Experimental detection of the ether

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Abstract

Michelson-Morley type experiments are shown to be non-sequitors because their logic fails to take into account the relationship between wavelenght and propagation velocity. An experimental demostration of anisotropy in wavelenght is described.

The experimental evidence cited to support the principle of relativity derives mainly from the Michelson-Morley experiment[1] and subsequently variants based on the same logic. That logic fails to take into account the relationship

$$c = \nu\lambda \tag{1}$$

If a source and receiver are comoving, and if c (the speed of light) changes, then λ (the wavelenght) must also change. The frequency ν cannot change as this would result in a continous increase or diminution of teh number of waves in the path, a circunstance in conflict with thermodynamics. It is, therefore, impossible to measure the one-way velocity of light by these means since, for example, if the velocity c were doubled, the wavelenght λ would also be doubled, and some crest would pass two points with the same time lapse as if the two parameters were not doubled. Light pulses generated by choppers of one sort or another behave in the same manner because a pulse is an ensemble of sine waves as taught by Fourier. The methods of Roemer and Bradley to measure the one-way velocity, while valid, are inconvenient to laboratory implementation.

Taking either leg of the Michelson-Morley interferometer the round trip transit time may be written as

$$t = \frac{L}{c_1} + \frac{L}{c_2} = \frac{L}{\nu\lambda_1} + \frac{L}{\nu\lambda_2} \tag{2}$$

which for the case $c_1 - c_2 = \mathbf{c}$ sums to $\frac{2L}{\nu\lambda}$, which, because the experiment yields a null result, must hold for all values of c_1 and c_2 if these can be unequal as will be shown to be the case. The equation for either leg of a Michelson interferometer may thus be written as

$$\frac{L}{\lambda_1} + \frac{L}{\lambda_2} = \frac{2L}{\lambda} \tag{3}$$

and the experiment is not to be definitive as the single equation contains two unknows. For the second equation it is necessary to turn to the experiment of Sagnac.[2]

[1] Feynman, Lecture on Physics Vol. 1, Ref. 1
[2] Sagnac, G., C. R., Ref. 2

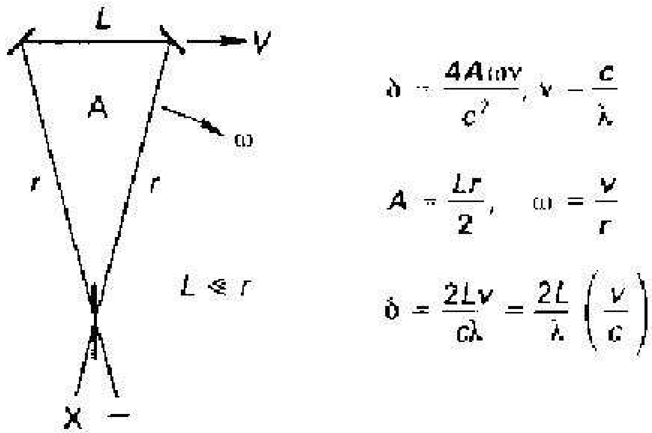

Figure 1: The Sagnac Interferometer

A particular geometry of the Sagnac interferometer is shown in Figure 1, that is, the centre of rotation is chosen to coincide with the beam splitter location. The Sagnac phase shift is independent of the location of the centre of teh rotation and the shape of the area. The equations accompanying Figure 1 shows that the phase shift along L is independent of r, that is, teh phase shift along L is preserved when L in pure translation. The difference in number of wavelenghts in reciprocal directions along path L may be written as

$$\frac{L}{\lambda_1} - \frac{L}{\lambda_2} = \frac{2L}{\lambda}\left(\frac{v}{c}\right) \tag{4}$$

Solving equations (3) and (4) for λ_1 and λ_2 we have

$$\lambda_1 = \frac{\lambda}{1+\frac{v}{c}}, \lambda_2 = \frac{\lambda}{1-\frac{v}{c}}, or c_1 = \frac{c}{1+\frac{v}{c}}, c_2 = \frac{c}{1-\frac{v}{c}} \tag{5}$$

Equations (5) show that the number of wavelenghts in the round trip becomes

$$n = \frac{L}{\lambda}\left(1+\frac{v}{c}\right) + \frac{L}{\lambda}\left(1-\frac{v}{c}\right) = \frac{2L}{\lambda} \tag{6}$$

and the round trip transit time becomes

$$t = \frac{L}{c}\left(1+\frac{v}{c}\right) + \frac{L}{c}\left(1-\frac{v}{c}\right) = \frac{2L}{c} \tag{7}$$

and both n and t are independent of v. Thus the Michelson-Morley experiment requires neither isotropy in c nor the Lorentz contraction to explain the null result. Indeed, the Lorentz contraction, were it real, would yield a fringe shift. For completeness, it is noted that the Mssbauer experiment of Turner and Hill[3] and teh deductions from pulsar observations by Cole[4] are defeated through the

[3] Turner, K.C., and Hill, H.A., Ref. 3
[4] Cole, T.W., Ref. 4

second order by the argument of Tyapkin[5].

While a laboratory measurement of the one-way velocity of light has been shown not to be possible, it is feasible to measure the one-way wavelenght of light, that is, the difference between the rest wavelenght λ and the wavelenght

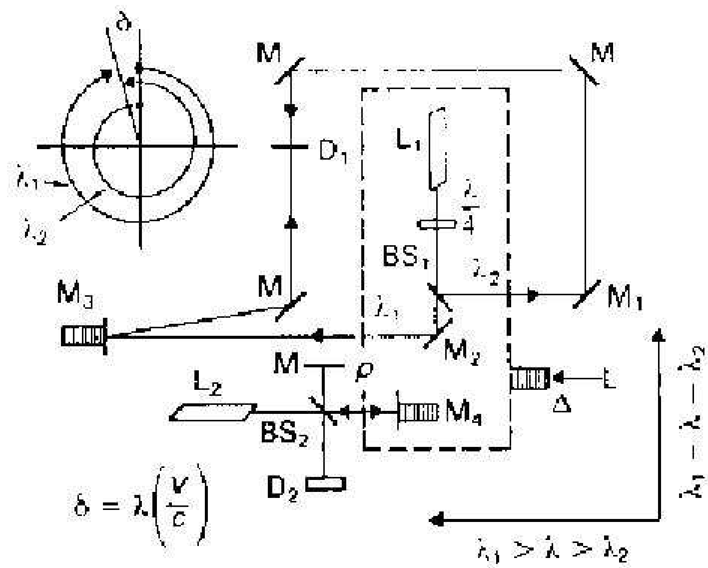

Figure 2: Measurement of the one-way wavelenght of light.

λ_1 and λ_2 as derived in equations (5). The ways to do this are shown in Figure 2. The parts within the dotted rectangle, laser L_1, quarter-wave plate, mirrors and beam splitter, are mounted on a linear slide such that the assembly can move in a direction parallel to the colinear beams M_2M_3 and BS_1M_1. By this means one of the above beams increases in path lenght by just the amount that the other beam decreases. The amount of motion is controlled by a micrometer drive Δ for coarse translation, and an associated piezo stack for fine translation. To ensure that an integral number of rest wavelenghts λ are traversed by the slide, a second interferometer assembly L_2MM_4 is used. The detector D_2 reads a maximum each time Δ changes $\frac{\lambda}{2}$, since the variable path p of that interferometer is round trip and, as seen from equation (6), is independent of any anisotropy in the wavelenght along the direction p.

The first interferometer $L_1M_2M_3M_1$ produces two beams oppositely directed each of which impinges on the detector[6] D_1 which senses its position in the standing wave pattern between the mirrors MM as shown. Mirrors M_3 and M_4 are mounted on piezo stacks excited by a common sine wave source such that the outputs of detectors D_1 and D_2 are also sinusoidal. If then the translating member moves towards M_3 an amount λ, then the wave impinging on D_1 by the route M_3 will advance less than a wave ($\lambda_1 > \lambda$), and the wave impinging on D_1 by the route M_1 will retard more than a wave ($\lambda > \lambda_2$). Thus, the two waves will remain in the same realtive phase, but

[5]Tyapkin, A.A., Ref. 5
[6]Ref. 6

the standing wave pattern will have shifted with respect to the photocathode of the detector D_1 by a first-order amount $\delta = \lambda\left(\frac{v}{c}\right)$. In the experiment the two detectors outputs are first brought into phase. This is accomplished by setting the voltage on the Δ piezo stack such that the output of D_1 is a maximum in either of the two phases the detector output may take. The output of D_2 is then also set to a maximum in the same phase as D_1 by means of a tilting plate phase shifter (not shown) in the path BS_2M. The movable assembly is then shifted some nominal distance Δ with the micrometer drive and teh voltage on that piezo stack is readjusted to restore the D_1 output to a maximum in the same phase as before. These adjustements are made visually from the D_1D_2 outputs as displayed on a dual-gun oscilloscope. The voltage adjustement is by means of a 10-turn potentiometer which makes a precise setting easy to accomplish. If there is no anisotropy in λ in the direction M_2M_3, then the D_2 output will again be in phase with D_1 in the new Δ location. If there is anisotropy in wavelenght then, in general, the output of D_2 will no longer be in phase with D_1. In this circunstance, Δ is adjusted to such a position that when the output of D_1 is set to the initial phase, the output of D_2 is reversed in phase, an arbitrary choice of the experimenter. This situation is obtained without readjustement of the tilting plate phase shifter. The number of rest wavelenghts n through which the linear slide is moved is $\frac{\Delta}{\lambda}$. For the phase reversal of D_2,

$$n\delta = \frac{\lambda}{2} \tag{8}$$

and

$$\frac{v}{c} = \frac{\delta}{\lambda} \tag{9}$$

The apparatus is mounted on an optical table such that it may be rotated about a vertical axis. When the line of travel Δ is oriented in an east-west (EW) direction at a time when the constellation Leo is on the horizon, Δ, as previosly defined, measures $0.25mm$. With the apparatus rotated 90^o (north-south) the outputs of the detectors remain in phase during an excursion of Δ. The detectors also remained in phase in the EW direction when Leo was 6 or 18 hours from the horizon. With a wavelenght of $0.63\mu m$ (HeNe) the velocity, from equation (9) indicates a v of $378km/s$. This value is in reasonable agreement with that of Muller[7] as deduced from the NASA-Ames U2 radiometer measurements.

Because the number of wavelenghts in a path in a moving frame may vary as a function of the velocity of the frame, then the Doppler frequency may be altered. This circunstance provides a satisfactory explanation for such observed, but unexplained, phenomenae as the apparently accelerating universe[8], the anomalous redshift of quasars, and the significant errors in GPS (Satellite Positioning System). As an interesting example the redshift equation contains an additional term, which, depending on the numbers, may dominate the situation

$$v_{obs} = v_{source}\left[\frac{\sqrt{1-\frac{v^2}{c^2}}}{\sqrt{1+\frac{v^2}{c^2}}} + \frac{L\bar{v}}{c^2}\right] \tag{10}$$

if $\bar{v}$ is not zero, because L may be of the order of $10^{27}cm$.

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[7] Ref. 7

[8] Ref. 8

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