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

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Abstract

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

Introduction

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

In 1913, A. Michelson carried out an experiment to test this hypothesis [1]. The outcome of the experiment indicated that the speed of light reflected from a moving mirror is constant c independent of mirror velocity, to a high degree of precision. With the advent of Albert Einstein's special relativity theory, and with additional experimental counter evidences such as moving source experiments, the classical emission theory was abandoned, with few advocates today [2].

Many years later, in 1967, an experiment was being carried to test Einstein's gravitational time dilation by bouncing radar pulses grazing the sun off the planet Venus, as proposed by Irwin Shapiro. As disclosed by Bryan G Wallace, large 'anomalous' first order variations in the time delay data were found in the raw data, in complete disagreement with Einstein's light postulate, but conforming to the long forgotten classical emission /ballistic theory.

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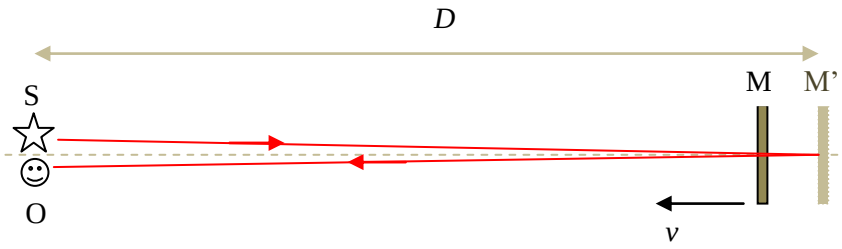
In this paper, I present a new model of the speed of light reflected from a moving mirror that resolves these contradictions. It turns out that the same mystery underlies the A. Michelson moving mirror experiment, the Venus planet radar range data anomaly, and the controversial Lunar Laser Ranging experiment.

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

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

Consider a light source S, an observer O and a mirror M. The mirror is moving with velocity *v relative to the observer*, towards the observer, as shown below.



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

The new theory is that the result of the experiment (in this case the time delay between emission of light from the source and detection of reflected light by the observer) is, inexplicably, determined only by two factors.

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

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

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

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

Let the distance between the source and the mirror be D at the instant of light emission, as shown above.

Therefore, the round trip time of the light will be:

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

The new model is unlike all classical theories (emission theory and ether theory) and special relativity. All these theories agree on the fact that the point where light is reflected from a moving mirror depends on the mirror velocity. In all of these theories, the speed of light (which depends on the respective

theories) and the velocity of the mirror are to be taken into account to determine the point where light is reflected from the mirror.

Next we apply this model to some known experiments.

The A. Michelson moving mirror experiment

We analyze the A. Michelson's 1913 moving mirror experiment [1] as follows.

T_1 is the time taken by the beam along the path ADECBA (Fig.1)

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

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

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

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

where

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

Therefore,

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

The fringe shift will be:

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

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

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

$$\Rightarrow \Delta \cong \frac{-8D}{c}\ \frac{v}{\lambda}$$

Except for the negative sign, this formula is the same as Michelson's formula that was confirmed by his experiment!

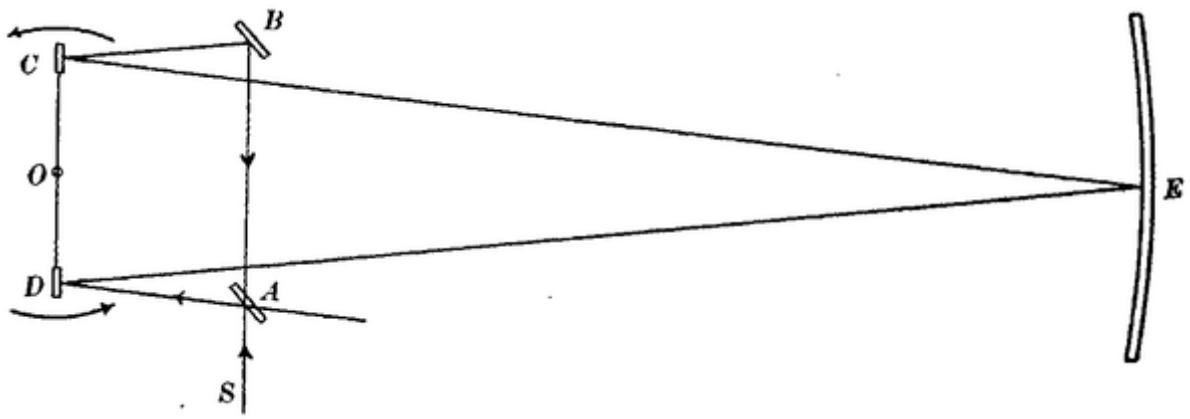
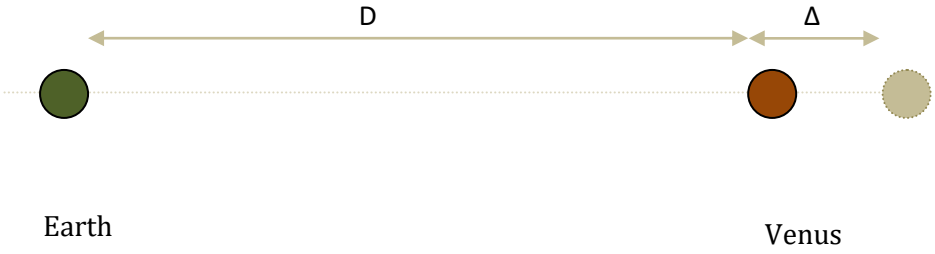


Fig.1. The A. Michelson's 1913 moving mirror experiment.
This image is taken from Michelson's paper.

The Venus planet radar ranging experiment

The Venus planet radar range anomaly, as announced by Bryan G.Wallace [3], is analyzed as follows.

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



The round trip time of the pulse is:

$$\tau = t_1 + t_2$$

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

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

where *v* is Earth-Venus relative velocity.

Therefore, the round trip time τ will be:

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

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

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

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

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

where

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

Therefore,

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

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

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

$$\Rightarrow D \cong \frac{\tau c}{2}\frac{c^2+vc}{c(c+v)} \quad , \text{ since } 2v^2 \ll c^2+vc$$

$$\Rightarrow D \cong \frac{\tau c}{2}$$

This is the same formula that Bryan G. Wallace [3] claimed the Venus radar range data indicated!

Lunar Laser Ranging experiment

Yet another experimental evidence against special relativity's constancy of the speed of light has been uncovered in [4]. The new analysis of this experiment is similar to the analysis of the Venus planet radar ranging experiment discussed above.

Conclusion

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

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

Notes and references

1. *Effect of Reflection from a Moving Mirror on the Velocity of Light*, by Albert Abraham Michelson , 1913

2. Even compared to ether theory, emission theory has few advocates today.

3. *RADAR TESTING OF THE RELATIVE VELOCITY OF LIGHT IN SPACE*, by Bryan G. Wallace

4. *Lunar Laser Ranging Test of the Invariance of c*, by Daniel Y. Gezari