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Comments on Prokhovnik's Critique of Marinov's Experiment(1)

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The essential second half of Marinov's experiment, neglected by Prokhovnik, is discussed.

Prokhovnik misrepresents the facts in his critique of the Marinov coupled-mirrors experiment. Marinov's(2) experiment was *performed* and not merely "proposed." Marinov reports, in fact, the value of 300 ± 20 km/sec, declination $\delta = -23 \pm 4°$, and right ascension $\alpha = 14.3 \pm 0.3^h$ for the absolute velocity of the sun, or solar system.

In order to try to give the impression that Marinov's experiment was not of the requisite accuracy, Prokhovnik simply omits any mention or discussion of the crucial second half of Marinov's experiment: Marinov balanced the interference intensity for the case where the transmitted light beam traveled down the shaft in the direction of the motion of the laboratory $(+v)$ with an independenly obtained interference intensity for the case where the transmitted light beam traveled down the shaft counter to the direction of the motion of the laboratory $(-v)$. The second setup had an independent laser source, independent mirrors, and an independent photoresistor detector, but used the same rotating shaft. It was thus possible to attain two independent interference intensities, identical in every respect, except that one had a phase shift ϕ^+, involving $(+v)$, while the other had a phase shift ϕ^- involving $(-v)$, where

$$\phi^+ = \phi c/(c - v), \qquad \phi^- = \phi c/(c + v), \qquad \phi = 8\pi^2 RNd/\lambda c \tag{1}$$

where N is the rotational frequency of the shaft, d is the length and R the radius of the shaft, and λ is the wavelength of light used.

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The photodetectors were photoresistors which responded linearly to the intensity I of incident light, $R' = a - bI$, where a and b are constants. The fractional difference $\Delta I/I_0 = (I^- - I^+)/I_0$ between the two interference intensities was accurately determined by placing the photoresistors in two of the arms of a Wheatstone bridge. Considering the variation of the interference intensity as a function of the phase shift, the fractional difference was given by

$$\Delta I/I_0 = \cos^2(\phi^-/2) - \cos^2(\phi^+/2) \tag{2}$$

Substituting Eqs. (1) into (2) and expanding to first power in v/c yields

$$\Delta I/I_0 = (v/c)\phi \sin \phi \tag{3}$$

Optimum sensitivity occurs when $\sin \phi = 1$, where $\phi = (n + 1/2)\pi$, where n is an integer. This condition was accomplished by choosing the appropriate rotation rate N. Under these conditions of optimum sensitivity the absolute velocity of the laboratory from Eqs. (3) and (1) was given by

$$v = (\lambda c^2/8\pi^2 RNd)(\Delta I/I_0) \tag{4}$$

The procedure for determining $\Delta I/I_0$ was straightforward. The resistance R_0' proportional to I_0 was obtained by first setting the shaft in a direction perpendicular to the absolute laboratory velocity v. The desired resistance R_0' was then given as the difference in the resistance in one of the photoresistors under minimum and maximum intensities, $R_0' = (a - bI_{\min}) - (a - bI_0)$, the different intensities being obtained by varying the rotation rate N. Next the rotation rate N was adjusted to yield half maximum intensity, so that $\phi = (n + 1/2)\pi$ for maximum sensitivity. This rotation rate was, of course, halfway between that for maximum and minimum intensities. Finally, the axis of the shaft was rotated through 90° so that it was parallel to the absolute velocity of the laboratory. It was then noted how much resistance $\Delta R'$ had to be transferred from one arm of the Wheatstone bridge containing one of the photoresistors to the other arm containing the other photodetector in order to reestablish a balance of the bridge. This resistance $\Delta R'$ was proportional to $\Delta I/2$; thus, $\Delta I/I_0 = 2\,\Delta R' R_0'$.

The fractional sensitivity of the photodetector–Wheatstone-bridge arrangement was immediately measurable by changing one of the resistances in one of the arms of the Wheatstone bridge. Marinov found a fractional sensitivity of $\delta I/I = 2 \times 10^{-3}$ for his setup. It was only this error that limited the accuracy of the determination of the absolute velocity of the laboratory. In terms of the velocity this fractional error corresponded to an error of $\delta v = \pm 17$ km/sec.

It should not seem strange that Marinov achieved a two-order-of-magnitude improvement with this balancing technique. Such balancing techniques are not new in the history of experimental physics, and they often yield such dramatic improvements in accuracy.

Marinov says that it required only a few seconds to determine $\Delta I/I_0$. He could readily orient the shaft to yield a maximum or minimum for $\Delta I/I_0$ at any time during the 24-h day during the year. It was, therefore, an easy matter (contrary to Prokhovnik's misrepresentations) to determine the direction as well as the magnitude of the absolute velocity of the solar system.

REFERENCES

1. S. J. Prokhovnik, *Found. Phys.* **9**, 883 (1979).
2. S. Marinov, *Eppur Si Mouve* (Centre Belge de Documentation Scientifique, Brussels, 1977), pp. 104–111.