Foundations of Physics, Vol. 11, Nos. 11/12, 1981

Proposal to Measure Velocity of a Closed Laboratory

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Received December 16, 1980

Uncoupling the mirrors in Marinov's[1] coupled-mirrors experiment allows them to be separated as far apart as desired, and orders of magnitude improvement in accuracy can be obtained for the determination of the absolute velocity of the closed laboratory.

Referring to Prokhovnik[2] and Wesley,[3] it is proposed to mount the two rotating mirrors involved independently rather than on a single shaft. The two mirrors are to be rotated by two independent motors (or clocks) which turn at the same rate. The intensities registered are then given by

$$I^{\pm} = I_0 \cos^2[(\phi^{\pm} + \phi_0)/2] \tag{1}$$

where I_0 is the maximum intensity and

$$\phi^{\pm} = 8\pi^2 RNd/\lambda(c \mp v \cos\theta) \tag{2}$$

where R is the radial position of the mirrors, d is the distance between mirrors, N is the rotational frequency of either motor, $v \cos\theta$ is the projection of the absolute velocity **v** along **d**, and ϕ_0 is a phase constant.

The phase constant ϕ_0 is unknown because the mirrors are uncoupled; but, whatever its value, it remains fixed over times during which the phases of the two motors (or clocks) remain stable. Present day clocks running independently cannot yield a sufficiently constant ϕ_0; but two clocks driven by the same oscillator should keep ϕ_0 constant. It is possible to choose the geometry such that the phase constant ϕ_0 remains the same for the light beam traveling in the plus and minus directions, as indicated in Eq. (1).

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It is possible to choose the phase constant ϕ_0 to have any convenient value by rotating one of the motors (the housing). In particular, it is possible to choose ϕ_0 such that

$$I^+ = I_0/2, \qquad \text{where} \quad \phi_0 = \pi/2 - \phi^+ \tag{3}$$

Substituting Eq. (3) for ϕ_0 into (1) for I^-, using Eq. (2), yields to first order in $v \cos\theta/c$ the result

$$v \cos\theta = (c^2\lambda/16\pi^2 RNd) \sin^{-1}[(I^- - I^+)/I^+] \tag{4}$$

All quantities on the right are observable. The quantity $(I^- - I^+)/I^+$ may be determined using appropriate photodetectors and an electrical bridge network. The quadrant for the arcsine function may be determined by increasing N or d from small values.

A similar analysis and result is obtained when two toothed wheels are used to chop the light beams instead of the interferometric method of chopping discussed here.

The proposed experiment provides an inexpensive and accurate method for checking Marinov's reported results.

REFERENCES

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3. J. P. Wesley, *Found. Phys.* **10**, 803 (1980).