An Interferometer Experiment that can be Many Orders of Magnitude More Sensitive than the Michelson-Morley Experiment

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Abstract

In this paper, an interferometer experiment that can be highly sensitive to absolute motion is proposed. This has been possible because the new theory (Apparent Source Theory) already proposed by this author revealed the fallacy in conventional and modern Michelson-Morley experiments.

Introduction

The failure of the Michelson-Morley experiment to detect absolute motion is normally cited as the main evidence for the theory of relativity. However, this author proposed a theory (Apparent Source Theory)[1] that can consistently explain not only the Michelson-Morley experiment and the Kennedy-Thorndike experiment, but also the Sagnac effect, moving source and moving mirror experiments, the Silvertooth experiment, the Marinov experiment, the Roland De Witte experiment, the (Bryan G Wallace) Venus planet radar range anomaly and other experiments. Apparent Source Theory reveals the fallacy in conventional and modern Michelson-Morley experiments. This enabled the conception of experiments that are capable to detect absolute motion. In this paper we present such an experiment that is, according to Apparent Source Theory (AST), highly sensitive to absolute motion. We will not discuss AST in detail in this paper. For a detailed discussion of Apparent Source Theory and the fallacy in Michelson-Morley experiments, see[1].

The new interferometer experiment

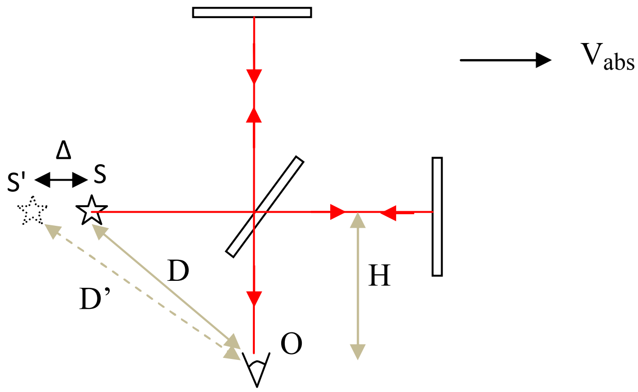
According to Apparent Source Theory, for absolutely co-moving light source and observer , the effect of absolute motion is just to create an apparent change in position of the light source relative to the observer (as seen by the observer/detector). This reveals the fallacy in the Michelson-Morley experiment (discussed in [1]) that no fringe shift is possible because the effect of absolute motion is just to create an apparent change in source position relative to the observer. Apparent change of source position will not create any significant fringe shift for the same reason that an actual change in source position will not create any significant fringe shift.

The effect of absolute motion on the Michelson-Morley interferometer is just to create an apparent change in source position *as seen from the point of observation/detection*. To analyze the experiment, we follow the following procedure:

1. Replace the real source by an apparent source. For this we use the *direct* distance between source and observer/detector.
2. Analyze the experiment by assuming the speed of light to be constant relative to the apparent source.

This means that once we have replaced the real source by an apparent source, we just assume Galilean space. In Galilean space emission theory holds. Our discussion here is restricted to co-moving source and observer, with constant velocity (i.e. without acceleration).

With this theory, all observers predict the null result of the Michelson-Morley experiment.



Observer/ detector

The analysis is as follows.

During the time interval that the light source moves from position S' to position S, the light goes from the apparent source S' to the observer/detector O. Note that we are talking about the light ray that goes to the observer/detector *directly* from the apparent source S'. This doesn't mean that the observer should necessarily detect the direct light from the (apparent) source. The observer may not detect any direct light from the (apparent) source because of an obstacle between the light source and the observer/detector. It is only required that there is a finite probability that the source emits photons *in the direction of* the observer/detector.

Therefore

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

and

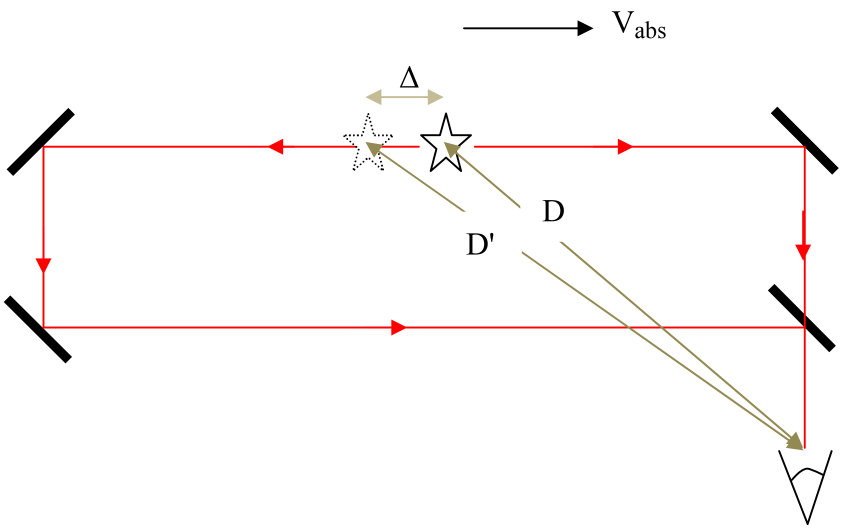
$$\sqrt{D'^2 - H^2} - \sqrt{D^2 - H^2} = \Delta$$

From the above two equations, Δ can be determined.

Now it is easy to see why no fringe shift should occur. Change (apparent or actual) of position of the light source will not create any significant fringe shift because the time delay of both the longitudinal and transverse light beams are affected identically. In the present case, *both* light beams are delayed by an amount

$$\delta\tau = \frac{\Delta}{c}$$

Next we propose an experiment that is sensitive to absolute motion, which is the subject of this paper. A hypothetical experiment that is capable of detecting absolute velocity is shown below.



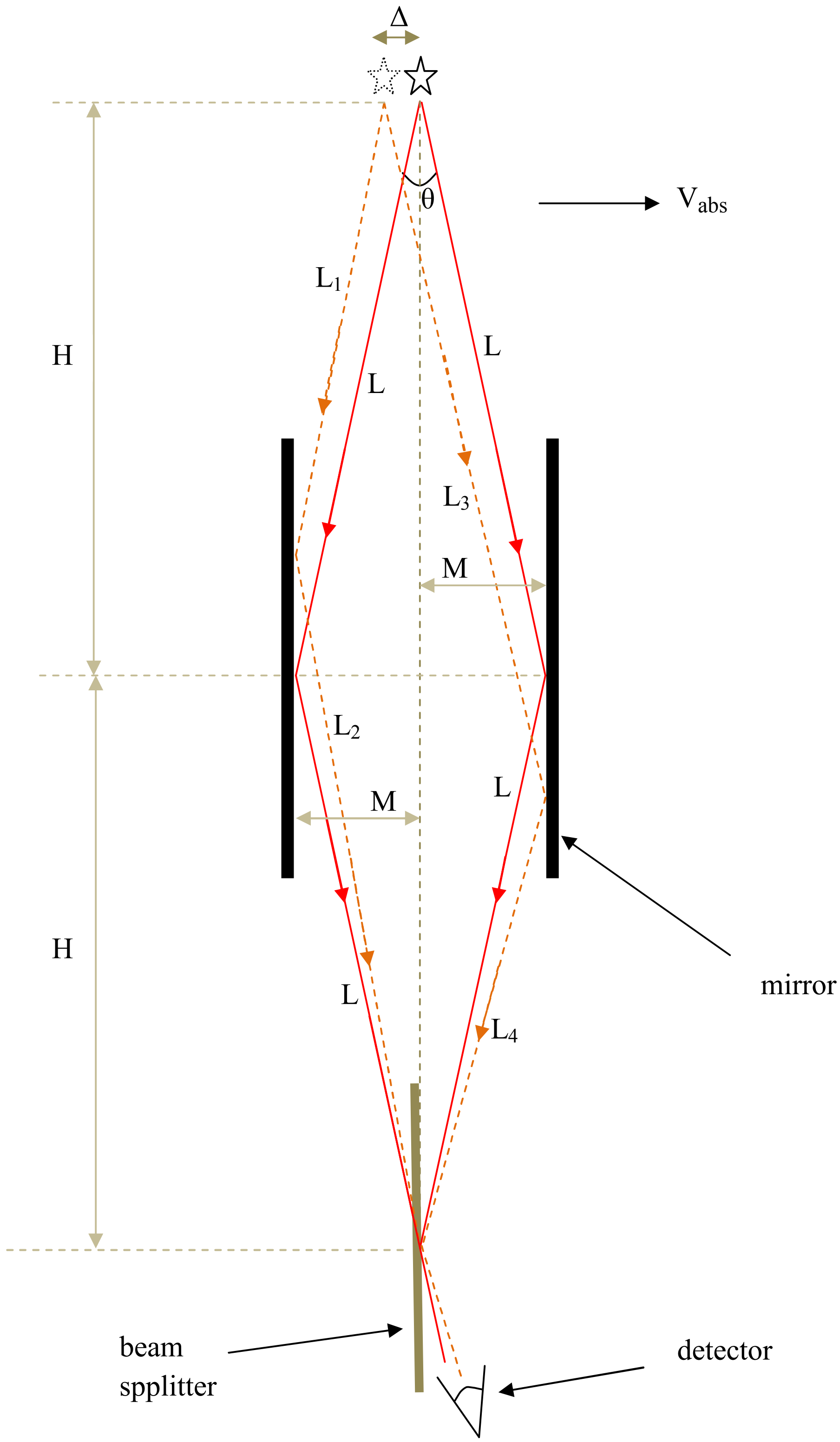
The source in this experiment should emit a photon in either direction with nearly equal (or comparable) probabilities, so that the photon interferes with itself at the detector. This is why the experiment is called hypothetical. Real macroscopic light sources cannot emit a single photon in opposite directions. Theoretically an isolated atom can be used as the source, since it can emit (nearly) equally in both directions. Real sources cannot be used since atoms in real sources cannot emit a photon in opposite directions. No beam splitter should be used to send a photon in opposite directions so that it interferes with itself at the detector, as in the Michelson-Morley experiment; the experiment will fail to detect absolute motion if a beam splitter is used.

As the apparatus is absolutely moved to the right, the path length of the right beam is lengthened and the path length of the left beam is shortened. A very large fringe shift will be observed ! For example, if distance D is about one meter, Δ is of the order of one millimeter, for absolute velocity 390 Km/s. One millimeter is about 2063 wavelengths, for $\lambda = 630$ nm !. From [1]

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

A more practical version of the above experiment is shown below. It contains a light source, two parallel plane mirrors, a beam splitter and a detector.

In the experiment shown below it is assumed that each photon has comparable probability of going to the right or to the left mirror. This may be true for small angles θ , but the experiment may become less sensitive to absolute motion as angle θ becomes small. Let us try to analyze this experiment to see if is sensitive enough to detect Earth's absolute velocity.


Δ
θ
Vabs
L1
L
L
H
L3
M
L2
M
L
H
L
L4
mirror
beam
spplitter
detector

With zero absolute velocity, the difference in path lengths, and hence time delays, of the two light beams is zero.

$$\delta\tau = \frac{2L}{c} - \frac{2L}{c} = 0$$

For non-zero absolute velocity ($V_{abs} \neq 0$), we proceed as follows to determine the difference in the path lengths of the two light beams.

For the left light beam (L_1L_2), since angle of incidence is equal to angle of reflection:

$$\frac{M - \Delta}{L_1} = \frac{M}{L_2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \ (1)$$

and

$$\sqrt{{L_1}^2 - (M - \Delta)^2} + \sqrt{{L_2}^2 - M^2} = 2H \quad \ldots\ldots\ldots\ldots (2)$$

For the right light beam (L_3L_4), since angle of incidence is equal to angle of reflection:

$$\frac{M + \Delta}{L_3} = \frac{M}{L_4} \qquad \ldots\ldots\ldots\ldots\ldots\ldots. \ (3)$$

and

$$\sqrt{{L_3}^2 - (M + \Delta)^2} + \sqrt{{L_4}^2 - M^2} = 2H \quad \ldots\ldots\ldots\ldots\ldots.. (4)$$

From equations (1)

$$L_2 = \frac{M}{M - \Delta} L_1$$

Substituting the above value of L_2 into equation (2)

$$\sqrt{{L_1}^2 - (M - \Delta)^2} + \sqrt{\left(\frac{M}{M - \Delta} L_1\right)^2 - M^2} = 2H$$

Let

$${L_1}^2 = a$$

$$\sqrt{a - (M - \Delta)^2} + \sqrt{\left(\frac{M}{M - \Delta}\right)^2 a - M^2} = 2H$$

Squaring both sides:

$$a-(M-\Delta)^2 + \left(\frac{M}{M-\Delta}\right)^2 a - M^2 + 2\sqrt{a-(M-\Delta)^2}\sqrt{\left(\frac{M}{M-\Delta}\right)^2 a - M^2} = 4H^2$$

$$a-(M-\Delta)^2 + \left(\frac{M}{M-\Delta}\right)^2 a - M^2 + 2\,\frac{M(a-(M-\Delta)^2)}{M-\Delta} = 4H^2$$

$$a\left(1+\left(\frac{M}{M-\Delta}\right)^2+\frac{2M}{M-\Delta}\right)-(M-\Delta)^2-M^2-2M(M-\Delta) = 4H^2$$

$$a=\frac{(M-\Delta)^2+M^2+2M(M-\Delta)+4H^2}{\left(1+\left(\frac{M}{M-\Delta}\right)^2+\frac{2M}{M-\Delta}\right)}$$

$$\Rightarrow a = {L_1}^2 = \frac{(M-\Delta)^2\left((M-\Delta)^2+M^2+2M(M-\Delta)+4H^2\right)}{(M-\Delta)^2+M^2+2M(M-\Delta)}$$

From equations (3)

$$L_4 = \frac{M}{M+\Delta}\,L_3$$

Substituting the above value of L_4 into equation (4)

$$\sqrt{{L_3}^2-(M+\Delta)^2} + \sqrt{\left(\frac{M}{M+\Delta}\,L_3\right)^2 - M^2} = 2H$$

Let

$${L_3}^2 = b$$

$$\sqrt{b-(M+\Delta)^2} + \sqrt{\left(\frac{M}{M+\Delta}\right)^2 b - M^2} = 2H$$

Squaring both sides:

$$b-(M+\Delta)^2 + \left(\frac{M}{M+\Delta}\right)^2 b - M^2 + 2\sqrt{b-(M+\Delta)^2}\sqrt{\left(\frac{M}{M+\Delta}\right)^2 b - M^2} = 4H^2$$

$$b-(M+\Delta)^2 + \left(\frac{M}{M+\Delta}\right)^2 b - M^2 + 2\,\frac{M(b-(M+\Delta)^2)}{M+\Delta} = 4H^2$$

$$b\left(1+\left(\frac{M}{M+\Delta}\right)^2+\frac{2M}{M+\Delta}\right)-(M+\Delta)^2-M^2-2M(M+\Delta)=4H^2$$

$$b=\frac{(M+\Delta)^2+M^2+2M(M+\Delta)+4H^2}{\left(1+\left(\frac{M}{M+\Delta}\right)^2+\frac{2M}{M+\Delta}\right)}$$

$$\Rightarrow b={L_3}^2=\frac{(M+\Delta)^2\left((M+\Delta)^2+M^2+2M(M+\Delta)+4H^2\right)}{(M+\Delta)^2+M^2+2M(M+\Delta)}$$

For example, we can compute the values for L_1, L_2, L_3, L_4 given the following.

H = 10m , M = 0.1m

Since

$$\Delta \approx \frac{V_{abs}}{c} D \qquad \text{and} \qquad D = 2H$$

$$\Delta = \frac{390Km/s}{300000Km/s} * 20m = 0.026m = 2.6\ cm$$

Using Excel, I computed the difference in the path lengths of the two light beams for H = 10m , M = 0.1m and Δ = 0.026m

$$(L_3+L_4)-(L_1+L_2)=519973\ nm$$

For a wavelength of λ=630nm , we observe a fringe shift of

$$\frac{519973nm}{630nm}\approx 825\ wavelengths\ !$$

This is an extremely sensitive experiment !!!

The angle θ is:

$$\frac{\theta}{2}=tan^{-1}\left(\frac{M}{H}\right)\Rightarrow \quad \theta=2tan^{-1}\left(\frac{M}{H}\right)\Rightarrow\theta=2tan^{-1}\left(\frac{0.1}{10}\right)=0.02\ radians$$

$$\Rightarrow \quad \theta = 1.146\ degrees$$

For H = 1.5m , M = 0.02m , Δ = 0.0039m = 3.9 mm

$$(L_3 + L_4) - (L_1 + L_2) = 103990.6\,nm$$

For a wavelength of λ=630nm , we observe a fringe shift of

$$\frac{103990.6nm}{630nm} \approx 165\,wavelengths\,!$$

The angle θ is:

$$\frac{\theta}{2} = tan^{-1}\left(\frac{M}{H}\right) \Rightarrow \quad \theta = 2tan^{-1}\left(\frac{M}{H}\right) \Rightarrow \theta = 2tan^{-1}\left(\frac{0.02}{1.5}\right) = 0.0267\,radians$$

$$\Rightarrow \quad \theta = 1.53\,degrees$$

The main question that remains is if the angle θ is small enough so that a light emitting atom emits photons with comparable probabilities within this angle.

Conclusion

In this paper we have proposed an experiment that not only detects absolute motion with extreme sensitivity but also reveals the fallacy in the Michelson-Morley experiment.

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

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