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# A Kinetic Reflection-Based Explanation of the Negative Result in Michelson's Experiment and Its Implications for Determining Earth's Velocity

Editura ASTROMIX
Cluj-Napoca, Romania

2025

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# 2

# WAS MICHELSON WRONG?

After careful analysis, we concluded that Michelson started on the wrong track from the beginning, as follows:

1. He assumed that when the interferometer is rotated by 90°, the round-trip times in the two arms are reversed, but he did not verify this.

2. He did not consider the second law of light reflection on the central mirror M.

3. Another shortcoming of Michelson's reasoning is that he considers the reflection of light on the interferometer mirrors to be instantaneous, which is not true. This would mean a return to the ancient principle of action at a distance.

4. The dilemma of the interferometer arm lengths: In his calculations, Michelson assumed that the arms of the interferometer were equal in length, which is optically very difficult to achieve.

5. He did not take into account the fact that, along with the Sun, the Earth moves through the galaxy at a speed of 220 km/s and toward the Solar Apex at a speed of 16.5 km/s.

6. Using the Huygens–Fresnel principle for moving mirrors (kinetic reflection), it is found that the direction of the reflected light beam matches Michelson's prediction, even when the central mirror is positioned on the bisector between the interferometer arms. This also holds true for the round-trip travel times of the light beams.

7. Michelson's main mistake is that he used series development in mathematical calculations. The use of the electronic computer leads to the conclusion that the time difference in the two arms of the interferometer is extremely small and no movement of the fringes can occur when the interferometer rotates.

Next, we will analyze one by one the inadvertences presented above.

# 3

# DETAILED PRESENTATION OF MICHELSON'S CALCULATIONS

Let us once again represent the path of the light pulses in the arms of the interferometer, as found in the current works, Fig. 3.1.

We will use the following notations: L - the common length of the interferometer arms, c - the speed of light through the light-propagating ether, considered fixed, and v - the speed of the Earth through the ether. The two components that leave the central mirror M are reflected on mirrors A and B placed at the ends of the two interferometer arms and then return to the central mirror, forming interference fringes.

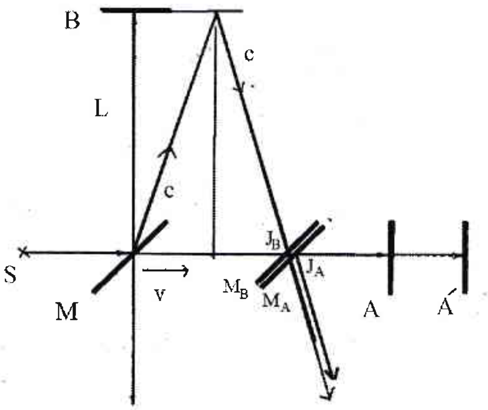


*Fig. 3.1 The true representation of the path of light pulses in Michelson's experiment.*

*Note:* All our calculations are carried out in a reference frame attached to the presumed ether, considered fixed, through which light travels at a speed of $c = 300000\ km/s$, while the interferometer, along with the Earth, moves at a speed of $v = 30\ km/s$. In the following, by the notations $T_A^0, T_A^{90}, T_A^{180}, T_A^{270}$ and $T_B^{90}, T_B^{180}, T_B^{270}, T_B^{360}$ we understand the round-trip time intervals in arms A and B at positions 0°, 90°, 180°, 270°, and 360° counterclockwise relative to Earth's velocity.

In Michelson's opinion, by placing arm A parallel to Earth's velocity around the Sun and arm B perpendicular to it, the round-trip time in the two arms should be different. In arm MA, the round-trip time should be $T_A^0 = \frac{2Lc}{c^2-v^2}$, while the round-trip time in arm B is $T_B^{90} = \frac{2L}{\sqrt{(c^2-v^2)}}$ and the time difference between the two arms would be:

$$\delta T_{AB}^{0-90} = \frac{2Lc}{c^2-v^2} - \frac{2L}{\sqrt{(c^2-v^2)}} = \frac{2L}{c}\left(\frac{1}{1-\frac{v^2}{c^2}} - \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\right)$$

Taking into account that $v^2 \ll c^2$, and using serial development $(1-x)^n \approx 1 - nx$, Michelsin obtained:

$\frac{2Lc}{c^2-v^2} = \frac{2L}{c}\left(\frac{1}{1-\frac{v^2}{c^2}}\right) \approx 2\frac{L}{c}\left(1+\frac{v^2}{c^2}\right)$ and $\frac{2L}{\sqrt{(c^2-v^2)}} \approx \frac{2L}{c}\left(1+\frac{v^2}{2c^2}\right)$

The difference $DT_{AB}^{0-90}$ has the value:

$$\delta T_1 = T_{AB}^{0-90} = 2\frac{L}{c}\left(1+\frac{v^2}{c^2} - 1 - \frac{v^2}{2c^2}\right) = 2\frac{L}{c}\frac{v^2}{2c^2} = \frac{L}{c}\cdot 10^{-8}\, s/m$$

Numerically $\delta T_1 = T_{AB}^{0-90} = Lx3.333333333x10^{-9}\, s/m$

Take in account that $L = 1.2m$ this has the value:

$$\delta T_1 = T_{AB}^{0-90} = 4x10^{-9}s$$

In this case, considering that $c\Delta t = \Delta\lambda$, the optical path difference between the two arms becomes $\Delta\lambda_1 = c \cdot \delta T_1 = L \times 10^{-8}$.

According to Michelson:

"If now the whole apparatus be turned through 90°, the difference will be in the opposite direction, hence the displacement of the interference fringes should be $2D\frac{v}{c}$. Considering only the velocity of the Earth in its orbit, this would be $2D \times 10^{-8}$. If, as was the case in the first experiment, $D = 2 \times 10^{-8}$ waves of yellow light, the displacement to beexpected would be 0.04 of the distance between the interference fringes."

Upon a 90° rotation, the round-trip times in the two arms are reversed, meaning:

$T_A^{90} = \frac{2L}{\sqrt{(c^2-v^2)}}$ and $T_B^{180} = \frac{2L}{\sqrt{(c^2-v^2)}}$

Now, according to Michelson, the difference in round-trip time intervals in the two arms becomes:

$$\delta T_2 = T_A^{90} - T_B^{180} = \frac{2L}{\sqrt{(c^v - v^2)}} - \frac{2Lc}{c^2-v^2}$$

In this case, $\Delta\lambda_2 = -\Delta\lambda_1$ and upon rotating the interferometer by 90°, a fringe shift appears, given by the formula:

$$N = \frac{\Delta\lambda_1 - \Delta\lambda_2}{\lambda}$$

For $L = 1.2m$ and the wavelength $\lambda = 5.9 \times 10^{-7}m$ we obtain $N = 0.04$ fringe.