as seen by the 'stationary' observer, in SRT and LC. In AST, space contraction is applied only when objects are considered as *sources* (sources of light, EM waves, electrostatic fields, gravity). In Apparent Source Transformation, it is assumed that only the position of the light source will apparently change relative to the detector/observer but the the mirrors, the beam splitter and all other parts of the apparatus will be assumed to be at their actual/physical positions to analyze the experiment. 5. In AST, it is space itself that contracts or expands relative to a moving observer regarding the position of sources 6.AST gives an exponential law of transformation of space, and is different from Lorentz transformations. 7. In AST, the observer is the light detecting device or the human *directly detecting the light* and light speed experiments should always be analyzed from the perspective of the inertial observer. More precisely, the observer is the atom detecting the light. Apparent Source Transformation evolved from a theory called Apparent Source Theory already proposed by this author. According to Apparent Source Theory, the effect of absolute motion of the Michelson-Morley experiment is to create an apparent change in position of the light source as seen by (relative to) the observer/detector.The resulting fringe shift is the same as if the source was actually /physically moved to the same position. Intuitively, we can guess that actually changing the source position will not result in significant fringe shift or gives only small fringe shift. Apparent Source Theory not only accounted for the 'null' fringe shift of the Michelson-Morley experiment, but also for the small fringe shifts observed such as in the original Michelson experiment of 1881 and the Miller experiments. It explains many other light speed experiments, including theSagnac effect, the Marinov experiment, the Silvertooth experiment, the Bryan G Wallace experiment, the Roland De Witte and other experiments.

Introduction

As we know, the Michelson-Morley experiment did not give the expected fringe shift. However, there are two interpretations of this statement. The mainstream view is that the experiment gave a completely null result. This is based on the reasoning that if the ether existed, it should have given the expected fringe shift. Since the observed fringe shift was much smaller than expected, the observed fringe shifts, if any, must be due to experimental error and the non-existence of the ether.

The opposite view is that the Michelson-Morley experiment in fact gave a significant fringe shift, but that was much smaller than expected. A small but significant part of the physics community holds this view. There is a huge difference between a null result and a smaller than expected result because even the slightest significant fringe shift with change in orientation of the apparatus in space would violate the very principle of relativity. This is regardless of whether the observed effect has theoretical explanations or not.It should be remembered that Michelson in his 1881 experiment and Michelson and Morley in their 1887 experiment reported that they observed a fringe shift upon rotating the apparatus. They did not say they observed a null fringe shift.We need to see at their reported results and the interpretations they gave by taking their original expectations into account.

This non-null interpretation was clearly confirmed by Dayton Miller's extensive experimental research over a period of thirty years. Miller repeated the Michelson-Morley experiment with great rigor and care. Miller would not spend thirty years of his life on an experiment that did not give any interesting results. Most significantly, Miller's data showed sidereal correlation.

The small fringe shifts observed violated not only the principle of relativity, but also the ether hypothesis because, if the ether existed, the expected result should have been observed. However, proponents of ether theory proposed that the ether may be dragged along with the earth, so that the ether near the surface of the earth would be stationary.

In 1976 Stephan Marinov reported that he had detected absolute motion with his novel rotating shutters experiment. His experiment was based on change of time of flight of light with change in orientation of the apparatus in space. Unlike the Michelson-Morley experiments, the observed effect was of first order. His attempt to get his results published in scientific journals and get the attention of the physics community failed. Ernest Silvertooth in 1986 also devised and carried out another novel experiment, which detected changes in wavelength of light with rotation of the apparatus. He reported an absolute velocity of the Earth of magnitude 390 Km/s , towards constellation Leo. What is remarkable about the Silvertooth experiment is that almost the same magnitude and direction of earth's velocity was obtained later on by the NASA COBE satellite, from CMBR anisotropy measurement.

Therefore, the Silvertooth experiment was a decisive blow to the very principle of relativity. However, the Silvertooth experiment not only disproved relativity, but also, in combination with the Michelson-Morley experiment, disproved the ether hypothesis. The Michelson-Morley experiment disproved the stationary ether hypothesis and the Silvertooth experiment disproved the dragged ether hypothesis.

But, on the contrary, modern Michelson-Morley experiments using cavity resonators have given almost completely null results. Such experiments try to detect change in resonance frequency of optical or radio cavity resonators due to possible anisotropy of the speed of light. By rotating the experimental apparatus, a change in resonance frequency of the cavity would be observed.

One alternative explanation for the Michelson-Morley (MM) experiment null result would be the emission (ballistic) theory of light, according to which the velocity of light is constant c relative to its source and varies with mirror velocity. Emission theory was so compelling and the most straight forward explanation of MM experiment. Emission theory also has additional experimental evidence, which is the anomalous Venus planet radar range data, as reported by Bryan G Wallace. The experiment was carried out to test Einstein's General Relativity theory, but unexpectedly the data clearly violated the principle of constancy of the speed of light. The data could be better explained by emission theory of light than Special Relativity or ether theory.However, emission theory has been conclusively disproved by moving source experiments using terrestrial experiments and astronomical observations.

Special Relativity Theory (SRT) is the mainstream theory today. It is based on two postulates: the principle of relativity for all laws of physics, including electromagnetism and the postulate of the constancy of the speed of light. Some of the consequences of these postulates are: relativity of space and time, length contraction, time dilation, the universal light speed limit and mass increase with velocity.

In mainstream physics, it is usually claimed that not a single experiment exists to this date that violated the Special Relativity Theory. However, a single experiment that violates the postulates or their consequences would be enough, in principle, to disprove it. As we have discussed above, there are several experiments that disproved the first postulate: the principle of relativity. These are the Miller, the Silvertooth, the Roland De Witte and many other experiments. The Bryan G Wallace Venus planet radar range anomaly disproves the second postulate of absolute constancy of the speed of light. An experiment has been reported that the speed of light varied with observer velocity[2]. In recent years, new experiments appeared that violate the assertion that no information can travel faster than light[3].

From this discussion we conclude that there is not a single known theory to this date that can explain all the empirical data on the speed of light, within the same theoretical framework. Some experiments and observations appear to support ether theory. These include the Michelson-Morley experiments, moving source experiments, the Miller, the Silvertooth, the Marinov and the Roland De Witte experiments. But some other experiments appear to support emission theory. The Michelson-Morley and the Bryan G Wallace experiments are some of these. Yet other experiments appear to support Special Relativity Theory. The Ives-Stilwell experiment and the universal light speed limit experiments are explained by SRT; they cannot be explained by conventional theories, such as ether theory and emission theory.

Therefore, all known models of the speed of light have failed, so a new theory is required. The new theory should explain the small fringe shifts observed in the conventional MM experiments. It should also explain the almost the null results of modern MM experiments using cavity resonators. It should explain the large first order wavelength change effect in the Silvertooth experiment. It should explain the Ives-Stilwell experiment. It should explain the Sagnac effect and moving source experiments. These are some of the requirements for the new theory.

I have already proposed two new theories years ago: Apparent Source Theory and Exponential Doppler Effect . However, the scientific community is largely unaware of these theories.

Apparent Source Theory states that the effect of absolute motion for co-moving light source and observer is to create an apparent change of source position relative to the observer. This theory successfully explained the Michelson-Morley experiment, the Silvertooth experiment and many other experiments. Exponential Doppler Effect was developed to explain the constancy of the phase velocity of light and to explain the Ives-Stilwell experiment.For an observer in motion relative to a light source, not only the frequency, but also the wavelength changes and this is unconventional. It is a new theory for the Doppler effect of light. The changes in frequency and wavelength are such that the phase velocity of light is always constant. i.e. $f \lambda = f' \lambda' = c$.

Despite their successes, however, these two theories had some associated problems. Apparent Source Theory created some apparent paradoxes and contradictions. The most serious problem was its contradiction with the phenomenon of stellar aberration. The universally accepted explanation of stellar aberration is that the apparent change of position of the light source is in the direction of the observer's velocity. Apparent Source Theory could not be successfully reconciled with this view.

These two theories are highly successful *models* for the speed of light and hence can correctly predict and explain the outcome of experiments. However, there was another important problem with these theories and this was lack of physical explanation.What is the physical meaning of apparent change in source position relative to the co-moving observer ? What is the physical meaning of change of wavelength for an observer moving relative to a light source ?

Another problem was that these two theories seemed to be separate or unrelated and I was not comfortable with this.

In this paper, a new insight that can solve almost all known light speed experiments and solve the above mentioned problems of Apparent Source Theory and Exponential Doppler Effect theory.

The new theory proposed in this paper has been called Apparent Source Transformation. It is the evolution of the two previous theories and effectively unites the two theories into one.

Absolute motion versus ether

One of the pitfalls in the development of physics of the last century turns out to be the presumption that absolute motion is necessarily motion relative to the ether. This has been a universally accepted view both among the proponents and opponents of ether theory. Opponents of ether theory cite the Michelson-Morley experiment as a strong evidence and as an assurance that absolute motion doesn't exist. Since the experiment failed to detect the ether, they, by default, concluded that absolute motion doesn't exist. The words absolute motion and ether are almost synonyms in physics. Critically, however, the Michelson-Morley experiment disproved the ether and not necessarily absolute motion. Many later experiments such as the Silvertooth and the Marinov experiments have clearly established the existence of absolute motion.

Therefore, as I have already proposed[1], the ether doesn't exist but absolute motion does exist. The question follows: if the ether doesn't exist, then what is absolute motion relative to? I speculated in [1] that absolute motion can be motion relative to all massive objects in the universe. But how does motion of a body relative to other bodies create absolute motion of that body, i.e. what is the mechanism? This seemed incomprehensible. Could absolute velocity be motion relative to space itself and not relative to other massive objects? Could it be that space is neither filled by ether nor 'emptiness' or ' nothingness' as we think, but could have some special properties: for example, create apparent change of source position relative to a co-moving observer (Apparent Source Theory), have definite permittivity and permeability? Pondering the last questions did not actually solve them, but led to another question: but how can we explain the apparent change in source position relative to a co-moving observer? This quest led to the revelation of the crucial insight that space apparently contracts or expands for absolutely moving observer. The apparent change in position of a light source as seen by co-moving observer is due to an apparent expansion or contraction of space relative to an absolutely moving observer/detector.

In this paper, I will not attempt to explain *what* absolute motion *is*. Rather I will present a new theory called Apparent Source Transformation that explains the *effect* of absolute motion.

Before presenting Apparent Source Transformation, we will review Apparent Source Theory and Exponential Doppler Effect theory.

Apparent Source Theory

Apparent Source Theory is formulated as follows:

The effect of absolute motion for absolutely co-moving light source and observer is to create an apparent change in position of the light source as seen by the observer, i.e. as seen from point of observation.. Therefore, the effect of absolute motion of the Michelson-Morley(MM) experiment is to create an apparent change in position of the light source as seen by the detector/observer.

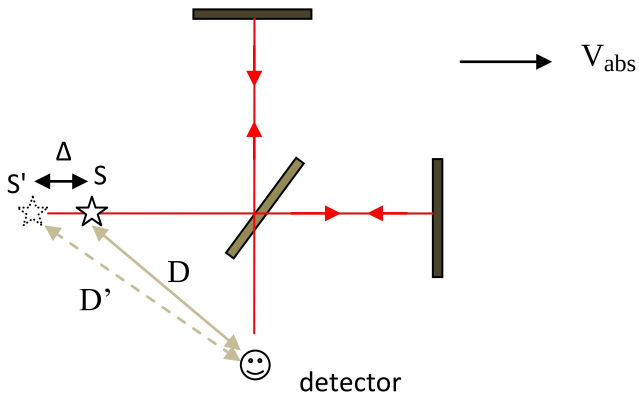
The procedure of analysis of the MM experiment is:

1. Replace the real light source by an apparent source. The apparent change in position of the source is determined by the direct source-observer distance, the magnitude and direction of the absolute velocity and the orientation of the source-observer line with respect to the direction of absolute velocity.

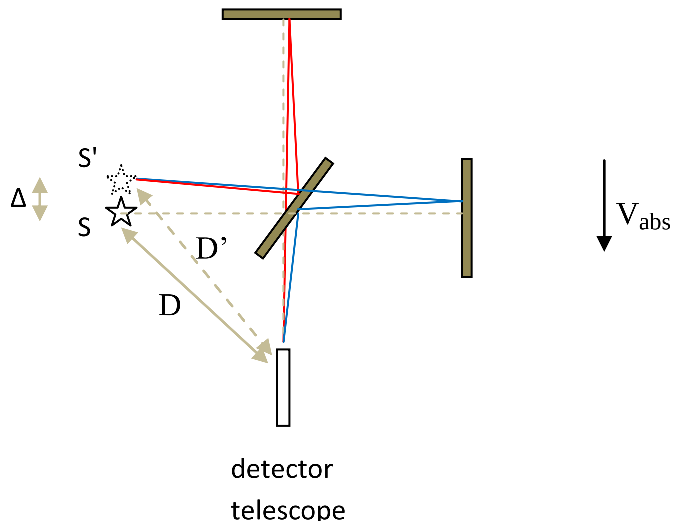
2. Analyze the experiment by assuming that the speed of light is constant relative to the apparent source.

Therefore, for the Michelson-Morley (MM) experiment, the effect of *apparent* change in source position is the same as *actually*/*physically* shifting the source to the same position. One distinction of AST is that there will be apparent change in position of the *light source only* and all other parts of the MM apparatus (the mirrors, the beam splitter,) are assumed to be at their actual/physical position, to analyze the experiment.

It can be easily explained intuitively why the MM experiment gave only a small fringe shift. Suppose that the MM apparatus is absolutely moving to the right, which will create apparent shift of the source position to the left as shown below. Obviously, apparent or physical/actual shift of the source backwards, for example, will not create any fringe shift at all because both the longitudinal and transverse beams will be affected identically: both will be delayed by the same amount.



If the absolute velocity is directed downwards, there will be an apparent shift of source position upwards, as shown below. In this case, there may be a small fringe shift because the longitudinal and lateral (virtual) light beams will follow different paths to meet at the detector, as shown below. This explains the small fringe shifts that were always observed in the Miller experiments.



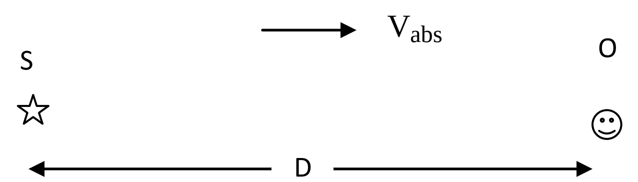
We have seen qualitative description of Apparent Source Theory.In the next section we will see the quantitative determination of the apparent change in position of the light source relative to the observer.

Quantitative determination of apparent source position relative to the observer

We restate Apparent Source Theory as follows:

The effect of absolute motion for co-moving light source and observer is to create an apparent change in the position (distance and direction) of the light source relative to the observer.

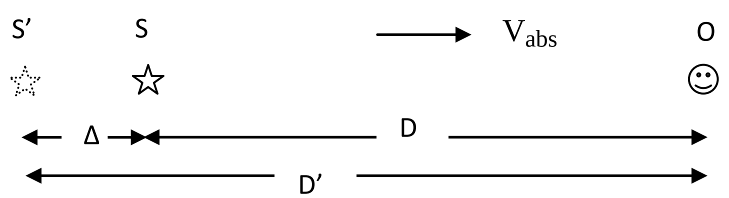
Imagine a light source S and an observer O, both at (absolute) rest, i.e. $V_{abs} = 0$.



A light pulse emitted by S will be detected after a time delay of

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

Now suppose that the light source and the observer are absolutely co-moving to the right.



The new interpretation proposed here is that the position of the source S changes apparently to S', *as seen by the observer, relative to the observer*.

During the time (t_d) that the source 'moves' from point S' to point S, the light pulse moves from point S' to point O, i.e. the time taken for the source to move from point S' to point S is equal to the time taken for the light pulse to move from point S' to point O.

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

But

$$D + \Delta = D'$$

From the above two equations:

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

and

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

The effect of absolute motion is thus to create an apparent change of position of the light source relative to the observer, in this case by amount Δ .

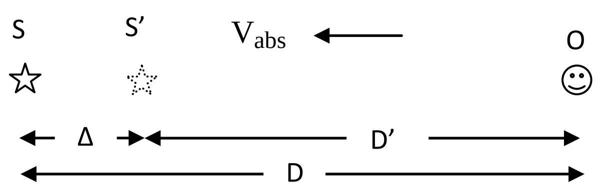
Once we have determined the apparent position of the source as seen by the co-moving observer, we can analyze the experiment by assuming that light was emitted from S' (not from S) and that the speed of light is constant relative to the apparent source.

Therefore, a light pulse emitted by the source is detected at the observer after a time delay of:

$$t_d = \frac{D'}{c} = \frac{D\frac{c}{c - V_{abs}}}{c} = \frac{D}{c - V_{abs}}$$

To the observer, the source S appears to be farther away than it physically is.

In the same way, for absolute velocity directed to the left:



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

From which

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

and

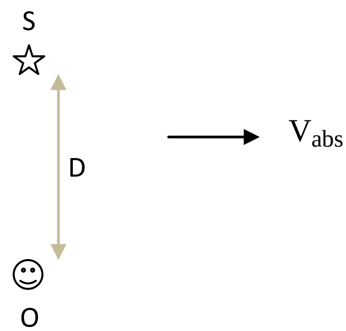
$$\Delta = D\frac{V_{abs}}{c + V_{abs}}$$

In this case, it appears to the observer that the source is nearer than it actually is by amount Δ.

Once we have determined the apparent position (S') of the source as seen by the co-moving observer, we can determine the time delay t_d. Therefore, a light pulse emitted by the source is detected at the observer after a time delay of:

$$t_d = \frac{D'}{c} = \frac{D\frac{c}{c + V_{abs}}}{c} = \frac{D}{c + V_{abs}}$$

Now imagine a light source S and an observer O as shown below, with the relative position of S and O orthogonal to the direction of their common absolute velocity.



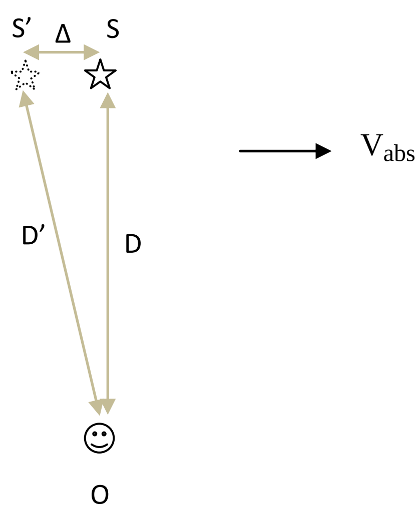
S and O are moving to the right with common absolute velocity V_{abs}.

If V_{abs} is zero, a light pulse emitted from S will be received by O after a time delay t_d

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

In this case, light arrives at the observer from the direction of the source, S.

If V_{abs} is not zero, then the source position appears to have shifted to the left as seen by the observer O.



In this case also, the effect of absolute velocity is to create an apparent change in the *position* (distance and direction) of the light source relative to the observer.

In the same way as explained previously,

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

i.e. during the time interval that the light pulse goes from S' to O, the source goes from S' to S.

But,

$$D^2 + \Delta^2 = D'^2$$

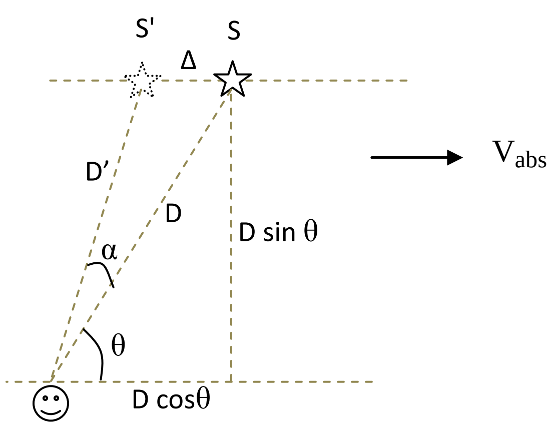
From the above two equations

$$D' = D\frac{c}{\sqrt{c^2 - {V_{abs}}^2}} \text{ and } \quad \Delta = D\frac{V_{abs}}{\sqrt{c^2 - {V_{abs}}^2}}$$

Therefore, the time delay t_d between emission and reception of the light pulse in this case will be

$$t_d = \frac{D'}{c} = \frac{D}{\sqrt{c^2 - {V_{abs}}^2}}$$

For a more general case of co-moving source and observer relative positions with respect to the direction of absolute velocity, the situation will be as follows.



We want to get the relationship between θ and Δ .

$$\frac{D'}{c} = \frac{\Delta}{V_{abs}} \qquad (1)$$

$$\Delta = D cos\theta - \sqrt{D'^2 - D^2 sin^2\theta} \qquad (2)$$

From (1) and (2)

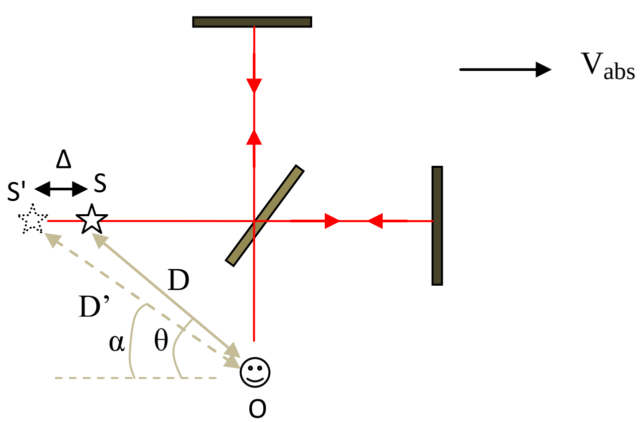
$$D'^2\left(1-\frac{V_{abs}{}^2}{c^2}\right)+\frac{2DV_{abs}}{c}\,cos\theta\;\;D'\;-\;D^2=0$$

which is a quadratic equation from which D' can be determined, which in turn enables the determination of Δ and α.

Quantitative analysis of the Michelson-Morley experiment

To analyze the Michelson-Morley experiment quantitatively, therefore, we must first determine the apparent position of the light source as seen by the detector, according to the procedures described in the last section.

It is crucial to note that the determination of the apparent position of the light source is determined only by the actual/physical position (distance and direction) of the source relative to the observer, the magnitude and direction of the absolute velocity. According to AST, the presence or absence or the position of all other parts of the MM apparatus (the beam splitter, the mirrors, and other parts) are irrelevant in the determination of the apparent position of the source.



Therefore, we determine the apparent position of the source as follows, as described in the last section.

During the time interval that the source 'moves' from S' to S, the light moves from S' to O . Therefore, the apparent source position , D' and α , can be determined from the following equations.

$$\frac{D'}{c} = \frac{\Delta}{V_{abs}} \qquad (1)$$

$$\Delta = \sqrt{D'^2 - D^2 sin^2\theta} \; - \; Dcos\theta \qquad (2)$$

$$sin\alpha = \frac{D \sin\theta}{D'} \qquad (3)$$

Once the apparent position of the source is determined, the paths of the two light beams can be determined from optics, which is simply a problem of geometry, from which the difference in path lengths and fringe shift can be determined.

Exponential Doppler Effect of light

We know that the classical law cannot explain the Ives-Stilwell experiments. Since it is based on the ether concept, it predicts variable phase velocity. Since we have postulated that the phase velocity of light is always constant, there is a need for a new theory for the law governing Doppler effect of light, as an alternative to Special Relativity Theory.

The new law should fulfill two criteria:

1. $f'\lambda' = f\lambda = c$

2. It should explain the Ives-Stilwell experiment.

I have already proposed a new exponential law governing the Doppler effect of light as follows:

$$f' = f\, e^{\frac{V}{c}} \qquad and \qquad \lambda' = \lambda\, e^{\frac{-V}{c}}$$

where e is Euler's constant and V is positive for source and observer approaching each other.

We will show that this law fulfills the above two criteria.

$$f'\lambda' = f\, e^{\frac{V}{c}}\, \lambda\, e^{\frac{-V}{c}} = f\,\lambda = c$$

Now let us apply the new formula to explain the red shift in the Ives Stilwell experiment.

Doppler shift for approaching ion:

$$\lambda_A{}' = \lambda\, e^{\frac{-V}{c}}$$

Doppler shift for receding ion:

$$\lambda_R{}' = \lambda\, e^{\frac{V}{c}}$$

By applying

$$e^x = 1 + x + \frac{1}{2}x^2 + \frac{1}{6}x^3 \ + . . . \quad (for - < x < \infty$$

Average wavelength

$$\Lambda = \frac{1}{2}\left(\lambda_A{}' + \lambda_R{}'\right) = \frac{1}{2}\ (\lambda e^{\frac{-V}{c}} + \lambda e^{\frac{V}{c}}\ )$$

$$\Lambda = \frac{1}{2}\lambda\ (\ 1 - \frac{V}{c} + \frac{1}{2}\frac{V^2}{c^2} + \ . . . \quad + \ 1 \ + \frac{V}{c} + \ \frac{1}{2}\frac{V^2}{c^2} + \ . . .)$$

$$\Lambda \ \cong \frac{1}{2}\lambda\left(\ 1 - \frac{V}{c} + \frac{1}{2}\frac{V^2}{c^2} + \ 1 \ + \frac{V}{c} + \ \frac{1}{2}\frac{V^2}{c^2}\right) \ , \ for \ V \ll c$$

$$\Lambda \ \cong \lambda\left(\ 1 + \frac{1}{2}\frac{V^2}{c^2}\right)$$

$$\Delta\lambda = \ \Lambda - \ \lambda \ = \ \lambda\left(\ 1 + \frac{1}{2}\frac{V^2}{c^2}\right) - \ \lambda$$

$$\Delta\lambda = \ \frac{1}{2}\frac{V^2}{c^2}\ \lambda \ = \frac{1}{2}\beta^2\, \lambda$$

This is exactly the value predicted by SRT and confirmed by the Ives Stilwell experiment.

For V << c , it can be shown that the exponential formula reduces to the classical one.

$$f' = f\, e^{\frac{V}{c}} \ = \ f \ \left(1 + \frac{V}{c} + \frac{1}{2}\frac{V^2}{c^2} + \ . . . \ \right) \cong \ f \ \left(\ 1 + \frac{V}{c}\right) = f\ \frac{c + V}{c} \ \cong \ \frac{c}{c - V} \ , \qquad for\, V \ \ll c$$

Problems associated with Apparent Source Theory and Exponential Doppler Effect of light

The two theories presented in the last sections, Apparent Source Theory and Exponential Doppler Effect, were already proposed in my other papers[1]. However, even though both theories were successful models, both suffered from lack of physical explanation.

In the case of Apparent Source Theory, a procedure to analyze the Michelson-Morley experiment (and other light speed experiments) was proposed as:

1. Replace the real light source with an apparent source. The apparent change in position of the source is determined by the *direct* source-observer distance, the magnitude and direction of the absolute velocity and the orientation of source-observer line with respect to the direction of absolute velocity.

2. Analyze the experiment by assuming that light was emitted from the apparent position of the source and that the speed of light is constant relative to the apparent source.

This model successfully explained the 'null' result of the Michelson-Morley and many other light speed experiments[1]. However, this procedure does not explain intuitively what apparent change of source position meant physically. Therefore, there was lack of physical meaning.

Exponential Doppler Effect (EDE) theory also explains the constancy of the phase velocity of light and the Ives-Stilwell experiments. According to EDE theory, not only frequency, but also wavelength changes relative to a moving observer. Again, EDE provided the correct model to explain the outcome of experiments but doesn't provide physical meaning.

Recently I also found that Apparent Source Theory is in contradiction with current understanding of the well known phenomenon of stellar aberration. Whereas the universally accepted theory of stellar aberration states that the position of a star will be apparently shifted in the same direction as the observer's velocity, Apparent Source Theory predicts just the opposite: the position of the star will change apparently from its true position in the direction opposite to observer's velocity. This was a serious problem.

Apparent Source Transformation(AST)

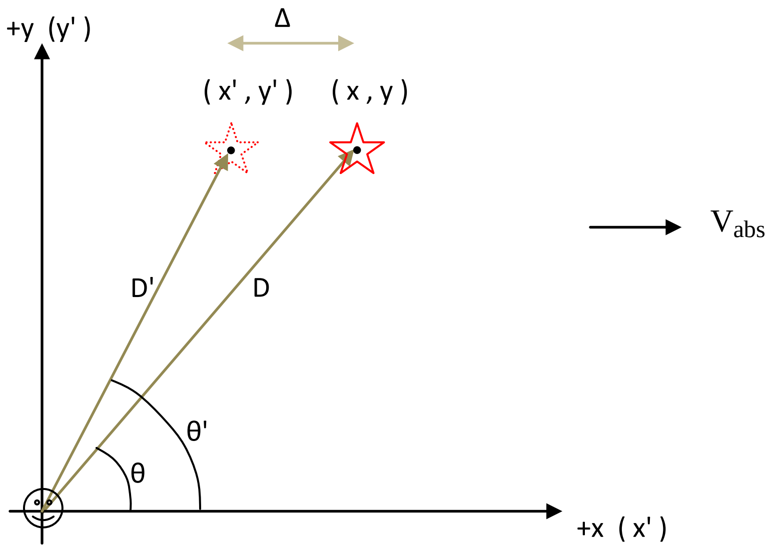
Although Apparent Source Theory and Exponential Doppler Effect theories of light were highly successful in explaining many light speed experiments, the physical meaning of both theories was not clear, as explained above. The new physical explanation proposed here is that apparent change in position of the light source can be explained by *contraction or expansion of space* as seen by the absolutely moving observer. Exponential Doppler Effect theory predicts , unconventionally, not only change in frequency but also change in wavelength of light for an observer moving relative to a light source. This is also physically not clear if we think of space as fixed. The new insight is that it is expansion and contraction of space itself as seen by an absolutely moving observer that creates change in wavelength of light.

We propose here a new law of transformation of space only *as seen by an absolutely moving observer*. In Special Relativity Theory (SRT) and Lorentz Contraction (LC), space or length of a 'moving' frame is contracted in the direction of motion *as seen by the 'stationary' observer*. In both SRT and LC, space or length only contracts with velocity, whereas in AST space contracts in front of an absolutely moving observer and expands behind the absolutely moving observer, as seen by the same absolutely moving observer. All observers see their own space, which is affected with their own velocity.

Next we will use Apparent Source Theory to derive the transformation law of space.

Consider an observer at the origin of an inertial reference frame moving with absolute velocity V_{abs} in the +x direction and a light source that is at absolute rest and at a point (x, y) if the observer was at rest. If the observer accelerates instantaneously from rest and starts moving with absolute velocity V_{abs} to the right, the location of the source will also jump instantaneously from (x, y) to (x', y') in the observer's reference frame.

We derive the space transformation equation for the absolutely moving observer based on the Exponential Doppler Effect theory.



As already stated, the frequency and wave length of a stationary light source as observed by an observer directly moving towards the source is:

$$f' = f\, e^{\frac{V_{abs}}{c}} \qquad and \qquad \lambda' = \lambda\, e^{\frac{-V_{abs}}{c}}$$

If the observer is moving towards the light source at an angle:

$$f' = f\, e^{\frac{V_{abs}\cos\theta'}{c}} \qquad and \qquad \lambda' = \lambda\, e^{\frac{-V_{abs}\cos\theta'}{c}}$$

From which

$$\frac{\lambda'}{\lambda} = e^{\frac{-V_{abs}\cos\theta'}{c}}$$

But

$$\frac{D'}{D} = \frac{\lambda'}{\lambda} = e^{\frac{-V_{abs}\cos\theta'}{c}}$$

From which,

$$D' = De^{\frac{-V_{abs}\cos\theta'}{c}}$$

Space compresses/expands only in the direction of absolute velocity and since the absolute velocity of the observer is parallel to the x'-axis,

$$y' = y$$

$$\Longrightarrow\ D'\sin\theta' = D\sin\theta$$

$$\Longrightarrow\ D' = D\,\frac{\sin\theta}{\sin\theta'}$$

$$\Longrightarrow\ De^{\frac{-V_{abs}\cos\theta'}{c}} = D\,\frac{\sin\theta}{\sin\theta'}$$

$$\Longrightarrow\ e^{\frac{-V_{abs}\cos\theta'}{c}} = \frac{\sin\theta}{\sin\theta'}$$

$$\Longrightarrow \ln\left(e^{\frac{-V_{abs}\cos\theta'}{c}}\right) = \ln\left(\frac{\sin\theta}{\sin\theta'}\right)$$

$$\Longrightarrow\ \frac{-V_{abs}\cos\theta'}{c} = \ln\left(\frac{\sin\theta}{\sin\theta'}\right)$$

But

$$\cos\theta' = \frac{x'}{\sqrt{x'^2+y'^2}} \qquad and \qquad \sin\theta' = \frac{y'}{\sqrt{x'^2+y'^2}} \qquad and \quad \sin\theta = \frac{y}{\sqrt{x^2+y^2}}$$

Therefore,

$$\Rightarrow \frac{-V_{abs}\cos\theta'}{c} = \ln\left(\frac{\sin\theta}{\sin\theta'}\right)$$

$$\Rightarrow \frac{-V_{abs}\frac{x'}{\sqrt{x'^2+y'^2}}}{c} = \ln\left(\frac{y}{y'}\frac{\sqrt{x'^2+y'^2}}{\sqrt{x^2+y^2}}\right)$$

Since y' = y ,

$$\Rightarrow \frac{-V_{abs}\frac{x'}{\sqrt{x'^2+y^2}}}{c} = \ln\left(\frac{\sqrt{x'^2+y^2}}{\sqrt{x^2+y^2}}\right)$$

The value of x' can be obtained from the above equation.

The Apparent Source Transformation of space is summarized as follows.

$$\frac{-V_{abs}\frac{x'}{\sqrt{x'^2+y^2}}}{c} = \ln\left(\frac{\sqrt{x'^2+y^2}}{\sqrt{x^2+y^2}}\right)$$

$$y' = y$$

$$z' = z$$

$$t' = t$$

Since space expands and contracts according to an exponential law, as implied by the new Exponential Doppler Effect theory, we have to review and modify our analyses in previous sections.

In previous sections, for example we used such formulas as,

$$D' = D\,\frac{c}{c \pm V_{abs}}$$

This should be modified as:

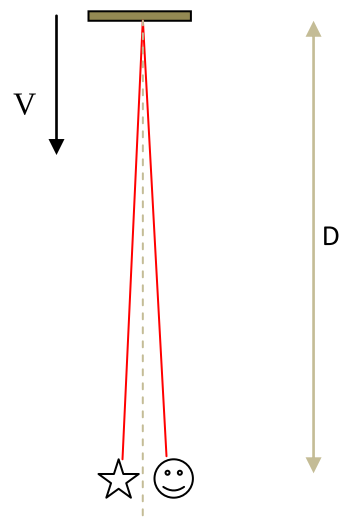
$$D' = D\, e^{\frac{\pm V_{abs}}{c}}$$

However , for $V_{abs} << c$, the two expressions give almost equal values.

Velocity of light relative to an observer at absolute rest

According to Apparent Source Transformation, the speed of light (both phase velocity and group velocity) is constant *c* relative to an observer at absolute rest, independent of source motion. However, the group velocity of light varies with mirror velocity. The phase velocity of light in vacuum is an absolute constant *c* , irrespective of motion of the source, the observer and the mirror.

Consider a light source and an observer at rest located close to each other as shown below. Assume that a mirror is moving directly towards the observer so that light reflects back on itself to the observer.



Obviously, for mirror not moving relative to the observer and the light source, the time delay t_d between emission and detection of light is:

$$t_d = \frac{2D}{c}$$

If the mirror is moving towards the observer with velocity V, then the distance D is continuously changing. The group velocity of light after reflection is c + 2V .(For a mirror moving away from the observer, the group velocity of light after reflection is c - 2V) .

The group delay is, therefore,

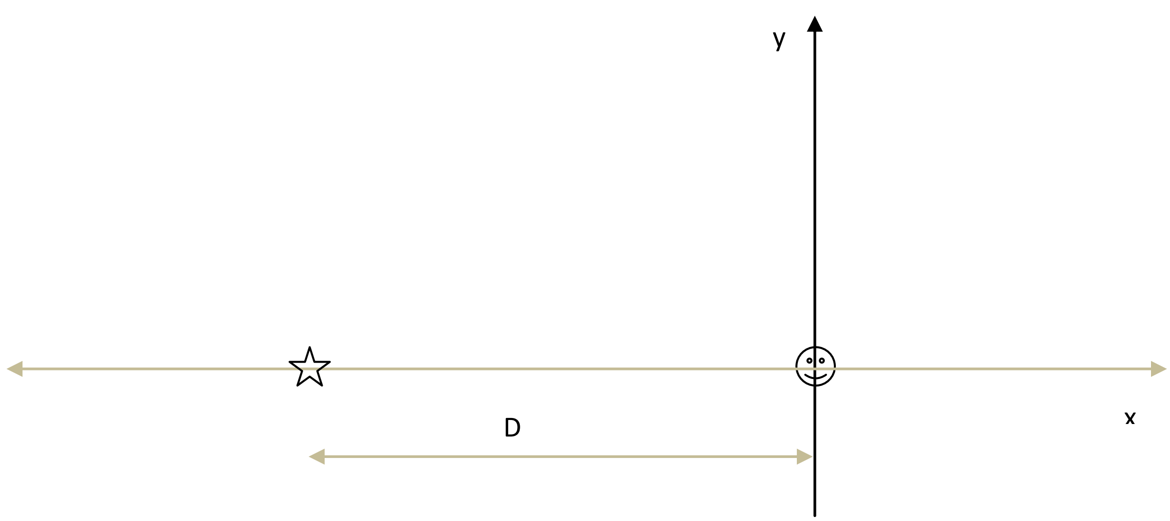
$$t_d = \frac{D}{c} + \frac{D}{c+2V} = \frac{2D}{c}\frac{c+V}{c+2V}$$

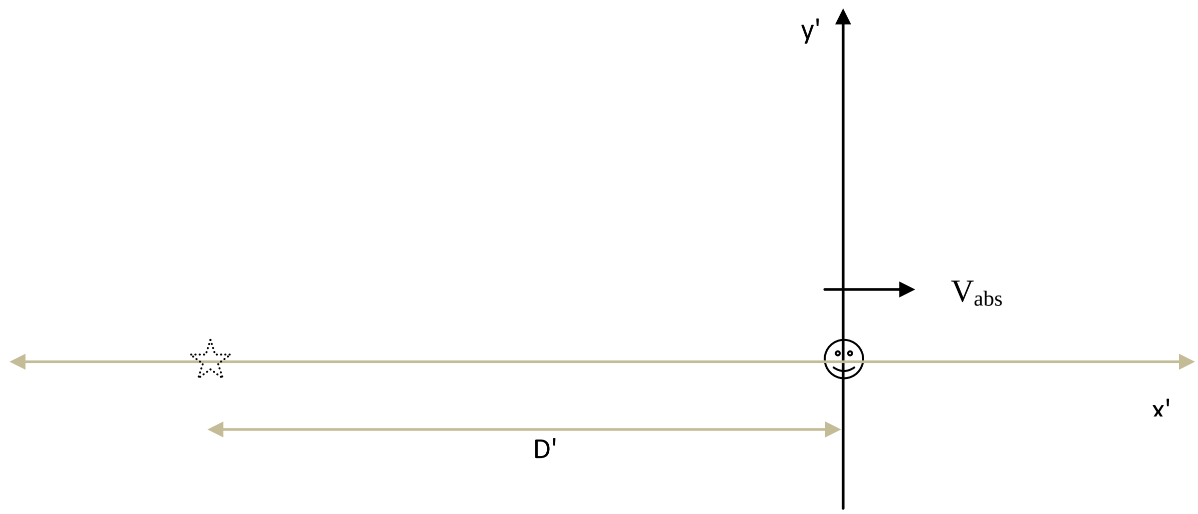
where D is the distance of the mirror at the instance of reflection.

Moving observer experiments

The distinction of Apparent Source Transformation (AST) becomes evident when an observer is in absolute motion. AST states that the speed of light (both phase velocity and group velocity) is constant *c* irrespective of absolute motion of the observer. Special Relativity Theory (SRT) makes the same claim, but since it denies absolute motion, it modifies not only space but also time so that absolute motion is not detectable. AST postulates absolute motion and absolute time and constancy of the speed of light for absolutely moving observer. AST accepts detection of absolute motion of an observer which will result in change in time delay of light detection, but it attributes this change in time delay to change in space and not to change in speed of light. Therefore, AST is able to incorporate the unconventional and beautiful ideas of Einstein's constancy of the speed of light for a moving observer by postulating contraction and expansion of space, without introducing any paradoxes. AST assumes universal time and absolute motion. Einstein proposed one of the greatest ideas in physics: the constancy of the speed of light for a moving observer and the contraction of space; but he spoiled the beauty of his theory when he introduced relativity of time so that absolute motion is not detectable, and this has led to paradoxes. He paid the price of relativity of time just to deny absolute motion.

Consider a light source that is at absolute rest and an observer that is moving with absolute velocity V_{abs} directly away from the source.





Imagine that initially the observer was at absolute rest and at distance D from the source just before emission of light, and then starts moving with absolute velocity V_{abs} to the right instantaneously. AST states that, in the reference frame of the absolutely moving observer, light was emitted not from x = - D , but from x = - D', where

$$D' = D\, e^{\frac{V_{abs}}{c}}$$

Therefore, the time taken for light to catch up with the observer will be:

$$t_d = \frac{D'}{c} = \frac{D\, e^{\frac{V_{abs}}{c}}}{c}$$

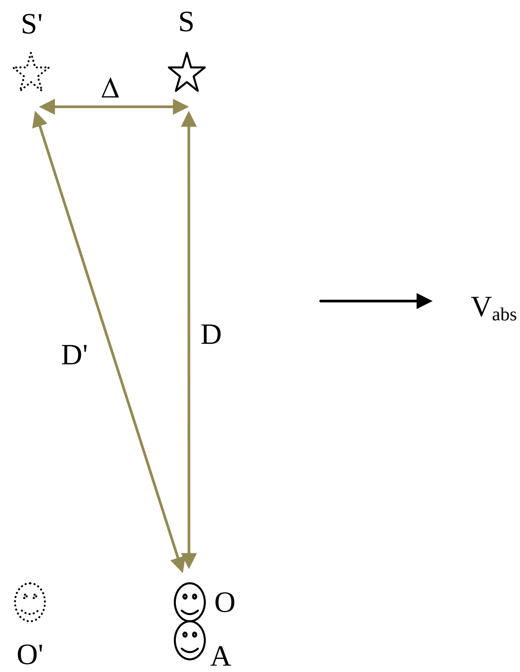
Note again that we have assumed that the speed of light relative to the moving observer is still *c* , regardless of motion of the observer, and not c - V_{abs} .

Therefore, AST postulates that there will be an additional time delay for light to catch up with an observer moving away from a light source, as compared to an observer at rest, but this additional delay is not because the velocity of light has decreased relative to the observer, *but because space behind the observer has expanded !*

Stellar aberration

As I mentioned already, one of the most difficult problems I faced regarding the original theory, Apparent Source Theory, i.e. before it evolved into Apparent Source Transformation, was its contradiction with the well known phenomenon of stellar aberration.

Imagine absolutely co-moving light source S and observer O. Assume also another observer A who is at absolute rest.

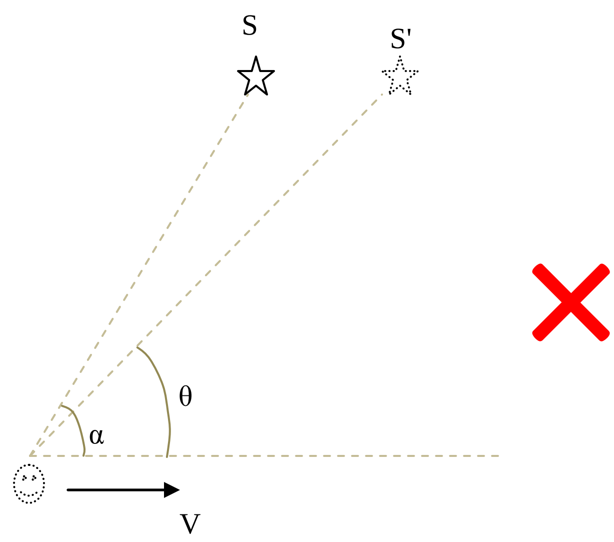


Assume that the source emits light at the instant when it is at position S' and the co-moving observer is at position O'. The observer A is always at absolute rest at point A. Assume that moving observer O detects the light just at the instant that he/she is passing through the location of stationary observer A. According to Apparent Source Theory, the co-moving observer O has to point his telescope towards point S' to see the light, due to apparent change in position of the light source for absolutely co-moving source and observer[1]. Since moving observer O and stationary observer A are at the same point at the instant of light detection, observer A will also detect the light at that instant. However, we know that observer A should also point his telescope in the direction of S', the point in space where light was emitted. We see that both the stationary observer and the moving observer have to point their telescopes in the same direction to see the light, although they are moving relative to each other. But according to the theory of stellar aberration,observer O should point his telescope towards S, and not towards S'.

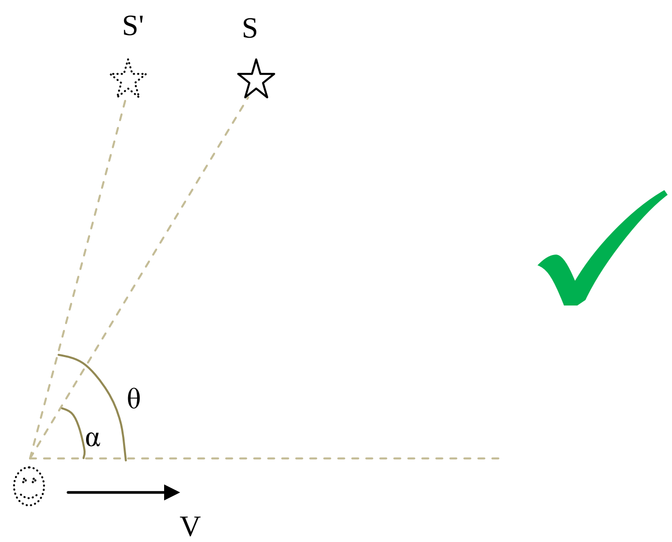
This puzzle has been solved after I gained the crucial insight of space contraction and expansion. One of the profound consequences of Apparent Source Transformation (AST) is that it changes current understanding of the phenomenon of stellar aberration, in totally unexpected way.

According to conventional, universally accepted knowledge, the apparent change in position of a star relative to a moving observer is towards the direction of motion. AST reveals that the apparent position of the star is opposite to the direction of observer velocity!!!

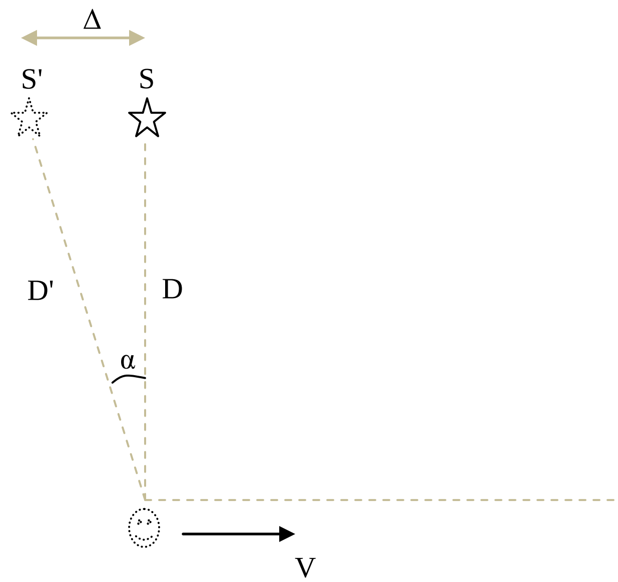
The phenomenon of stellar aberration is due to contraction (expansion) of space in front of (behind) an absolutely moving observer !!!



stellar aberration



The quantitative expression of the angle of aberration for a star directly overhead is determined as follows.



Using previous results based on Apparent Source Theory:

$$D' = D\frac{c}{\sqrt{c^2 - {V_{abs}}^2}} \text{ and } \quad \Delta = D\frac{V_{abs}}{\sqrt{c^2 - {V_{abs}}^2}}$$

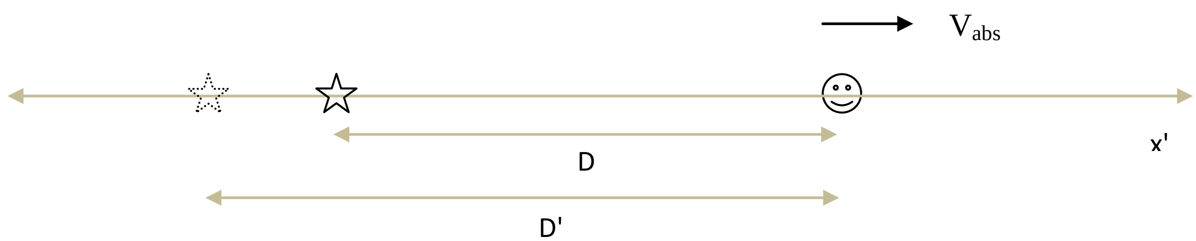
$$\sin\alpha = \frac{\Delta}{D'} = \frac{D\frac{V_{abs}}{\sqrt{c^2 - {V_{abs}}^2}}}{D\frac{c}{\sqrt{c^2 - {V_{abs}}^2}}} = \frac{V_{abs}}{c}$$

which agrees with the conventional and experimentally confirmed formula.

Conventional vs. exponential formulas

The conventional formula approximates the exact, exponential formula for observer absolute velocities much less than the speed of light. So it can be used to analyze many conventional experiments since the absolute velocities involved are much less than the speed of light.

However, conventional formulas lead to erroneous results and conclusions for absolute velocities comparable to the speed of light. For example, consider a light source that is at absolute rest and an observer that was at rest just before emission of light and, just after emission, starts moving away from the source with absolute velocity almost the same as the speed of light. Imagine that the distance between the source and the observer just before emission of light is D.



The question is : after what time delay will light catch up with the observer ? According to my previous assumptions[1], the group velocity of light relative to the observer would be V= c - V_{abs} , and since V_{abs} = c in this case, V = c - V_{abs} = c - c = 0 , so the light will never catch up with the observer.

$$t_d = \frac{D}{c - V_{abs}} = \frac{D}{c - c} = \frac{D}{0} = \infty$$

If we use the new exponential formula of expansion of space behind the absolutely moving observer and the postulate that the speed of light is always constant c irrespective of observer's absolute velocity:

$$t_d = \frac{De^{\frac{V_{abs}}{c}}}{c} = \frac{De^{\frac{c}{c}}}{c} = \frac{De}{c} \cong 2.7183\ \frac{D}{c}$$

This is a drastically different result from the above. In this case, the light will catch up with the observer only after about 2.7183 times the time it would take if the observer was not moving.

The Sagnac effect

Unlike the uniformly moving Michelson-Morley, Silvertooth, Marinov and other experiments that can be analyzed relatively easily by the procedure of Apparent Source Theory, the analysis of Sagnac effect was challenging.

In the case of experiments of absolute translational motion, such as the Michelson-Morley experiment, the procedure of analysis is restated as follows:

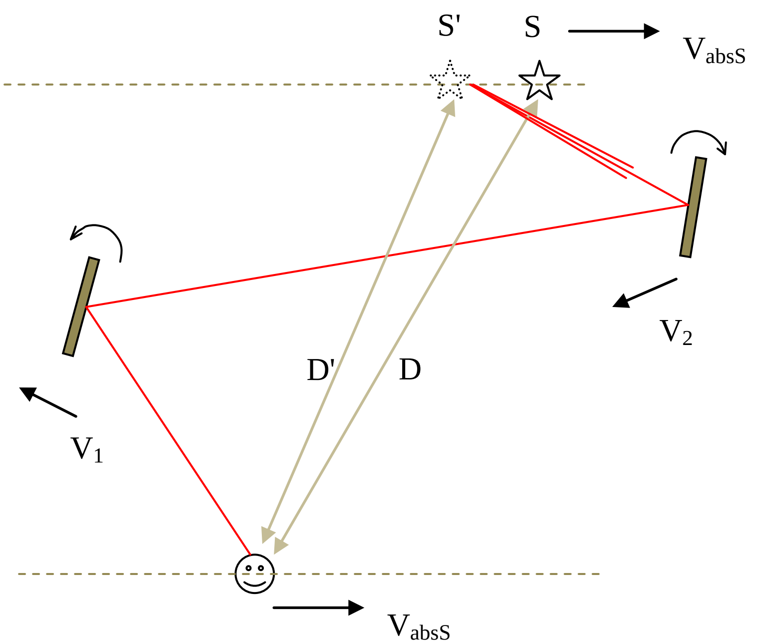
1. Replace the real light source with an apparent source. The apparent change in position of the source is determined by the direct source observer distance, the magnitude and direction of the absolute velocity and the orientation of source-observer line with respect to the direction of absolute velocity.

2. Analyze the experiment by assuming that light was emitted from apparent source position and that the speed of light is constant relative to the apparent source.

Only the light source is assumed to undergo apparent change of position due to absolute motion and all other parts of the apparatus (the beam splitter, the mirrors, e.t.c.,) are assumed to be at their actual/physical position, to analyze the Michelson-Morley experiment.

However, the analysis of the Sagnac effect is not as easy because the light source, the detector, the beam splitter and the mirrors are all in accelerated motions. Therefore, the Sagnac effect requires a general principle of analysis for arbitrary motions.

Consider absolutely co-moving light source and observer, and mirrors rotating and moving relative to the source and the observer.



Assume the source emits a very short light pulse just at time t = 0. The problem is to determine the time delay of light before it is detected by the observer. This is a complicated problem compared to the Michelson-Morley (MM) experiment in which the light source, the detector, the beam splitter and the mirrors are all at rest relative to each other.

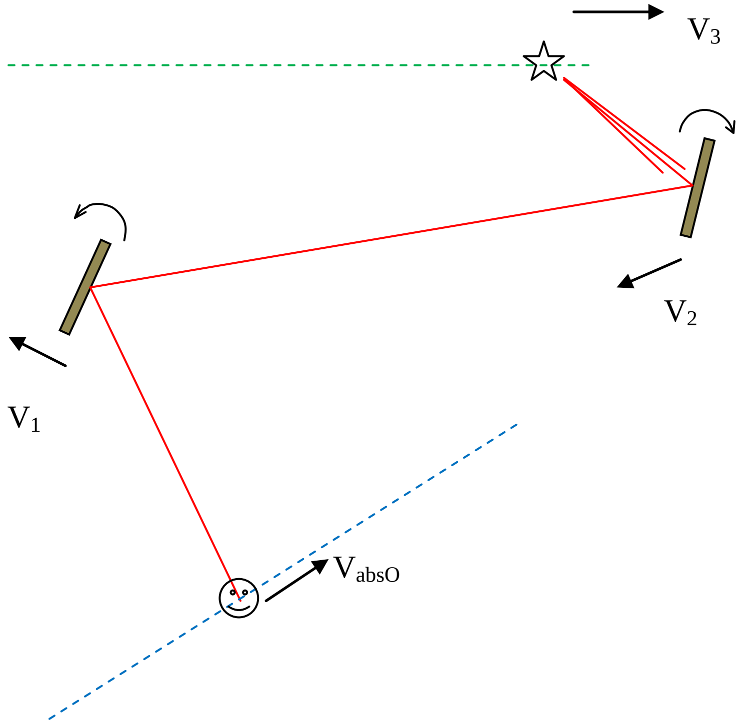
But the last statement assumes that the observer will detect that light pulse. However, if we assume that the beam width is infinitely small, the observer will detect the light pulse only if the positions (both linear and angular) and motions (both linear and angular) of the mirrors is such that the light beam will pass through the location of the observer. However, in practice, light sources emit light with finite beam width, as shown in the figure above. For any given linear and angular position and state of motion (translation and rotation) of the mirrors, in principle it is possible to determine the time delay between emission and detection and the total path length of the light pulse, although this will be a complicated problem.

For this, since the co-moving source and the observer are in absolute motion, the apparent position of the source relative to the observer should be determined first. This can also be interpreted as contraction of space relative to the observer in this case. Once the apparent position of the source is known, the path of the light pulse can be predetermined for known positions and motions of the mirrors, which is a classical optics problem but more complicated one.

The analysis of the above experiment was based on Apparent Source Theory. But the apparent change in position of the source relative to the observer can be/should be seen as contraction of space relative to the absolutely moving observer.

But what if the source and the observer are not co-moving, i.e. if they have different absolute velocities, in which case they will also be moving relative to each other? Therefore, the more general problem is if the absolute velocities of the source, the mirrors and the observer are not uniform (continuously changes magnitude and direction), with all parts (the light source, the mirrors, the observer) having independent motions.

At first let us consider the case of observer and source in relative motion. We assume that the light source and the mirrors are moving in the observer's reference frame.



We will apply Apparent Source Transformation (AST).

According to AST:

1. An *inertial* observer's reference frame is always the preferred reference frame. The observer is the human or device directly detecting the light. The problems of the speed of light should be analyzed only from the perspective of the light detector (whether this is a human being or a device).
2. The speed of light coming directly from a light source is constant *c* relative to the inertial observer, irrespective of observer's absolute velocity. However, the group velocity of light varies with mirror velocity.
3. Space contracts (expands) in front of (behind) an absolutely moving observer. However, this contraction and expansion of space applies only to the position of light sources (and to all sources of electromagnetic and gravitational fields and waves)

The procedure of analysis of this problem is as follows:

1. Define the physical positions and motions of the light source and mirrors (and beam splitters) in the reference frame of the inertial observer.

2. Then determine the *apparent past position* of the source (i.e. the apparent position of the source at the instant of light emission) in the observer's reference frame. We cannot use the

actual point of emission (i.e. the actual point where the source was at the instant of emission). We should use the apparent past position of the source. Apply Apparent Source Transformation to determine the apparent past position of the source, by using the actual position of the source, the absolute velocity of the observer in the Apparent Source Transformation equation. We can also put a source at the actual point of emission and apply Apparent Source Theory.

3. Create an (x',y') coordinate with the inertial observer at the origin and with the x'-axis parallel with the observer's absolute velocity vector.To determine the apparent past position of the source in the absolutely moving observer's reference frame (x',y'), draw a straight line parallel to the observer's absolute velocity vector ($\mathbf{V}_{\mathbf{absO}}$) through the point where the source is located.

4. Apply Apparent Source Transformation to determine the apparent past position of the source (the apparent point of light emission, not actual point of emission).

$$\frac{-V_{abs}\frac{x'}{\sqrt{x'^2+y^2}}}{c} = \ln\left(\frac{\sqrt{x'^2+y^2}}{\sqrt{x^2+y^2}}\right)$$

$$y' = y$$

$$z' = z$$

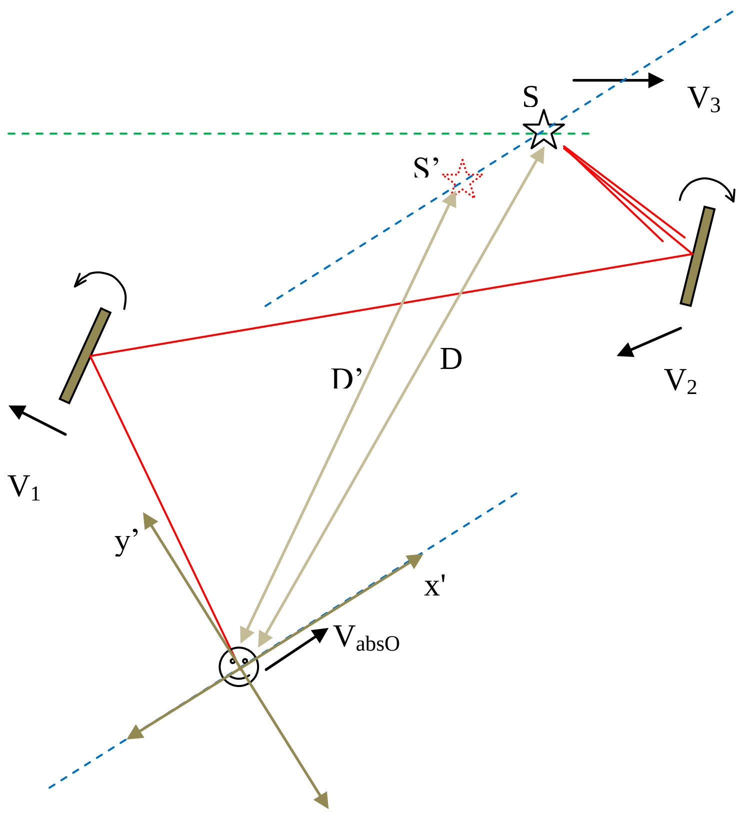
$$t' = t$$

5. Once the apparent past position (apparent point of emission) of the source is determined in the observer's frame, we imagine a light source fixed at the apparent point of emission and simply use emission (ballistic) theory according to which the velocity of light is constant relative to the source and varies with mirror velocity. Emission theory is wrong for a moving source, but correct for a stationary source. Emission theory is also correct regarding the velocity of light reflected from a moving mirror. However, emission theory is wrong regarding phase velocity of light. Since we are assuming an imaginary source fixed at the apparent point of light emission, we can use emission theory to analyze the problem. Also since only group velocity (and not phase velocity) of light is relevant to determine the path length and time of flight, we can apply emission theory. Phase velocity will be used to get phase of detected light based on path length of light which is determined by group velocity.

To summarize this:
1. use emission theory to determine the path, path length and time of flight
2. use absolute constancy of the phase velocity to determine the phase of detected light, which is

determined by the path length calculated in (1) above.

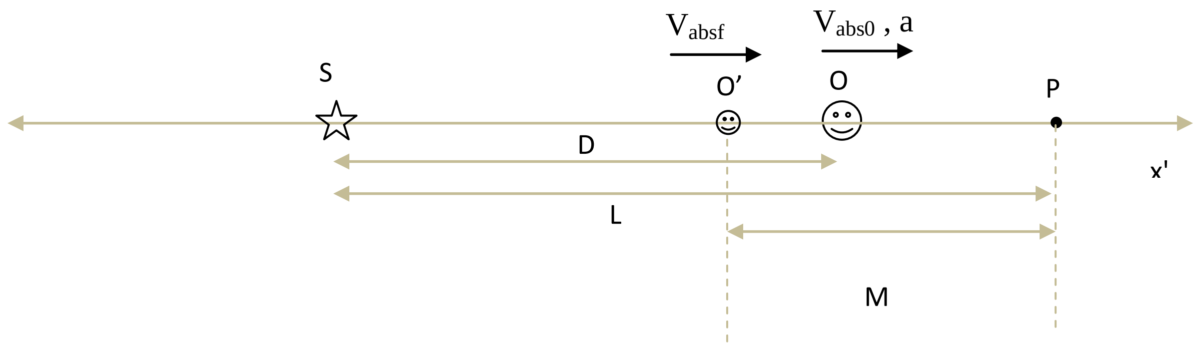
Note that Apparent Source Transformation is applied only to determine the apparent past position of the source. For the mirrors, beam-splitters and all other parts, only their physical/actual positions relative to the observer is used.



So far we have assumed uniform motion of the light source, the observer, and the mirrors. Next we consider even a more general case in which the light source, the mirrors and the observer move in an accelerated motions (both magnitude and direction), in arbitrary curved paths.

As we have stated earlier, the reference frame of the inertial observer is the preferred reference frame. However, we don't use the actual point of light emission (actual past position); we use apparent past position of the source relative to the inertial observer. However, all the problems we have analyzed so far involve uniform motion of the observer. What principle is applied for an observer in accelerated motion?

Consider a simple case in which an observer is accelerating directly away from a light source that is at absolute rest.



Suppose that, initially, at the instant of light emission, the observer was moving with initial absolute velocity V_{abs0} , at distance D from the source. Imagine that, just after emission of light, the observer starts accelerating to the right. The problem is to determine the time it takes light to catch up with the observer.

We will start by assuming that the observer O will detect the light at point P, which is at distance L from the light source.

The problem is to find the inertial observer that will be just passing through point P , moving with the instantaneous velocity of observer O at point P. For this, we first have to determine the absolute velocity of observer O at the instant that he/she is just passing through point P.

We use the formula for uniformly accelerated motion:

$$S = V_0 t + \frac{1}{2}\, a\, t^2$$

In this case

$$\frac{1}{2}\, a\, t^2 + V_0 t - S = 0$$

$$\Longrightarrow \quad a\, t^2 + 2V_0 t - 2S = 0$$

$$\Longrightarrow \quad t = \frac{-2V_0 \pm \sqrt{(2V_0)^2 - 4a(-2S)}}{2a}$$

$$\Longrightarrow \quad t = \frac{-2V_0 + \sqrt{4{V_0}^2 + 8aS}}{2a}$$

But

$$S = L - D$$

Therefore,

$$\Rightarrow \; t = \frac{-2V_0 + \sqrt{4{V_0}^2 + 8a(L-D)}}{2a}$$

$$\Rightarrow \; t = \frac{-2V_{abs0} + \sqrt{4{V_{abs0}}^2 + 8a(L-D)}}{2a}$$

During this time the observer will attain a final velocity of:

$$V_f = V_0 + at$$

$$\Rightarrow \; V_{absf} = V_{abs0} + a\left(\frac{-2V_{abs0} + \sqrt{4{V_{abs0}}^2 + 8a(L-D)}}{2a}\right)$$

$$\Rightarrow \; V_{absf} = V_{abs0} + \frac{-2V_{abs0} + \sqrt{4{V_{abs0}}^2 + 8a(L-D)}}{2}$$

This means that the observer O is moving at this velocity at the instant that he/she is just passing through point P. We have to determine the imaginary inertial observer O' moving with the same constant velocity as the instantaneous velocity (V_{absf}) of observer O at point P.

So, at the instant of light emission, the inertial observer was at a distance of:

$$M = V_{absf} * t$$

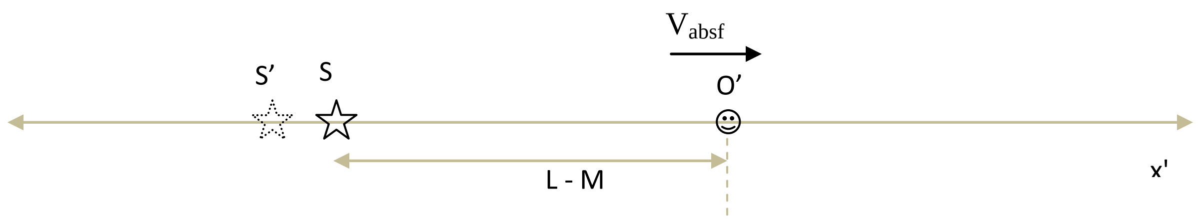
to the left of point P, as shown in the above diagram.

$$M = \left(V_{abs0} + \frac{-2V_{abs0} + \sqrt{4{V_{abs0}}^2 + 8a(L-D)}}{2} \right) * \frac{-2V_{abs0} + \sqrt{4{V_{abs0}}^2 + 8a(L-D)}}{2a}$$

The distance between S and O' , i.e. the distance between the source and imaginary *inertial* observer at the instant of light emission is:

$$L - M$$

Now we can determine the time of detection of light by the imaginary observer.



The apparent position of the source in the reference frame of the imaginary inertial observer is:

$$(L - M)\frac{c}{c - V_{absf}}$$

Note that the above formula is only approximate and we use it for simplicity, and it is accurate enough for $V_{abs} << c$; the correct formula would be :

$$(L - M)e^{\frac{V_{absf}}{c}}$$

So we use the approximate formula.

The time delay of light, therefore, will be:

$$t = \frac{D'}{c} = \frac{(L - M)\frac{c}{c - V_{absf}}}{c} = \frac{L - M}{c - V_{absf}} = \frac{L - V_{absf}t}{c - V_{absf}}$$

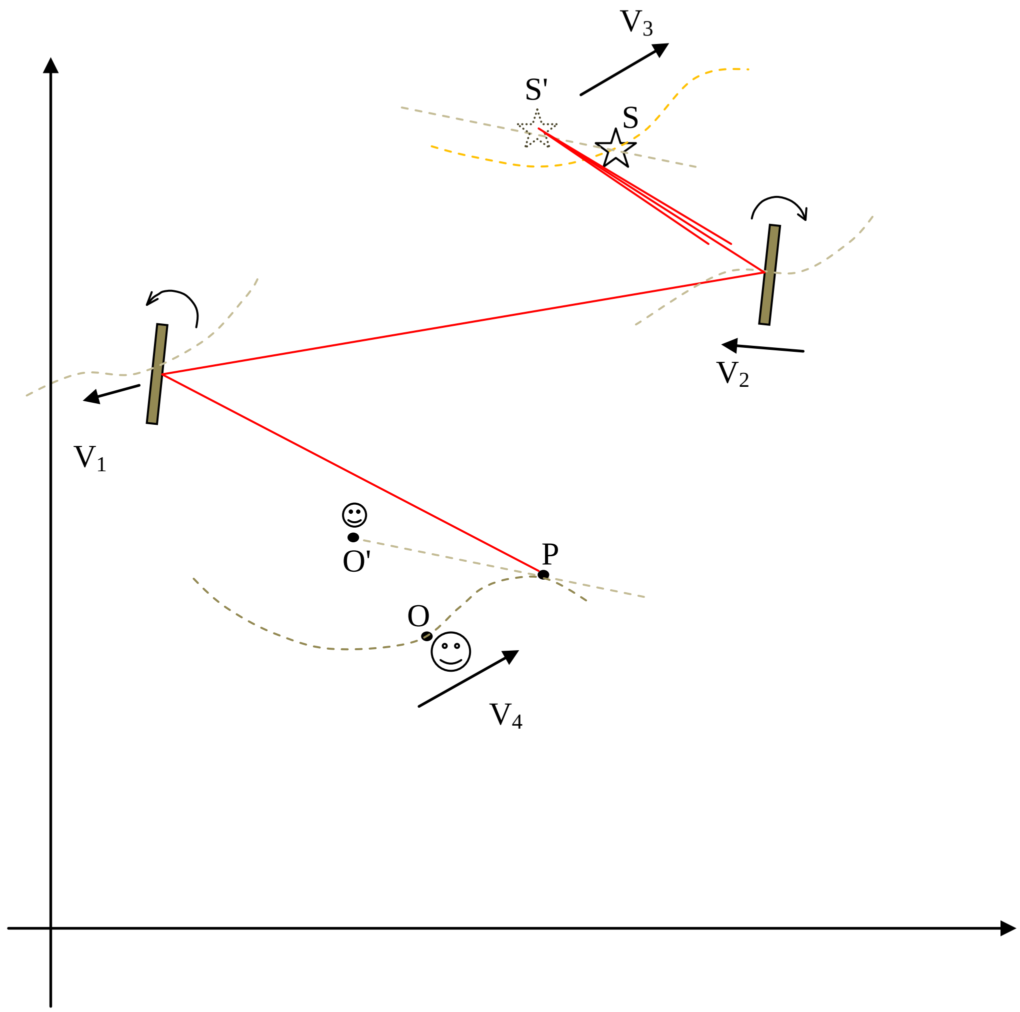
$$t = \frac{L - \left(V_{abs0} + \frac{-2V_{abs0} + \sqrt{4{V_{abs0}}^2 + 8a(L-D)}}{2}\right) * \frac{-2V_{abs0} + \sqrt{4{V_{abs0}}^2 + 8a(L-D)}}{2a}}{c - (V_{abs0} + \frac{-2V_{abs0} + \sqrt{4{V_{abs0}}^2 + 8a(L-D)}}{2})}$$

Equating this value of t with the previous value of t :

$$\frac{L-\left(V_{abso}+\frac{-2V_{abso}+\sqrt{4V_{abso}{}^{2}+8a(L-D)}}{2}\right)*\frac{-2V_{abso}+\sqrt{4V_{abso}{}^{2}+8a(L-D)}}{2a}}{c-\left(V_{abso}+\frac{-2V_{abso}+\sqrt{4V_{abso}{}^{2}+8a(L-D)}}{2}\right)}=\frac{-2V_{abso}+\sqrt{4V_{abso}{}^{2}+8a(L-D)}}{2a}$$

L is determined from the above equation and then used to determine time of flight t.

In the above example, we assumed rectilinear acceleration of the source. In reality, the motion of the observer can be non-rectilinear accelerated motion, as shown below.



The procedure of analysis is first to define the positions and motions of the mirrors, the beam splitter and other components, the observer, the light source in the absolute reference frame or any convenient inertial reference frame whose absolute velocity is known.

What is the preferred reference frame to analyze such experiment?

We propose here that the preferred reference frame for an experiment involving an observer in non-rectilinear accelerated motion is the reference frame of an imaginary inertial observer who will be just passing through the same point and moving with the same velocity as the real observer at the instant of light detection.

The procedure is as follows:

1. We assume that the observer O will detect the light when he is just passing through point P. At the instant of light emission (at t = 0), observer O is at point O.

2. Based on the velocity function of the observer O, we get the expression for the time *t* taken by the observer to move from point O to point P. The initial absolute velocity (at the instant of light emission) of the observer is V_{abs0} and the final absolute velocity (at the instant of light detection) is V_{absf} , which is the instantaneous velocity of observer O at point P.

3. We get the expression for the instantaneous velocity (magnitude and direction) V_{absf} of the observer at the instant of light detection (at the instant of passing through P)

4. We assume an imaginary inertial observer O' whose velocity is V_{absf} and determine his initial location at the instant of light emission (t = 0) so that he/she will arrive at point P at the instant of light detection, i.e., real observer O and imaginary observer O' will arrive at point P simultaneously, so that both will detect the light at point P. Imaginary observer O' is at point O' at the instant of light emission.
This means we get an expression for the distance of imaginary inertial observer from point P (i.e. the distance between point P and point O') at the instant of light emission:

$$distance\ between\ P\ and\ O' \ = \ V_{absf} \ * t$$

where t is the time taken by observer O to move from point O to point P. Note that distances OP and O'P have been exaggerated in the diagram.

6. We then attach a reference frame to the imaginary inertial observer O' , with the x'-axis parallel to the path of observer O' , with observer O' at the origin.

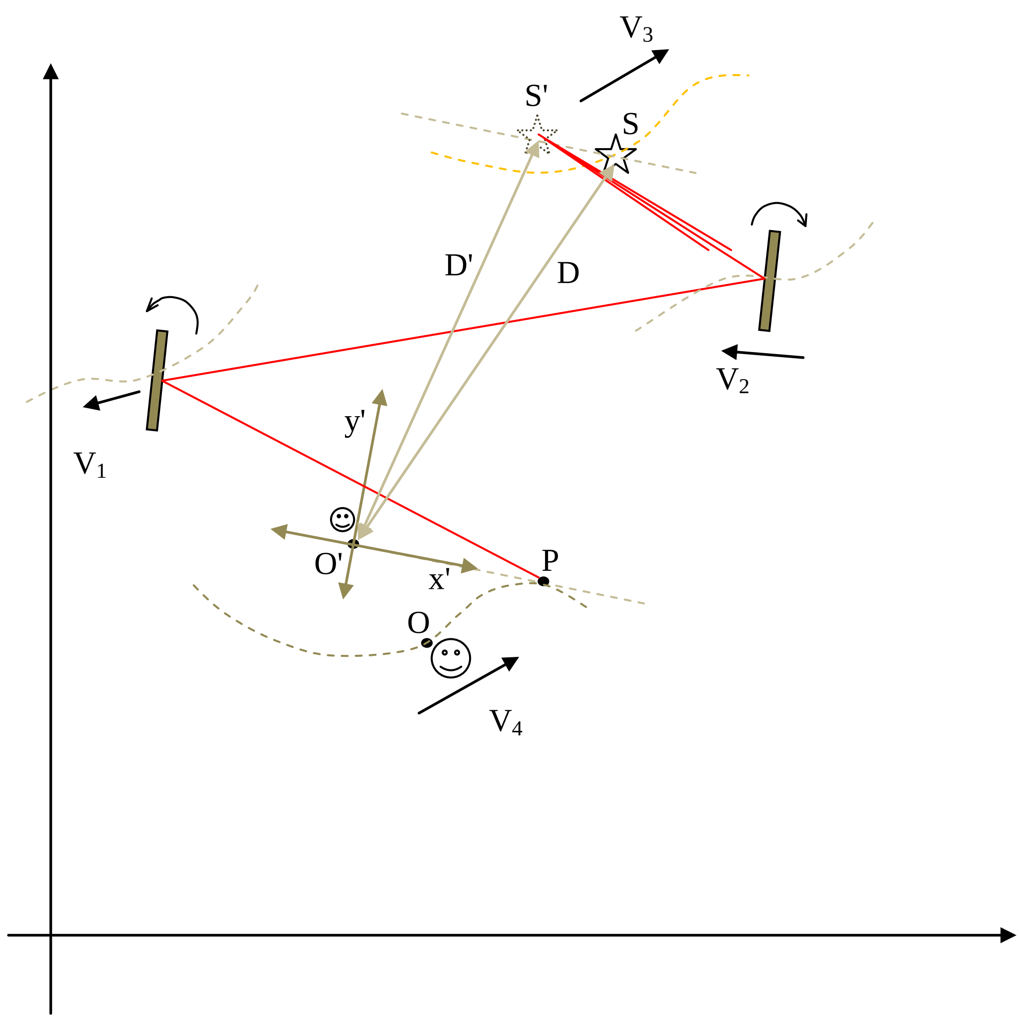
7. In the reference frame of imaginary observer O', we determine the apparent past position of the source (as opposed to actual past position of the source), shown as S' in the diagram. Note that S is the actual position of the source at the instant of light emission. S' is the apparent position of the source at the instant of emission. Up to this point we used only relative velocities. We use the absolute velocity of the observer to determine the apparent past position of the

source. *Therefore, although all parts of an optical experiments will have their own absolute velocities, the only relevant absolute velocity in analysis of light speed experiments is the absolute velocity of the inertial observer and we only use it to determine the apparent past position of the source. Once we have determined the apparent past position of the source, we use only relative velocities.*

8. In the reference frame of the imaginary observer O', we define the positions and motions of the mirrors, beam splitters

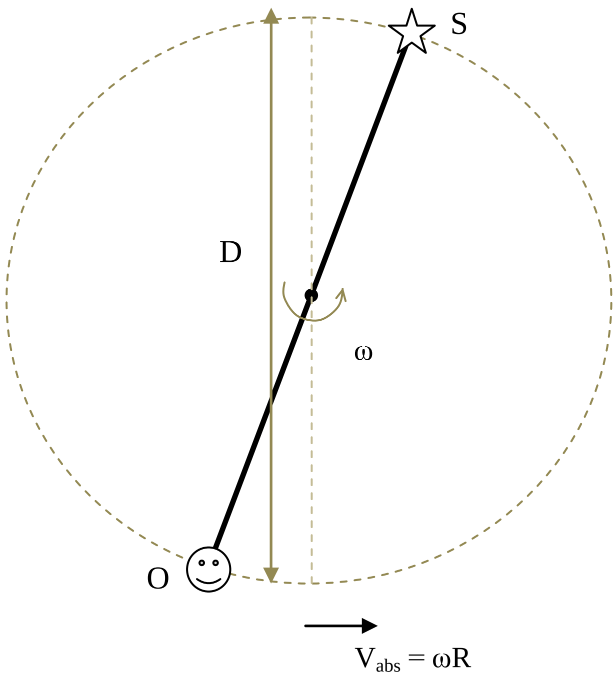
9. By assuming that light was emitted from S', and taking into consideration the positions and motions of mirrors, beam splitters e.t.c. , we get the expression for the time delay of light between emission from S' and detection by the imaginary inertial observer O'.

10. By equating the expression for the time delay obtained in (2) with that obtained in (9), we solve the equation for the length of path OP, from which we get the time of flight t and pat and path length of light. The phase of detected light is then determined by using the path length of light.



Next we apply the above principle to the Sagnac effect.Since the light source, the beam splitter, the mirrors and the detectors are in accelerated motions, with rotations of the mirrors and beam splitter also involved, the above procedure applies to the Sagnac effect.

Let us first consider a simple problem involving rotation. An observer O and a light source S are attached to the two ends of a rigid rod and rotate about the center of the rod, as shown below.

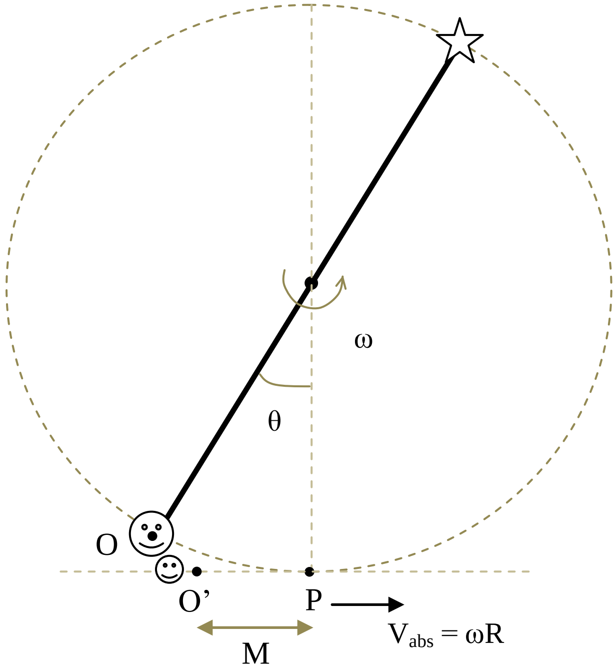


Our problem is to determine the path, the path length, the time delay and phase of a short pulse of light emitted by the source and detected by the observer.

We first use a convenient inertial reference frame to define the positions and motions of the different parts of the apparatus, in this case the source and the observer. We assume the apparatus to have zero absolute translational velocity. The most convenient inertial reference frame is the reference frame in which the device is rotating. For simplicity, we assume that the device (the whole system) is not in absolute translational motion, i.e. it is at rest regarding translational motion. Therefore, the tangential velocity of the observer will also be his/her absolute velocity.

So the absolute velocity of the observer will be:

$$V_{abs} = \omega R \, , \;\; where \;\; R = \frac{D}{2}$$



Suppose that the source emits a short light pulse at t = 0 at the position shown. We start by assuming that the observer will detect the light at point P. Therefore, observer O will be moving with absolute velocity ωR to the right as he is just passing through point P. According to the general procedure we introduced already, we find an imaginary inertial observer O’ who will arrive at point P simultaneously with observer O and who is moving with the same velocity (magnitude and direction) as the instantaneous velocity of observer O at point P , which is ωR to the right . Therefore, observer O’ will have a constant velocity ωR to the right.

The time taken for observer O to move from his/her current position (point O) (his position at t = 0 , which is instant of light emission) to point P is the same as the time taken by the imaginary inertial observer O’ to move from point O’ to point P. O' is the position of observer O' at t = 0.

We first get the expression of the time taken by observer O to move from point O to point P.

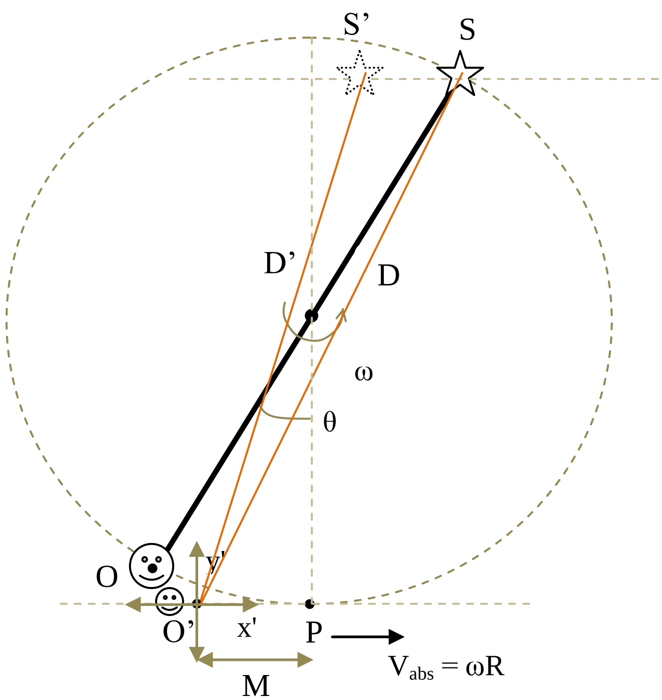
$$t = \frac{\left(\frac{2\pi R\theta}{360}\right)}{\omega R}$$

Next we get the expression for distance from O’ to P, i.e. the position of imaginary inertial observer O’ at the instant of light emission, denoted as length M in the figure above.

$$M = (\omega R)t$$

Once we get the expression for the location of the imaginary observer at the instant of light emission, we attach a reference frame (x’, y’) to O’, with +x' axis parallel to the direction of the velocity of observer O'. We then define the *physical* positions and motions of all components of the experimental setup in the optical path. In this case, there are no mirrors and beam splitters and the only component of the experimental apparatus other than the observer O is the source S. For the source, we need only to find its location in the reference frame of imaginary observer O, at the instant of light emission. Therefore, for the source, all we need is its initial position at t = 0 in the inertial frame. We don't need to define its motion because, once the source emits light, its motion is irrelevant. We don't need the velocity of the source at the instant of emission or afterwards. However, for all other parts of the optical experiment, except observer O, which are mirrors, beam splitters and other components, we need to define their positions and motions in the inertial frame.

Then we determine the *apparent* position of the source relative to the inertial frame of imaginary observer O', which is always assumed to be at the origin his reference frame. The apparent position of the source is obtained by using the *physical* position of the source in the frame of imaginary observer O' and then applying Apparent Source Transformation. Note that what apparently changes position in the imaginary observer's frame is the *point of emission*, not the physical source itself. This means we use Apparent Source Transformation only to determine the apparent point of emission.



Then the problem is analyzed in the reference frame of O', to get the expression for the time delay of light from emission by the source to detection by the observer O', i.e. the time of flight.

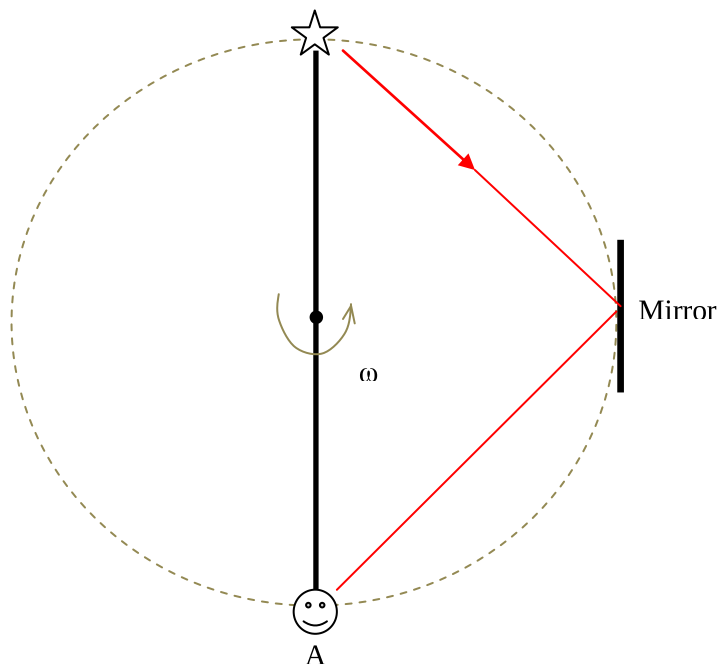
This expression is equated with the expression for time taken by observer O to move from point O to point P, which is:

$$t = \frac{\left(\frac{2\pi R\theta}{360}\right)}{\omega R}$$

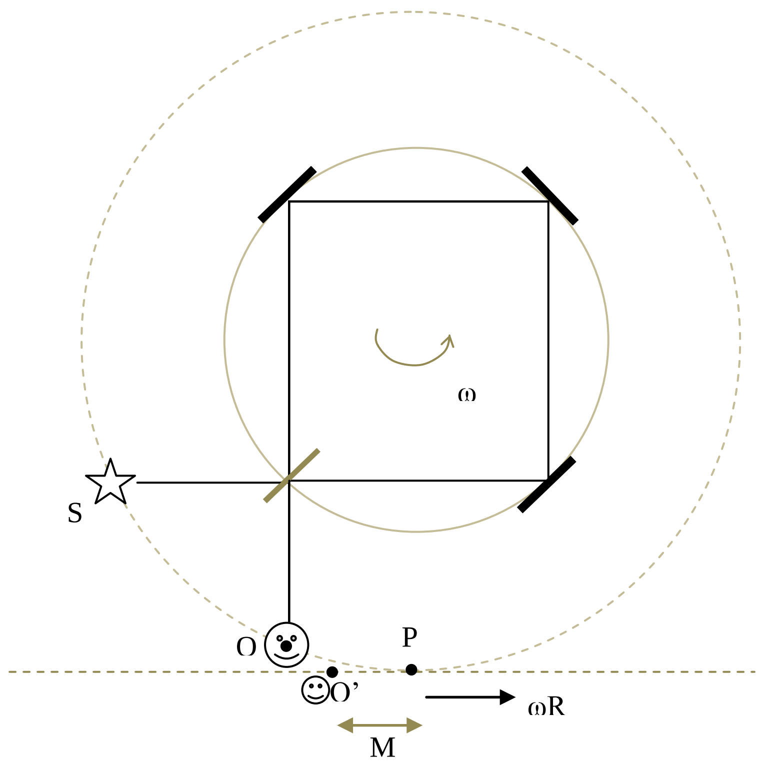
The solution of this equation will give the value of θ, from which time of flight t can be obtained, which in turn will enable the determination of path and path length of light detected by observer O. Note that the time t determines the time of flight of the light pulse, which is the group delay, whereas the *path length* determines the *phase* of light observed by O.

$$\text{phase of detected light relative to emitted light} = \Delta\phi = \frac{\text{path length of light}}{\text{the phase velocity of light (c)}}$$

The same procedure can be followed if, for example, a mirror co-moving with the source and observer is added to the experiment, as shown below.



The Sagnac effect is analyzed with the same procedure.



Suppose that light is emitted by the source at the position of the apparatus shown above. As before, we start by assuming that the accelerating observer O will detect the light at the instant that he is just passing through some point P, at which his absolute velocity is ωR to the right.

First we get the expression of the time *t* required for the observer O to move from its current position, point O, (position at instant of light emission, t = 0) to point P. This will be the length of arc OP divided by the tangential velocity of the observer.

Then we find the position of an imaginary inertial inertial observer O' who will be just passing through point P at the same instant of time as observer O, and who has the same velocity as the instantaneous velocity of observer O at point P, which is equal to ωR to the right.

Therefore, for imaginary observer O' to arrive at point P simultaneously with observer O, observer O' should be at a distance of:

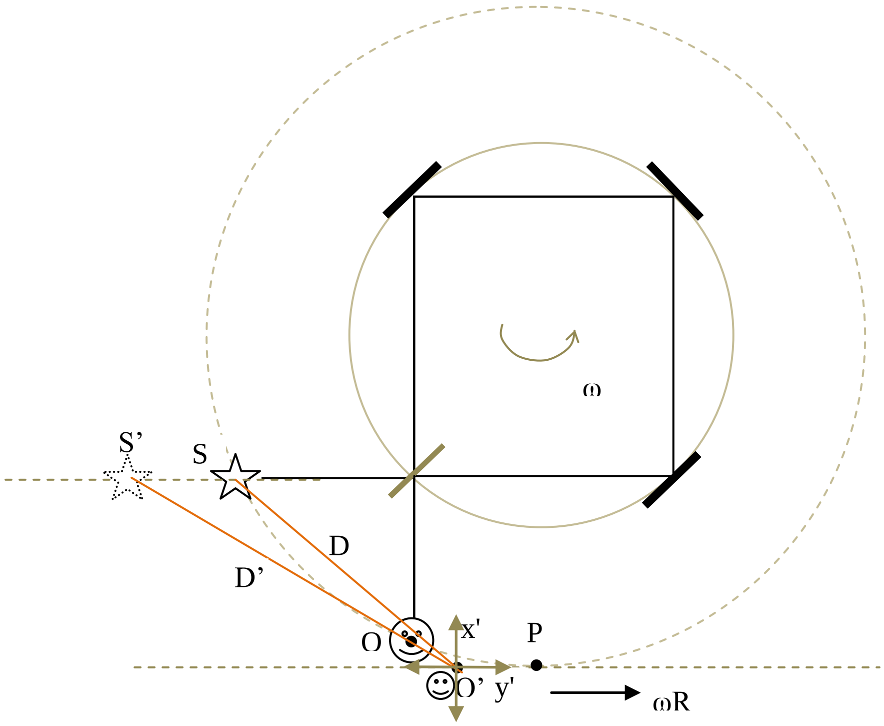
$$M = \omega R * t$$

from point P at the instant of light emission, where *t* is the time taken by observer O to move from point O to point P.

We then attach a reference frame (x', y') to inertia observer O', with observer O' at the origin and with +x axis parallel with the velocity vector of observer O'. Then the positions and motions

of the mirrors and the beam splitters are defined in the (x', y') reference frame. We then determine the apparent position (S') of the source relative to observer O' (i.e. relative to the origin of (x', y')). By assuming that light is emitted from S', and by taking into account the positions and motions of the beam splitter and the mirrors, we determine the expression for the time *t* taken for light to travel from source to observer O'. Note that we assume that the phase velocity of light is always constant, whereas the group velocity varies with mirror velocity. Once the expression for the time *t* is obtained, we equate it with the expression for *t* we obtained earlier, which was the time taken by observer O to move from point O to point P.
Solving the resulting equation enables the determination of time *t* and the path and path length of light. The phase of the detected light is determined by the path length, whereas the time of flight will be the time *t* itself.

In this procedure, note that we analyze the problem from the perspective of imaginary inertial observer O'. We determine the time of flight of light observed by observer O'. We solve the problem for observer O' , and not for observer O. Since O and O' will detect the light simultaneously at the same instant, solving the problem for observer O' will automatically solve the problem for observer O. When we say that we define the positions and motions of parts of the experimental apparatus in the reference frame of the imaginary observer, we mean all parts except the accelerating observer O. We don't need to define the position and motion of the accelerating observer in the inertial frame because the accelerating observer will not affect the path of light and his/her position and motion in the inertial frame is not relevant. There is also a distinction regarding the source. We only need to locate the apparent point of emission, by using actual/physical position of the source at the instant of emission. Afterwards, the position and motion of the source is not relevant. Even at the instant of light emission, we need to know only the physical *position* of the source; the velocity of the source is not relevant at the instant of emission. For mirrors, beam splitters and other parts, we need to define their positions and motions in the reference frame of imaginary observer O'.



Therefore, we are analyzing the problem in the reference frame of an imaginary inertial observer O' who is moving with velocity of ωR to the right. It is as if the Sagnac device is translating to the left (relative to reference frame (x', y')) and rotating at the same time.

We will not undertake the quantitative analysis in this paper. However, we will see if this theory predicts the behavior of light in Signac's experiment, qualitatively.

We have stated that the Sagnac effect should be analyzed in the reference frame of an inertial observer moving with velocity ωR to the right, in the present case. Thus, the Sagnac apparatus is not only rotating in this reference frame, but also translating with velocity ωR to the left.

Therefore, there will be a combination of translational and rotational motions. The question is, can we ignore the translational motion of the device and only deal with the rotational motion, which would simplify the problem?

As we have stated above, once we have defined the positions and motions of the parts of the experimental apparatus and determined the apparent point of emission (apparent past position of the source) in the reference frame of the imaginary inertial observer, we simply use conventional emission theory to analyze the path, path length and time of flight of light, in which only the group velocity (not the phase velocity) of light is relevant. Phase of the observed light is determined from the path length and frequency of observed light. But the path length is determined by using group velocity. According to conventional emission theory, the speed of light varies with source and mirror velocity. However, conventional emission theory is wrong regarding the dependence of light speed on source velocity. It is also wrong regarding the phase velocity of light, which I have proposed to be an absolute constant in vacuum, irrespective of source, mirror, and observer velocity. However, emission theory is correct with regard to group velocity of light and mirror velocity: the *group* velocity of light varies with mirror velocity.

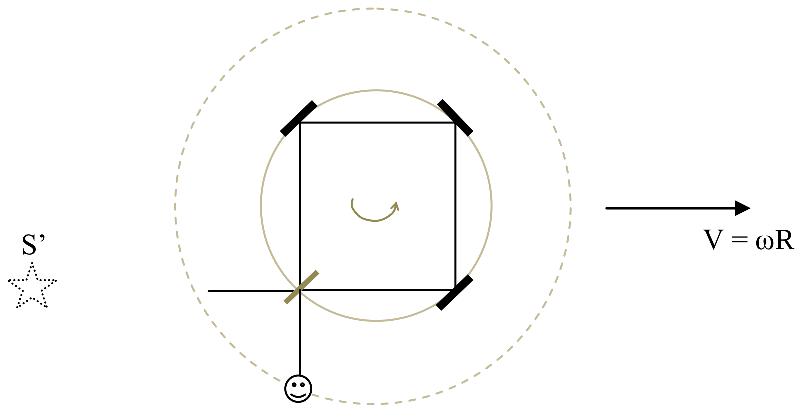
Therefore, even though conventional emission theory is wrong in general, we will use it in analysis of light speed experiments, as introduced in this paper, because we use only its correct features.

In the case of Sagnac effect, we can use emission theory for the analysis which involves only group velocity. Once we have determined the apparent point of emission in the inertial imaginary observer's reference frame, the motion of the source is irrelevant. The motion of the source is relevant only to determine the Doppler effect on observed light, for source and observer in relative motion. Since in the Sagnac experiment the path length of light is not changing, Doppler effect does not exist. Once we have determined the apparent past position of the source (apparent point of emission) we can put an imaginary source that is at rest in that inertial frame, at that point. Therefore, since the *apparent* source is at rest, we can say that the speed of light is constant relative to the *apparent* source. I mean that emission theory is correct for a stationary source. It fails only for a moving source. Therefore, for our purpose, since we are not considering the motion of the source, we can use emission theory of light for group velocity of light. In other words, emission theory fails only when the source starts moving and our imaginary source is stationary in the inertial observer's reference frame, fixed at the apparent past position of the source.

Going back to our earlier question regarding the effect of translational motion on Sagnac effect, we have reduced the problem of Sagnac effect to a simpler problem as follows. We can consider the inertial observer's frame as an absolute reference frame in which a light source is at rest but the mirrors and the beam splitter are in translational and rotational motions, i.e. the Sagnac apparatus is being translated as a whole while rotating at the same time.

As we have discussed above, therefore, we can apply emission theory to analyze the Sagnac experiment because the apparent source is at rest (in this case the apparent source is the apparent point where light was emitted). In any inertial reference frame in absolute motion, the *source* is the apparent point in that reference frame where light was emitted. For an observer at absolute rest, the apparent point of emission is the same as the actual point of emission. So, in this case the source is the (actual) point where light was emitted, which is fixed (not moving) in that reference frame. For an observer in inertial absolute motion, the (apparent) source is the *apparent fixed point of emission* in that observer's reference frame. In all cases, the source is the fixed point in thatframe where light was actually or apparently emitted. The point here is that the source (or apparent source) is a point in an inertial frame, which is fixed.

Therefore, since a *source* (as a point of light emission) cannot be moving, we can apply emission theory to analyze the Sagnac effect that is in both translational and rotational motions at the same time.



S' , which is the apparent point of emission, is at rest, so the speed (group velocity) of light emitted by the source is equal to c in the inertial reference frame in which the device is translating, until it hits the beam splitter. Once the light hits the beam splitter and the mirrors, it will attain a component of the translational velocity of the whole device. Therefore, once the light beam hits the mirrors, it almost behaves as if it came from a co-rotating imaginary source located on the apparatus so that it directs light with the same angle and towards the same point on the beam splitter and the mirrors, but relative to which the speed of light is c + w, which is the velocity of light coming from the source relative to an observer sitting on the beam splitter. So we have reduced the problem to conventional emission theory, according to which the *time of flight* of the two counter-propagating light beams is (almost ?) equal. So for the purpose of analysis, we can apply conventional emission theory in which the speed of light varies with both source and mirror velocity.

Therefore, even according to emission theory, even though the clockwise propagating and counterclockwise propagating *groups* will arrive simultaneously at the observer (both will have equal times of flight), the path lengths of the two beams differ significantly. In the above diagram of counterclockwise rotating Sagnac device, the counter clockwise propagating light will have to travel larger distance than the clockwise propagating light. This means that the path lengths of the two light beams is different.

Since we have stated that the phase of observed light is determined only by the frequency and path length of light, and not by time of flight, the Sagnac experiment will give a fringe shift.

In effect what we have seen is that absolute motion has little effect in the Sagnac effect. The only effect of absolute motion of the observer in the above analysis is to create an apparent change in past position of the light source (i.e. apparent point of emission). We can see that this has little effect on the fringe shift because it will affect both light beams almost equally.

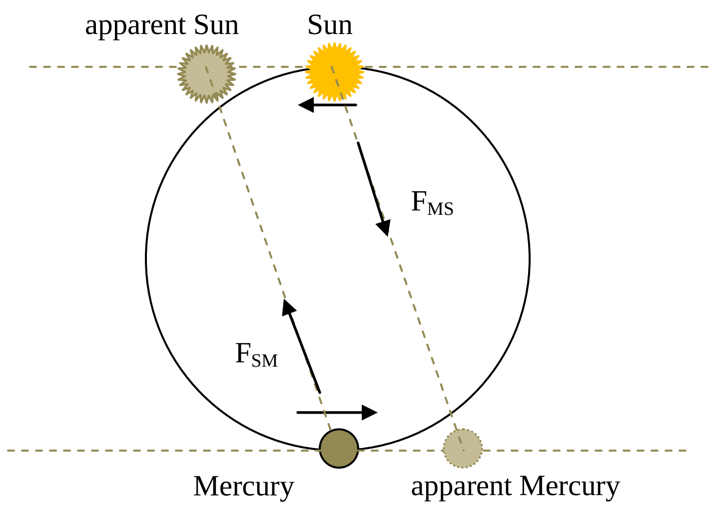
Therefore, Sagnac effect is almost not a result of absolute motion, but a consequence of the distinction between phase velocity and group velocity of light. It is a consequence of the dependence of group velocity on mirror velocity and the absolute constancy of the phase velocity. Even though the two light beams arrive (almost) at the same time at the observer, their path lengths are different and this is what gives rise to a fringe shift.

Mercury Planet Anomalous Perihelion Advance

As we know, Newton's laws of mechanics and gravitation do not predict perihelion advance for a single Sun and single planet system. They predict pure elliptical or circular orbits in such case. However, astronomers in the nineteenth century observed a small residual advance of the perihelion of planet Mercury that could not be explained by Newton's laws. This anomalous effect was much smaller than the total observed perihelion advance, most of which could be explained by Newton's laws.

A scientist by the name Paul Gerber developed a successful explanation by assuming finite speed of gravity, which he assumed to be the speed of light. According to this assumption, Mercury is not be attracted towards the current, instantaneous position of the Sun, but towards the *retarded position* of the Sun, i.e. the position where it was t seconds ago, where t = D/c, D being the distance between Mercury and Sun t seconds ago and c the speed of light.Likewise, the Sun is attracted towards the retarded position of Mercury.

However, the new theory introduced in this paper, i.e. the theory of contraction and expansion of space relative to an absolutely moving observer, makes a prediction opposite to that of Paul Gerber. The new theory suggests that the planet Mercury is attracted towards neither the current, instantaneous position, nor the retarded position of the Sun. Mercury is attracted towards the *advanced* position of the Sun and the Sun is attracted towards the advanced position of Mercury. Note that by 'advanced' we don't mean the actual future position of the bodies, which will be on the circular orbit; it just means a point in front of the Sun (not behind) and a point in front of Mercury.



F_{SM} is the gravitational force of Sun on Mercury and F_{MS} is the gravitational force of Mercury on Sun.

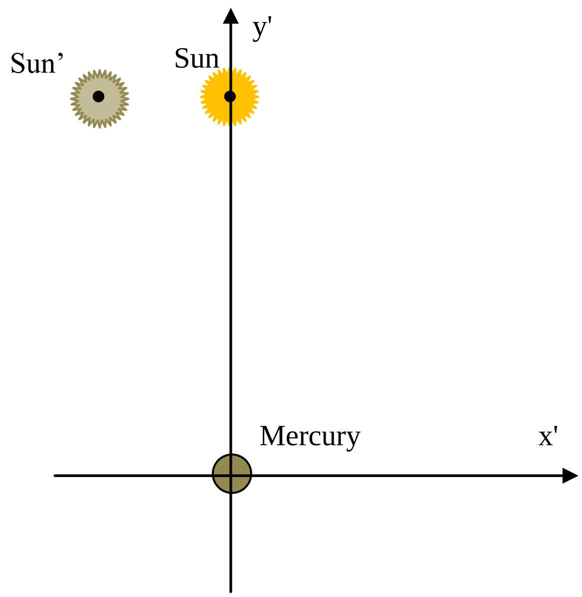
One objection to this view is that this will create a couple which will lead to continuous increase of the velocities of the two bodies, resulting in instability of planetary orbits. However, this argument is based on conventional, simplistic,'ether' view and is fallacious because the system should be seen only from the perspective of the *observer*, which in this case is the Sun or Mercury. There will be no couple from the perspective of Mercury because it is always attracted towards the apparent Sun, so there is no couple between Mercury and the apparent Sun. There is no couple between the real Sun and apparent Mercury also. The two bodies are not orbiting about a single common center, which is the conventional view; Apparent Source Theory revealed that both rotate about their own centers[1].

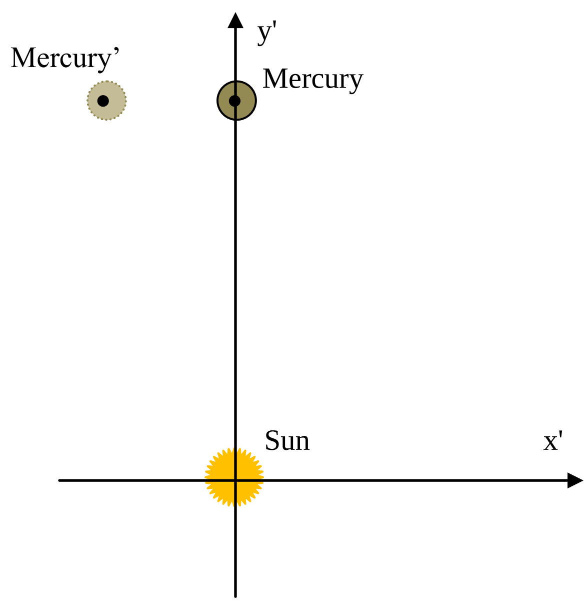
The resulting orbit is a complicated, continuously changing *instantaneous* but stable orbit. Therefore, calculations based on conventional physics will not give strictly accurate results for planetary orbits; the orbits of planets are more complex than predicted with conventional physics.

The above argument applies only if the Sun and Mercury were attached to the ends of a huge rigid rod, so that they would be forced not to orbit in their complex but stable orbit. In this case, the Sun and Mercury would be constrained to rotate around a single common center, so a couple would arise and accelerate the system, with continuously increasing acceleration. This will clearly violate the principle of conservation of energy, which should no more be considered as a universal principle.

This explanation is based on Apparent Source Transformation theory. If we consider a Sun-Mercury system that is at absolute rest, meaning that the absolute translational velocity of the system is zero, for simplicity, the absolute velocity of the Sun and Mercury is only that resulting from their respective angular velocities in their respective orbits. If the radius of *instantaneous orbit* of Mercury is R_M and that of the Sun is R_S , then their respective absolute velocities will be ωR_M and ωR_S , respectively. We apply the equations of Apparent Source Transformation to determine the apparent position of the Sun from the perspective of Mercury and the apparent position of Mercury from the perspective of Sun, as shown below.

As for the quantitative analysis of the value of Mercury perihelion advance based on this theory, I will not undertake that in this paper.





Summary of the principles and procedures of analysis for any light speed experiment according to Apparent Source Transformation (AST)

The procedure of analysis of any light speed experiment, including interference pattern and time of flight experiments, is summarized as follows.

1. According to AST, an observer is a human, an animal or any device or particle (for example, an atom) that is *directly* detecting the light. All light speed experiments should be analyzed from the perspective of such observer. If a monkey is the one directly detecting the light, the experiment should be analyzed from the perspective of the monkey and not from the perspective of a physicist standing by and trying to analyze the experiment. So *the observer is the detector of light.* This is clearly distinct from the 'observer' in Special Relativity Theory, who is typically an inertially moving physicist trying to predict the outcome of a light speed experiment in his own reference frame.

2. All light speed experiments should be analyzed in the reference frame of an *inertial* observer, with the observer at the origin of the co-ordinate system for convenience, and the +x-axis aligned with the direction of *absolute velocity* of the observer. Note again that the *observer* is the detector of light.

3. The inertial observer (hence the inertial reference frame) can be at absolute rest or can have some constant absolute velocity, and this should be known or assigned a variable if not known.

4. The analysis starts by defining the *physical* positions and motions of all components of the optical experiment, including mirrors, beam splitters and the light source, in the inertial reference frame of the *observer*.

5. Once the physical positions and motions of parts of the experimental apparatus are defined in the inertial frame, the next step is to determine the apparent position of the light source at the instant of light emission. This is obtained from knowledge of actual/physical position of the source at the instant of light emission, and from knowledge of observer's absolute velocity, and then applying Apparent Source Transformation to determine the apparent position of the source at the instant of light emission. In other words, we determine the *apparent past position* of the source in the inertial frame.

6. Once the (apparent) point where light was emitted in the inertial frame is known, we simply apply conventional emission theory to determine the path, the path length and the time of flight of light (the time taken for light to move from source to observer).We apply emission theory only regarding the group velocity of light, not the phase velocity. It is the group velocity that is relevant to determine the path length and time of flight. Note again that we are talking about the single observer who is at the origin of the co-ordinate system and who directly detects the light. Note that it is wrong to consider the telescope as the detector, strictly speaking, because the telescope only directs the light beam to the point of detection, and does not detect the light itself.

Therefore, the atoms on the detector device or the atoms in the retina of a human observer (for example looking at interference patterns) are the true observers, to which Apparent Source Transformation applies.

7. According to classical emission theory, the speed of light varies with source velocity and with mirror velocity. However, the hypothesis that the velocity of the source will add to the velocity of emitted light has been disproved by multiple experiments and observations. But the variation of the (group) velocity of light with mirror velocity has experimental evidence: the Bryan G Wallace analysis of Venus planet radar range data. However, in our inertial reference frame discussed above, the apparent point of light emission is fixed in that reference frame. It is as if the light source is stationary in that reference frame. And we know that, regarding group velocity of light, emission theory fails to account for moving sources. Emission theory works for stationary sources. Since the source is always considered to be stationary at the apparent point of light emission in the inertial reference frame, we can say that we can apply emission theory regarding group velocity of light, which is relevant in determining the time of flight and the path and path length of light, from which the phase of detected light can be determined by using the path length and constant phase velocity *c*.

8. In summary, we determine the apparent position of the source at the instant of emission and imagine as if the light was emitted by a source that is fixed (not moving) at that point. We then apply emission theory, in the inertial reference frame, according to which the group velocity of light varies with mirror velocity.

9. The phase velocity of light is always constant *c* relative to any observer, regardless of motion of the light source, motion of mirror and motion of the observer. For interference experiments, the phase of detected light is determined by the path length of light between the (apparent) source, i.e. the apparent point of light emission, and the observer/detector and the frequency of detected light. The phase of observed light relative to emitted light is:

$$\Delta\emptyset = 2\pi\, f\, t \;=\; 2\pi\, f\, \frac{L}{c}$$

where L is the distance between the apparent point of light emission and the observer.*c* is the *phase velocity* of light and is absoluteconstant in vacuum.

Therefore, we determine the path length L by applying emission theory to the group velocity of light and then, using L, determine the phase of detected light.

10. So far we have considered only light speed experiments in which the observer/detector is inertial. However, in reality the observer can be in accelerated motion, with continuously changing magnitude and direction of velocity.

11. Suppose that O is the accelerating observer. The problem is to determine the path and path length, the time delay and phase of light detected by observer O. Experiments involving

accelerated observers/detectors are analyzed from the perspective of an imaginary *inertial* observer O'. Since observer O is accelerating, we cannot use his/her reference frame to analyze the experiment, even though the problem is to determine the time delay of light for observer O. Imagine an experiment involving a light source, mirrors and beam splitters and an observer O, all of which can be in accelerated motion, including observer O. To analyze such experiments, we use the following argument to clarify our idea. Imagine infinitely many imaginary inertial observers, with all possible positions and constant velocities defined in the absolute reference frame. The procedure we have described so far will apply to all such observers because they are inertial. Therefore, imagine that we analyze the experiment in all such reference frames, i.e. we determine the path and path length of light, the time of flight and the phase of light detected by each of the infinitely many imaginary inertial observers O'. The argument is that, at each point P and instant of time t, accelerating real observer O will be detecting exactly what is being detected by an imaginary inertial observer O' who is also just passing through point P, at that instant of time t, and is moving with the same velocity (both magnitude and direction) as the instantaneous velocity of observer O at point P.

12. Analytically, the above argument would mean as follows. We start by defining the positions and motions of all components of the light speed experiment, including mirrors, beam splitters, the light source, the detector, in the absolute reference frame or any other convenient inertial reference frame whose absolute velocity is known. Assume that the source emits light at t = 0 , from some point in this reference frame. Suppose that accelerating observer O is at point O in this frame, at instant of light emission (t = 0). Since the motion of accelerating observer O is completely known, we know at which point observer O will be for each instant of time. Additionally, we know the instantaneous velocity of observer O for each instant of time. The procedure is first to assume that observer O will detect light emitted by the source at some point P along the path of observer O. We then assign a variable, say L, for the distance between the location of observer O at the instant of light emission and his/her location at the instant of light detection, which is point P. We then get an expression of the time *t* required by observer O to move from point O to point P, which will depend on the acceleration of observer O and the variable L. We then use the expression for *t* to get the expression for the instantaneous velocity (magnitude and direction) of observer O at point P. Once we get the expression for the instantaneous velocity (say, V_f) of observer O at point P, we determine the expression for the initial position (distance) (at t = 0) of an imaginary inertial observer O'moving with constant velocity V_f (i.e. with the same velocity as the instantaneous velocity of observer O at point P) , assuming that observer O' will reach point P simultaneously with observer O. The distance of imaginary inertial observer O' at t = 0, moving with constant velocity V_f , should be equal to V_f * t , at t = 0, so that observer O' and observer O will reach point P simultaneously. Now we have located the initial position (at t = 0) and velocity of the imaginary inertial observer O'. We attach a reference frame (x', y') to imaginary inertial observer O' in which we can analyze the experiment. The +x' axis should be in the direction of absolute velocity of the imaginary observer. The absolute velocity of the imaginary observer is found by using the velocity of the

imaginary observer relative to the convenient inertial reference frame used and the absolute velocity of the convenient reference frame used. Note that the position, velocity and absolute velocity of the imaginary observer are still expressions in terms of variable L and acceleration function of the real observer. Now we can apply the procedure we followed previously for real inertial observers.In the inertial reference frame (x',y'), we re-define the initial *physical* positions and physical motions of all parts of the optical experiment, including mirrors and beam splitters, except that of the source and the accelerating observer. For the source, we need only its initial physical position at instant of emission. This is because, once the apparent point of emission of light is determined in the (x', y') reference frame, the subsequent motion of the source is irrelevant afterwards. This is obviously because the motion of the source is irrelevant once the source has emitted the light. We determine the expression for apparent point of emission (i.e. the apparent past position of the source) from the actual/physical location of the source at the instant of emission by applying Apparent Source Transformation. Now we know the expressions for apparent point of light emission (at t = 0) and for the initial positions and motions of the mirrors and beam splitters. We simply apply emission theory to get an expression for the time of flight of light, which is the time taken by light to move from apparent point of emission (in (x', y') frame) to imaginary observer O', who is at the origin of (x', y') co-ordinate for convenience.Since observers O and O' will detect the light simultaneously, then this expression for time *t* of flight will be equated for the expression of time taken by observer O to move from point O (his position at t = 0) to point P, which was determined earlier.

time taken by accelerating observer O to move from point O to point P = time of flight of light from apparent point of emission to observer O'

Remember that point O is the location of observer O at the instant of light emission and point P is the location of observer O at the instance of light detection.

From the resulting equation, L can be obtained, from which time of flight *t* , path and path length and phase of light observed by observer O can be determined.

It should be noted that actually following this procedure to analyze experiments with accelerating observer will be complicated, especially if the accelerating observer is moving along curved path.

Conclusion

Although Apparent Source Theory is a compelling theory, it led to some contradictions and paradoxes. Most importantly I recently found that it is in contradiction with the universally accepted theory of stellar aberration. Exponential Doppler Effect theory was another compelling theory that agrees with constancy of the phase velocity of light and that can explain the Ives-Stilwell experiment. However both theories lacked physical, intuitive explanation. A single insight of contraction and expansion of space relative to an absolutely moving observer resolved all these problems. Apparent Source Transformation united the above two seemingly unrelated theories into one. Profoundly, it also revealed the mystery of stellar aberration, which will change current understanding in totally unexpected way.

Thanks to God and the Mother of God, Our Lady Saint Virgin Mary

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