Apparent Source Theory – an Alternative Model of the Speed of Light

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Abstract

The Michelson-Morley experiment was flawed in that it was meant to detect something that never existed: the ether. The Michelson-Morley experiment was capable to detect the ether, if it existed, but was/is incapable to detect absolute motion. The terms 'absolute motion' and 'motion relative to ether' were always wrongly presumed to be the same. Despite the failure of Michelson-Morley experiment, absolute motion was detected with several other kinds of experiments, such as the Sagnac, the Michelson-Gale, the Marinov, the Silvertooth, the Ronald de Witte experiments. A new interpretation of absolute motion and the speed of light is proposed in this paper: the speed of light is constant relative to the apparent source. The effect of absolute motion is to create an apparent change in the position (distance and direction), and not the speed of light, of a light source relative to the observer, for absolutely co-moving source and observer.

Introduction

In 1887 Michelson and Morley devised and carried out a brilliant experiment to detect and determine the velocity of the earth relative to the then prevailing hypothetical ether. However, they didn't detect any fringe shift and this was not what they expected. This experiment has been repeated in its various forms during the last one hundred years and no motion relative to the ether has been detected.

Despite the failure of Michelson Morley experiments, the ether/absolute motion has been detected by different kinds of experiments, including the Sagnac effect (1913), Michelson-Gale experiment (1925), Ronald de Witte, Marinov, Silvertooth(1986). Even the historical Michelson-Morley experiment result was not null, but a small fringe shift was reported. The Miller experiments are known to have detected small, systematic fringe shifts.

Distinction between absolute motion and the ether

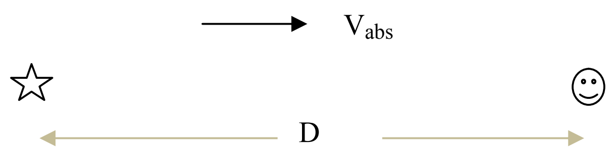
This discrepancy makes one to suspect a flaw in the conception of Michelson-Morley (MM) experiment. The MM experiment was meant to and was capable to detect something that never existed: the ether. The null result of Michelson-Morley experiment was interpreted to mean non-existence of absolute motion. Absolute motion was presumed to be motion relative to the ether. No one suspected if there was distinction between the two. A new interpretation of absolute motion is proposed in this paper.

Consider Michelson-Morley experiment (MMX) and Sagnac effect. Why no fringe shift is observed in MMX but is observed in Sagnac experiment? A true model of the speed of light should convincingly reconcile these two experiments before making any other claims.

In this paper we will prove the existence of absolute motion by putting aside the 'relative to what question' for the time being.

Apparent Source Theory (AST)

Consider a light source and an observer absolutely co-moving as shown below.

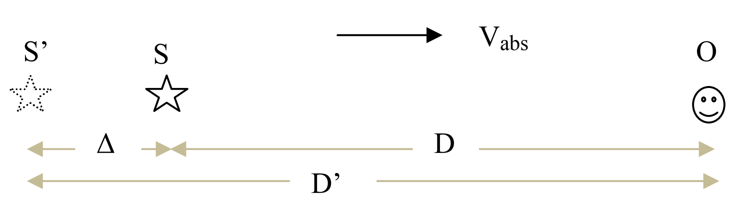


If the source and observer are at absolute rest ($V_{abs} = 0$), the time delay between emission of a light pulse and its detection at the observer will be:

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

However, if $V_{abs} \neq 0$, the time delay will be different, i.e. $T \neq \frac{D}{c}$. We may *postulate* that the effect of absolute motion is to create a change in the time delay T. At this point we make a careful interpretation. Why does time delay T vary with absolute velocity? Is it because the speed of light is variable relative to the observer, like a sound wave? No, because this would imply a medium for light transmission which was disproved by the Michelson-Morley experiment. For co-moving source and observer, the speed of light is always equal to *c*. How then does T vary with absolute velocity if c is constant, as physical distance D is also constant ?

This puzzle is solved as follows: time delay T varies with absolute velocity because the source observer distance *apparently* changes with absolute velocity. For absolutely co-moving source and observer, light behaves *as if* the distance between source and observer is different from the actual, physical distance D. In other words, the position of the source apparently changes relative to the observer, for absolutely co-moving source and observer, in the case of an observer in front of the source with reference to the direction of motion.



The source appears to have shifted away from the observer by distance Δ. The observer O measuring the time delay T between emission and detection of the light pulse will be able to make correct explanation and prediction only by assuming that the light pulse started from S' and not from S, and by assuming that the speed of light is equal to c relative to the apparent source S'.

The amount by which the source apparently shifts position is determined as follows. The time elapsed for the light pulse to go from apparent source position S' to the observer is equal to the time elapsed for the source to move from position S' to S. i.e.

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

But

$$D' = D + \Delta$$

From the above two equations

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

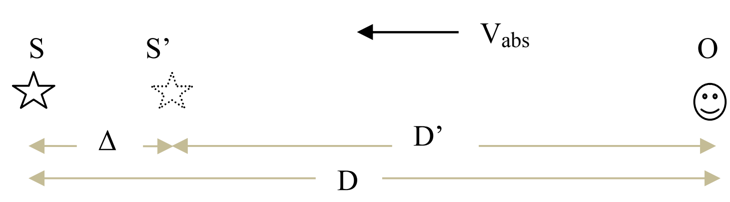
The time delay T will be:

$$T = \frac{D'}{c} = \frac{D}{c - V_{abs}}$$

In the above interpretation, each apparent source position S' applies only to a single point relative to the source. This means that the apparent source position is different for observers at different positions relative to the source. Each observer sees their own apparent source. This is because the apparent source distance D' depends on the physical source distance D and on absolute velocity V_{abs}.

Thus the effect of absolute motion is just to create an apparent change in position (distance and direction) of the source relative to the observer. To analyze an experiment involving absolutely co-moving source and observer, therefore, we just replace the real source with an apparent source. We analyze the experiment by assuming the speed of light to be constant *relative to the apparent source*. ***The speed of light is always constant relative to the apparent source.***

Similar analysis applies for an observer behind the light source, i.e. an observer 'chasing' a light source. In this case, the source *appears* to have shifted towards the observer by an amount Δ.



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

But

$$D' = D - \Delta$$

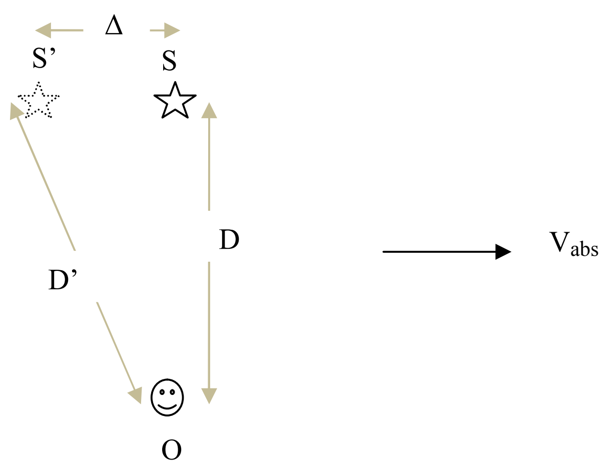
From the above two equations

$$D' = D\frac{c}{c + V_{abs}} \quad \text{and} \quad \Delta = D\frac{V_{abs}}{c + V_{abs}}$$

The time delay T will be:

$$T = \frac{D'}{c} = \frac{D}{c + V_{abs}}$$

Next 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.



During the time interval that the light pulse goes from S' to O, the source goes from S' to S.

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

But,

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

From the above two equations

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

Therefore, the time delay *T* between emission and detection of the light pulse in this case will be:

$$T = \frac{D'}{c} = \frac{D}{\sqrt{c^2 - V_{abs}{}^2}}$$

From the above interpretation, we can work out the procedure to analyze any light speed experiment as follows:

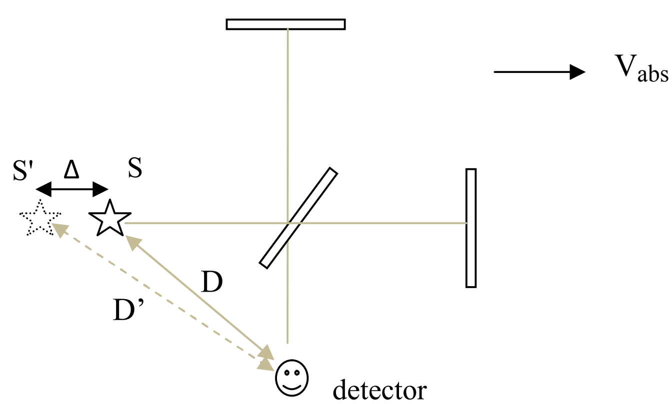
1. Replace the real source with an apparent source
2. Analyze the experiment by assuming that the speed of light is constant relative to the apparent source.

This means that we replace to real source with an apparent source to account for absolute motion. Once we put the apparent source at the apparent position, we assume space to be Galilean, and analyze the experiment by assuming the speed of light to be constant c relative to the apparent source. This is analogous with conventional emission theory in which the speed of light is constant relative to the source.

The distance D we use to determine apparent source position D' in the above analyses is always the *direct* source observer distance, even if no light comes directly from the source to the observer, but through mirrors as in the Michelson-Morley experiment.

Michelson-Morley experiment

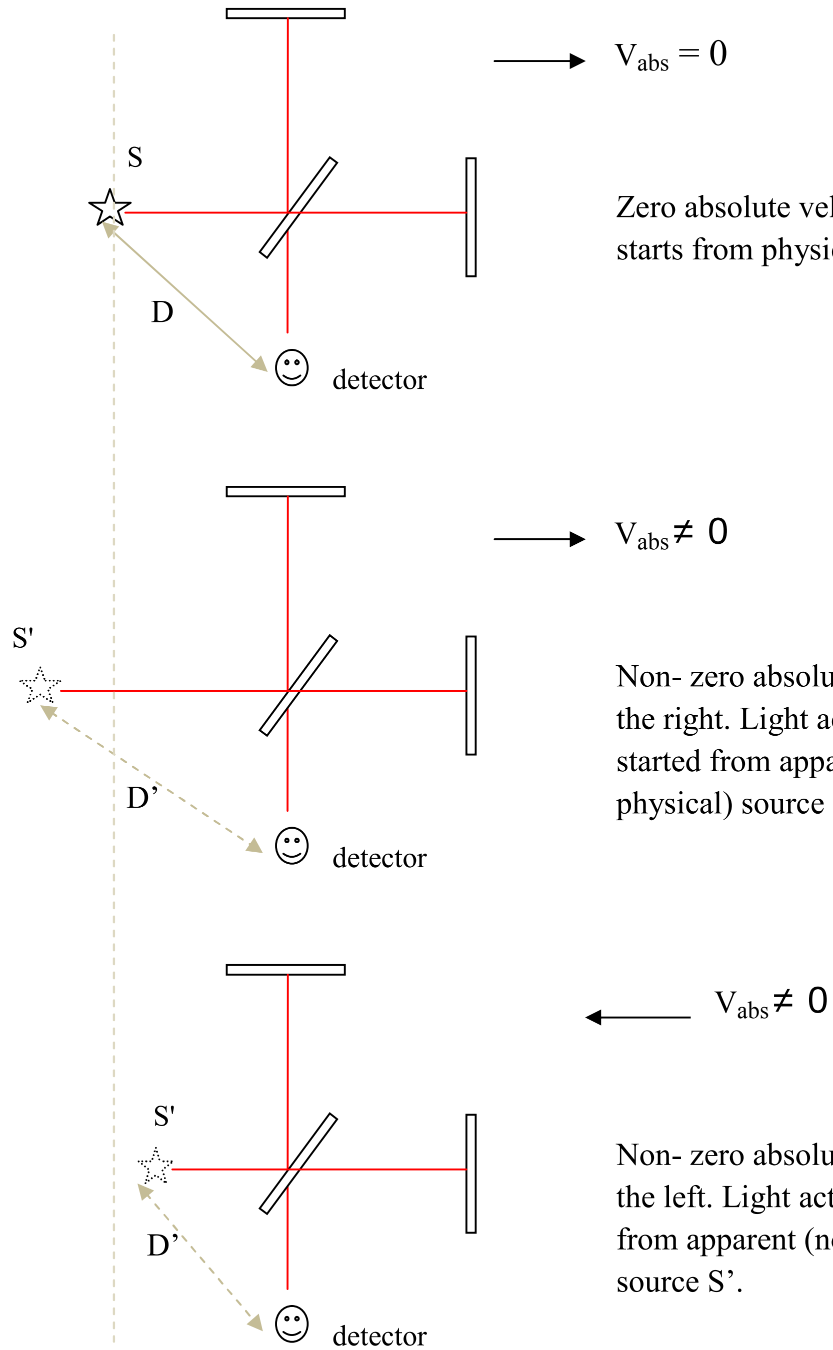
Now let us apply Apparent Source Theory (AST) to the Michelson-Morley experiment.



In the above diagram of Michelson-Morley experiment, the real source S has been replaced by an apparent source S'. Once we replace S with S', we assume the speed of light to be constant relative to S'. We may think of this as applying conventional emission theory to S'.

To understand the above analysis, one only needs to ask: assuming Galilean space, will actually/ physically moving the source from position S to position S' create any fringe shift. The obvious answer is NO because both the lateral and longitudinal beams would be affected equally.

The above diagram is redrawn below to show cases of zero absolute velocity and non zero absolute velocities.



Zero absolute velocity. Light starts from physical source S.

Non- zero absolute velocity to the right. Light acts *as if* it started from apparent (non-physical) source S'.

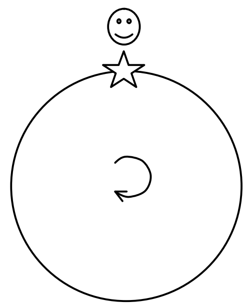
Non- zero absolute velocity to the left. Light acts *as if* it started from apparent (non-physical) source S'.

No (significant) fringe shift will be expected simply because the source position has changed.

Note that *physically* light always starts from the real source S, but light acts as if it started from apparent source S'.

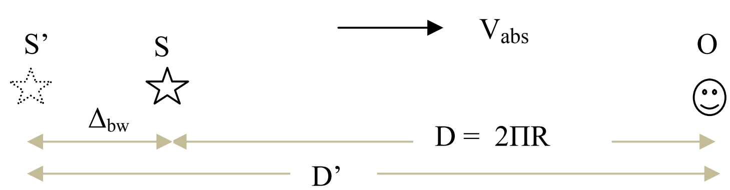
Sagnac effect

Let us consider a hypothetical Sagnac interferometer.



Assume that the light source emits light in the opposite directions tangentially. The two light beams travel in circular paths in opposite directions before being detected at the detector. A circular mirror is used to make light travel in circular path.

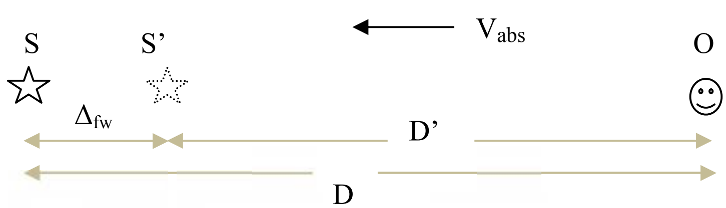
Consider the light emitted in the forward direction. This case can be considered to be an absolute translation problem already discussed, with the observer in front of the source.



From our previous analysis:

$$D' = D_{bw} = D\frac{c}{c - V_{abs}} = 2\Pi R\frac{c}{c - V_{abs}} \quad \text{and} \quad \Delta_{bw} = D\frac{V_{abs}}{c - V_{abs}}$$

The case for light emitted backwards can be represented as follows.



$$D' = D_{fw} = D\frac{c}{c + V_{abs}} = 2\Pi R\frac{c}{c + V_{abs}} \quad \text{and} \quad \Delta_{fw} = D\frac{V_{abs}}{c + V_{abs}}$$

The observer sees two different apparent sources when looking in the backward direction and when looking in the forward direction. The distance of the apparent source when looking in the backward direction, D_{bw} , is greater than the physical source observer distance D = 2ΠR. The distance of the apparent source when looking in the forward direction, D_{fw} , is less than the physical source observer distance D = 2ΠR.With the apparatus rotating, a fringe shift will be observed at the detector because $D_{bw} > D_{fw}$.

The path difference of the forward and back ward beams will be:

$$\Delta = \Delta_{fw} + \Delta_{bw} = D \frac{V_{abs}}{c + V_{abs}} + D \frac{V_{abs}}{c - V_{abs}} = D \frac{2V_{abs}c}{c^2 - V_{abs}{}^2}$$

But

D = 2ΠR and $V_{abs} = \omega R$

From which

$$\Delta = 2\pi R \frac{2V_{abs}c}{c^2 - V_{abs}{}^2} = 4\pi R \frac{\omega R c}{c^2 - \omega^2 R^2} = 4\pi R^2 \frac{\omega c}{c^2 - \omega^2 R^2} = 4A \frac{\omega c}{c^2 - \omega^2 R^2}$$

where $A = \Pi R^2$ is the area of the circle.

Dividing both the numerator and denominator by c^2

$$\Delta = \frac{4\omega A c}{c^2 - \omega^2 R^2} = \frac{\frac{4\omega A}{c}}{1 - (\frac{\omega R}{c})^2}$$

In the above analysis of a hypothetical Sagnac experiment, we just interpreted it as two absolute translational motions, with the observer chasing the light source and the observer escaping from the light source. There is no reason why we can't consider the Sagnac effect as an absolute translation, at least for this hypothetical, simplest case. This is because the observer is moving along the light paths, just like an observer behind or in front of a light beam, for absolutely co-moving (translating) source and observer.

Even though the analysis of a real Sagnac experiment is fundamentally based on the above interpretation of this hypothetical case, it requires some profound interpretations. The basic questions that need to be answered are:

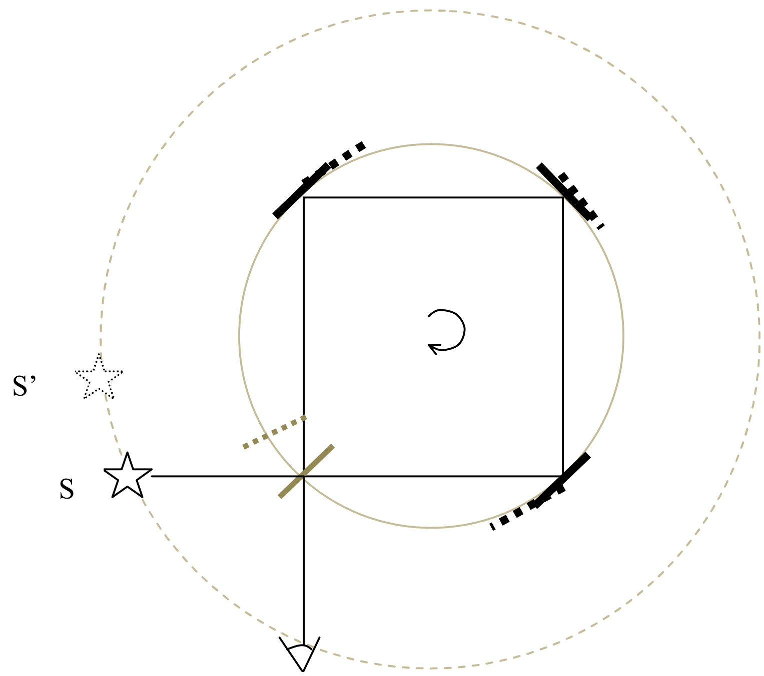
1. How can the apparent source position be determined for a real Sagnac experiment?
2. Are the motion of the mirrors considered?

In the case of Michelson-Morley experiment, all we need to do is to replace the real source with an apparent source. Once we do this, we do not consider the (absolute) motion of the mirrors, as in the conventional analysis of Michelson-Morley experiment by Special relativity and ether theory. The question here is do we not consider the motion of the mirrors in the case of Sagnac experiment also?

To determine the apparent source position, we proceed as follows, as shown in the figure below. It is assumed that the source and observer move along the same circular path in this case, since the radius of the two circular paths is equal, for simplicity. What is the 'direct' source observer distance in this case ? We have interpreted the source observer 'direct' distance to be the length of the circular path along which the source and observer move in the analysis of the hypothetical Sagnac experiment above. We apply the same interpretation in the analysis of real Sagnac experiment. We assume that light emitted by the source in the forward and backward directions move along the circular path shown, by imagining a circular mirror (even if there is no such mirror in the experiment) to make the forward and backward light beams travel in a circular path. Then we can determine the apparent source position easily as discussed already.

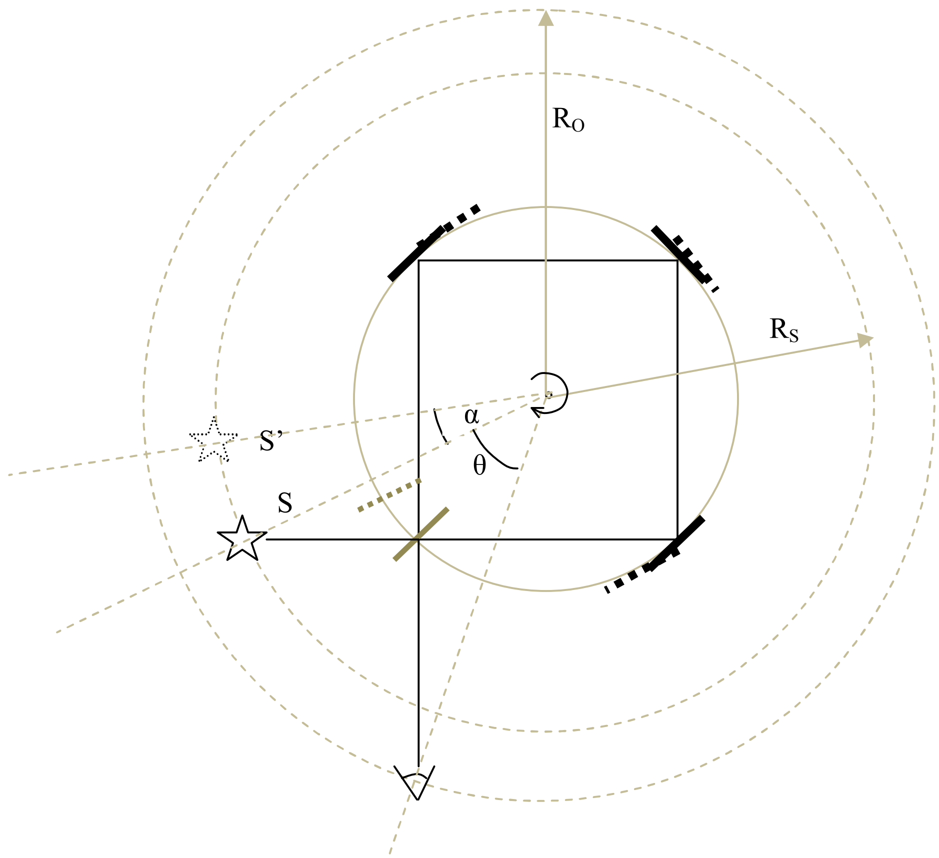
The second question is whether we consider the motion of the mirrors in the case of Sagnac experiment. Remember the procedure of analysis for any light speed experiment.

1. Replace the real source with an apparent source
2. Analyze the experiment by assuming that the speed of light is constant relative to the apparent source.

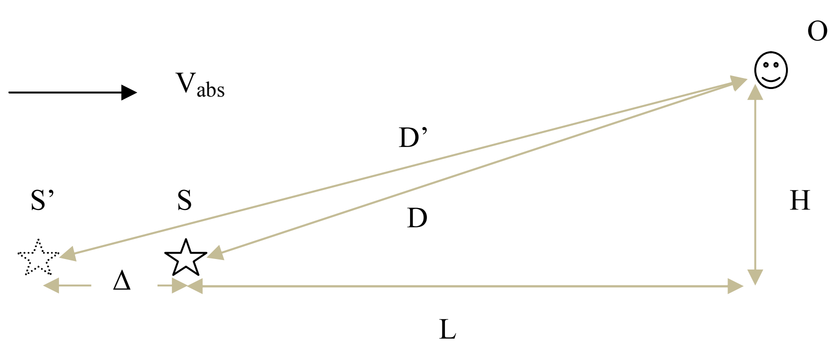


Applying this procedure to the real Sagnac experiment, we replace the real source with an apparent source as shown, then assume that the speed of light is constant relative to the apparent source S'. In other words we apply emission theory after replacing the real source with an apparent source. This would obviously predict a fringe shift because of path difference.

In the above case, we assumed that the source and detector move along the same circular path. In general this is not the case.



'Unwinding' this apparatus we get the following, for the case when the observer looks backwards.



$$L = 2\pi R_s \frac{360 - \theta}{360}$$

$$H = R_O - R_S$$

We substitute the above expressions for L and H in to the following equation to determine D.

$$L^2 + H^2 = D^2$$

Once we determine D, we can determine D' as follows.

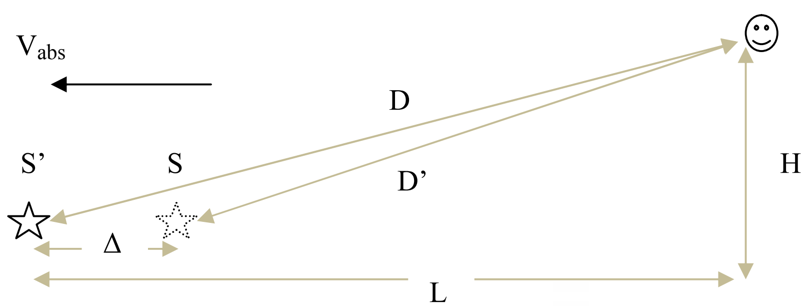
$$\frac{D'}{c} = \frac{\Delta}{V_{abs}}$$

and

$$\sqrt{D'^2 - H^2} - \sqrt{D^2 - H^2} = \Delta = \Delta_{bw}$$

From the last two equations we determine $\Delta = \Delta_{bw}$.

The case for the observer looking forward is represented as follows.



$$L = 2\pi R_s + 2\pi R_s \frac{\theta}{360}$$

$$H = R_O - R_S$$

We substitute the above expressions for L and H in to the following equation to determine D.

$$L^2 + H^2 = D^2$$

Once we determine D, we can determine D' as follows.

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

and

$$\sqrt{D^2 - H^2} \;-\; \sqrt{D'^2 - H^2} \;=\; \Delta = \Delta_{fw}$$

From the last two equations we determine $\Delta = \Delta_{fw}$.

The path difference of the forward and backward light beams will be

$$\delta = \Delta_{fw} + \Delta_{bw}$$

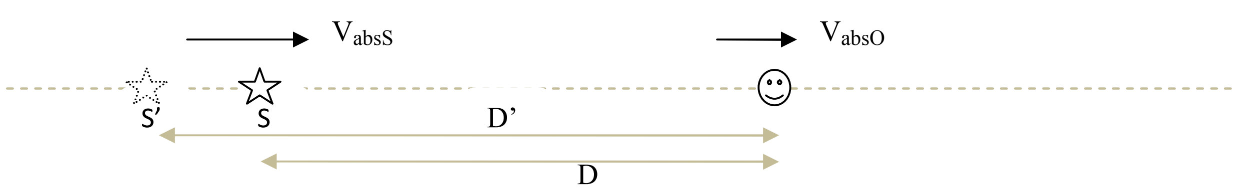
Source and observer in absolute and relative motion

So far we have considered the specific case of absolutely co-moving source and observer in which both the source and observer have a common absolute velocity. This is a specific case of the general case in which the source and the observer can have different, independent absolute velocities. The principle governing any light speed problem is proposed as follows.

The procedure of analysis of any light speed experiment is as follows:

1. Determine the distance between the observer and the apparent source *at the instant of emission*
2. From the absolute velocities of the source and the observer, determine the velocity of the source relative to the observer, from which the velocity of the *apparent* source *relative* to the observer will be determined
3. Solve the problem by assuming that the speed of light is constant *relative to the apparent source*

The apparent position of the source relative to the observer is determined solely by the absolute velocity of the source and the source observer distance D at the instant of light emission. Once the apparent position of the source (at instant of emission) is determined, we consider the effect of observer's absolute velocity. The velocity of the source *relative* to the observer is determined from observer's absolute velocity and source absolute velocity. From source observer relative velocity V, we determine the velocity V' of the apparent source relative to the observer. Once we determine the apparent source position D'at the instant of light emission and the apparent source velocity V', we analyze the problem by assuming the speed of light to be constant relative to the apparent source.



The apparent source position at the instant of emission and the apparent source velocity are determined as follows:

$$D' = D\frac{c}{c - V_{absS}} \quad \Rightarrow \quad \frac{dD'}{dt} = V' = \frac{dD}{dt}\frac{c}{c - V_{absS}} = V\frac{c}{c - V_{absS}}$$

where V and V' are the velocity of the source and of the apparent source relative to the observer.

But

$$V = V_{absS} - V_{absO} \quad , \quad \text{for } V_{absS} > V_{absO}$$

The time delay τ between emission and observation of light is:

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

(the plus sign is because the source and observer are approaching each other)

Substituting the previous values for D' , V' and V,

$$D' = D\frac{c}{c - V_{absS}} \quad , \quad V' = V\frac{c}{c - V_{absS}} \quad , \quad V = V_{absS} - V_{absO}$$

we get

$$\tau = \frac{D}{c - V_{absO}}$$

We see that the (absolute) velocity of the source V_{absS} does not appear in the above equation.

We can determine the velocity (c_o) of light relative to the observer as follows.

$$c_0 = c + V' = c + V\frac{c}{c - V_{absS}} = c + (V_{absS} - V_{absO})\frac{c}{c - V_{absS}}$$

$$= c\,\frac{c - V_{absO}}{c - V_{absS}}$$

We see that this result is distinct from (c - V_{absO}) , which is the velocity of light relative to the observer in ether theory, where V_{absO} is the velocity of the observer relative to the ether.

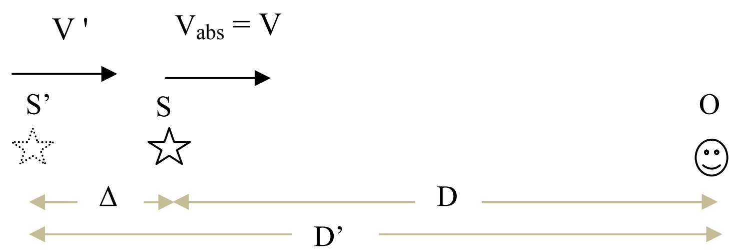
The general formula will be:

$$c_0 = c\,\frac{c \pm V_{absO}}{c \pm V_{absS}}$$

Moving source, observer at absolute rest

Now we apply the above general analysis to the specific case of moving source and stationary observer.

Consider a light source moving towards an observer that is at absolute rest. We want to show that the speed of light is independent of the speed of the source.



Assume that the distance between source and observer *at the instant of light emission* is D. Assume also that the observer is at absolute rest.

The procedure of analysis is to determine the distance between the *apparent source* and the observer at the instant of emission and the velocity of the apparent source relative to the observer.

The apparent source distance D' is :

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

The velocity V' of the apparent source is determined by differentiating both sides of the above equation with respect to time:

$$D' = D\frac{c}{c - V_{abs}} \Rightarrow \frac{dD'}{dt} = \frac{dD}{dt}\frac{c}{c - V_{abs}} \Rightarrow V' = V\frac{c}{c - V_{abs}}$$

where V is the velocity of the real source and V' is the velocity of the apparent source.

According to AST, the speed of light is constant relative to the apparent source. So the speed of light relative to the observer will be $c + V'$. Therefore, the time elapsed between emission and detection of light will be:

$$T = \frac{D'}{c + V'} = \frac{D\frac{c}{c - V_{abs}}}{c + V\frac{c}{c - V_{abs}}} = \frac{Dc}{c\,(c - V_{abs} + V\,)} = \frac{D}{c}$$

This shows that the physically measured speed of light is independent of source velocity, as confirmed by several experiments.

Moving observer, source at absolute rest

Now consider a light source that is at absolute rest and an observer moving away from the light source with velocity V.

Let us restate the procedure of analysis:

1. Determine the distance between the observer and the apparent source *at the instant of emission*
2. From the absolute velocities of the source and the observer, determine the velocity of the source relative to the observer, from which the velocity of the *apparent* source *relative* to the observer will be determined
3. Solve the problem by assuming that the speed of light is constant *relative to the apparent Source*

From

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

1. Since the absolute velocity of the source is zero, D' = D. i.e. the apparent source is at the same position as the real source.

2. The velocity of the apparent source relative to the observer is, therefore, equal to the observer's velocity V itself.

3. Since the speed of light is constant relative to the apparent source, the (group) velocity of light will be variable relative to the observer, equal to c ± V.

Therefore, the light will be observed by the observer after a time delay of

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

Discussion

In this paper, no attempt has been made to explain the physical meaning of Apparent Source Theory (AST). The main aim of this paper is to present a new *model* of the speed of light that can consistently predict and explain the results of light speed experiments.

As a very successful theory, AST also gives profound implications regarding the fundamental nature of light. The puzzle of light being a local or a non-local phenomenon is long standing and is still unsolved. The solution to the puzzle is proposed as follows:

Light is a dual phenomenon: local and non-local (action at a distance).

The other important problem is the implication of AST on Maxwell's equations. The electric and magnetic fields at every point in space seem to be controlled independently by the source. Consider absolutely co-moving source and observer. The light detected at the point of observation is more accurately understood as coming directly at the speed of light from the *apparent* source, and not from an adjacent point as in local phenomenon (e.g. sound wave). What is meant here is that light at point of observation comes from adjacent points of space, but you can't observe this physically but we just imagine it. If one tries to observe what is happening at an adjacent point, they will detect a wave coming to that point only. To every point of observation comes *its own* wave. If the source is at absolute rest, light can be modeled accurately as a local phenomenon. Light is a dual phenomenon: local and non local. The current understanding of Maxwell's equations is based on a tacit assumption of the ether. Electromagnetic wave is still thought to be a local phenomenon, just as material waves, which is wrong. An EM wave propagates from the (apparent) source to the point of observation. We should not think this as material waves. We can't observe the propagation of the wave in the path between the apparent source and the observer: we just imagine it. *Each point in space surrounding the source observes its own, independent EM wave.* This is the distinction between electromagnetic waves and material waves. In material waves, all points along the path see the same wave, only differing in phase. *In the case of a light source (an EM wave source), an independent wave propagates to each point in space !*

Conclusion

We have seen that Apparent Source Theory (AST) can consistently explain the Michelson-Morley experiment, Sagnac effect, moving source experiments, and moving observer experiments. Existing theories of light including Special Relativity, ether theory and emission theory fail on least on one of these experiments. AST not only explains light speed experiments, but also hints on the fundamental nature of light.

References

1. Absolute/Relative Motion and the Speed of Light, Electromagnetism, Inertia and Universal Speed Limit *c* - an Alternative Interpretation and Theoretical Framework, by Henok Tadesse, Vixra

Thanks to God and His Mother, Our Lady Saint Virgin Mary