Michelson-Morley null result a classical Doppler effect

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PAC 0340 K Waves and wave propagation, general, mathematical aspects
PAC 4280 Optical devices, instruments and application.
PAC 4385 Acoustic measurment and instrumentation.
PAC 0330 Special relativity.

Abstract. Feist [1] has shown the out & back phase velocity of sound to be isotropic with respect to wind $(-\mathbf{v})$ with magnitude $c'(\text{out \& back}) = c(1 - v^2/c^2)$, which results from the oneway phase velocity for the classical Doppler effect, $c' = c(1 - \mathbf{v}\cdot\mathbf{c}/c^2)$. Since light is also a classical wave; and since the Michelson-Morley [2] null result also shows the out & back phase velocity to be isotropic with respect to the ether wind; the M-M null result is also simply a classical Doppler effect.

Phase velocity for a moving observer. - A plane wave in a stationary medium may be represented by

$$\Psi = \sin(\mathbf{k}\cdot\mathbf{r} - \omega t). \tag{1}$$

where $\mathbf{k}$ is the propagation constant and ω is the angular frequency. The unique wave velocity $\mathbf{c}$ in this case equals the phase velocity $\mathbf{c}'$ and the energy velocity $\mathbf{c}^*$ relative to the medium; thus,

$$\mathbf{c} = \mathbf{c}' = \mathbf{c}^* = \mathbf{k}\,\omega/k^2. \tag{2}$$

This wave, Eq.(1), as seen by an observer moving with the velocity $\mathbf{v}$ with respect to the medium may be obtained by making the transformation

$$\mathbf{r} = \mathbf{r}' + \mathbf{v}t, \tag{3}$$

where $\mathbf{r}'$ is some initial position relative to the medium, yielding

$$\Psi = \sin\left[\mathbf{k}\cdot\mathbf{r}' - (\omega - \mathbf{k}\cdot\mathbf{v})t\right]. \tag{4}$$

The phase velocity then becomes

$$\mathbf{c}' = \mathbf{k}\omega'/k^2 = \mathbf{k}\,\omega(1 - \mathbf{k}\cdot\mathbf{v}/\omega)/k^2 = c(1 - \mathbf{c}\cdot\mathbf{v}/c^2). \tag{5}$$

This is the Doppler effect for the phase velocity c'.

This result (5) is independent of the motion of the source; as the wave represented by Eq.(1) is taken as the wave as it already exists in the medium, no matter how it might have been generated originally. This result (5), thus, represents the phase velocity for an observer in an ether wind with the velocity $-\mathbf{v}$.

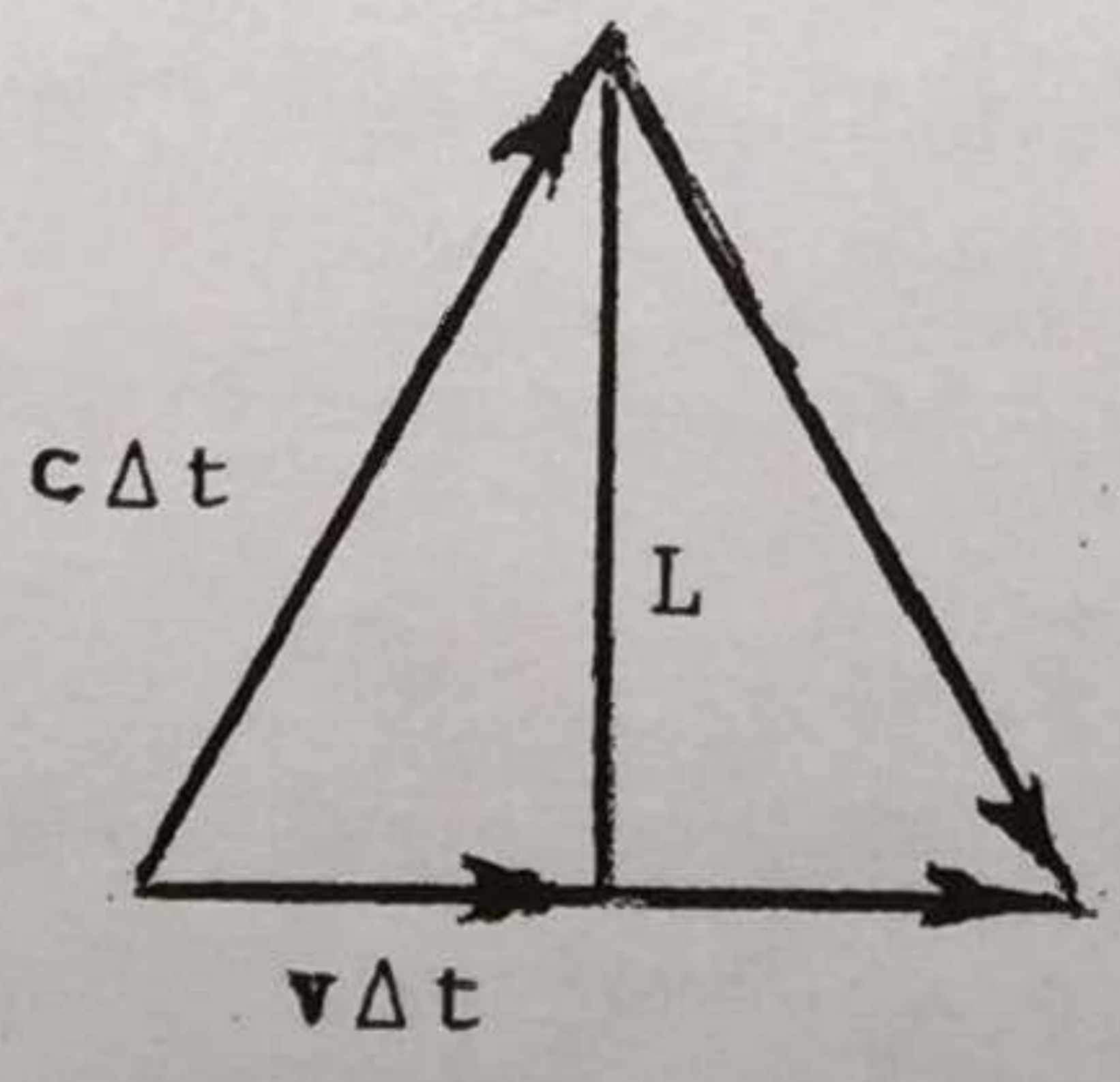
Out & back phase velocity in a wind. - If $\mathbf{c}_+$ is the light velocity as measured with repect to the medium out from the source and $\mathbf{c}_-$ is the velocity back, then the out & back phase velocity is given by

$$\begin{aligned} 1/c'(\text{out \& back}) &= 1/2c(1 - \mathbf{c}_+\cdot\mathbf{v}/c^2) + 1/2c(1 - \mathbf{c}_-\cdot\mathbf{v}/c^2) \\ &= 1/c(1 - v^2/c^2). \end{aligned} \tag{6}$$

This result (6) is isotropic with respect to the direction of the ether wind. This result (6) may be readily proved by a straight forward, but lengthy, analysis. It is sufficient for this Letter to consider the two cases: when light is sent out & back parallel to the ether wind and when the light is sent out & back transverse to the ether wind. For light sent out & back parallel to the ether wind $\mathbf{c}_+\cdot\mathbf{v} = cv$. and $\mathbf{c}_-\cdot\mathbf{v} = -cv$; so Eq.(6) yields

$$1/c'(\text{out \& back}) = 1/2(c - v) + 1/2(c + v) = 1/c(1 - v^2/c^2). \tag{7}$$

which then proves Eq.(6) for this case. Referring to the figure, light



sent out & back from the source transverse to the ether wind yields

$$\mathbf{c}\cdot\mathbf{v} = cv(c/v) = v^2. \tag{8}$$

The phase velocity from Eq.(5) is then seen to be $c(1 - v^2/c^2)$ out as well as back, which then proves Eq.(6) for this case as well. The out & back phase velocity is, thus, seen to be precisely the same for the longitudinal as well as the transverse case.

The particular Michelson-Morley case that is usually considered in the literature is for one interferometer beam travelling out & back in the diorection of the ether wind and the other interferometer beam travelling out & back transverse to the ether wind. Since the phase velocity out & back is precisely the same in these two directions the phase difference between these two beams was found by Michelson and Morley to be null - no fringe shift.

Since the out & back phase velocity is the same for all directions; Michelson and Morley found the same null phase difference between their two interferometer beams for all orientations of their interferometer. In particular, they demonstrated experimentally that the out & back phase velocity for light is isotropic.

Michelson expected a non-null result, because he made the mistake of confusing the energy velocity of light $\mathbf{c}^*$, which is given by

$$\mathbf{c}^* = \mathbf{c} - \mathbf{v}, \tag{9}$$

where $\mathbf{v}$ is the observer's velocity relative to the ether, with the phase velocity given by Eq.(5). The energy velocity cannot, of course, be used to predict the phase difference observed. The phase velocity must be used to predict the phase difference. For the longitudinal case the phase velocity happens to equal the energy velocity; but for the transverse case the out & back energy velocity is $c\sqrt{1 - v^2/c^2}$, which differs from the out & back phase velocity given by Eq.(6).

It has, thus, been proven here that the Michelson-Morley null result is a classical Doppler effect. And the space-time explanation of "special relativity" is wrong, along with it's many other failures [eg., 3].

REFERENCES

[1] FEIST N. 25 page monograph"Über die Lichtgeschwindigkeit in bewegten

Systemen" (2001). Available from author: Leo-Fall-Strasse 26, 86368 Gersthofen, Germany.

[2] MICHELSON A. A. and MORLEY E. W., Am. J. Sci. **34**, 333, 427 (1887).

[3] GALECZKI G. and MARQUARDT P., *Requiem für die Spezielle Relativität* (Haag & Herchen, Frankfurt am Main, 1997).